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Agricultural Interventions in the Bhutanese Context for Sustainability—A Documentary Analysis Using a Thematic Conceptual Framework

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Abstract: Innovation contexts and associated elements determine the type of innovation and adoption. This study aimed at the understanding of the innovation policy and intervention mechanism within the Bhutanese Department of Agriculture (DoA). We developed a conceptual model from the themes and the OECD evaluation criteria based on the conceptual model. The national issues and opportunities related to the agriculture and forestry of Bhutan were defined, and policy gaps were identified between the national plan and the institutional programs that were implemented. A total of 67 government documents from the relevant agencies were collected, of which, 33 documents were included, based on the inclusion criteria that matched with the conceptual, thematic analytical model. Our results from the document analysis show that the institutional innovative interventions appeared relevant to the Bhutanese context; however, inadequate coherence (mapping and alignment) of the institutional intervention programs with the national issues and goals suggested the need for the Bhutanese agricultural innovation system to enhance the effectiveness and efficiency of the program results. Similarly, coordination and collaboration were found to be necessary to extract the synergistic impact of the innovative interventions at the various levels of administrative hierarchy. Institutional accountability and interventional coherence at different organisational levels needs reviewing in order to achieve the sustainability of the outcome in Bhutanese agricultural research.

Keywords: Bhutan; agriculture; policy; research; intervention; innovation

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1. Introduction

Globalisation occurs at a faster rate when every individual society remains interconnected in one way or other, forming a complex social system. Often, underpinning a loophole in a complex system at its elemental or individual level imbalances the system's structure and the functioning of its whole, thereby negatively affecting the system's output [1]. However, if such issues are viewed holistically from a system perspective, it can yield a beneficial solution for a complex and dynamic system, and often, the outputs are greater than their individual contributions. The composite elements and factors interact and collectively contribute to a synergistic effect. Holistic, critical system practice enables the understanding of the ramifications of the composite elements and their interactions. Policy diagnosis using past documents offers insights into the coordination, collaboration, and alignment of the planned programs within the system.

Systems thinking has been increasingly applied to study the complex problems in the context of innovation systems. Barry Richmond, who first coined the term "system thinking", defines it as the science and art of making reliable inferences about behaviour by developing an increasingly deep understanding of the underlying structure [2]. However,

the concept was criticised for its failure to mention the interconnections and interdependence of the elements and their functions [3]. Institutional interdependence and interconnectedness call for stretching beyond the technicalities of the natural sciences. Thus, identifying issues and corresponding innovative solutions requires understanding bigger pictures and their patterns.

Innovation starts with an understanding of a context or phenomenon that is highly complex, interactive, and dynamic. The success of innovation, or any intervention adoption, depends on how well the interwoven and complex context is studied. Existing policy and the process of innovation intervention forms a larger package of innovation systems. While research interventions, development interventions, and innovation interventions differs conceptually, we use the terms interchangeably, as all of the interventions in this study were deployed to seek solutions to complex, systemic issues. A national innovation process depends on knowledge, skills, demand, funding support, and institutions, as well as their dynamics [4]. A national innovation system also differs slightly from entrepreneurial innovation as it deals more with solving national and regional issues which occur within the institutional and policy context at different levels of technology generation and adoption [5]. Chaminade and Esquist [6] mention innovation policy design as a question of the division of labour between the actions of private entrepreneurs and the actions of public organisations. In fact, policy, as federal or state government actions on societal issues in the form of acts, laws, or direct governmental agencies in the form of strategy documents, masterplans, guidelines, statutes, or administrative codes [7], remain an integral components of an innovation system. Thus, to collectively address national issues, each governmental agency needs to coherently plan and implement programs within their policy objectives and their respective institutional mandates. This system of policy, aimed at addressing societal issues, appears to be a rather top-down and prescriptive approach. Thus, line agencies implementing the policy need to have the capacity to identify not just the right approaches, but also to come up with the appropriate interventions.

Agricultural innovation has gained attention among policymakers and funding agencies involved in addressing developmental challenges. Bhutanese agricultural innovation experiences slower growth due to the difficulty in changing the organisational and policy settings intended to promote innovation for development [8]. In addition, inappropriate and contradictory policy environments adversely impact the functioning of the agricultural innovation system [9,10]. Although past studies on agricultural innovation depicted different levels of an innovation system approach, a limited number of empirical studies have applied comprehensive, whole-system analysis to the identification of innovation enablers [11].

Bhutan is an agrarian country with almost 70 percent of its population depending on agriculture for its livelihood. However, the rugged terrain limits area expansion, and only 13.5% of the area is currently directly devoted to agriculture, employing 59.9% of the country's population [12]. Bhutan's Ministry of Agriculture and Forests annually intervenes to solve the existing and emerging issues through the generation of agricultural technologies. Bhutan currently has four agricultural research and development centres located in four different agro-ecological zones [13]. Each of these research institutions has specific national and regional mandates. The Agriculture Research and Development Centre (ARDC) Wengkhar, in Eastern Bhutan, has a national mandate to coordinate horticultural research activities whereas ARDC Bajo, located in the west-central region, has a national mandate to coordinate the field crop research program on cereals. However, these institutions have regional mandates to conduct research in all spheres of agricultural plant science to cater to the needs of their regional clients. These research institutions conduct adaptive and applied research to enhance agricultural crop production and productivity. These research institutions are also entrusted with identifying appropriate interventions based on the growers' requirements and field issues.

Since its initiation in the 1960s, development intervention has followed the system of aligning strategies for solving emerging national issues. A large volume of documents

exists in the form of acts, laws, strategy documents, policy documents, masterplans, guidelines, annual performance agreement (APA) documents, and institutional codes or terms of reference (ToRs). Guided by these documents, agencies annually implement planned programs and publish their outcomes in the form of an annual report. Despite the abundance of reports (published by the implementing agencies) available in the public domain, some of the societal issues remain unaddressed, likely due to inadequate or incoherent policy and implementation modalities. Such inconsistencies adversely impact the generation of innovations and their adoption.

However, for the successful adoption of an innovation, it is imperative to comprehend the existing innovation-generation process and, more importantly, the innovation policy context. In the absence of a concrete, nationally coordinated innovation system in Bhutan, the respective agencies frame research agendas based on national priorities within their given mandates. The performance efficiency of the innovation system depends on the ability of these agencies to effectively and synergistically pursue an innovation. As such, this is the case with agricultural research and innovative development interventions in Bhutan. Until 2013, agricultural research programs were based on the *Renewable Natural Resource (RNR) Research Policy of 2011*. The Council of RNR Research (CoRRB) was the apex body that coordinated RNR research across the various disciplines within the Ministry of Agriculture and Forests. However, with the recent organizational changes, the CoRBB was dissolved, affecting the interdepartmental collaborative research culture.

Many researchers have attempted to study the innovation system using systems structures, dynamics, and performance to identify gaps in policy [10], policy goals, and implementation [14,15]. Yet, the innovation systems approach has been criticised for not yielding complete, implementable guidelines. A lack of relevance (the information or technology meets the actual needs client) and coherence (mutually supporting policy actions across governmental departments and institutions) is likely to affect the realisation and sustainability of intervention adoption.

Although the innovation interventions at the institutional level are linked to national priorities and issues through the respective departments, the institutions develop their own plans and implement interventions within their mandates. Such a system of innovation and intervention has resulted in disciplinary interventions being carried out. Cross-cutting systemic issues, requiring interdepartmental collaborative and wholistic programs, suffer from quick fixes, resulting in a dwindling of the public funds applied to research and innovation.

The available governmental documents of the Bhutan MoAF portray sound content, revealing much about the existing policies and planned research interventions. These documents provide a great deal of insight into agricultural research and interventions. However, no such analysis has yet been conducted so as to provide a deeper understanding about the current policies, innovations, and interventions, as well as recommendations for a way forward. Thus, a synthesised and systematically analysed document would help in developing a realistic (i.e., a sensible and practical idea of what can be achieved by an innovation or intervention), relevant (i.e., appropriate to the problems, the present time, and the circumstances of the Bhutanese contemporary context), efficient (i.e., a system which achieves optimum productivity with minimum resources) and effective (i.e., successful in producing the desired or intended results) intervention outcome.

Therefore, the present study sought to understand the innovation interventions carried out by the Bhutanese Ministry of Agriculture and Forests (MoAF) using qualitative documentary analysis and a systems theory approach. The specific research questions that this study answers are: 1. How do the Bhutanese policies and planned interventions match national priorities? 2. How do national plans and institutional goals relate to national goals? 3. How are the planned interventions at different levels of the administrative hierarchy linked? 4. Do the targets' achievement indicators actually depict positive impacts? (See the References for further details).

2. Materials and Methods

This study took a perspective that views the Ministry of Agriculture and Forests (MoAF)'s policy, organizational structure, and functioning mechanism as a system. We used a systems thinking approach to evaluate the implementation of agricultural research and innovative interventions. Although they are conceptually different, we considered research interventions, innovative interventions, and developmental interventions as innovative interventions. We considered only the Bhutanese Ministry of Agriculture and Forest's (MoAF's) existing policy framework and organizational structure to shed light on the implementation of a health-tested citrus seedling (HTS) production mechanism. The Bhutanese Department of Agriculture and the institutions involved in the production of HTSs were purposely included as the case selected for this study because the inclusion of all of the MoAF's interventions would be vast and complex. The findings helped us understand how the institutions function when it comes to the implementation of an innovation intervention. The different levels of the administrative hierarchy under the MoAF, as depicted by different departments, and the institutions involved in HTS were included. The existing structure of the MoAF, within the scope of our study, is shown in Figure 1.

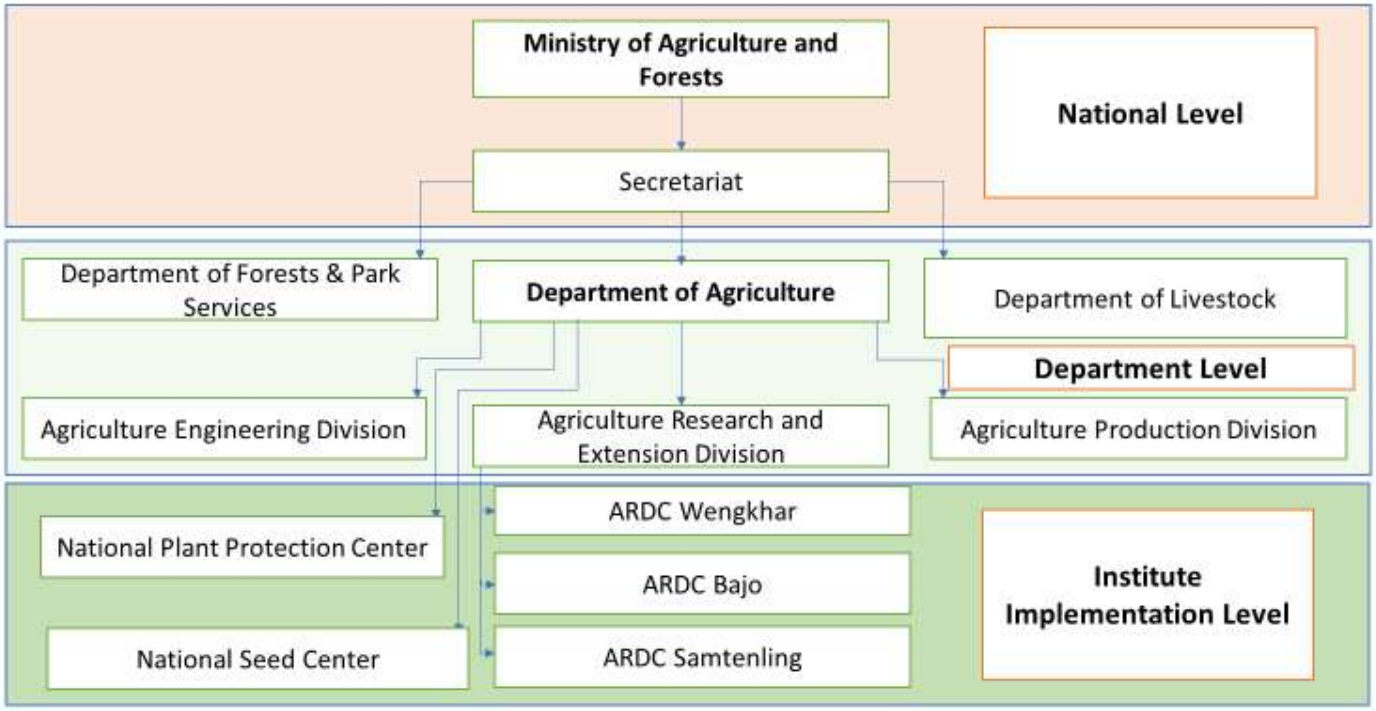

Figure 1. Organisational structure of the Bhutan MoAF, as identified in the present study.

Using the documents that met the inclusion criteria, we identified the structure, elements, and interconnectivity of implementation for the innovation or development of interventions in line with the national goals of the MoAF and its objectives. We then studied their respective institutional goals and objectives and their alignment with the national goals. We explored the existing policies and the mechanism of innovation-generation using policies, plans, and program implementation reports. To systematically identify conflicting policies, interventions, and their interlinkages for promoting mutually reinforcing policy and intervention actions while creating synergies towards achieving the goals, qualitative documentary analyses were deployed.

2.1. Documentary Analysis

Documentary analysis (DA) is a novel qualitative research method for analysing documents [16]. Documents provide evidence of how a complex system existed in the past, and they help to organize and inform future influences on the processes involved in the ways we make sense [17]. Documentary analysis basically tries to collect and analyse data from the messages published or communicated through various means [18]. The approach provides a descriptive explanation of existing problems or opportunities.

DA uses different forms of documents, depending on the research questions. For example, the use of newspaper articles in documentary analysis has provided applicable content for assessments [19]. Presently, the method is used in various areas of the social and natural sciences. As a qualitative method, it has been used in public health studies to examine the validity of clinical guidelines [20] and also to explore the mental health of the survivors of communal riots [21]. A systematised method of document analysis called the READ approach is widely used in health policy research [22], and it includes the following steps: (1) Ready your materials, (2) Extract data, (3) Analyse data, and (4) Distil your findings).

Documentary analysis (DA), if carefully applied with reflexivity, provides researchers with exceptional benefits. Documentary analysis in qualitative research has gained momentum as the approach delivers researchers with unique advantages. First, a great variety of documents can serve as data, and the gathering is easy, cheap, efficient, and effective. The documents, once collected, remain unchanged and can be analysed iteratively any number of times. Further, the documentary data are not influenced by researchers and the research process. On the flipside, since the documents collected were not created for our research agenda, it is highly likely that they may totally lack the information required, or that information may be sparse [23]. In some instances, documents may not be easily available or accessible. The researchers' positionality and subjectivity lead to questions of credibility, and therefore, it is critical for the researchers to focus on the original purpose of the document and the target audience [24]. The researchers' ontological and epistemological positions influence the approach to qualitative data analysis. Thus, only an explicit framework underpinning the qualitative data analysis (QDA) methods can enhance the credibility of the study [17].

2.2. Document Collection

The study of mechanisms helps us understand complex sociological and physiological process in order to explain a phenomenon, make predictions, and then intervene [25]. We deployed a systems approach to understand the Bhutanese intervention mechanism within the MoAF. First, we identified the elements of the system using the ministry's organogram and its mode of operation within the Bhutanese policy framework. We extracted systemic elements (institutions under the MoAF) and structures (hierarchical functional linkages) that directly or indirectly influence the research innovation intervention mechanism in Bhutan. The selections were made based on the institution involved in the production of HTSs. Accordingly, we conducted document searches within the domain of innovation intervention implementations and policy frameworks for the agencies identified. The documents included policies and strategies, planning documents, and reports on the intervention, which were then further selected using the inclusion criteria, as discussed below.

2.3. Inclusion Criteria

The main purpose of this study was to understand the policy contexts of innovation interventions within the Bhutanese Ministry of Agriculture and Forests (MoAF) using the available documents. We used the organisational (MoAF) hierarchical structure to study the existing innovation implementation modalities. With the MoAF at the apex, we identified key institutions implementing the innovations within the existing contexts and drew up document-screening criteria surrounding the case—HTS production. Only the documents that met the following criteria were included.

1. The guiding policy or strategy documents within which the intervention works;
2. The broader national issues and the objectives based on which vertical institutional objectives are perched;
3. The national plan for the interventions, upon which the downstream institutional plan was formulated;
4. Implementations of the institutionally planned programs and their reports;
5. The mechanism of implementation-based document selection; and
6. Documents that are available in soft copy (i.e., not printed).

2.4. Documentary Analysis

We assessed policy frameworks, national issues, plans, and the ways in which the institutes, within their mandates, set goals and implemented programs to yield the desired changes as contributions to the solution of national issues. First, we identified themes, and then we developed a conceptual model for analysis. The themes identified from the documents included the national issues mentioned in the MoAF's policy and planning documents, the national plan, the respective national programs, and the expected outcomes. Likewise, at the institutional level, we identified institutional issues, institutional objectives, planned and implemented interventions, and their outcomes. We looked at how these institutional interventions individually contributed to the achievement of the national goals. We also considered the synergies and interlinkages among the institutional interventions using the Organisation for Economic Co-operation and Development (OECD) criteria for evaluation [26].

2.5. Analytical Steps

The OECD [26] has classified coherence into two types, prospectively, those being vertical and horizontal coherence. In this study, vertical coherence refers to the consistency of the intervention across the different levels of an institution under a single governmental development organisation whereas the horizontal perspective refers to the logic, rationale, and compatibility of the programs as conducted by different institutions at the same level within the administrative hierarchy. Our study of vertical perspective started with the national issues, as identified by the Gross National Happiness Commission (GNHC), and continued with the MoAF's issues, revealed by the existence of policy friction at the departmental level, as reflected in the 12th five-year plan document [27].

The researchers familiarised themselves with the documents before identifying the themes. We used NVivo [28] (a qualitative text-mining software program) to perform text searches using the text search query, and we coded the concepts to the predetermined institutional themes (issues, objectives, program design, results, and outcomes). Themes were predetermined because all of the innovative interventions were carried out to solve prevailing agricultural issues. We used five of OECD elemental criteria to assess the intervention process. We charted the themes and mapped the elements and the structures using the OECD criteria (relevance, coherence, effectiveness, efficiency, and sustainability), as shown in Figure 2. The documents' content was used for interpreting them according to the OECD evaluation criteria, as based on the themes. We looked at how the issues, plans, goals, and outcomes at the institutional level remain relevant and coherent with the national issues.

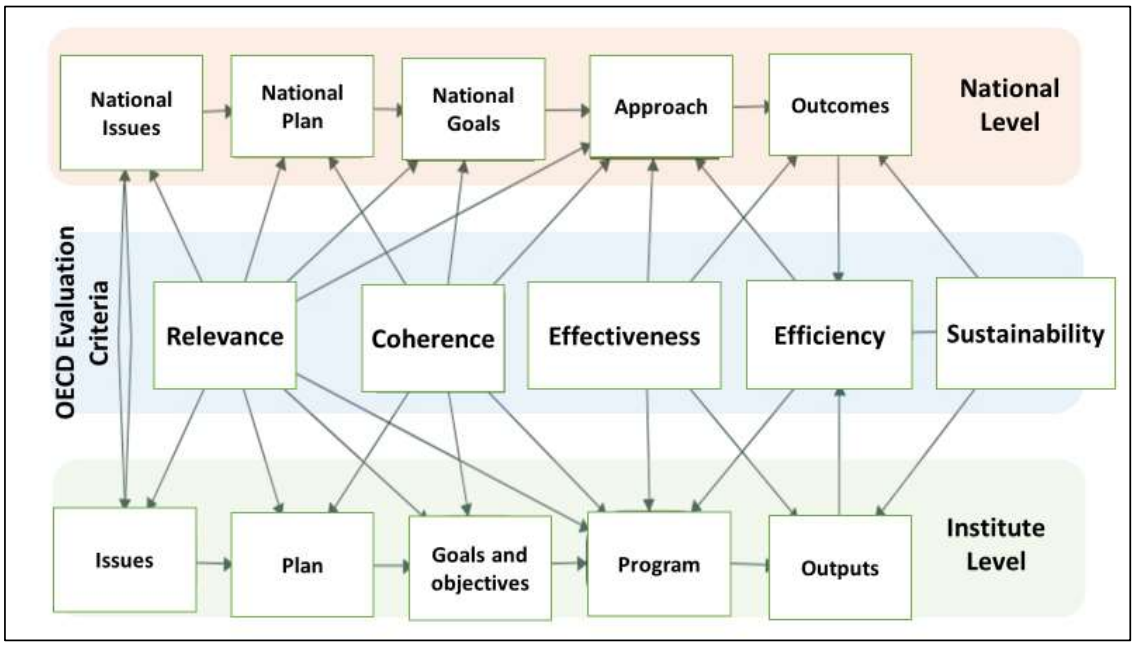

Figure 2. A conceptual model for the thematic analysis of intervention evaluation using OECD criteria. OECD criteria (relevance, coherence, effectiveness, efficiency, and sustainability) are mapped against the Bhutanese intervention mechanism.

3. Results and Discussion

Based on the search procedures, we obtained 67 relevant documents of various types. These documents included policy and strategy documents, national planning documents, departmental and institutional plans, and reports related to the field of agriculture, and in particular, crop science. We distilled our findings based on 33 documents that met with the predefined inclusion criteria via thematic conceptual framework. The hard copies of the documents were purposely not included in the study so as to enhance the reproducibility and reliability of the findings, owing to inaccessibility issues. The details of the documents and the sources are presented in Table 1. Our findings on the themes were interpreted based on the 33 documents we analysed from various institutes under the Bhutanese MoAF. The steps of searching for, screening, and including, as well as the documents that resulted in being included, are shown in Figure 3.

Table 1. Types of documents included in the study, along with their respective institutions and sources.

Administrative Hierarchy	Document Type	Document Title	Source	Number of Documents
National Level	Planning documents	*10th Five-Year Plan*	Policy and Planning Division, MoAF Secretariat, Bhutan	N = 1
		11th Five-Year Plan	Policy and Planning Division, MoAF Secretariat, Bhutan	N = 1
Departmental Level	Policy and strategy documents and reports	*RNR Research Policy, 2011*	https://policy.asiapacificenergy.org › default › files (accessed on 20 January 2021)	N = 1
		Agricultural Research and Extension Strategy, 2018	Guidelines and ManualsDoA, Bhutan	N = 1

Table 1. *Cont.*

Administrative Hierarchy	Document Type	Document Title	Source	Number of Documents
		Department of Agriculture Annual Performance Agreement	DoA, Bhutan	N = 1
		Agricultural Research and Development Highlights, 2016–2017	Reports DoA, Bhutan	N = 1
		Inventory of Released and Denotified Crops in Bhutan (1988–2020)	Reports DoA, Bhutan	N = 1
Institutional level	ARDC Bajo, reports	Annual Reports, 2011–2018	ARDC Bajo, Bhutan	N = 8
	ARDC Wengkhar, reports	Annual Reports, 2011– 2018	ARDC Wengkhar Bhutan	N = 8
	Annual Report, National Plant Protection Centre	Annual Reports, 2011–2017	Annual Reports—National Plant Protection Centre (https://www.nppc.gov.bt/annual-reports/) accessed on 2 February 2019	N = 7
	Annual Report, National Seed Centre	Annual Reports, 2015–2018	National Seed Centre, Chundudingkha, Paro	N = 4

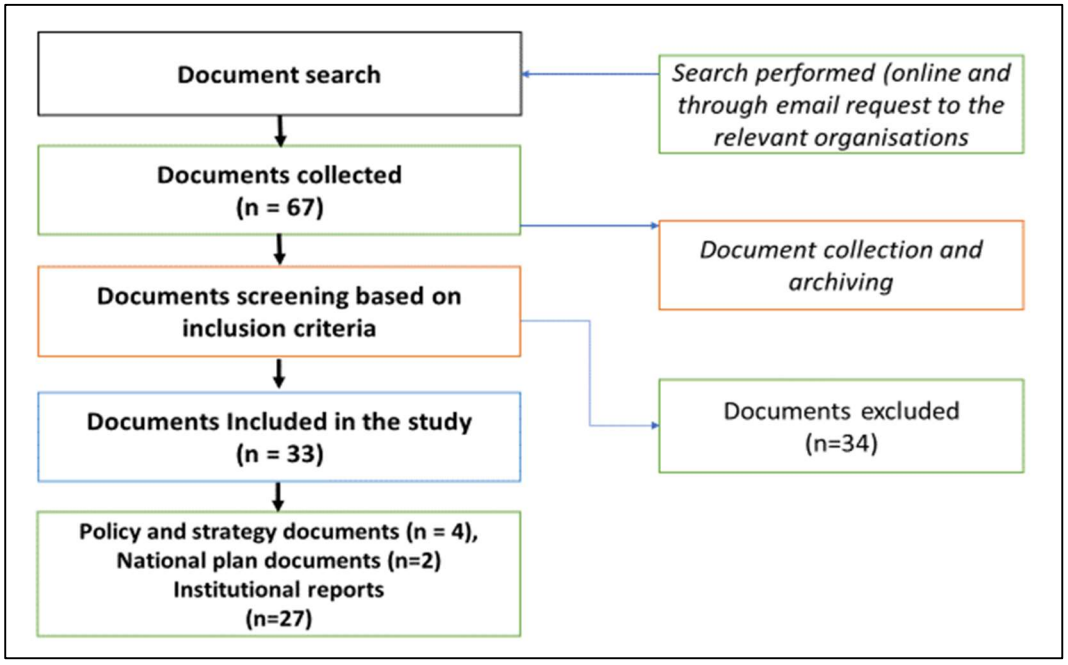

Figure 3. Document search performed using the inclusion criteria, yielding 33 documents for analysis.

3.1. Policy and Planning Interventions

Bhutan currently lacks a policy framework for a national innovation system that guides overall innovation at the different ministries. However, *Renewable Natural Resource (RNR) Research Policy, 2011,* currently guides the Bhutanese agricultural research and interventions system at the ministerial level [29]. Earlier RNR concepts included the Bhutanese Department of Livestock (DoL) and the Department of Forests and Park Services (DoFPS) in addition to the Department of Agriculture (DoA). The earlier RNR concepts bridged different departments under the MoAF for interdisciplinary research and innovation. The regional institutes and research centres were mandated to intervene from within these three departments to carry out an integrated RNR research program. However, with the reorganisation and the dissolution of Council of RNR Research of Bhutan (CoRRB), the apex body of the RNR research, the research centres were re-aligned with their respective departments [30]. The Bhutan Department of Agriculture (DoA) currently lacks a policy document that suits the current organisational set-up after the re-organisation and dissolution of the RNR concept. In the absence of appropriate research and policy documents, the Agricultural Research and Extension Division (ARED) published a research strategy document in 2018 [30]. In the interim, the interdepartmental collaborative research culture vanished, thereby affecting interdepartmental program coordination and collaboration [30]. Since then, the research focus has shifted from integrated RNR research to respective disciplinary research.

Based on our identified themes and the elements of the conceptual model, the included documents outline pertinent issues and the opportunities that emerged in the Bhutanese context at different levels of the organizational hierarchy. The documents highlight the national innovation development and intervention plan to deliver on the national priorities. These priorities were based on national issues and opportunities. Fighting against poverty, enhancing income generation, and achieving national food security remain in the list of top agendas [31]. However, the decreasing public investment in the agricultural research sector [32]; the loss of agricultural land to other types of development; the lack of infrastructure, such as irrigation and postharvest storage facilities; farm-labour shortages; rural–urban migration (RUM); human–wildlife conflicts; and the lack of credit opportunities continue to be the main barriers at the national level. At the departmental level (an organization that strategizes MoAF's plan for implementation via the relevant institutions), the main constraints identified by the Department of Agriculture were the depletion of natural resources, the scarcity of water, the declining soil fertility and increasing land degradation, the increasing cost of inputs, the scarcity of human resources for farming, and unpredictable weather conditions, which were considered as priorities. These challenges indicate that the difficulty of achieving national food security through increased production and productivity requires addressing these issues holistically, with an emphasis on policy interventions. However, no evidence on policy intervention studies was reported in the documents. The lack of evidence in the reports and the planning documents indicated an absence of policy-related research interventions within the country. Thus, to bridge the policy and implementation gap, an effective, coherent, and comprehensive policy-support program remains crucial for Bhutanese innovation intervention systems.

3.2. Relevance of the Interventions

Bhutan's national priorities that corresponded to the Bhutan MoAF's organizational structure and functions were the eradication of poverty, the enhancement of income-generation, and the achievement of national food security [33,34]. Thus, the MoAF ranked increasing the production and yields of cereals, oilseeds, vegetables, and fruits as the top program. The Department of Agriculture, along with the research institutes, carries out interventions for increasing crop yields and production. Institutions, such as the ARDCs at the grassroots level, conducted research activities aimed at enhancing the production and yields and at generating rural income. The chief among the technologies was the release of high-yielding, biotic and abiotic stress-tolerant crop varieties [30]. Quite a number of

innovative research interventions were found in regard to the issue of human–wildlife conflicts, with varying degree of success. Lately, Bhutanese agricultural research has prioritised climate-smart agriculture as a potential area of inclusion. Various seed varieties tolerant to cold, heat, and soil-moisture stress have been assessed at the research centres in Bhutan. The use of climate-resilient seed varieties has been intensified and suggested as one of the fundamental measures to counter climate adversities [35]. The Agricultural Machinery Centre (AMC), under the Department of Agriculture, has intervened in farm mechanisation to reduce both animal and human drudgery, as well as to reduce the cost of production, while addressing the issue of the farm-labour shortage. However, the steep slopes and small-acreage landholdings, due to land fragmentation, pose other challenges to farm mechanization. While land consolidation appears to be a distant possibility due to landownership, the MoAF emphasizes land development through broad terracing for farmers owning enough acreage. Such a land development intervention would not only help retain fertile topsoil, but it would also make the land accessible to farming machinery, thus reducing the cost of production.

Yet, farming in Bhutan is hardly youth-friendly as it needs hard physical work and investment, involving high risks due to weather anomalies and wildlife crop depredation. Guarding crops from wild animals increases the cost of production significantly. Bhutanese potato- and maize-growers guard their crops on an almost-daily basis [36]. Bhutan's 70.77% forest cover [37] surrounds most of the farmland, making it more vulnerable to wildlife depredation. Furthermore, the income generated from farm activities is far less than that of off-farm activities. Thus, agriculture, as in many other developing countries, fails to attract youth, mainly because of economic reasons. Agricultural subsidies have minimally benefited smallholders, the most vulnerable group, probably because the cost-sharing mechanism still requires a farmer to bear a certain percentage of the cost of a subsidized item [38]. The increased influx of youth into urban areas occurs mainly because the younger generation prefers the easy urban lifestyle to the rural life, where farming is the only occupation [39]. Their migration to urban areas has added pressures on urban unemployment, health, and the provision of other amenities. As a consequence, the incidence of youth conflict with law enforcement has increased in major towns and cities. The Bhutanese government and the Department of Agriculture needs to look at making rural farming attractive through strategic policy interventions aimed at making farming more remunerative, or at least on par with off-farm activities. While the issues and the opportunities reflected in the national planning documents remain relevant and pertinent to Bhutanese farming communities, progress in farming appears rather slow, with only a limited number of research institutions attempting to intervene.

3.3. Coherence

Policy coherence has been described as an approach, rather than as a precise decision-making tool [40]. Two directions (vertical and horizontal) of coherence have been discussed [41]. The vertical coherence of themes at the national, ministerial, departmental, and institutional levels show varying levels of logical and conceptual consistency. The insights of interdepartmental collaborative interventions under the umbrella of the MoAF were neither found in the planning documents nor executed as per the reports published. Similarly, collaborative development interventions at the institutional level (under the department) ceased since the CoRBB was dissolved due to a lack of a coordinating apex body at the ministerial level. Complex issues, such as human–wildlife conflict management, require collaborative research interventions from the researchers of the DoA and the Department of Forests and Park Services (DoFPS). Simultaneously, the issues of the farm-labour shortage and rural-to-urban migration require multidisciplinary socioeconomic and policy research. Multidisciplinary policy and socioeconomic research were emphasised in the ministry's *11th* and *12th Five-Year Plan* documents [34], but no reports currently exist regarding outcomes in this area. In addition, professional connections and the interdepartmental collaborative atmosphere among the researchers within the MoAF

have drastically declined as the departments are independent, both administratively and professionally. In fact, the alignment of research institutes to the respective departments widened the gap and weakened collaborative research linkages, particularly in the area of socioeconomic and policy research and innovation. An earlier study on climate-change adaptation, flood risks, and policy coherence showed a resulting decoherence in policies due to changes in the institutions [42]. The disconnect and division of the disciplinary departments affected the implementation of collaborative, transdisciplinary interventions, and synergistic outcomes.

In view of the current Bhutanese institutional setting and context, the Agricultural Research and Extension Division (ARED), under the Department of Agriculture, in its agricultural research strategy, mentions the need for socioeconomic and policy research within the department [43]. At the same time, human-resource capacity-building tops the list for the department and the MoAF [27]. Yet, human-resource capacity-buildings has been affected by limited funding support directed towards only a few sectors.

The existence of conflicting or overlapping policy provisions creates implementation difficulties [27]. Some of the issues that challenge food and nutrition security are the loss of fertile agricultural land to urbanisation in urban areas, while fallow areas continue to increase in rural parts of the country. Another issue is the conflict between the farm-labour shortage on rural farms as caused by the migration of the youthful population to urban areas. Another conflict involves human–wildlife conflicts and wildlife crop depredation versus the conservation of the natural environment. Consequently, Bhutan's national laws ban the use of chhuzhing (the Dzongkha term for paddy land) for other purposes. Landowners and public institutions do not uphold the ban as they have different opportunities for maximizing the economic returns from their land. The rural poor in the far-flung villages face the brunt of policy glitches as the local agricultural products, left over after wildlife predation, fail to compete with cheap products imported from India. As a result, rural land remains fallow due to poor economic returns and the continuing migration of the younger generations to urban areas. Current technologies, such as high-yielding varieties, the introduction of new crops, enhanced measures for crop protection, and protected climate-smart agriculture, are less likely to hold the rural youth back and remain on farms. Our analysis showed that food security in Bhutan is challenged by a number of inconsistent policies and interventions.

3.4. Effectiveness and Efficiency

According to the Organization of Economic Co-Operation and Development (OECD), the effectiveness of innovation evaluations refers to the achievement of objectives set in the results chain or causal pathway [26]. For the intervention of an innovation to be effective, a clear understanding of the intervention's aims and objectives remains critical for designing and strategizing the implementation procedure thoughtfully and with reflexivity [44]. As researcher positionality influences the kind and quality of the research, institutions have a greater influence on setting objectives and planning so as to show the maximum outputs in order to be on the safer side, irrespective of the actual impact in the field. Our assessment of the effectiveness, based on the objectives designed at the different levels of the administrative hierarchy, appeared rather rational from the top down to the institutional level. Policy makers', planners', and implementers' targets were more abstract than concrete, giving them room to claim achievements without actual, long-term change in the ways to sustain the Bhutanese farming community. The target and the indicator at the onset of the project were successfully achieved in many of the reports, but the question that remained unanswered was how the targets and the indicators proportionately represented the benefit or the impact in the field.

A study by Bizikova, et al. [45] on the contribution of agricultural intervention to food security revealed varying results (positive, neutral, and negative), indicating the validity of the indicators. The institutions under the ministry's department mobilise the resources to increase food production via the promotion of high-yielding crop varieties,

reaching for climate-smart technologies, and supporting farmers with technologies to stem wildlife crop depredation. These interventions have contributed to the national objectives of food and nutrition security in their own ways. What still remains unclear is the amount that these indicators actually represented the impact they had on the beneficiaries. A lack of what are called "evidence-based indicators" in the Bhutanese agricultural research and innovation system is prospectively hindering the portrayal of research contributions and the securing of funds. The proportion of state funds provided to the agricultural sector has constantly decreased over the years [46]. RNR sector research receives less than 2% of the GDP [32]. Better, evidence-based yardsticks will not only lead to a better understanding of the significance of the technology and the screening procedure to channel limited resources appropriately, but also to the framing of evidence-based, informed policies and implementation modalities.

Research institutions in Bhutan have achieved their set objectives by releasing a number of innovation technologies, as indicated in their planned targets. Yet, a major chunk of these innovative technologies is not what farmers want, leading to the questioning of the efficiency, transparency, and accountability of the public resources spent. The overriding effects of such technologies are often low as their adoption largely depends on a complex systems context, including the technical, economic, social, cultural, political, and ecological effects [47,48]. As these are public research institutions, major chunks of funding spent on the research is funded by the taxpayers and donors, and the funds need to be fully accounted for and explicitly reported.

The type of planned targets or indicators (the number of technologies released, the number of farmers trained, the percentage of fruit trees planted, etc.) appears loosely framed and connected to the goals although these programs contribute to increased food production and nutrition security. For example, biochar and bokashi, which is a soil amendment technology, were found to be rigorously promoted by the research centres as climate-smart technologies. However, the farmers are less likely to take up these technologies. This is mainly due to the fact that the results of the technologies are not worth the resources required from a famer, without any immediate, visible outcomes. The degree and the level of contribution need proper mapping, with concrete evidence to prioritise the program from the client's perspective. Ideally, a clear link between the policy guidelines and implementation remains critical to guide institutions with the evidence required to amend the programme [49]. The lack of a research-assessment framework for Bhutanese agricultural research is likely to have resulted in such an inefficiency in the use of research outputs.

3.5. Sustainability

The sustainability principle states that the resources meet the current demand without compromising the needs of our future generations [50]. Globally, sustainable development goals (SDGs) and the *2030 Agenda* policy framework remain as the overarching policy framework, and they guide the majority of national intervention strategies. However, the narrow sectoral economic gains and business interests still lead the global innovation system. Economic differences and divisions between countries interfere in priority-setting towards the achievement of sustainable goals [51].

In the present study, sustainability is viewed from the perspective of holistic intervention and the longevity of its effects with respect to society, the economy, and the environment. Bhutan's GNH developmental philosophy ensures that the noneconomic aspects of social well-being are an integral part of an economic development intervention [52].

Agriculture is complicated by a nexus between several sustainable development goals and the race for enhanced production amidst environmental protection [53]. Yet, the missing link appears apparent between the research outcomes and the sustainable development goals. The national goals and objectives of the national planning documents mention strong connections between Bhutan's intervention and the SDGs aimed at solving issues locally. Bhutan's main goals include preserving and promoting the culture and traditions, main-

taining a healthy ecosystem (carbon-neutral and climate-resilient development), promoting a healthy and caring society to ensure safety, liveability, and sustainability. However, agriculture remains most vulnerable to the impacts of climate change, and it directly depends on the ability to mitigate both social and ecological systems [54].

Sustainability in agriculture revolves around the need to develop technologies and its adoption without adversely affecting the natural environment, resulting in effective and increased productivity [55]. Agricultural interventions that consider social and political stability long with ecological aspects are not without costs and sacrifices. Rugged mountain terrain limits farm mechanisation, while wildlife-caused crop damage increases production cost. The issues of the farm-labour shortage and rural–urban migration contradict each other as farming appears less lucrative than other, off-farm activities. Similarly, Bhutan's constitution mandates the maintenance of 60% forest cover, while human–wildlife conflicts highlight the need for nature conservation, and local Bhutanese agricultural produce would be cheaper if the issue of crop depredation, caused by the wildlife harboured by Bhutan's thick forest cover, were minimised. In fact, the Bhutanese, from the growers to the consumers alike, pay enormous sums and make sacrifices (in public goods and services) for the protection of the natural environment [56].

The research institutions' reports across the country show interventions in various sectors, of which the most prominent were human–wildlife conflict and climate-smart technologies [57,58]. Electric fencing is one such activity that has been widely promoted by politicians, policy makers, and researchers [59]. At the moment, a government subsidy supports the electric fencing technology, which has proven effective against certain wildlife species, such as wild boars. However, sustainability is a question for the long run. Similarly, the promotion of water-harvesting structures, the construction of irrigation channels [60], and the development of biotic and abiotic stress-tolerant crops are some of climate-resilient technologies [57,61]. Soil-amendment innovation technologies, such as biochar and bokashi, were the technologies implemented to enhance soil health. Since such innovations are not likely to yield immediate, visible economic benefits, such technologies need to be packaged with innovations that yield immediate and visible returns. For example, promoting soil amendment using mineral fertilizers and other biofertilizers in an integrated approach would result in the greater appreciation and adoption of innovative technologies. Additionally, creating awareness, campaigning, and providing hands-on training in crop husbandry appear to be dominant interventions implemented by the institutions.

The sustainability of such interventions by the Bhutanese research institutions remains questionable although significant short-term benefits appear to be apparent. For example, electric fencing against wildlife is reportedly welcomed by the growers as it helps protect the crops from wild animals. However, the maintenance of the electric fencing after its establishment confronted nontechnical social challenges, which, again, require expertise for community mobilization (i.e., social scientists). As much as researchers intervene, so does the wildlife. Evidence shows that electric fencing has become less effective against primate species and wild boars in some parts of the country. Such conditioning interventions against the free-ranging wildlife species are questioned for effectiveness within the context and for external validity [62]. Unless researchers focus on understanding the root cause, such interventions prove temporary and unsustainable, ecologically and economically. Infrastructure developments, such as research and extension offices, irrigation channels, laboratories, etc., remain essential for agricultural development, but it is less likely to hold the rural youth back on the farm. Rural–urban migration, causing farm-labour shortages and youth conflicts with law enforcement in urban areas, is likely to continue if the current pattern and mechanism of intervention and policy remains unchanged.

Despite the significant contribution of agriculture to Bhutan's GDP, the state's funding of agricultural research has been dwindling over the years [46]. This lack of assured funds adversely affects the overall capacity-building and the quality of research outcomes. Without external funding support, annual budgetary allocations from public funds are less likely to yield any significant impact with the current rate and kind of interventions.

The agricultural research and extension division of Bhutan reflects a way of looking for research endowment funds [43]. Such funds would provide renewed hope for the future of agricultural research and innovation systems in Bhutan. Furthermore, politicians are more attracted to short-term projects that yield immediate, short-term benefits for their political mileage [10]. Long-term, lucrative investments, such as citrus orchards, that yield foreign revenues receive lower priority in the Bhutanese political arena.

4. Conclusions

Documentary analysis, along with a thematic conceptual model, can be successfully applied to studying the mechanism of agricultural interventions in Bhutan. Based on the identified themes, Bhutan's GNH, as the guiding philosophy and project-screening tool for overall development intervention, matches many of the SDGs. The sacred responsibility bestowed on agricultural institutions in Bhutan is to achieve food and nutritional security without disturbing the natural environment and ecosystem. The mammoth task ahead is achieving food and nutrition security amidst the backdrop of several constraints (wildlife crop depredation, a shortage of farm labour, rural-to-urban migration, climate change impacts, increased fallow land, etc.), necessitating a deeper understanding of the system's functions, structure, and challenges. Such diverse, complex, and dynamic issues, which are interwoven, cannot be resolved through a copy-and-paste mechanism. Broader multidisciplinary research and coordination among disciplinary departments remain essential to break the disciplinary boundaries and reap a synergistic impact.

While sound policy and planning documents exist at the national and departmental levels, relevance to and coherence with the local institutional agendas appears to be unclear, and they are only partially linked. Furthermore, many of the institutional program activities aim more at achieving targets based on set indicators than at realising actual field impacts and bringing about positive and sustainable changes. The actual field impacts are far from realisation, as opposed to what is shown by the development indicators and target achievements. Synchronisation and harmonisation of intervention programs with the actual needs of the beneficiaries remain critical. Policy dialogue, between and among policy makers, researchers, funding agencies, and local institutions are considered as necessary to enhance the effectiveness and efficiency of program interventions followed by rigorous implementation.

While interventions such as the organizational development (OD) exercise were necessary and timely, yet fitting them into the systems appears inadequate, primarily due to the dwelling of the stakeholders within their disciplinary boundaries. A similar situation attends the annual performance agreement (APA) initiative between the hierarchical agencies to enhance the efficiency of service delivery. However, the APA objectives have not been adequately realised, mainly because bureaucrats lack technical understanding, while implementers in the field lack a socioeconomic background. As a result, program implementers in the field set comfortable performance targets and indicators, based on which the government rates the organisation. Institutional focus shifted from actual field impacts to the realization of target indicators set by the institutions. The indicators and milestones that assess the achievement of the objectives remains compromised. While the development of a knowledge society and the building of human-resource capacity were enshrined as national goals and objectives, limited funds and the underutilisation of human resources appears pertinent.

Nevertheless, we have listed possible solutions for achieving the national food and nutritional security, as follow:

1. Research on the agricultural innovation system and research policy need rethinking so as to enable holistic trans- or interdisciplinary studies that enhance long-term sustainability;
2. In order for innovation research to sail through political agendas and politics, assured funds and commitments appear crucial in the future;

3. Strengthening agricultural innovation research policy and implementation research is necessary;
4. Increasing subsidies and the proper channelling of existing subsidies to the targeted agricultural sectors should be based on their direct contribution to food and nutrition security;
5. The bridging of the social and income inequality among the farming communities and other sections of the Bhutanese population must occur;
6. Realistic minimum price supports for agricultural commodities must be provided;
7. Systematic compensation to farmers for wildlife crop depredation must be provided;
8. Monitoring and maintaining wildlife population balances through food-chain and forest ecosystem research must occur;
9. Cooperative farming and the processing of agricultural products must be implemented; and
10. The use of sensors and information transmitted via communication technologies should be implemented to guard crops against wildlife.

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