

RESEARCH ARTICLE



Capacity Needs Assessment for Implementation of Renewable Energy and Energy Efficiency in the Cardamom Value Chain of Nepal's Mountain Regions: Results of a Survey Study

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Abstract: The Hindu Kush Himalayan region presents an immense opportunity for implementing decentralized, sustainable energy solutions that rely on renewable energy (RE) sources. However, the region remains vulnerable to energy poverty due to inadequate capacity at various levels for deploying RE and energy efficiency (EE) solutions in mountainous areas. To achieve sustainable economic, social, and environmental performance, a thorough understanding of capacity development in RE and EE deployment within the value chain concept is crucial. This paper introduces a capacity needs assessment framework for the mountainous context, which was developed and applied to Nepal's cardamom value chain to explore the interplay of different core capabilities at individual and organizational levels. The survey study aimed to identify the specific capacity requirements necessary for the effective deployment of RE and EE solutions in the cardamom value chain. The analysis revealed significant capacity development needs on core capabilities affecting RE and EE deployment within the value chain, including technical skills, knowledge transfer, institutional strengthening, and policy development. The study also identifies challenges encountered when implementing RE and EE solutions in the cardamom value chain, such as financial constraints, technical challenges, and lack of awareness and education. Based on the study's findings, policymakers can design and implement effective capacity development initiatives that address the identified gaps and challenges and promote the deployment and implementation of RE and EE solutions in Nepal's mountain regions. This framework's applicability can extend to other value chains, such as tourism, dairy, poultry, and transportation sectors, by considering appropriate study dimensions and key indicators for value chain analysis.

Keywords: renewable energy, energy efficiency, capacity needs assessment, cardamom value chain, Hindu Kush Himalayan region, capacity development

1. Introduction

Renewable energy (RE) and energy efficiency (EE) solutions are essential for building the resilience of mountain communities in the Hindu Kush Himalayas (HKH). However, despite the vast potential of RE sources for decentralized sustainable energy solutions, the HKH region remains energy poor and vulnerable [1, 2]. There are various challenges associated with the deployment of RE and EE solutions in the value chain of the HKH mountain regions, such as [1–6]:

1) **Poverty:** The HKH region possesses over 600 GW of hydropower and significant potential for other RE sources. However, clean energy access rates undoubtedly lag well

behind among the HKH countries. It is due to the inability of the majority of the population to afford modern energy services [7, 8]. The region relies heavily on traditional biomass for cooking and heating, resulting in poor indoor air quality, respiratory illnesses primarily affecting women and children, deforestation and land degradation, and the impacts of climate change.

- 2) **Lack of mountain-specific energy data:** There is a lack of accurate HKH mountain-specific energy data, including demand and supply patterns and trends. The energy data gap hinders the creation of evidence-based mountain-specific energy policies, targets, projects, investments, and regulatory frameworks for the region's sustainable energy governance and market growth.
- 3) **Lack of capacity:** RE and EE solutions are becoming a more competitive alternative to conventional sources due to their global availability and adaptability. A lack of awareness about the solutions within institutions and the population is one of

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the challenges for the implementation of RE and EE solutions in the region.

- 4) **Failure of nexus resource assessments:** Policies and assessments often overlook the intersection of water, energy, and food resources in Alpine areas, leading to inefficient resource use amidst the significant impact of climate change, which includes changes to hydrological regimes, glacial melting, glacier loss, flooding, and decreased river flow due to receding glaciers. Thus, policymakers need to adopt a more comprehensive approach to tackle the challenges of climate change in the region.
- 5) **Lack of integrated rural energy policy planning and monitoring processes:** Providing affordable and reliable energy services to remote areas far from the national grid infrastructure is challenging due to various factors such as inadequate infrastructure, socio-economic hardship, poverty, and extreme weather conditions. The absence of integrated gender-sensitive rural energy policy planning and monitoring processes, as well as inadequate regulatory frameworks for renewables, has further hindered the deployment of decentralized energy solutions in the HKH regions.

The lack of capacity at various levels, such as individual, institutional, and organizational, is one of the significant challenges for deploying RE and EE solutions in the HKH region. A clear understanding of capabilities at various levels and the internal and external challenges that contribute to the deployment of RE and EE solutions in the value chain is needed to advance the field. To understand the capabilities, a clear capacity needs assessment (CNA) is required. Various CNA methodologies and frameworks were developed by many international organizations. However, no separate capacity development framework or guidelines exist for the mountain context. Keeping this in view, the objectives of the study are:

- 1) Assess existing CNA frameworks and approaches
- 2) Customize the CNA framework for the Nepal mountain context
- 3) Case study assessment of capacity development for the implementation of RE and EE solutions in Nepal's cardamom value chain.

2. Capacity Development for Deployment of RE and EE Solutions

Capacity development is the process by which individuals, groups, organizations, institutions, and countries develop, enhance, and organize their systems, resources, and knowledge, all reflected in their abilities, individually and collectively, to perform functions, solve problems, and achieve objectives [9]. Capacity is not an end in itself – it is the ability to achieve something in a broader environment [10]. Structured capacity development initiatives at the individual, institutional, and organizational levels can accelerate the transition from traditional energy to RE and EE markets. Capacity building must be viewed holistically, and it should address [11–14]:

- 1) Issues concerning the enabling conditions for RE and EE, such as the availability of appropriate policy, regulations, and standards, as well as the relationship between the relevant stakeholders in the sector
- 2) Issues at the institutional level, such as the existence of required institutions capable of effectively carrying out their objectives and adapting their operations to changes
- 3) Issues at the individual level, knowledge, and skills

To achieve capacity development, it introduces the concept of CNA, an analytical approach for identifying the specific capacity requirement at the various levels, such as individual, local,

organizational, institutional, and national levels, to deploy RE and EE solutions in the system/value chain. When formulating an effective CNA, policymakers must understand the strengths, weaknesses, and preparedness to meet capacity development objectives. Conducting a CNA provides essential information for strategic planning and decision-making regarding capacity development initiatives. The specific characteristics of the energy sector and the levels and types of capabilities available, including system, institutional, and individual, must be considered when conducting a capacity analysis. By identifying capacity gaps and needs, policymakers can design and implement effective capacity development initiatives that promote the deployment and implementation of RE and EE solutions.

2.1. Tools and instruments for CNA

Various sectors have been investigated to determine their capacity needs, using different CNA frameworks and approaches. Most of these frameworks evaluate capacity needs at three levels: institutional/organizational, network, and enablers. However, some frameworks have been examined at four levels: system, individual, organizational, and network. This section describes existing frameworks and approaches to determine CNA.

2.1.1. UNDP capacity assessment methodology

UNDP capacity assessment methodology consists of a framework, process, and supporting tools. The assessment comprises five steps: (i) engaging stakeholders in capacity development; (ii) assessing capacity assets and needs; (iii) developing a capacity development response; (iv) implementing a capacity development response; and (v) evaluating capacity development. The methodology is based on a capacity assessment framework, a capacity assessment process, and an excel-based supporting tool. Various CNA studies have been conducted following the UNDP methodology and framework. To implement UNDP's CAN framework, we need to mobilize and design, conduct the capacity assessment, and summarize and interpret results with a three-dimensional framework. The three-dimensional framework consists of interdependent dimensions: assessment of point of entry, core issues, and functional and technical capabilities that are used to identify the strengths and weaknesses of an organization or individual in each of the capacity areas, levels, and development processes, and to develop strategies for capacity development [15].

2.1.2. Capacity assessment approach of FAO

FAO's approach consists of three basic processes: a problem tree, stakeholder mapping, and a capacity questionnaire. The problem tree aids in identifying the underlying cause of the problem and the identification of the required capability. Stakeholder mapping assists in identifying those who are participating at various stages of the process and different levels of the process. Finally, the questionnaire covers key indicators and examines the system's three parts: the enabling environment, the organizations, and the individuals. Each level has different critical indicators for evaluating capacity needs [16, 17].

2.1.3. Capacity Development Needs Diagnostics for Renewable Energy of IRENA

The Capacity Development Readiness Evaluation (CaDRE) was developed by IRENA in partnership with GIZ, IDEA, and NREL. It is a country-driven, comprehensive approach to

analyzing existing capacity, forecasting future capacity needs, identifying capacity gaps, and making recommendations for capacity development strategies. CaDRE’s approach is based on four levels of capacity: system, individual, organizational, and network. The CaDRE process includes scoping, diagnostics, review, and recommendations and uses a three-dimensional framework assessment to design strategies, strengthen conditions, and monitor and evaluate progress [18].

2.1.4. The 5 capabilities framework of IPAT

The 5C framework is an organizational assessment approach developed by IPAT. The framework defines organizational capacity across five functional areas: the capabilities to commit and act, relate and attract, balance diversity and coherence, create results, and adapt and self-renew. This approach emphasizes robust dialog and process orientation. Through these capabilities, organizations can thrive in changing circumstances [10].

2.1.5. Practitioner’s guide to capacity development in Project Finance Management (PFM) of OECD

The Practitioner’s Guide to Capacity Development in PFM by OECD has adopted the UNDP capacity development process. However, the framework was modified for PFM and includes indicators developed on resources, management, institutional frameworks, and support structures. It focuses on three levels of capacity: individuals, organizations, and the enabling environment [9].

3. CNA Methodology for Mountain Context

Institutional stability, resources, gender and social inclusion, research training, and monitoring are essential to sustain capacity-building programs, particularly given the mountain region’s dependence on resources and susceptibility to climate change. A unique capacity assessment framework and methodology have been developed for implementing RE and EE solutions in the HKH mountain region [19, 20]. Building capacity in the mountain context takes significant time and effort, requiring a tailored approach considering institutional stability, resources, research, and monitoring. By addressing these issues, capacity development

programs can achieve their objectives and contribute to sustainable development in the region.

3.1. Approach for conducting CNA

Once the assessment steps and framework have been developed, it is crucial to approach the steps and framework in assessing the capacity needs. The study develops a four-way approach for conducting CNA such as review, research design, field survey, and analysis and result. Figure 1 shows the approach for conducting the assessment study. Table 1 shows the CNA process, stages, and tools for the deployment of RE and EE solutions in the value chain process in the HKH region.

3.2. CNA steps

Conducting a CNA to implement RE and EE solutions includes defining the boundaries, understanding capacity gaps, and prioritizing capacity needs. Defined boundaries aid understanding of current and future energy nodes, as well as national/sub-national policies and priorities for deploying solutions. Understanding capacity gaps evaluates solution providers’ and users’ existing core capabilities as well as the capacity required to deploy solutions. Prioritizing capacity needs allows for identifying the most strategically appropriate capacity

Figure 1 Approach for conducting the capacity need assessment study

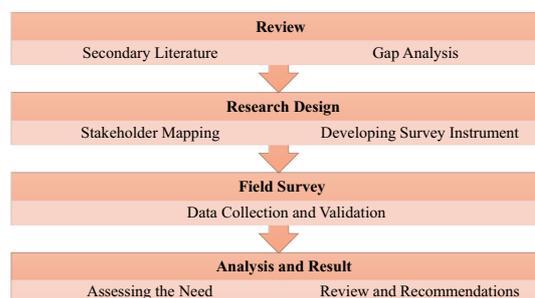
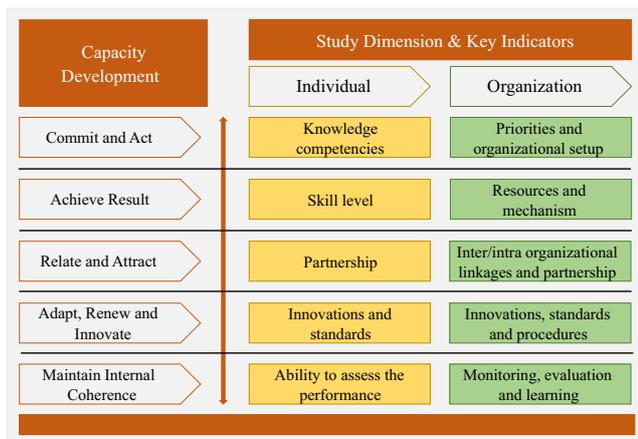


Table 1 Capacity needs assessment process, stages, and tools

Processes	Stages	Key outcomes	Tools
Review	Understanding of the assessment process – what we try to do and why	A clear understanding by the assessment team of responsibilities for conducting the assessment, resources available, and boundaries in which the assessment will occur	Visioning workshop, brainstorming
	Review of available literature	Better insight into the productive application of RE and EE in the agriculture and tourism sector	Keywords for searching literature and review
	Situation analysis – whom we are approaching for what	A clear understanding of possible actors (individuals and institutions)	Stakeholders’ analysis
Analysis	Selection of critical informants, target groups for a questionnaire, and face-to-face interviews	Assessment of the current capacity of individuals and organizations to implement critical actions and where capacity gaps exist	Checklists or questionnaires for CD needs assessment
	Assessing existing capacities and gaps	Drafting interventions to bridge capacity gaps	Data collection method Analysis of field data and triangulation
Documentation	Actions and strategies to fill capacity gaps	The documentation of the assumptions, objectives, process, outcomes, feasibility, etc.	Structure of the report
	Resources required and responsible agencies	Documentation of required resources, responsibilities, and timelines	Presentation and interpretation of data

Figure 2
Capacity needs assessment framework



development actions based on a set of criteria. Conducting a CNA includes defining the boundaries, understanding capacity gaps, and prioritizing capacity needs.

3.3. CNA framework

The CNA framework has three dimensions (Figure 2):

- 1) **Defining the boundaries:** As discussed in the previous sections, the capacity resides at different levels: system, organizational, individual, network, and enabling environment, and each of these levels is the defining boundary. The CNA for the value chain in the HKH mountain context explicitly targets individuals and organizations.
 - a. Individuals – The stakeholders and the individuals who are directly in the value chain process and are the sole beneficiaries of any program or initiatives
 - b. Organizations – All others come under organizations.
- 2) **Understanding the capacity gaps:** The CNA framework considers the five core capabilities that are most commonly

encountered in the levels of capacity in the HKH mountain context across the two boundaries of the value chain: (1) commit and act, (2) achieve result, (3) relate and attract, (4) adapt, renew, and innovate, and (5) maintain internal coherence. Figure 3 describes five core capabilities.

- 3) **Prioritizing capacity needs:** Prioritizing the capacity needs is the key indicator with respect to the core capabilities. The CNA framework has five indicators for each level. For individuals: knowledge competency; skill level; partnership; innovations and standards; and ability to assess performance. For the organization: priorities and organizational setup; resource and mechanism; inter/intra-organizational linkages and partnerships; innovations, standards, and procedures; and monitoring, evaluation, and learning (MEL).

3.4. Questionnaire

The authors created an online survey questionnaire to investigate the adoption of RE and EE within the cardamom value chain in Nepal. The questionnaire was designed to collect information from both individuals and organizations. The questionnaire consisted of multiple-choice questions and was divided into several sections. For individuals, the first section gathered general, personal, and farming information from respondents. The second section focused on the respondent’s capabilities in several areas, including knowledge, skills, partnership, attitude, values, behavior, and performance assessment. The first section of the organization’s questionnaire gathered information about the organization and the respondent. The second section focused on the organization’s capabilities in priorities and setup, resources and implementation mechanisms, linkage and partnership, innovation, standards, and procedures, and MEL competency. Table 2 shows the questionnaire details to investigate individual and organization capabilities. The questionnaire was developed in English and translated into Nepali to better understand the individuals.

3.5. Field survey

There are various stakeholders, and the national/district-level umbrella organizations are involved in the cardamom value chain in Nepal. Figure 4 shows the cardamom value chain process and the organization and stakeholders in developing cardamom in Nepal.

Figure 3
The five core capabilities of the capacity needs assessment framework

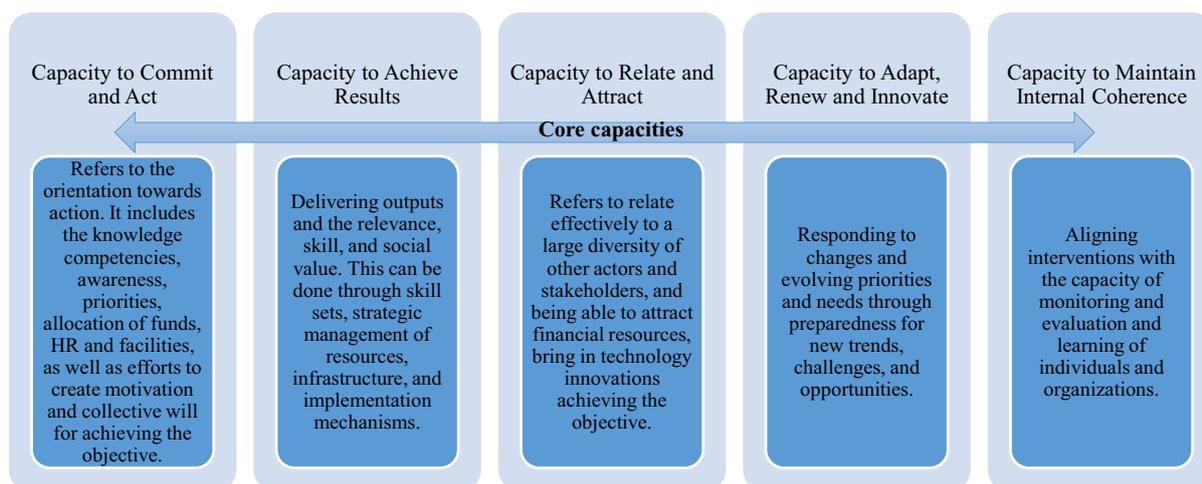
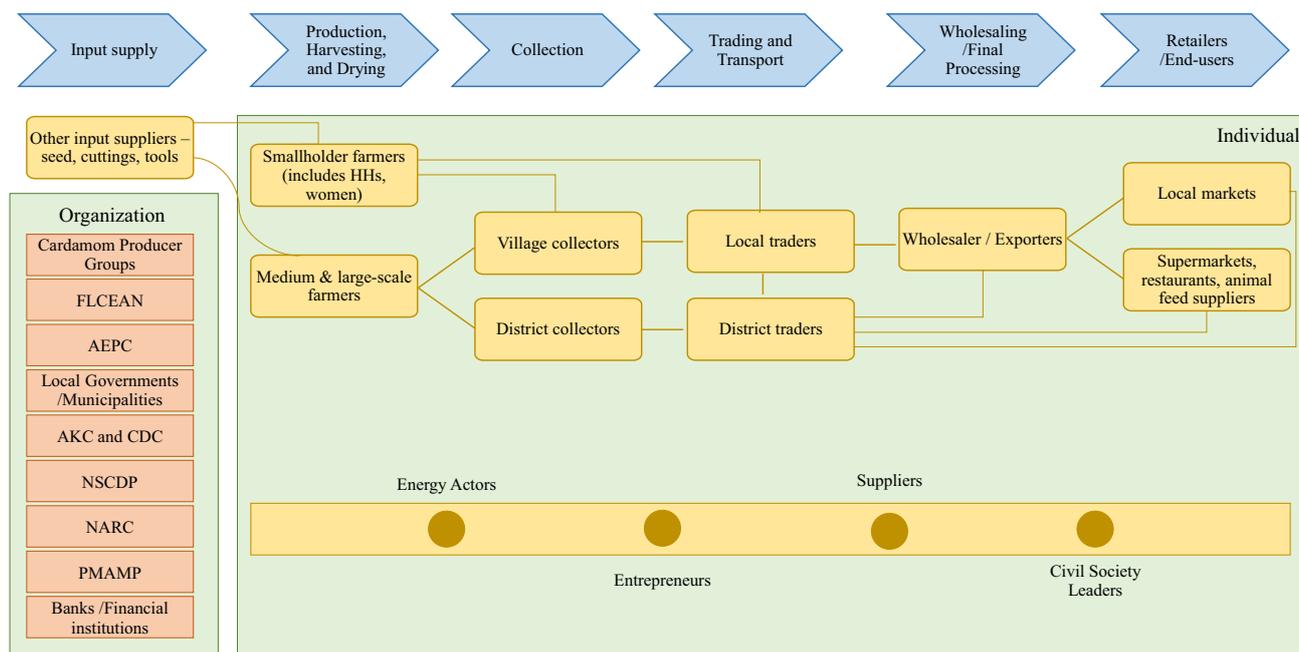


Table 2
Capacity assessment questionnaire for individual and organisation level

Capability	Individual	Capability	Organization
Knowledge to commit and act	<ul style="list-style-type: none"> – Level of awareness – Level of knowledge on use, benefits, policy, subsidies, and service providers – Interest in learning 	Priorities and setup defined to commit and act	<ul style="list-style-type: none"> – Program and plan existence – Program and plan priorities – Human resource and financial capacity
Skill to achieve result	<ul style="list-style-type: none"> – Able to access – government subsidy/ incentives; technology providers; finance 	Resources and implementation mechanism to achieve results	<ul style="list-style-type: none"> – Manpower – Budget/financial resource – Infrastructure facility – Implementation mechanism
Partnership to relate and attract	<ul style="list-style-type: none"> – Existing type of partnership – Required type of partnership in future 	Linkage and partnership to relate and attract	<ul style="list-style-type: none"> – Existing type of partnership – Required type of partnership in future
Attitude, values, behaviors to adapt, renew, and innovate	<ul style="list-style-type: none"> – Scale of interest – Willingness to spend; capacity development – Reason to adapt 	Innovation, standards, and procedures to adapt, renew, and innovate	<ul style="list-style-type: none"> – Scale of interest – Willingness to spend; capacity development – Reason to adapt
Ability to assess the performance	<ul style="list-style-type: none"> – Financial track record – Information on monitoring and evaluation existence 	Monitoring, evaluation, and learning (MEL) competency	<ul style="list-style-type: none"> – MEL framework – MEL performance – Best practices

Figure 4
Cardamom value chain



The stakeholder mapping and category have been done based on the involvement in the value chain process. The stakeholders are directly involved in the value chain process and directly impact the cost of the products as individuals. The policy enablers are categorized as organizations. The stakeholder mapping covers both the micro-level (individuals) and macro-level (institutions and umbrella organizations). Figure 5 provides the stakeholder mapping and the categories of the stakeholder level used in the survey. An enumerator carried out the individual survey with local knowledge, and the organizational survey was carried out through email. Given

the diversities in the scale of operation, kind of products, and location, a purposive selection method was used to select informants for the survey. The survey includes the primary national-level umbrella organizations, national agriculture programs, local governments, cooperatives, financial institutions (FIs), district-level agriculture programs, district-level associations, knowledge centers, and entrepreneurs’ associations.

The study area included four districts: Ilam, Jhapa, Panchthar, and Taplejung, which are all major cardamom producers in Nepal. The individuals were selected on a random sample method of 84,

Figure 5
Stakeholder mapping



covering all the players in the cardamom value chain, such as farmers, district and local traders, energy actors, exporters, civil society leaders, entrepreneurs, and processors. The survey includes 61% of men and 39% of women. In terms of educational qualifications, 39% completed secondary school (Grades 9–10), 25% completed higher secondary school (Grades 11–12), 11% completed a bachelor's degree, 2% completed a master's degree, and 17% had formal education (1–8 Grades). The remaining 6% are uneducated. The household size of the survey covers three categories such as 19% are less than three members family size, 70% are between 4 and 6 members family size, and 11% are more than six members family size. Regarding the household annual income generation of the surveyed individuals, 31% lies between 1 and 3.6 lakh¹ NPR², 48% are between 3.6 and 7.2 lakh NPR, 14% between 7.2 and 12 lakh NPR, 5% between 12 and 30 lakh NPR, and 2% are more than 30 lakhs NPR annual income generation. In terms of land availability, 4% has less than 8 Ropani lands³, 18% has 9–16 Ropani lands, 40% has 17–40 Ropani lands, 29% has 41–80 Ropani lands, 2% has more than 80 Ropani lands, and the remaining 7% do not own any land. This 7% of the individuals are traders who do not have land but work in the cardamom value chain. Regarding the age group of the surveyed individuals, 10% are less than 30, 63% are between 31 and 50, and the remaining 27% are more than 50.

4. Case Study Assessment

4.1. Individual

4.1.1. Capacity to commit and act

To access the capacity to commit and act, it is necessary to have knowledge competence in areas such as awareness, knowledge of technology, government policy and program, technology suppliers, and comprehension of resolve resulting from the usage of RE and EE. Figure 6 shows individuals' capacity to commit and act. During the survey, around 54% of the individuals responded to limited awareness of RE and EE use in the cardamom value chain, and 25% were unaware of RE and EE use in the cardamom value chain. Regarding the knowledge level of RE and EE solutions, 68% have limited knowledge, and nearly 21% do not know RE and EE. In terms of knowledge level about

the government policy, program, and subsidy available for RE and EE use in the cardamom value chain, 67% have limited knowledge, and 26% do not know about it. In terms of knowledge level concerning technology service providers, 29% reported no knowledge, and 64% reported little understanding.

It is evident from the survey findings that there is a lack of awareness and knowledge among individuals about RE and EE use in the cardamom value chain. In terms of interest in learning about RE and EE use in the cardamom value chain, 93% have shown interest in learning, and the remaining 7% have responded with maybe learning about it in the future. Ninety-two of the samples want RE and EE solutions in the cardamom value chain for grinding and powdering, followed by 70% for drying. Surprisingly, only 4% of the samples want irrigation solutions. The survey results revealed a lack of awareness and knowledge about RE and EE use in the cardamom value chain among the individuals, indicating a lack of willingness and ability to commit and act on this information. The findings, on the other hand, suggest that the individuals are interested in learning about RE and EE solutions, as well as understanding the importance of these solutions in the value chain. It also demonstrates that the individuals are engaged and motivated to take action to install RE and EE solutions throughout the value chain. There is a requirement for organized awareness programs to educate the general public about the fundamental knowledge and benefits of using RE and EE solutions in the cardamom value chain rather than traditional fossil fuels. Local institutions, such as municipalities/local governments, NGOs, and civil society leaders, may be involved in spreading awareness and knowledge development campaigns not only about the use and benefits of RE and EE but also about the subsidy program/policies and technology providers.

4.1.2. Capacity to achieve results

The capacity to achieve the result is to apply the solutions to get access to service providers and finance/FIs. The key indicator for the capacity to achieve the result is the skill level to apply the solutions to access service providers and finance, including the individual's ability to access the government subsidy, finance/FIs, and service providers. Figure 7 shows individuals' capacity to achieve results. The survey findings show that only 37% of the respondents felt somewhat likely, only 2% were very likely able to access the subsidy, and more than 50% felt that neither likely nor unlikely was able to access the subsidy. Regarding access to service providers, only 2% were very likely able to access, and 19% responded somewhat likely, whereas 69% felt neither likely nor unlikely able to access the service providers. Regarding access to finance/FIs, only 15% can somewhat likely access it, 73% felt neither likely nor unlikely, and 12% responded that they were very unlikely able to access it.

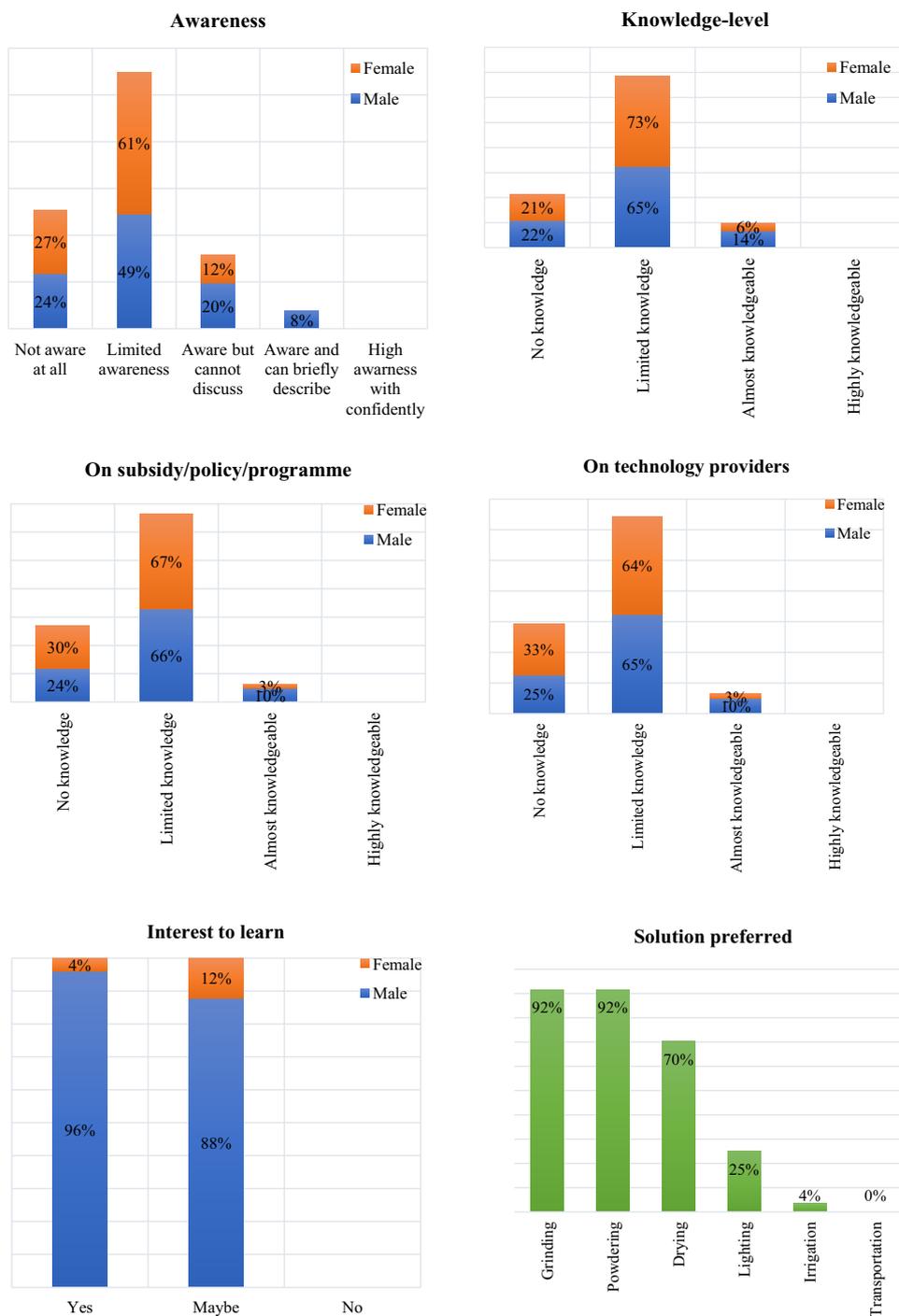
The survey discovered that there is a lack of skill set to use RE and EE in the cardamom value chain among the individuals, which indicates a lack of capacity to achieve results. Program/project implementation agencies and organizations may conduct skill development programs to encourage the individuals who operate in the cardamom value chain to adopt RE and EE solutions. Local government/municipalities, FIs such as banks and micro-finance institutions, and RE and EE technology suppliers such as micro-enterprises and small- and medium-sized enterprises (SMEs) may be encouraged to participate in such a skill development program to support the financing requirements and technology availability for RE and EE in the cardamom value chain.

¹Lakh = 100,000.

²1 US Dollar = 128 Nepalese Rupee (NPR).

³1 Acre = 7.9547 Ropani.

Figure 6
Individual capacity to commit and act

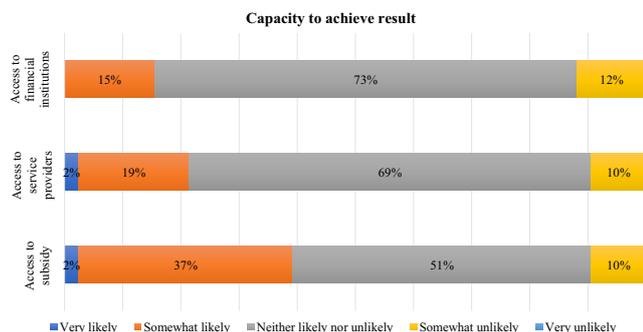


4.1.3. Capacity to relate and attract

A partnership allows individuals to replicate themselves and expand their influence to a broader audience. The capacity to relate and attract can only be accessed through a partnership. It includes the type and kind/nature of partnerships involved and the accomplishment of partnerships. Figures 8 and 9 show individuals' capacity to relate and attract. Hundred percent of respondents work in collaboration with at least one additional

stakeholder. Since over 90% of respondents are farmers, farmers are obliged to form partnerships with other stakeholders, mainly traders, to sell their products. The study findings indicate that 94% of respondents partner with traders, followed by 68% with cooperatives. It is self-evident that 98% have trading partnerships, followed by 55% for financial assistance and 49% for capacity-building and training partnerships. In terms of the partnership

Figure 7
Individual capacity to achieve results



accomplishment, 99% responded that the partnership had helped them promote their business, followed by access to finance for 60%, capacity-building/training partnership for 39%, and 23% has knowledge development.

The survey results demonstrate unequivocally that the individuals had the capacity to relate and attract. Partnerships with a variety of other stakeholders are possible for everyone. Most of those who have done so have stated that the collaboration has helped them grow their business. However, 86% of individuals have agreed that partnership and collaboration are required when it comes to the necessity of partnership to strengthen the business.

It will assist them in expanding their reach and replicating their success. But, it is surprising that 90% of the individuals felt that capacity building and training are more important than the financial and technical support from the partnership. As a result, there is an opportunity for an individual capacity-building and training programs to help them improve their ability to attract and relate to others. In this context, the national agencies collaborating unit should be positioned to facilitate capacity building/training in support of programs implementing RE and EE use in the cardamom value chain in partnership among the responsible individual stakeholders and agencies.

4.1.4. Capacity to adapt, renew, and innovate

Innovations and standards are the key indicators to evaluate the capacity to adapt, renew, and innovate. It shows the individual’s attitude, values, and behavior to think about doing new things and will be able to adapt, renew, and innovate new and clean technologies used in the value chain. The questions cover the individual’s interest in adapting, willingness to adapt, ability, and interest to learn new and innovate. Figures 10 and 11 show individuals’ capacity to adapt, renew, and innovate. The survey suggests 100% are willing to adapt, renew, and innovate RE and EE use in the cardamom value chain. Among these, 36% are extremely interested, and 64% are somewhat interested. The survey indicates that 55% of the individuals are willing to spend money on adapting RE and EE in the cardamom value chain.

Moreover, only one-fourth of the respondents felt that some innovations and standards already exist in RE and EE use in

Figure 8
Individual capacity to relate and attract

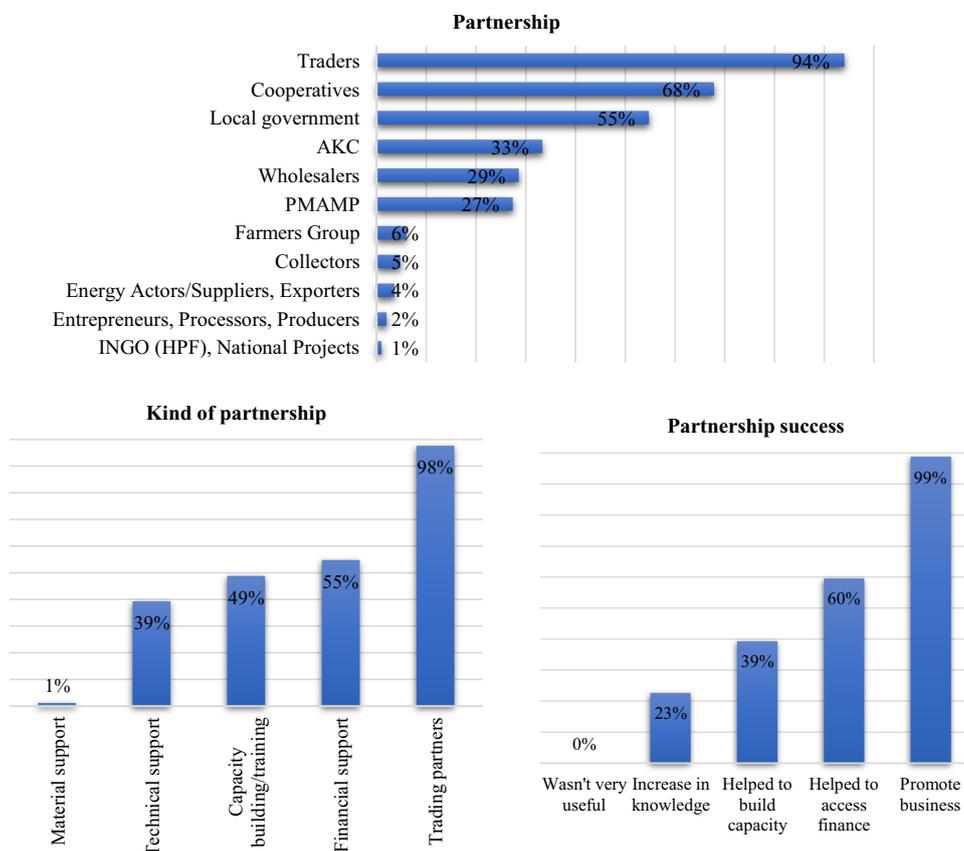


Figure 9
Individual capacity to relate and attract

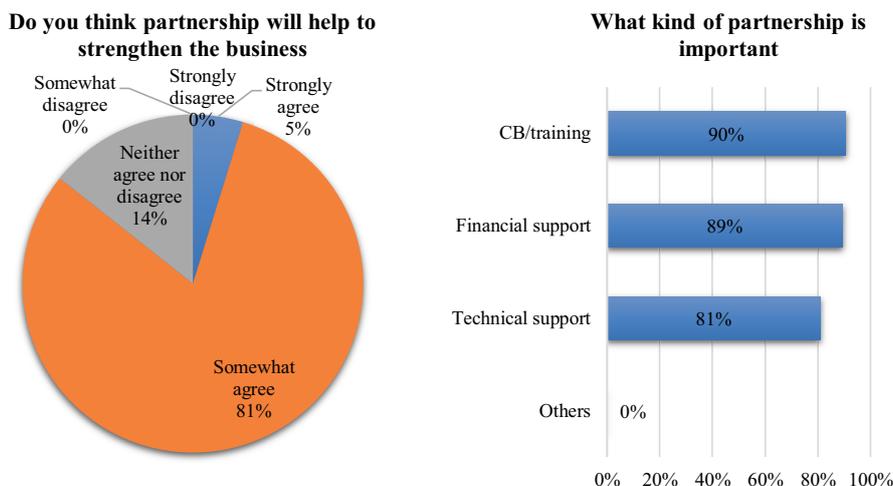
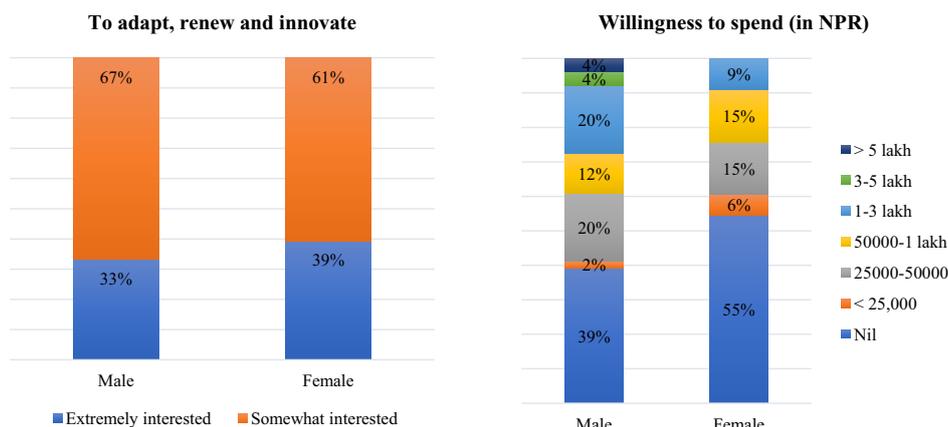


Figure 10
Individual capacity to adapt, renew, and innovate



the cardamom value chain, and 74% were not sure about the existence of innovations and standards. In terms of access to the innovations and standards for RE and EE use in the cardamom value chain, 42% responded that there is not enough platform to access, and 54% felt that neither agree nor disagree. Only 2% felt a sufficient platform available to access the innovations and standards in RE and EE use in the cardamom value chain. The survey also investigates the reasons behind the motivation to RE and EE in the cardamom value chain. Save labor has been ranked first for the reasons (Box 1).

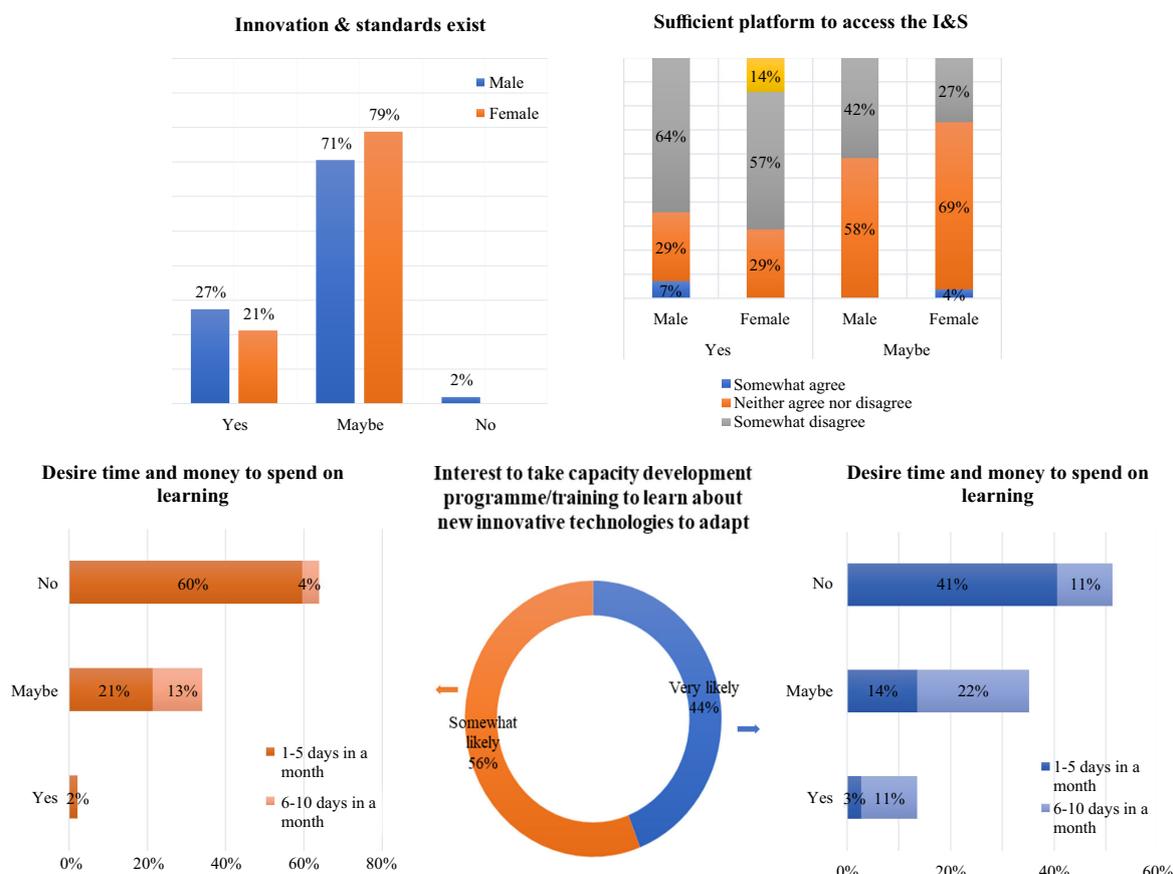
Regarding undertaking training and capacity-building programs to learn more about the innovations, standards, and new technologies of RE and EE use in the cardamom value chain, 44% are very likely interested, and 66% are somewhat interested. All the individuals have responded that they are ready to spend between 1 and 10 days to take capacity-building and training programs; even 7% are willing to pay fees, and 35% may consider paying the fee. The survey findings indicate that the individuals have the capacity to adapt, renew, and innovate; however, it is shown that the majority mentioned that they are not aware of the innovations and the platform to access the

innovative technologies and systems. So, there is a gap between the platform to access the innovation and awareness about the innovation existing. There is a need to demonstrate innovations in RE and EE use in the cardamom value chain at the grassroots level.

4.1.5. Capacity to maintain internal coherence

The ability to assess performance is a crucial indicator of the capacity to maintain internal coherence. The ability to assess the performance includes maintaining the database on financials, tracking income details, cash flows, expenses, and system monitoring such as keeping a logbook/database on energy usage. Figure 13 shows individuals' capacity to maintain internal coherence. The survey suggests that only 19% of the respondents monitor and keep any financial record or monitor the revenue, and only 17% keep track of the income, cash flows, and expense data. No respondent keeps any logbooks or databooks to monitor energy usage. From the survey, it is clear that there is a lack of capacity to maintain internal coherence among the respondents. A capacity-building program for the individuals on an efficient monitoring

Figure 11
Individual capacity to adapt, renew, and innovate



system is needed to provide evidence-based feedback for improving the capacity to maintain internal coherence. There is a need to strengthen and harmonize the capacity to assess performance by switching the benefits and knowing about the money and time savings due to RE and EE use in the cardamom value chain.

4.2. Organization

4.2.1. Capacity to commit and act

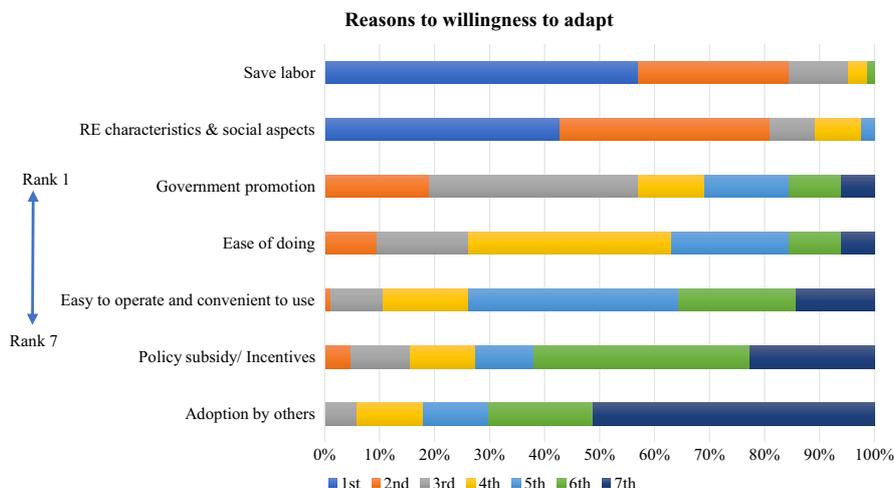
The priority and the organizational setup are the key indicators of the capacity to commit and act. The priority and organization setup include the availability of dedicated human resources, separate divisions, and a dedicated program/mission for the development of RE and EE solutions in the cardamom value chain. Figures 14 and 15 show the organization's capacity to commit and act. The survey findings show that 45% of the organization considers RE and EE as one of its program priorities, while the remaining 55% do not have RE and EE as a priority. Of which 19% of the organization is likely to prioritize RE and EE development in the future, 20% may start, and 16% is unlikely to prioritize RE and EE in the future. Only 13% of the organizations have dedicated human resources for the development of RE and EE, with 75% having dedicated divisions and 100% having assigned roles and responsibilities to their employees for this purpose. According to the survey findings, dedicated human resources to RE and EE development are lacking in 87% of all organizations. As for their plans to establish dedicated human resources, 16% of those surveyed said they had no plans, while 13% said they would do so in the future. According to the survey, 58% felt neither likely nor unlikely to establish dedicated resources.

Fewer than one-third (13%) of organizations have a dedicated program for the development of RE and EE. Three-fourths of the program is still going, and the remaining have been discontinued over the years but are planning to relaunch. All these programs are on capacity building/training and technical assistance, and some of the programs include financial support, policy support, and healthy planting materials production. Among the 87% of organizations that do not have a dedicated program on RE and EE in the cardamom value chain in the future, and 10% said they were unlikely to do so. The remaining 51% said they were neither likely nor unlikely to establish a dedicated program. Most of the organizations surveyed have dedicated RE and EE priorities; however, there is no dedicated human resource and a dedicated program for the development of RE and EE use in the cardamom value chain. The survey findings indicate that the organization has lacked priorities and setup defined to commit and act. Thus, the organizations surveyed work in the cardamom value chain, and the organizational capacity building extends beyond individual training and technical help. Organizations must be strengthened to bring together individual talents, external technical help, and managerial skills.

4.2.2. Capacity to achieve results

The resources and implementation mechanism available for the development of RE and EE in the cardamom value chain are the

Figure 12
Individual capacity to adapt, renew, and innovate



Box 1. Ranking the reasons for motivation to adapt RE and EE use in the cardamom value chain 57% of respondents ranked save labor as the first reason behind RE and EE use in the cardamom value chain, and 42% ranked the characteristics of RE and social aspects as the reasons (Figure 12). Overall, saving labor ranked first, followed by clean energy, environment, and social aspects reasons are the second. In contrast, policy subsidy and incentives were ranked sixth for motivation to adapt RE and EE use in the cardamom value chain, indicating that good policy subsidy and incentives are required.

Figure 13
Individual capacity to maintain internal coherence

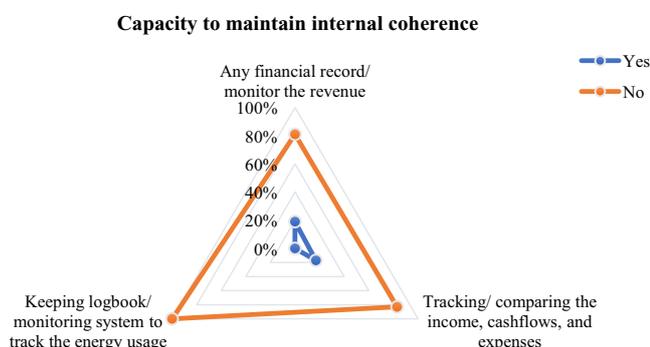
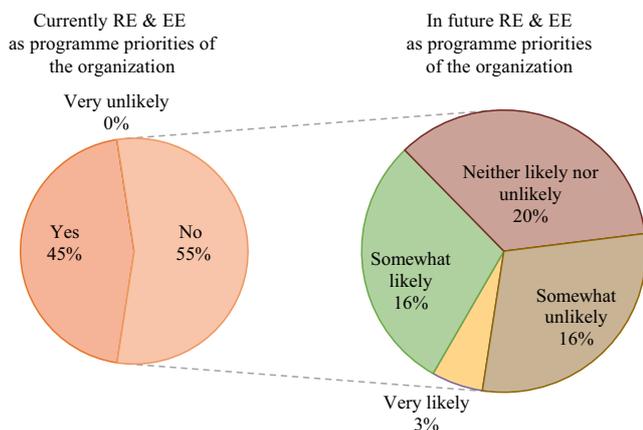


Figure 14
Organization capacity to commit and act



indicator for the organization to achieve the results. It comprises the availability of sufficient manpower, budget/finance, and infrastructure. Figure 16 shows the organization’s capacity to achieve results. The survey findings show that only 10% of the organization has sufficient budget/finance, and only 6% have sufficient manpower to implement RE and EE in the cardamom value chain. Regarding the availability of infrastructure facilities for the development of RE and EE in the cardamom value chain, 64% of the organizations have the infrastructure facility, and just 10% lack the necessary infrastructure facility. In contrast, little over one-fourth (26%) of the organizations have an implementation mechanism for developing RE and EE use in the cardamom value chain. It is clear from the study results that insufficient resources and implementation mechanisms are available to help organizations accomplish their objectives. A well-functioning manpower unit with good information technology would aid in the identification of future capacity requirements, gaps, and improvements.

4.2.3. Capacity to relate and attract

Linkages and partnerships are indicators for assessing the organization’s capacity to relate and attract. Both inter- and intra-sectorial linkages and partnerships include the type, kind, and achievement of the partnerships and linkage objectives. Figure 17 shows the organization’s capacity to relate and attract. According to the survey results, every organization partners with at least one stakeholder. Partnerships with cardamom producer’s groups and cooperatives account for 71% of the organizations, followed by the partnership with the Prime Minister’s Agriculture Modernization Project unit and individual stakeholders (such as farmers, individual entrepreneurs, processors, traders) for 58%. Regarding the sectoral linkages, 84% of the organizations have other organization linkages, such as agriculture, financing/banking, food, and tourism sectors.

Regarding the nature of partnerships and linkages, 74% of the organizations have technical support partnerships, followed by both capacity building/training and financial support at 68%. Regarding

Figure 15
Organization capacity to commit and act

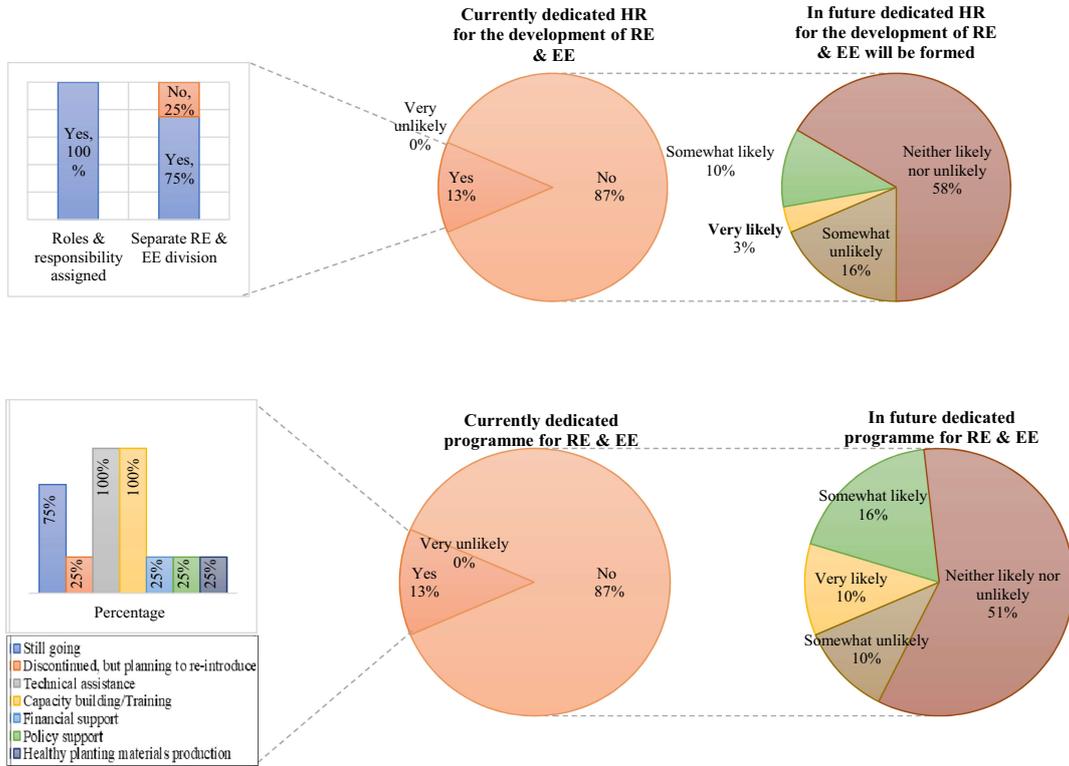


Figure 16
Organization capacity to achieve results

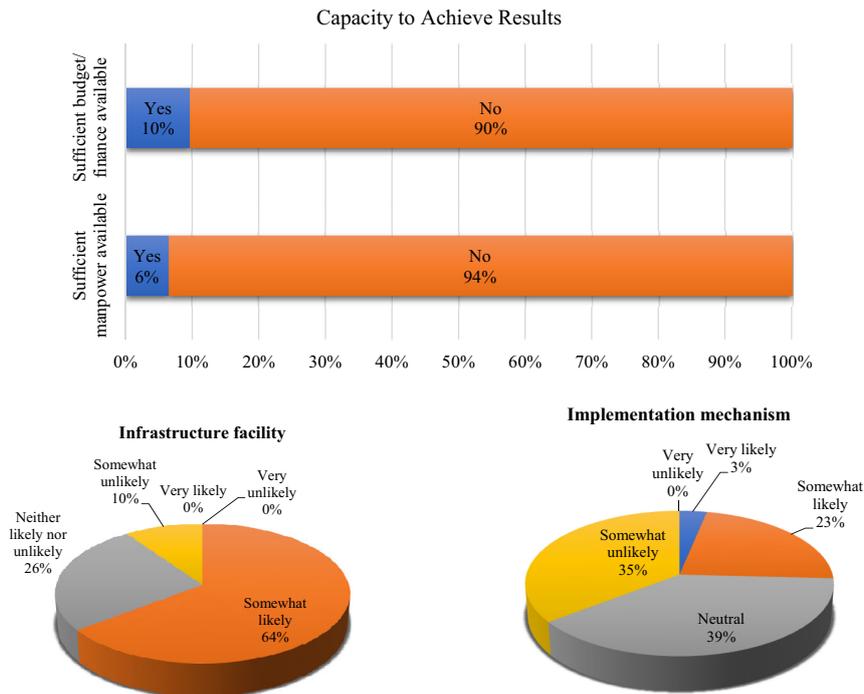
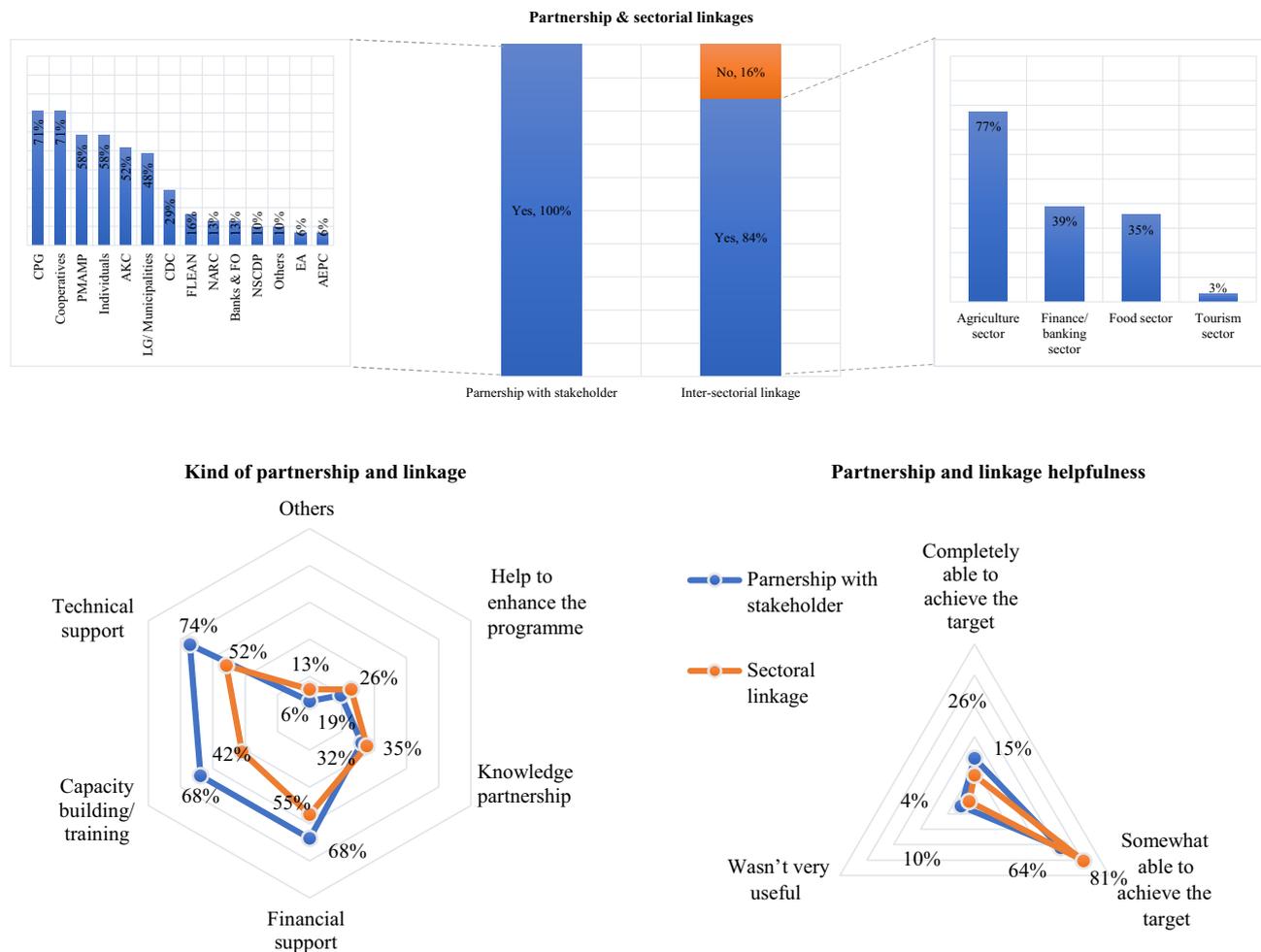


Figure 17
Organization capacity to relate and attract



sectoral linkages, financial support with other organizations topped 55%, followed by technical support at 52%. Regarding the usefulness of partnerships, 10% of the organizations responded that the partnerships were not helpful, 26% were completely able to achieve the partnership’s objective, and the remaining 64% somewhat achieved the objective. For sectoral linkages, 4% responded that linkages were not helpful, 15% were completely able to achieve the objective, and 81% responded that they were somewhat able to achieve the objective for the linkages. The survey findings suggest that the organizations partner with other stakeholders and sectoral linkages. The partnerships and linkages are technical, financial, capacity, and knowledge. Most respondents responded that the linkages and partnerships were somewhat helpful for their business and achieving the objective. Eighty-four percent of the organizations, including national and district-level programs and associations, local governments, FIs, knowledge centers, and farmer groups, felt that the linkages and partnerships would help promote RE and EE in the cardamom value chain. So, at the organizational level, a capacity exists to relate and attract.

4.2.4. Capacity to adapt, renew, and innovate

Innovations, standards, and procedures are the key indicators to evaluate the organization’s capacity to adapt, renew, and innovate. This gives the organization the flexibility to think and adapt to

innovations. Only 10% of the organizations have documented procedures/standards for developing RE and EE in the cardamom value chain. The remaining 90% do not have a documented procedure/standard, but 96% are eager to collaborate with external organizations/institutions to adapt, renew, and innovate in the cardamom value chain. Regarding the presence of innovations and standards, 65% of respondents stated that there are innovations and standards in the RE and EE use in the cardamom value chain. However, 25% believe an adequate platform exists to access the innovations and standards. Figure 18 shows the organization’s capacity to adapt, renew, and innovate. Even though most organizations do not have the documented procedure to adapt RE and EE, all the organizations are interested in adapting and renewing new technologies and solutions in the cardamom value chain. Sixty-one percent of organizations felt they could engage with other stakeholders to adapt RE and EE use in the cardamom value chain. So, it is evident from the survey findings that the organizations have the capacity to adapt, renew, and innovate new technologies and solutions in the cardamom value chain.

4.2.5. Capacity to maintain internal coherence

MEL competency is the parameter for the organization to maintain internal coherence. The organization has a monitoring, evaluation, and learning system in place to maintain internal coherence and ensure feedback loops are established. The survey

Figure 18
Organization capacity to adapt, renew, and innovate

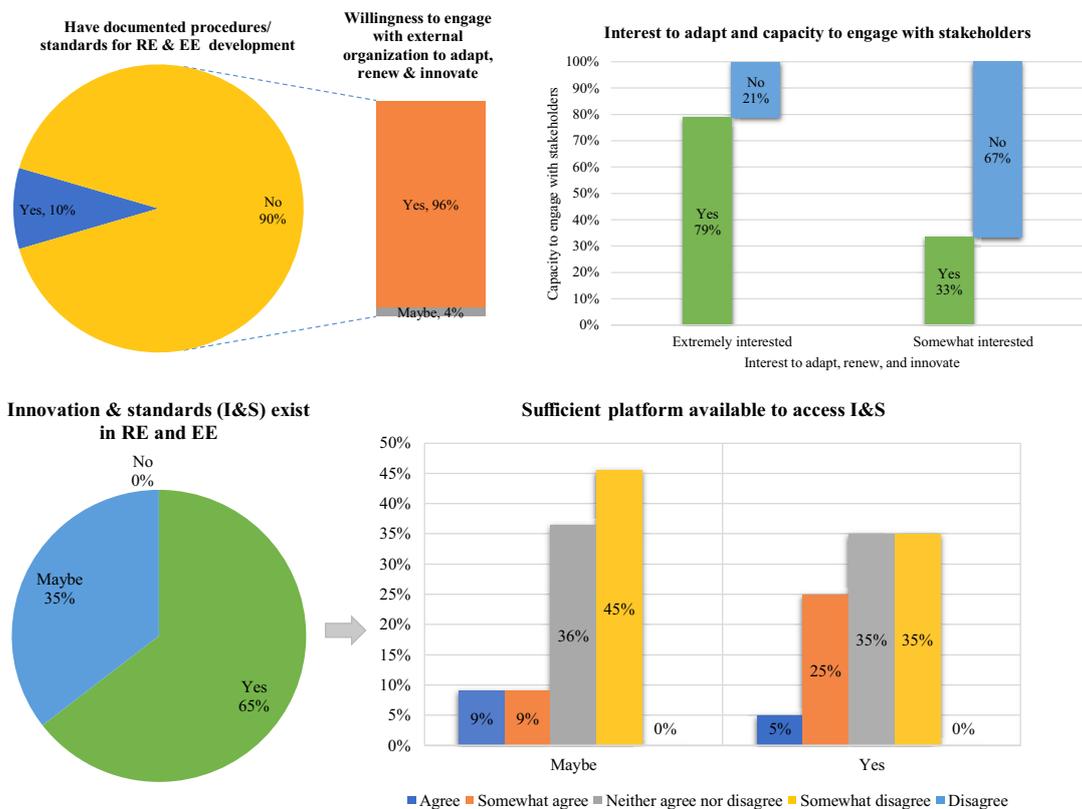
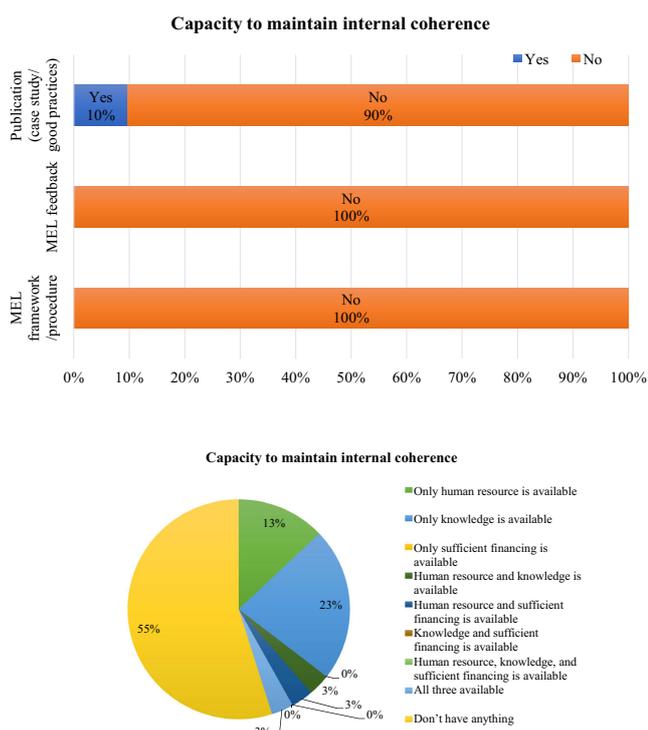


Figure 19
Organization capacity to maintain internal coherence



findings state that no organization has a monitoring and evaluation framework or procedure and documented MEL feedback or publication for deploying RE and EE solutions in the cardamom value chain. Only 10% of organizations have publications such as case studies or good practices on RE and EE use in the cardamom value chain. Figure 19 shows the organization's capacity to maintain internal coherence. In terms of human resource, finance, and technical knowledge available for the organizations to conduct MEL in the future, merely 3% of them have all three, 3% have only human resource, and sufficient financing is available, and 13% has only human resource available. More than half of the organizations (55%) do not have any of these to establish MEL competency in the future. The survey indicates a lack of organizational capacity to maintain internal coherence to deploy RE and EE in the cardamom value chain. A capacity-building program for organizations on efficient monitoring and evaluation systems is required to give evidence-based feedback and improve the capacity of organizations to maintain internal coherence.

5. Conclusion and Recommendations

The methodology and approach developed for conducting capacity assessments in the HKH mountain context value chain are systematic, accurate, flexible, and adaptable. The framework covers awareness, knowledge competency, skill level, ability to access the innovation and standards, partnership, and ability to assess performance. However, it is essential to note the study's potential weaknesses. The study has analyzed the CNA for RE and EE solutions in the cardamom value chain using these key indicators. The results of the

study cannot be considered gospel because they are correlated mainly with input data received from field visits trips in Nepal, the local needs, and the indicators considered. Before extrapolating the results to similar circumstances in other developing nations, these limitations should be noted. Therefore, it is challenging to generalize the study's findings. A further generalization necessitates data on a broader range of initiatives. The framework can be applied to a wide range of other value chains, such as tourism, dairy, poultry, and transportation sectors, by considering appropriate study dimensions and key indicators for the CNA Based on the analysis of data collected from the CNA survey at the individual and organization levels, the following recommendations have been identified:

5.1. Individuals

1) Focus on enhancing effective communication campaign

The most common reasons for not availing RE and EE are lack of awareness and knowledge stated by the majority of individuals (i) lack of knowledge about the benefits of using RE and EE, (ii) lack of awareness about the RE and EE use, and (iii) lack of skill set to apply the solutions to get access to service providers/finance. These issues can be resolved by organizing structured awareness campaigns to educate individuals about the benefits of using RE and EE over traditional methods in the cardamom value chain.

Local government, municipalities, local institutions, NGOs, and civil society leaders may be involved in spreading awareness and knowledge campaigns about the scheme, as well as the benefits of using RE and EE in the cardamom value chain.

2) RE and EE solutions should be on the process side of the value chain

RE and EE solutions should be on the process side of the value chain, such as grinding, powdering, and drying, rather than transportation and irrigation. Whereas the process side activities require a labor force, using RE and EE will significantly reduce labor costs. The survey reflects that save laborers ranked first among the reasons to use RE and EE in the cardamom value chain.

3) Encourage RE and EE-led enterprises and skill development

National program/project implementation agencies may conduct skill development programs to encourage individuals to adopt RE and EE solutions in the cardamom value chain.

FIs such as banks, micro-financing institutions, as well as technology providers, such as micro-enterprises and SMEs, may be encouraged to participate in such a skill development program to support the financing needs and technology available for the deployment of RE and EE in the cardamom value chain.

4) Need for demonstrating innovations in RE and EE use in the cardamom value chain at the grassroots level

5) Focus on evidence-based feedback for improving the capacity to maintain internal coherence

Individuals need to be trained to use an efficient monitoring system to improve their performance. Measuring performance by switching benefits and understanding the money and time saved using RE and EE in the cardamom value chain require strengthening and harmonizing capabilities.

6) Mainstreaming GESI focus on the value chain process and activities

There is a need for a dedicated component specifically focusing on gender equality and social inclusion in the provision of promotion of RE and EE technologies and solutions. This is done by explicitly targeting women and youth-led businesses in adopting RE and EE technologies and solutions, targeting women and vulnerable groups in awareness-raising activities as well as designing tailored financial products. Women are considered not only as beneficiaries, but women entrepreneurs are key drivers of change in the promotion of RE and EE technologies and solutions in the value chain.

5.2. Organizations

1) Need for focused and periodic monitoring and evaluation technique

More focused monitoring and evaluation techniques, disseminating effective capacity-building techniques, and forming strategic relationships with comparable organizations.

Data/information on RE and EE use in the cardamom value chain by the organization should be regularly updated and made available in the public domain.

2) More RE and EE-focused program priorities

More than 50% of the organizations do not have RE and EE as their program priority. The organizations surveyed for this study all work in the energy and agriculture sectors. There is a lack of RE and EE-focused program priorities.

3) Focus on enhancing effective skill and organizational setup

Organizational capacity building goes beyond individual training and technical assistance. Organizations must be enhanced to bring together individual abilities, external technological help, and management skills.

Need for strengthening and complementing the individual's capacity at the organizations to commit and act.

4) Focused awareness campaign on innovation and standards available and platform to access it

Strong desires to renew, innovate, and adapt new technologies in the value chain. However, the lack of a platform to access the innovations and standards of RE and EE solutions in the value chain is challenging.

Acknowledgements

The authors are grateful to the editor and reviewers for their constructive suggestions and comments on an earlier version of this manuscript. We thank Dr Sudha Sapkota from Nepal Agricultural Research Council (NARC) for the comments on the manuscript. This work was part of the ICIMOD initiative Renewable Energy and Energy Efficiency Capability for the Hindu Kush Himalaya (REEECH), supported by the Austrian Development Agency (ADA) through the United Nations Industrial Development Organization (UNIDO).

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data available on request from the corresponding author upon reasonable request.

Author Contribution Statement

Pugazenthi Dhananjayan: Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Surendra Raj Joshi:** Conceptualization, Methodology, Writing – review & editing. **Ujala Rajbhandari:** Writing – review & editing. **Mewang Gyeltshen:** Supervision, Project administration.

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How to Cite: Dhananjayan, P., Raj Joshi, S., Rajbhandari, U., & Gyeltshen, M. (2025). Capacity Needs Assessment for Implementation of Renewable Energy and Energy Efficiency in the Cardamom Value Chain of Nepal's Mountain Regions: Results of a Survey Study. *Green and Low-Carbon Economy*, 3(1), 44–59. <https://doi.org/10.47852/bonviewGLCE3202672>