



Enabling sustainable agrifood value chain transformation in developing countries

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ABSTRACT

As agri-food value chains in developing countries transform to serve higher value markets, they are coming increasing under pressure to embrace sustainable practices. Many key players, particularly smallholders, find it difficult to comply with sustainable practice requirements. They face various barriers in the chain's operation (in terms of governance and value addition), while their primary focus is on increasing incomes to alleviate poverty. Therefore, this study empirically identifies and analyses the factors that enable sustainable value chain transformation in developing countries. A total of three key dimensions (sustainability, governance, and value addition) were used to explore the factors that enable sustainable value chain transformation. Furthermore, the existing practice as well as future intentions towards sustainable value chain practices are evaluated. A quantitative method was employed within Indonesia's cashew sector, and structured interviews were conducted with 159 smallholders from the key production area on Madura Island. The analysis was performed using a combination of descriptive and principal component analyses (PCA). A total of eight factors that enable sustainable transformation were identified. Farm practices and information communication were identified as the most significant enabling factors, as well as stakeholder support, certification motivation, and market expansion. Conversely, the most challenging factors were pre-harvesting value, value capturing, and value adding activities. The results reveal the current practices, barriers, and enablers, and provide policy and practice insights for transforming sustainable value chains in developing countries.

1. Introduction

Agrifood value chains in developing countries are transforming to service higher-value markets, which are increasingly requiring players to embrace sustainable practices. Consumers in such markets demand more processed products and consistent quality and safety standards (Filippi and Chapdaniel, 2020; Hidayati et al., 2021b; Miller and Jones, 2010; Ramos-Mejía et al., 2018). To achieve this, value chain players must amend their products and services to be more sustainable (economic, social, and environmental) (Borsellino et al., 2020; Hubeau et al., 2017; Liu et al., 2019). To improve 'value' towards sustainability expectations requires proficient governance and tailored value addition activities (Borsellino et al., 2020; Hidayati et al., 2021c).

In most developing countries, a focus on smallholders' practices serves as the foundation for value chain transformation; however, enabling sustainable practices can encounter serious barriers. Although

smallholders account for the majority of raw material suppliers, they are often decoupled from chain operations, particularly in terms of governance and value addition (Hidayati et al., 2021a, 2021b; Thorpe, 2018). Furthermore, smallholders typically prioritise practice advancements that improve their income (Maspaitella et al., 2018; Ramos-Mejía et al., 2018; Sjauw-Koen-Fa et al., 2016), which may divert attention away from overall sustainability goals. This economic focus is aimed at reducing poverty, which means that socio-environmental factors receive less attention in developing countries (FAO, 2014; Hidayati et al., 2021c; Schoon et al., 2013). In particular, concentrating solely on the economic aspects of value chain transformation could result in degradation of social and environmental factors. Consequently, sustainable value chain transformation in developing countries remains a critical area of research.

Given the complex challenges in developing countries, several studies have investigated this area through a range of arguments and

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approaches such as identifying drivers and barriers (Borsellino et al., 2020; Gold et al., 2017; Mangla et al., 2018; Mohseni et al., 2022), upgrading activities (Larsen, 2016; Morone and Cottoni, 2016; Vroegindewey and Hodbod, 2018) and measurement techniques (FAO, 2014; Latruffe et al., 2016; Monastyrnaya et al., 2017). These studies have contributed significantly to the growth of knowledge by identifying key indicators for sustainable value chain transformation based on current transformational challenges. However, which factors should be prioritised during the sustainable transformation process remains uncertain. According to Kheiri (2015), smallholders' attitudes towards sustainable practices require further attention as they are impacted by a range of obstacles. Hidayati et al. (2021c) proposed a framework for sustainable value chain orientation trajectory customisation using a structured approach based on three dimensions: sustainability, governance, and value addition. Each dimension has the potential to either enable or obstruct sustainable transformation (Seidel-Sterzik et al., 2018). Therefore, despite the importance of these dimensions in the sustainable value chain approach, it is critical to empirically examine both current practices and intentions towards sustainable value chain practices to better understand how to enable sustainable transformation.

This study empirically identifies and analyses the factors that enable sustainable value chain transformation in developing countries. Indonesia's cashew sector was selected to obtain empirical evidence from a developing country. Approximately 99.8% of cashew producers in Indonesia are smallholders (Directorate General of Plantation, Agricultural Ministry of Indonesia, 2020). Approximately 70% of Indonesia's cashew products are sold globally in the form of a raw commodity (Hidayati et al., 2021b). Given the dominance of exports over domestic trade, Indonesia's adoption of sustainable value chain practices is unavoidable in the long term. The global supply of cashews is heavily reliant on developing countries, with Indonesia being a major player (Royer et al., 2016). The Indonesian government has recently identified the cashew sector as important for global trade (Directorate General of Plantation, Agricultural Ministry of Indonesia, 2020).

This study makes a significant contribution by identifying the factors and vectors that enable sustainable value chain transformation in developing countries based on empirical evidence. Moreover, this study can serve as a replication guide for practitioners and policymakers. The rest of this paper is structured as follows. A literature review that provides a theoretical basis for the research is presented in section 2. In section 3, methodology is justified and the empirical approach explained. The resulting data is analysed in section 4. Finally, a discussion that links the results to previous research and the conclusion identify the original contribution and future research avenues are presented in sections 5 and 6, respectively.

2. Literature review

In recent years, there has been a growing discussion on agrifood value chains in developing countries that are transforming into higher-value markets, with sustainable practice as their main challenge. Some studies argue that the urgency of incorporating sustainability practice into agrifood value chains was fuelled by the central attention on food safety and quality (FAO, 2014; Morone and Cottoni, 2016). With respect to this, many studies have also highlighted the way food is produced in the agrifood industry, leading to an emphasis on food security and recommendations for sustainable value chain practice (Berry et al., 2015; Mohseni et al., 2022; Morone and Cottoni, 2016; Vroegindewey and Hodbod, 2018). The sustainable value chain lens is a multidisciplinary approach that combines the value chain and sustainability approaches. Such practices enable all players throughout the chain to produce and deliver high-end value via sustainability practices. At each stage of the value chain, the economic, social, and ecological dimensions are all acknowledged as beneficial (D'heur (ed.), 2015; Hidayati et al., 2021c).

Many previous studies have revealed that enabling sustainable

practices in developing countries' chains is far from simple (FAO, 2014; Hansen et al., 2018; Hidayati et al., 2021c; Meybeck, 2016). Various critical challenges in developing countries have been investigated, which can be summarised as two major problems. First, as key players in agrifood value chains in many developing countries, smallholders lack capacities across a number of practices including; production, marketing, and coordination (Sjauw-Koen-Fa et al., 2016; Thorpe, 2018; Trienekens, 2011). For these reasons, they are often decoupled from downstream value chain practice especially regarding governance and value addition (Hidayati et al., 2021a, 2021b). Governance is accepted as a key activity in developing successful value chain practices (Gereffi et al., 2005; Kaplinsky and Morris, 2000; Mishra and Dey, 2018) via vertical (power allocation and integration among chain members) and horizontal coordination (collective actions) (Hidayati et al., 2021b; Trienekens, 2011). Value addition activities are equally important. Value addition is frequently defined as a set of product transformations that provides key attributes in terms of product quality and safety (Collins, 2014; Norton, 2017). Smallholders with limited governance and value addition activities are more likely to be excluded from wider value chains. Therefore, the FAO (2014) insisted that agrifood chain development should focus on preserving smallholders in the first place.

Value chain players in developing countries generally prioritise income improvement to reduce poverty (Ramos-Mejía et al., 2018; Sjauw-Koen-Fa, 2012). However, the emphasis on income improvement in the process of value chain transformation has drawn some criticism. For instance, Morone and Cottoni (2016) highlighted that, despite economic gains, many value chain transformations contribute to environmental destruction (overexploitation of natural capital, pollution, and waste). Furthermore, Zocca et al. (2018) asserted that current agricultural problems are mainly a result of the industrial revolution. Therefore, profit-driven value chain transformations carry high-risk operations regarding sustainability. These risks are exacerbated because farming is heavily reliant on natural capital and is the source of raw materials and value-adding basis for subsequent stages (Nastis et al., 2019).

A wide range of factors have been postulated to enable sustainable agrifood value chain transformation in developing countries, as outlined in Table 1. Previous research can be categorised into information communication, institutional, government, facilitation, and market factors (Hidayati et al., 2021b; Thorpe, 2018; Trienekens, 2011). In addition, certification and attitudes/behaviour are critical factors that signify sustainable practice transformation in the agrifood sector. Certification is a mandatory standard of practice in sustainability (Schooneveld et al., 2019), and is closely related to control over intellectual property (Humphrey, 2006). Attitude reflects individual intentions towards sustainable practices (Hansson et al., 2019). While current practice demonstrates how individuals behave and act in actual activities, intention may imply a signal of expectation towards change. Attitude is determined by the individual's behavioural beliefs, which is the subjective probability that a particular action will result in a specific outcome (Hansson et al., 2019). This attitude may also include individual perceptions towards risks (Nastis et al., 2019). Hence, understanding actors' attitudes may serve as fundamental in understanding the key enabling factors towards sustainable practice transformation, especially as a major constraint in embracing such practice by smallholders are often attitudinal, such as being reluctant to change (Kheiri, 2015).

In addition to the indicators listed in Table 1, enabling sustainable transformation may require further investigation to identify the priorities for transformation. Successful value chain practice advancement requires structure (Griffith et al., 2017) and the integration of actions (Childerhouse and Towill, 2011). Some studies offer practical guidelines for structuring the development of sustainable value chains. FAO (2014) proposes three steps (measuring, understanding, and improving performance). Pérez and Oddone (2016) and Monastyrnaya et al. (2017) introduced the structure through identification of current practice

Table 1
Enabling sustainable agrifood value chain transformation factors.

Key Indicators	Description	Method	Sources
Attitude/ Behaviour	Behaviour motivates individual actors to adopt the sustainable practice	Psychometric and qualitative	Hansson et al. (2019)
		Descriptive and correlational design	Kheiri (2015)
		Risk perception (mean analysis)	Nastis et al. (2019)
Information- Communication	Symmetrical information and communication will encourage actors to improve sustainable practice and capture more value	Qualitative study	Silva and Figueiredo (2020)
		Principal component analysis and spearman analysis	Béné et al. (2020)
		Multi-level perspective with systematic review	El Bilali and Allahyari (2018)
Institution	The institution helps the actors in the collective actions, such as proceeding with contractual arrangement	Supply Chain Operation Reference model	Idowu and Schmidpeter (2015)
		Case study	Mishra & Dey (2018)
		Qualitative	Filippi and Chapdaniel (2020)
Government Role	Regulation and intervention of government provide fundamental task and ability to adopt sustainability practice	Case study	Grwambi et al. (2016)
		ISM - fuzzy DEMATEL	Larsen (2016)
		Multi-level perspective	FAO (2014)
Facilitation (including training and incentivization)	Facilitation in various forms, including training and incentives, help the actors to escalate sustainable practice	PCA, ISM, DEMATEL	Mangla et al. (2018)
		Systematic review	Morone & Cottoni (2016)
		Case study	Paul et al. (2022)
Markets	Access to sustainable markets encourages participation in sustainability practice and provides a better opportunity	PCA	Borsellino et al. (2020)
		Systematic review	Grwambi et al. (2016)
		Qualitative	Joshi et al. (2020)
Certification	Certification provides standard practice compliance in sustainability	Framework development	Borsellino et al. (2020)
		Cluster analysis	Gold et al. (2017)
		Mixed method	Hidayati et al. (2021c)

bottleneck/problem, followed by improvement plans. However, these methods still leave significant room for interpretation as to which factors are considered influential in leading the transformation process. Hidayati et al. (2021c) proposed a structured approach comprised of an escalation of orientation towards the sustainable value chain through three critical dimensions in developing countries (sustainability, governance, and value addition). The sustainability dimension seeks to strike a balance between economic profit and socially engaged and environmentally friendly practices. Next, the governance dimension strives to develop an integrated and collaborative multi-level value sharing system, starting at the smallholders' level, progressing towards the value chain level, and finally to include broader stakeholders. Finally, the value addition dimension focuses on products with a high value creation orientation, which frequently shifts from commodity-based to processed-based and branded-certified product orientation. A structured approach to sustainability via governance and

value addition provides a solid foundation to determine activity priorities during sustainable value chain transformation.

There is no single or common universal method or indicator to assist with sustainable agrifood value chain transformation. Diazabakana et al. (2014) stated that whether the nature of the research is quantitative or qualitative, indicators assist users in making decisions, building agenda, and creating models to provide information for society and policy-makers, share knowledge, and build consensus among stakeholders. However, to provide a more structured approach, principal component analysis (PCA) is an exploratory analysis approach that seeks to condense a large number of data points into a smaller dataset with minimal information loss to identify and define the core constructs/dimensions that underpin the original variables (Hair, 2019; Taherdoost et al., 2020). PCA has previously been beneficial for identifying critical factors in supply chain sustainability (Paul et al., 2022).

3. Methodology

A quantitative survey methodology was used to achieve the research agenda. The quantitative approach is capable of condensing data to see the big picture by measuring objective facts and focusing on the most reliable variables (Neuman, 2014). The Sumenep Regency of Madura Island was chosen as the survey area because it is one of the key cashew producing regions and was a recipient of 'the cashew belt' programme support for intensifying cashew planting. The region is located close to export-import facilities in Surabaya, as illustrated in Fig. 1. The six main cashew subdistricts within the Sumenep Regency were targeted for this study (Dasuk, Manding, Gapura, Batuputih, Lenteng, and Rubaru) as they are the main producing areas. These sub-districts were chosen based on the statistical data provided by the local government and in consultation with the extension officers. A total of 159 cashew smallholders were surveyed through structured interviews from June to September 2021. PCA requires a minimum of 100 data points (Taherdoost et al., 2020). Purposive sampling was used to ensure that the particulars of the respondents aligned with the study criteria (Neuman, 2014); smallholders with at least ten cashew trees who have been harvesting cashews for at least two years. Face-to-face interviews were conducted under strict Covid pandemic protocols.

In line with the research agenda, a data collection instrument was developed that incorporated questions about sustainability, governance, and value addition. The data also incorporated the demographic characteristics of smallholders (i.e. age, gender, education, experience, farm typology), their current practices, and their intention towards transformation in terms of production, marketing, certifications, and coordination (with other farmers and with other stakeholders) activities. The data of intention towards sustainable value chain was collected using a five-point Likert scale (1- Strongly Disagree, 2: Disagree, 3: Undecisive, 4: Agree, 5: Strongly Agree), the specific activities are listed in Appendix A.

SPSS statistical software was used to conduct PCA and descriptive analysis. The latter was used to analyse the respondents' characteristics, current practices, and orientations towards sustainable transformation. Descriptive analysis illustrates the samples/variables in the study (Cresswell, 2014) via frequency distributions, measurements of central tendency, and standard deviation. For a five-point Likert scale, a standard deviation of less than 2.5 is required to test the influence of variables (Mutingi et al., 2017).

A series of tests are required to conduct PCA. The Likert-based scale analysis requires a Cronbach alpha test in order to determine the reliability (exceed 0.7 for the exploratory approach) (Hair, 2019). Next, Kaiser-Meyer-Olkin (KMO) (above 0.70 is acceptable; over 0.8, meritorious and over 0.9, marvellous) was used to check the sampling adequacy (Watkins, 2018). This was followed by the Bartlett test, with a significant ($p < .05$) suitable for PCA (Taherdoost et al., 2020). After the test results are confirmed, the eigenvalues produced are used to estimate the number of components (Hair, 2019; Watkins, 2018). For



Fig. 1. Study Area: a) Indonesia, b) Madura Island.

interpretation, only component structures with eigenvalues greater than one should be retained (Taherdoost et al., 2020) and importantly, a component should also have at least two variables (Taherdoost et al., 2020; Williams et al., 2010). A value of 0.45 is used as a guideline for identifying substantial factor loading of variables, which is suitable for a sample size of around 150 (Hair, 2019). According to Hair (2019), interpretation will need a strong foundation on the theoretical concept to successfully anticipate the established components and their rationale, requiring the researcher to make subjective decisions on the number of factors to extract, how to select the groupings, and the adequacy of relationships in justifying grouping variables.

4. Findings

The findings are presented in three parts: an overview of the sample, analysis of sustainable value chain components, and assessment of the intention towards sustainable value chains.

4.1. Sample overview

An overview of the survey is provided through respondents' characteristics and their current practices that are relevant to value chain activities. The overview of sample characteristics is focused on the

Table 2
Survey respondents' characteristics.

Demographic Variables	Categories	Percentage
Age	17–35 years	23
	>35–60 years	55
	Over 60 years	23
Gender	Male	38
	Female	62
Education	No education/Not finished primary school	41
	Primary School	39
	Junior High School	8
	Senior High School	9
	Tertiary	3
Experience	±2–5 years	8
	>5–10 years	10
	Over 10 years	82
Cashew Farm Arrangement	Single cashew farm (single crop)	37
	Mixed farming (hedgerow arrangement)	64
Cashew Trees Type Arrangement	Inherited Cashew Trees	64
	Self-Cultivation Cashew Trees	26
	Combination (including government grant tree)	10

demographic and typology description of cashew farms contained in Table 2.

Overall, the data in Table 2 indicate that most respondents are aged 35 to 60, and women play a crucial role in the cashew sector. Education levels are generally at a low-level; conversely, most respondents have over a decade of experience in cashew farming. Regarding farm typology, most are small-scale inheritance cashew farming that typically apply mixed farming to their land to generate additional income. To do so, they planted cashew trees as hedgerows and allocated open farm areas for other seasonal crops (i.e. corn and paddy). On the other hand, farm size does not reflect cashew tree ownership in the study area. The average number of trees owned by smallholders is 32, most of which are hereditary rather than self-planted or government-grant trees. The production of these cashew trees varies, and the average productivity of the inherited trees is 13 kg, while the maximum is 80 kg. Meanwhile, the average productivity of self-planted trees and government-grant trees is roughly similar at approximately 16 kg. However, self-planted trees may produce up to 69 kg, while government-grant trees produce up to 50 kg. The diverse management practices used on cashew farms seem to result in large production disparities and varying yields.

The respondents' current practices are presented in five areas: cashew production, marketing, certification, and coordination (with other smallholders and stakeholders), as summarised in Table 3 (see details in Appendix B). Weeding, fertilisation, pruning, and harvesting are the most common production operations. Meanwhile, the majority

Table 3
Current value chain practices.

Elements	Summary of Current Practice
Production	Over 50% smallholders have practiced weeding, fertilizing, pruning, harvesting, and over 40% maintain hedgerow agreements Less than 30% of smallholders applied pest disease control and rejuvenation
Marketing	Over 50% smallholders have practiced: - Selling 'dry in-shell' nuts - No grading activities - Small-scale intermediaries reliant - Selling to different buyers - Searching and sharing price information - No negotiation (Price takers) - Supporting community-neighbourhood farmers
Coordination between smallholders	68% were non- members of farmer groups
Coordination with stakeholders	97% limited coordination with stakeholders
Certifications	100% were uncertified

Note: Details of frequency distribution results are presented in Appendix B.

of smallholders neglected rejuvenation and did not control pests or diseases on their farms. Smallholders are heavily reliant on themselves and their main family members as workers.

Most of the cashew products were sold as 'dry in-shell' nuts, whilst most smallholders did not grade their cashew products, preferring small-scale intermediaries as their buyers. They want to obtain a better price and be more flexible in terms of selling. Several respondents preferred to sell their cashew nuts to a regular buyer as they were more familiar or had good relationships, resulting in higher prices and reduced gaming. Nonetheless, smallholders would still generally seek price information to sell their cashew nuts and are likely to share their information with neighbourhood farmers. However, smallholders are typically price takers. None of the respondents had any form of certification for cashew farming or products. Many smallholders lack information and are unaware of the importance of certification. Some respondents also believed that this was not beneficial for them because they were already making a profit from their regular activities.

Only a small majority of the farmers are members of farmer groups. This information implies that smallholders generally do not work collectively on activities such as cashew production or marketing. Smallholders are not part of a farmer group for various reasons, such as

limited time, no interest in joining, no available farmer group in their area, withdrawal from the farmer group due to previous issues (i.e. deceitful leaders), being too old, and not knowing how to join the farmer group. Of the third of respondents who are members, these cooperative activities were relatively irrelevant to cashew farming activities; rather, their focus was on seasonal crop practices. The vast majority of smallholders have little or no coordination with stakeholders (either the government or NGO).

4.2. Sustainable value chain practice

Understanding smallholders' characteristics and their current practices at the farm stage is a good starting point, but it is critical to further identify the components of sustainable value chain transformation through their intentions towards future practices, as summarised in Table 4. Initially, data on intention towards sustainable value chain practice were analysed using means and standard deviations (see Appendix C). The mean analysis indicated that most of the variables signify a positive sustainable transformation, while a few variables impede sustainable transformation. The overall standard deviation was less than 2.5, indicating that the data are well-distributed around the means and

Table 4
Sustainable value chain practice components in Sumenep Regency's cashew sector.

Components	Variables	Loading	Description
Farm Practice Milieu	Manure application	PC1	Most of the variables in this component reflect smallholders' intention to improve farm production practice.
	Loan for neighbours	14.3%	
	Pesticide application		
	Chemical fertilizer application		
	Better family lifestyle		
	Neighbourhood helping in marketing activities		
	Herbicide application		
	Digital tool use in information-communication		
	Modern tools investment for cashew harvesting		
	Modern tools investment for cashew cultivation		
	Financial support		
	Rejuvenation by using own seeds		
	Better payment to employees		
	Non-family members employment		
Stakeholder Support	Training support in cashew marketing	PC2	These variables reflect smallholders' intention to access critical facilitations from stakeholders to develop their practice.
	Training support in cashew processing	11.7%	
	Training support in cashew production		
	Processing tool subsidy support		
	Input subsidy support		
	Maintain/join membership of farmer group		
	Support of certification training		
Certification Motivation	Expert support		This component mainly relates to smallholders' intention to obtain certification.
	Support of simple procedure certification	PC3	
	Support of certification information	7.3%	
	Support of certification financial		
Market Expansion	Charity allocation from income contribution		These relate to smallholders' intention to develop their cashew market.
	New buyers' finding	PC4	
Pre-Harvesting Value	New buyers' connection support	5.4%	Smallholders' intention to improve the cashew nuts quality at the farmgate make up most of the variables in this component.
	Harvesting ripe nuts	PC5	
	Cone harvesting method application	5.0%	
Information-Communication	Regular pruning after harvesting		These variables mainly focus on information searching and sharing.
	Hedgerow agreement with neighbourhood farms		
	Broader information sharing	PC6	
Value Adding Products	Broader information searching	4.7%	Smallholders' intention to increase cashew nuts value is the focus.
	Manual weeding		
Value Capturing	Cashew nuts unshelling	PC7	Smallholders' intention to capture more value by grading their products, negotiating price, and contracting.
	Ready-to-eat product processing	4.7%	
	Cashew nuts grading	PC8	
	Fixed-price contract consideration	4.3%	
	Cashew nut price negotiation		

hence, suitable for use as indicators. However, these results are insufficient in terms of providing a clear picture of the key factors that enable sustainable transformation.

A structured approach is required to explore how the variables fit into a transformational group of activities. Thus, PCA was utilised to synthesise factors that enable sustainable value chain practices. A series of preliminary reliability and validity tests were conducted (see Appendix D). The Cronbach's alpha is 0.92 (higher than 0.7), indicating that the data are highly reliable, the KMO result is 0.84, demonstrating that the sample size is more than sufficient for PCA. Next, the Bartlett test is 0.00 (less than 0.05), indicating there are a sufficient number of correlations between variables to proceed with the PCA. A total of eight components in Table 4 were identified based on an eigenvalue greater than 1, at least two variables loaded as a component, and factor loadings ≥ 0.45 (see Appendix D). From these components, the total variance accumulated in the rotated factors is 57%. Total variance with a 50–60% solution is commonly considered sufficient in the social sciences, where information is generally less accurate (Hair, 2019; Williams et al., 2010).

4.3. Intention towards sustainable value chain practice

To discern the direction of smallholders' intention towards future practice, the components of sustainable value chain practice need to be further organised, as illustrated in Fig. 2. Each component has factor loadings that operate as Constanta in the model (Jolliffe, 2002), making it easier to assess the average mean score of the component (detailed analysis is presented in Appendix E). According to Fig. 2, the majority of component scores are in the range of 3–4, indicating that respondents are generally positive towards sustainable value chain practices. With a score approaching 4, the three leading components are Information-Communication (PC6), Market Expansion (PC4) and Certification Motivation (PC3). These are followed by Stakeholder Support (PC2) and Farm Practice Milieu (PC1), with an average score statistically significantly higher than 3. Pre-harvesting Value (PC5) has a score of around 3, suggesting that the component is in somewhat of an indecisive state. Importantly, the last two components need to be highlighted. The Value Capturing (PC8) and Value Adding Products (PC7) are noted as lower than 3, indicating a lack of future practice intention. The overall score is far from the optimal level of 5 to fully enable advancement towards long-term sustainable value chain practice.

5. Discussion

There is a growing interest in exploring how to enable sustainable agrifood value chain transformation. Many studies emphasise the importance of smallholders as critical players for this transformation in developing countries. Rather than providing other variables to proceed with transformation, this study contributes to synthesizing these factors to enable such transformation. Smallholders' current practices and their intention towards sustainable value chains were empirically examined

Indonesia's cashew sector.

The empirical findings indicate that the current value chain practices of cashew smallholders are generally immature. However, they have a positive future intention towards sustainable value chain practices. These results provide a different perspective on sustainable transformation in developing countries compared with existing studies. Previous studies assert that a poverty reduction agenda prompts players in developing countries to advance their practices by primarily focusing on economic profit (FAO, 2014; Ramos-Mejía et al., 2018); therefore, they often overlook other aspects of sustainability (Hidayati et al., 2021c; Schoon et al., 2013). Recognising the gaps between current and intended practice enables the development of a method for prioritising factors that will guide the process of sustainable value chain transformation. A summary of current and intended practices across eight principal components of value chain sustainability is provided in Table 5.

How influential a factor is in enabling sustainable value chain transformation is revealed in Table 5. The farm practice milieu and information-communication are the most advanced sustainable value chain transformation factors. Smallholders have demonstrated a relatively mature sustainability practice in terms of social and environmental activities through their local-cultural farming activities. Thus, highlighting sustainability practice in developing countries can be based on traditional and cultural means. Transformation towards high value markets increases incomes (Maspatella et al., 2018; Tray et al., 2021); however, this study argues that sustainable value chain transformation should also maintain some traditional practices as additional value could be created through sustainably produced products.

Market expansion, stakeholder support, and certification motivation are secondary factors that enable sustainable value chain transformation. These results confirm Schoneveld et al.'s (2019) argument that smallholders are less likely to participate in certification and progress to sustainable markets without support (i.e. training and incentives) and market access. Governance plays a central role in developing certification activities. Integrating smallholders and stakeholders

Table 5
Current and intended practice towards sustainable value chain transformation.

Components	Current Practice	Intention Towards Sustainability
Farm Practice Milieu	***	***
Information-Communication	***	***
Market Expansion	*	***
Certification Motivation	*	***
Stakeholder Support	*	***
Pre-Harvesting Value	*	**
Value Capturing	*	*
Value Adding Products	*	*

Key: *Practice*: * immature, ** average, ***mature. *Intention*: * unmotivated, ** neutral, *** motivated.

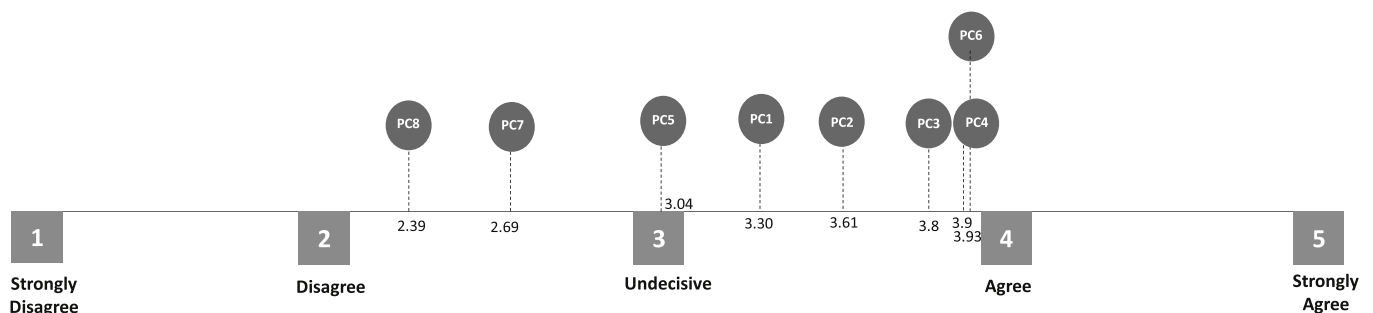


Fig. 2. Sustainable value chain transformation trajectory.

(especially the government) is critical, whilst farmer groups play an important role in horizontal coordination. Although these activities may require long-term intervention, many scholars have observed that government assistance is typically in the form of project-based temporary activities (Hidayati et al., 2021c; Schneemann and Vredevel, 2015; Sjauw-Koen-Fa et al., 2016).

Pre-harvesting value, value capture, and value-adding products were identified as the most challenging factors in sustainable value chain transformation. This is a common problem in many developing countries, as food is typically considered a commodity rather than containing value-added processes and activities (Lindgreen et al., 2013). However, a lack of value addition activities may not only constraint a value chain from moving into a more sustainable state but also restrict smallholders to the lowest profit segments of the chain. Since both current practice and intention towards value delivery activities are low in our study, further investigation of these factors is needed to fully enable sustainable value chains in developing countries.

This study sheds further light on the factors that enable sustainable agrifood value chain transformation in developing countries. As Mangla et al. (2018) suggested, developing a structural model to analyse enablers within the contextual relationship is critical to better support sustainable practice implementation. Our research has also provided a crucial lens of smallholders' initiatives in unveiling which activities need urgent action and which parts require further exploration. Previous studies suggest that, to compete in the market, smallholders should strategically focus on production improvement (Chiamjinnawat and Garnevska, 2018; Maspaitella et al., 2018). However, this strategy is likely to be precarious in terms of the sustainable value chain context. Smallholders often start by improving farm productivity by using more chemicals (i.e. fertilizer, pesticides, and herbicides) (Siddique et al., 2018). Therefore, rather than focusing on production, this study proposes a greater insight by maintaining the current indigenous-sustainable traditional farm practices, focusing on sensing the sustainable market and exploring value delivery activities. As Borsellino et al. (2020) postulate, research development must focus not only on enhancing basic knowledge and recognising opportunities but also on designing meaningful actions that encourage transition towards sustainability practices within the markets.

For practitioners, particularly those in the cashew sector, this study can serve as a foundational understanding of the mechanism as well as a roadmap for moving value chains into more sustainable practices. As Silva and Figueiredo (2020) note, it is vital to recognise supply chain echelons practices to strengthen sustainability practices for responsible chain businesses. The findings allow key chain players to assess what type of support is required by cashew farmers (as suppliers), and what initiatives are needed to help with sustainable value chain improvements. Farmer-focused interventions should be supplemented with value chain-focused initiatives (Schoneveld et al., 2019). However, integration of smallholders with the rest of the value chain requires attention. Despite the fact that integration enhances the performance of every chain, the right level of market orientation may be far more varied (Childerhouse and Towill, 2006). Therefore, intervening in smallholders' practice improvement critically involves policymakers and the public sector. This study contributes to clarifying which important activities should be addressed in the short- and long-term to enable sustainable value chains. Some areas will necessitate the most intense

assistance, while others will necessitate the participation of other players. To avoid cross-purposes among value chain actors and be coherent with the government policy framework, governance of the chain is critical (Vroegindewey and Hodbod, 2018).

6. Conclusion

This study contributes to the identification and analysis of the factors that enable sustainable value chain transformation in developing countries. A total of eight factors were identified and subsequently analysed. The results prioritise a combination of farm practice milieu and information communication factors. The next step is to extract the coalescence of factors, such as market expansion, stakeholder support, and certification motivation. Finally, the transformation challenge lies in value delivery activities by elevating enhancing pre-harvesting value, value capturing, and value-adding products. These prioritised factors lay the foundation for an effective sustainable value chain transformation pathway that provides clear guidance for users (practitioners and policymakers).

Although this study has advanced our knowledge of enabling sustainable value chain transformation, further research is required to address the limitations and explore new avenues. The cashew sector may have unique features that are different from other agrifood commodities, such as perishability, processing, and value adding. Second, the case study location may not accurately reflect the overall situation in Indonesia or other developing countries. Further larger scale research will aid in obtaining more representative results in the context of developing countries. In addition, another method could potentially be used in the research, such as a qualitative method to unpack causality and change mechanisms. Finally, since this study highlights smallholders in general, further research is required to categorise sustainable practice intentions based on smallholders' socioeconomic heterogeneity. Another possible avenue is to broaden the smallholder centric lens by including a wider set of value chain actors.

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CRediT authorship contribution statement

Dwi Ratna Hidayati: Conceptualization, Formal analysis, Investigation, Writing – original draft. **Elena Garnevska:** Supervision, Conceptualization, Writing – review & editing. **Paul Childerhouse:** Supervision, Conceptualization, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Appendix A. Elements of Sustainable Cashew Value Chain Transformation

Activities	Key Elements
1. Production	1) Rejuvenation by using Government grant seeds (P ₁) 2) Rejuvenation by using own seeds (P ₂) 3) Manual weeding (P ₃)

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Activities	Key Elements
	4) Herbicide application (P ₄) (-) 5) Manure application (P ₅) 6) Chemical fertilizer application (P ₆) (-) 7) Smoking the cashew farm for pest-disease control (P ₇) 8) Pesticide application(P ₈) (-) 9) Regular Pruning after harvesting (P ₉) 10) The ripe nuts harvesting (P ₁₀) 11) Ripe cashew apples use as income alternative (P ₁₁) 12) Cone harvesting method application (P ₁₂) 13) Modern tools for cashew cultivation (P ₁₃) 14) Modern tools for cashew harvesting (P ₁₄) 15) The hedgerow agreement (P ₁₅) 16) A better payment to employees (P ₁₆) 17) A better payment for family labour (P ₁₇) 18) Non-family members employment (P ₁₈)
2. Marketing	1) Cashew nuts grading (M ₁) 2) Cashew nut drying (M ₂) 3) Cashew nuts unshelling (M ₃) 4) Ready-to-eat product processing (M ₄) 5) Farmgate/home transaction (M ₅) (-) 6) Market/buyer's place transaction (M ₆) 7) New buyers' finding (M ₇) 8) A broader information finding (M ₈) 9) Digital tool use in information-communication (M ₉) 10) Cashew nut price negotiation (M ₁₀) 11) A fixed-price contract consideration (M ₁₁) 12) A broader information sharing (M ₁₂) 13) Neighbourhood helping in marketing activities (M ₁₃) 14) Charity allocation (M ₁₄) 15) Loan for neighbours (M ₁₅) 16) Children's/family education improvements (M ₁₆) 17) Family lifestyle improvements (M ₁₇)
3. Certification and Coordination (with other farmers & Stakeholders)	1) Certification information support (C ₁) 2) Certification training support (C ₂) 3) Certification financial support (C ₃) 4) Easy and simple procedure certification support (C ₄) 5) Maintain/join farmer group membership (CF) 6) Training support in cashew production (CS ₁) 7) Training support in cashew processing (CS ₂) 8) Training support in cashew marketing (CS ₃) 9) Input subsidy support (CS ₅) 10) Processing tool subsidy support (CS ₆) 11) Loan/credit with low interest support (CS ₇) 12) Financial support (CS ₈) 13) New buyers' connection support (CS ₉) 14) Sharing with expert support (CS ₁₀) 15) Extension officers/Government support (CS ₁₂) 16) NGO/Non-Government Organisation support (CS ₁₃)

Note: P = Production, M = Marketing, C = Certification, CF= Coordination with Other Farmers, CS= Coordination with Stakeholders, (-) = negative statement for transformation.

Appendix B. Distribution Frequency

Table B.1
Smallholder's Characteristic

Variables	Categories	Frequency	Percentage
Age	17-35 years	36	22.6%
	>35-60 years	87	*54.7%
	Over 60 years	36	22.6%
	Total	159	100%
Gender	Male	60	37.7%
	Female	99	*62.3%
	Total	159	100%
Education	No education/Not finished primary school	65	*40.9%
	Primary School	62	39%
	Junior High School	13	8.2%
	Senior High School	14	8.8%
	Tertiary	5	3.1%
	Total	159	100%
Experience	±2-5 years	13	8.1%
	>5-10 years	16	10.1%
	Over 10 years	130	*81.8%
	Total	159	100%
Cashew Farm Arrangement	Single cashew farm (Single crop)	58	36.5%

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Table B.1 (continued)

Variables	Categories	Frequency	Percentage
Cashew Trees Type Arrangement	Mixed farming (hedgerow arrangement)	101	*63.5%
	Total	159	100%
	Inherited Cashew Trees	101	*63.5%
	Self-Cultivation Cashew Trees	42	26.4%
	Combination (Including government grant tree)	16	10.1%
	Total	159	100%

Table B.2

Distribution Frequency of Production and Marketing

Variables	Application	Frequency	Percentage
Rejuvenation	No	103	*64.8%
	Yes	56	35.2%
	Total	159	100%
Weeding	No	34	21.4%
	Yes	125	*78.6%
	Total	159	100%
Fertilizing	No	75	47.2%
	Yes	84	*52.8%
	Total	159	100%
Pest and Disease Control	No	129	*81.1%
	Yes	30	18.9%
	Total	159	100%
Pruning	No	44	27.7%
	Yes	115	*72.3%
	Total	159	100%
Harvesting	No	NA	NA
	Yes	159	*100%
	Total	159	100%
Hedgerow Agreement	No	91	*57.2%
	Yes	68	42.8%
	Total	159	100%
Self-Employment	No	10	6.3%
	Yes	149	*93.7%
	Total	159	100%
Main Family Employment	No	30	18.9%
	Yes	129	*81.1%
	Total	159	100%
Non-Family Employment	No	122	*76.7%
	Yes	37	23.3%
	Total	159	100%

Table B.3

Distribution Frequency of Marketing

Variables	Elements	Frequency	Percentage	
Cashew Marketing Products	Dry in shelled nuts	107	*67.3%	
	Wet in shelled nuts	50	31.4%	
	Combination (Wet in shelled nuts & Dry in shelled nuts)	2	1.3%	
	Total	159	100%	
Grading	No Grading	125	*78.6%	
	Grading	34	21.4%	
	Total	159	100%	
Buyers	a) Wet in Shell nuts	Small-scale Intermediaries	40	*76.9%
		Cashew Centre/main wholesaler	1	1.9%
		Other Wholesalers	10	19.2%
		Combination	1	1.9%
		Total	52	100%
b) Dry in Shell nuts	Small-scale Intermediaries	72	*66.1%	
	Cashew Centre/main wholesaler	7	6.4%	
	Other Wholesalers	24	22.0%	
	Combination	6	5.5%	
	Total	109	100%	
New/Different Buyers	Same buyer	Different buyer	69	43.4%
		Combination	86	*54.1%
		Combination	4	2.5%
		Total	159	100%
Transaction Site	Farmgate/home	36	22.6%	

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Table B.3 (continued)

Variables	Elements	Frequency	Percentage
Transportation	Marketplace/Buyers' site	123	*77.4%
	Total	159	100%
	bicycle	15	9.4%
	motorbike	139	*87.4%
	pick-up vehicle/car	4	2.5%
Information Searching	combination	1	0.6%
	Total	159	100%
	No-Searching	50	31.4%
	Searching Information	109	*68.6%
	Total	159	100%
Information Sharing	No Sharing	42	26.4%
	Sharing with neighbourhood farmers	114	*71.7%
	Others	3	1.9%
	Total	159	100%
Price Setting	Accept cashew nut price set by the buyers	137	*86.2%
	Negotiate with the buyers	22	13.8%
	Total	159	100%
Helping Neighbourhood in Marketing	No helping activities	77	48.4%
	Mutual help with neighbourhood farmers (i.e. to pack, carry, etc.)	82	*51.6%
	Total	159	100%
Charity Allocation (from Cashew Marketing Income)	No allocation	5	3.1%
	Yes, by 'Shodaqoh' (charity) at mosque/poor neighbourhood	154	*96.9%
	Total	159	100%
Cashew Marketing Income on Family Fulfilment	Not adequate	71	44.7%
	Adequate	88	*55.3%
	Total	159	100%

Table B.4
Certification and Coordination (With Other Farmers and Stakeholders)

Variables	Elements	Frequency	Percentage
Certification Status	No	159	*100%
	Yes	0	0%
	Total	159	100%
Non-Certified Reason Status	Lack of information (don't know)	126	*79.2%
	Complicated procedures	2	1.3%
	Not beneficial	23	14.5%
	Other Reasons	1	0.6%
	Combination	7	4.4%
	Total	159	100%
Farmer Group Membership	No	108	*67.9%
	Yes	51	32.1%
	Total	159	100%
1. Training			
	a. Training Participation		
b. Non-Training	No	155	*97.5%
	Yes	4	2.5%
	Total	159	100%
	Lack of information (don't know)	99	*63.9%
	Not beneficial for you	1	.6%
	Busy	44	28.4%
Combination	11	7.1%	
Total	155	100%	
2. Supporting Program			
	Supporting Program		
Supporting Program	No	155	*97.5%
	yes	4	2.5%
	Total	159	100%

Appendix C. Respondents' Intention towards Sustainable Value Chain Practice

Activities	Key Elements	Mean	Standard Deviation (SD)
1. Production	1) Rejuvenation by using Government grant seeds (P ₁)	3.45	1.168
	2) Rejuvenation by using own seeds (P ₂)	3.31	1.454
	3) Manual weeding (P ₃)	4.12	.874
	4) Herbicide application (P ₄) (-)	*2.58	1.365
	5) Manure application (P ₅)	3.82	1.262
	6) Chemical fertilizer application (P ₆) (-)	3.28	1.383
	7) Smoking the cashew farm for pest-disease control (P ₇)	3.13	1.278
	8) Pesticide application(P ₈) (-)	*2.80	1.321

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Activities	Key Elements	Mean	Standard Deviation (SD)
	9) Regular pruning after harvesting (P ₉)	3.65	1.115
	10) The ripe nuts harvesting (P ₁₀)	3.41	1.208
	11) Ripe cashew apples use as alternative income (P ₁₁)	3.61	1.125
	12) Cone harvesting method application (P ₁₂)	3.35	1.263
	13) Modern tools investment for cashew cultivation	*2.84	1.302
	14) Modern tools investment for cashew harvesting (P ₁₄)	*2.82	1.305
	15) The hedgerow agreement with neighbourhood farms (P ₁₅)	3.35	1.676
	16) A better payment to employees (P ₁₆)	*1.93	1.410
	17) A better payment for family labour (P ₁₇)	*1.82	1.237
	18) Non-family members employment (P ₁₈)	*2.06	1.485
2. Marketing	1) Cashew nuts grading (M ₁)	3.05	.947
	2) Cashew nut drying (M ₂)	4.03	.856
	3) Cashew nuts unshelling (M ₃)	*2.40	.780
	4) Ready-to-eat product processing (M ₄)	*2.38	.761
	5) Farmgate/home spot transaction (M ₅) (-)	3.36	.963
	6) Market/buyer's spot transaction (M ₆)	3.81	.851
	7) New buyers' finding (M ₇)	3.86	.875
	8) A broader information searching (M ₈)	3.78	.946
	9) Digital tool use in information-communication (M ₉)	3.75	1.077
	10) Cashew nut price negotiation (M ₁₀)	2.97	.889
	11) A fixed-price contract consideration (M ₁₁)	2.03	.750
	12) A broader information sharing (M ₁₂)	3.91	.889
	13) Neighbourhood helping in marketing activities (M ₁₃)	3.47	1.054
	14) Charity allocation from income contribution (M ₁₄)	4.33	.570
	15) Loan for neighbours (M ₁₅)	3.75	.907
	16) Better children's/family education (M ₁₆)	4.48	.514
	17) Better family lifestyle (M ₁₇)	3.91	.990
3. Certification and Coordination (with Farmers & Stakeholders)	1) Support of certification information (C ₁)	3.44	.883
	2) Support of certification training (C ₂)	3.33	1.028
	3) Support of certification financial (C ₃)	4.01	.861
	4) Support of simple procedure certification (C ₄)	3.68	.963
	5) Maintain/join membership of farmer group (CF)	3.20	.933
	6) Training support in cashew production (CS ₁)	3.55	.919
	7) Training support in cashew processing (CS ₂)	3.50	.913
	8) Training support in cashew marketing (CS ₃)	3.58	.910
	9) Input subsidy support (CS ₅)	4.11	.656
	10) Processing tool subsidy support (CS ₆)	3.96	.754
	11) Loan/credit with low interest support (CS ₇)	*2.25	.954
	12) Financial support (CS ₈)	4.48	.501
	13) New buyers' connection support (CS ₉)	3.94	.836
	14) Expert support (CS ₁₀)	3.69	1.007
	15) Extension officers/Government support (CS ₁₂)	4.31	.492
	16) NGO/Non-Government Organisation support (CS ₁₃)	3.99	.784

Note: P = Production, M = Marketing, C = Certification, CF= Coordination with Other Farmers, CS=Coordination with Stakeholders (-) = negative statement for transformation, * = lack of orientation towards practise transformation.

Appendix D. PCA analysis result

Element	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Manure application (P ₅)	.766							
Loan for neighbours (M ₁₅)	.735							
Pesticide application (P ₈) (-)	.731							
Chemical fertilizer application (P ₆) (-)	.699							
Family lifestyle improvements (M ₁₇)	.682							
Neighbourhood helping in marketing activities (M ₁₃)	.658							
Herbicide application (P ₄)	.633							
Digital tool use in information-communication (M ₉)	.605							
Modern tools for cashew harvesting (P ₁₄)	.591							
Modern tools for cashew cultivation (P ₁₃)	.584							
Financial support (CS ₈)	.507							
Rejuvenation by using own seeds (P ₂)	.483							
A better payment to employees (P ₁₆)	.463							
Non-family members employment (P ₁₈)	.463							
Training support in cashew marketing (CS ₃)		.847						
Training support in cashew processing (CS ₂)		.845						
Training support in cashew production (CS ₁)		.843						
Processing tool subsidy support (CS ₆)		.647						
Input subsidy support (CS ₅)		.647						
Maintain/join farmer group membership (CF)		.613						
Certification training support (C ₂)		.600						
Sharing with expert support (CS ₁₀)		.492						
Easy and simple procedure certification support (C ₄)			.778					

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Element	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Certification information support (C ₁)			.755					
Certification financial support (C ₃)			.717					
Charity allocation (M ₁₄)			.460					
New buyers' finding (M ₇)				.755				
New buyers' connection support (CS ₉)				.614				
The ripe nuts harvesting (P ₁₀)					-.644			
Cone harvesting method application (P ₁₂)					-.636			
Regular pruning after harvesting (P ₉)					.534			
The hedgerow agreement (P ₁₅)					.480			
A broader information sharing (M ₁₂)						.708		
A broader information searching (M ₈)						.601		
Manual weeding (P ₃)						.509		
Cashew nuts grading (M ₁)							.747	
A fixed-price contract consideration (M ₁₁)							.636	
Cashew nut price negotiation (M ₁₀)							.554	
Cashew nuts unshelling (M ₃)								.892
Ready-to-eat product processing (M ₄)								.843
Sum of squared (Eigen Value)	7.285	5.972	3.686	2.743	2.539	2.414	2.250	2.176
Sum of squared (% of Variance)	14.284	11.709	7.228	5.379	4.978	4.734	4.411	4.267
Cronbach Alpha	.919							
KMO	.840							
Bartlett's Test	.000							

Note: P = Production, M = Marketing, C = Certification, CF= Coordination with Other Farmers, CS= Coordination with Stakeholders, (-) = negative statement for transformation.

Appendix E. Analysis of Average Means on Each Component

PC	Element	Factor Loadings	% Factor Loading	Means	% Factor Loading x Means
PC1	Manure application (P ₅)	0.766	8.91%	3.82	0.34
	Loan for neighbours (M ₁₅)	0.735	8.55%	3.75	0.32
	Pesticide application(P ₈) (-)	0.731	8.50%	3.2	0.27
	Chemical fertilizer application (P ₆) (-)	0.699	8.13%	2.72	0.23
	Family lifestyle improvements (M ₁₇)	0.682	7.93%	3.91	0.31
	Neighbourhood helping in marketing activities (M ₁₃)	0.658	7.65%	3.47	0.27
	Herbicide application (P ₄)	0.633	7.36%	3.42	0.25
	Digital tool use in information-communication (M ₉)	0.605	7.03%	3.75	0.26
	Modern tools for cashew harvesting (P ₁₄)	0.591	6.87%	2.82	0.19
	Modern tools for cashew cultivation (P ₁₃)	0.584	6.79%	2.84	0.19
	Financial support (CS ₈)	0.507	5.90%	4.48	0.26
	Rejuvenation by using own seeds (P ₂)	0.483	5.62%	3.31	0.19
	A better payment to employees (P ₁₆)	0.463	5.38%	1.93	0.10
	Non-family members employment (P ₁₈)	0.463	5.38%	2.06	0.11
Sum	8.60	100%		3.30	
PC2	Training support in cashew marketing (CS ₃)	0.847	15%	3.58	0.55
	Training support in cashew processing (CS ₂)	0.845	15%	3.5	0.53
	Training support in cashew production (CS ₁)	0.843	15%	3.55	0.54
	Processing tool subsidy support (CS ₆)	0.647	12%	3.96	0.46
	Input subsidy support (CS ₅)	0.647	12%	4.11	0.48
	Maintain/join farmer group membership (CF)	0.613	11%	3.2	0.35
	Certification training support (C ₂)	0.6	11%	3.3	0.36
	Sharing with expert support (CS ₁₀)	0.492	9%	3.69	0.33
Sum	5.53	100%		3.61	
PC3	Easy and simple procedure certification support (C ₄)	0.778	29%	3.68	1.06
	Certification information support (C ₁)	0.755	28%	3.44	0.96
	Certification financial support (C ₃)	0.717	26%	4.01	1.06
	Charity allocation (M ₁₄)	0.46	17%	4.33	0.73
	Sum	2.71	100%		3.81
PC4	New buyers' finding (M ₇)	0.755	55%	3.86	2.13
	New buyers' connection support (CS ₉)	0.614	45%	3.94	1.77
	Sum	1.369	100%		3.90
PC5	The ripe nuts harvesting (P ₁₀)	-0.644	28%	2.59	0.73
	Cone harvesting method application (P ₁₂)	-0.636	28%	2.75	0.76
	Regular pruning after harvesting (P ₉)	0.534	23%	3.65	0.85
	The hedgerow agreement (P ₁₅)	0.48	21%	3.35	0.70
	Sum	2.294	100%		3.04
PC6	A broader information sharing (M ₁₂)	0.708	39%	3.91	1.52
	A broader information searching (M ₈)	0.601	33%	3.78	1.25
	Manual weeding (P ₃)	0.509	28%	4.12	1.15
	Sum	1.818	100%		3.93
PC7	Cashew nuts grading (M ₁)	0.747	39%	3.05	1.18
	A fixed-price contract consideration (M ₁₁)	0.636	33%	2.03	0.67
	Cashew nut price negotiation (M ₁₀)	0.554	29%	2.97	0.85
	Sum	1.937	100%		2.69

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PC	Element	Factor Loadings	% Factor Loading	Means	% Factor Loading x Means
PC8	Cashew nuts unshelling (M ₃)	0.892	51%	2.4	1.23
	Ready-to-eat product processing (M ₄)	0.843	49%	2.38	1.16
	Sum	1.735	100%		2.39

Note: Reverse scoring for negatives statements (–) was applied for the summated scale calculation.

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