INNOVATION AND PATHS TO SOCIAL-ECOLOGICAL SUSTAINABILITY

Inovação e caminhos para sustentabilidade socio-ecologica

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Abstract: The traditional approach to innovation assessment has mainly focused on the economic outcomes and failed to capture the ecological and social dimensions of sustainability. By giving high attention to the role of specific kind of innovation (technological innovation), there is little empirical work on whether combining different kinds of innovation leads to progress in social-ecological sustainability in developing countries. The sustainability orientation in the assessment of innovation performance becomes increasingly important for achieve successful transformation towards sustainability. The research question of this study is under what condition or combination of conditions the intervention for innovation reconciles the trade-offs between socioeconomic and ecological performance and thus improve progress towards sustainability in poor countries. Combing concepts and methods from literature on strategic corporate social responsibility (CSR), value chain upgrading, sustainability, and technological capability, this study identifies different mechanisms and conditions for building innovation capacity and then empirically evaluates the relationship between the degree of innovation capacity and the progress towards social-ecological sustainability by taking four cases from Ethiopia. The data for this study is collected using key informant interviews, focus group discussion, and biodiversity and innovation scorecard questionnaire. Mixed methods combing comprehensive fuzzy evaluation, biodiversity scorecard and qualitative comparative analysis are used for analysis. The study found that combing value chain innovation and green governance innovation either with technological upgrading or innovation platform learning are sufficient conditions for achieving social-ecological sustainability. We also found that innovation in green governance and in value chain are necessary conditions for sustainability. By developing and applying fuzzy comprehensive evaluation model for measuring innovation capacity and fuzzy set qualitative comparative analysis for identifying necessary and sufficient conditions for sustainability, this study made an important methodological contribution to existing literature.

Key Words: Innovation; qualitative comparative analysis; sustainability; Fuzzy assessment

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Resumo: A abordagem tradicional da avaliação da inovação centrou-se principalmente nos resultados económicos e não conseguiu captar as dimensões ecológica e social da sustentabilidade dando grande atenção ao papel de um tipo específico de inovação (inovação tecnológica). Há pouco trabalho empírico sobre se a combinação de diferentes tipos de inovação leva ao progresso na sustentabilidade sócio-ecológica nos países em desenvolvimento. A orientação para a sustentabilidade na avaliação do desempenho da inovação torna-se cada vez mais importante para alcançar uma transformação bem-sucedida em direção à sustentabilidade. O tema de pesquisa neste trablhao é sob que condição ou combinação de condições a intervenção para a inovação concilia os trade-offs entre o desempenho socioeconômico e ecológico e, assim, melhorar o progresso rumo à sustentabilidade nos países pobres. Combinando conceitos e métodos da literatura sobre responsabilidade social corporativa estratégica (RSE), valorização da cadeia de valor, sustentabilidade e capacidade tecnológica, este estudo identifica diferentes mecanismos e condições para o desenvolvimento da capacidade de inovação e avalia empiricamente a relação entre o grau de capacidade de inovação e o Progresso rumo à sustentabilidade sócio-ecológica, tomando como base quatro casos da Etiópia. Os dados para este estudo foram coletados usando entrevistas de informantes-chave, discussão em grupo de foco e questionário tipo scorewcard sobre biossegurança e inovação. Métodos mistos combinado uma avaliação fuzzy abrangente, um scorecard sobre biodiversidade uma análise comparativa qualitativa foram utilizados para a análise. O estudo descobriu que combinando inovação na cadeia de valor e inovação na governança ecologica, seja atraves do aprimoramento tecnológico, ou com uma plataforma deaprendizagem em inovação poderima ser condições suficientes para alcançar a sustentabilidade sócio-ecológica. Constatamos também que a inovação na governança ecológica e na cadeia de valor são condições necessárias para a sustentabilidade. Ao desenvolver e aplicar um modelo de avaliação fuzzy abrangente para medir a capacidade de inovação e a análise comparativa qualitativa utilizango logica fuzzy para identificar condições necessárias e suficientes para a sustentabilidade, este estudo pode contribuir de forma importante para a literatura existente.
Palavras-chave: Inovação; Análise comparativa qualitativa; Sustentabilidade; Avaliação difusa(fuzzy).

INTRODUCTION

The concept sustainability was initially defined by the Brundtland Report in 1987 as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland et al., 1987, p. 16). The basic challenge in sustainable development agenda has been how to reconcile the trade-offs between economic development, social progress and conservation of the natural ecosystem. Innovation has been well recognized for achieving successful transformation towards sustainability (Westley et al., 2011). Olsson and Galaz (2012) pointed out that social-ecological innovation needs the incorporation of social and ecological considerations in the innovation processes, which involve the integration of technology, governance and ecosystem stewardship.

Over recent decade, governance reform (Murty, 2009) and CSR adoption (Herrmann, 2004; Moon, 2007) have been promoted as conditions for introducing innovation in resource governance and in value chain for achieving sustainability respectively. Kemp, Parto, and Gibson (2005) argue that better governance is a prerequisite for a progress towards Sustainability. They pointed out that, besides technological innovations, sustainability requires governance initiatives that result in co-evolving societal processes and continuous changes in formal and informal institutions. Existing literature revealed that different forms of forest governance arrangement such as decentralization, concession, and certification are emerging in recent decades as a result of important social, economic, and political driver (Agrawal, Chhatre, & Hardin, 2008) These change in forest governance is not only related to involvement of nonhierarchical stakeholders and actors with diverse interests from different levels but it is also associated with the emergence of new institutional arrangements to cope with complex challenges in the forest sector (Weiland & Dedeurwaerdere, 2010).

Other scholars have focused on the factors affecting the effectiveness of environmental/green governance. Anderson, Keilor, Howarth, and Walker (2010) pointed out that adaptive capacity is a foundational dimension of environmental governance and its determinants such as institution building, trust building, and social learning are critical enabling factor for building multilevel governance systems for social-ecological system. Several contextual and other factors affect effectiveness of environmental governance. These include clear definition and enforcement of property rights, forest user participation, investments in capacity building at different levels, effective monitoring and rule enforcement (Agrawal et al., 2008); emergence of bridging organizations for collaboration and facilitation; interactions and learning among diverse set of actors (Kurian, 2011); and building system-wide knowledge and awareness of ecological dynamics, enabling coordination, negotiation, and collaboration across sectors, and across institutional level (Schultz, Folke, Österblom, & Olsson, 2015). However, there is a major gap in existing knowledge on understanding how different forest governance arrangements affect ecological, economic and social outcomes (Agrawal et al., 2008).

In addition to governance initiatives, Corporate Social responsibility (CSR) has been promoted to introduce innovation for sustainable value chain in many developing countries. CSR is defined as a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis (Commission of the European (2002). Halme and Laurila (2009) argue that CSR can contribute to higher social performance by integrating responsibility aspects with core business operations such as engaging stakeholder management, ensuring high product quality, investments in R&D, supporting responsibility measures in the supply chain and applying environmentally benign practices and policies towards the local community as well as developing new business models and innovation for solving social and environmental problems. By promoting partnership among different stakeholders, increasing market power and networked mode of operation, CSR appeared to become new governance that pushed the inclusion of social criteria into market decision that reflect some compatibility of sociability and business success (Moon, 2007). A number of studies have shown that there is strong association between strategic CSR and innovation capacity (Asongu, 2007; Commission, 2008; Ubius, Alas, & Vanhala, 2009).

The introduction of innovation requires building of innovation capacity. The concept innovation capacity has been defined as "the context specific range of skills, actors, practices, routines, institutions and policies needed to put knowledge into productive use in response to an evolving set of challenges, opportunities and technical and institutional contexts (Hall, 2005). Studies found that there is strong relationship between types of innovation introduced in a value chain and its innovation capacity (Arlbjørn, de Haas, & Munksgaard, 2011; Ferrer, Hyland, & Bretherton, 2009). Introducing value chain innovation has recently gained increased attention as means of overcoming risks, and as sources of competitive advantage (Martin, 2012; 2005). Value chain innovation capacity can be defined as "a continuous improvement of the overall capability of firms to generate innovation for developing new products and processes to meet market needs" (Ferrer, 2009, p. 198). It is also understood as "the intra and inter organizational competence within supply chain to cooperate, identify, develop and implement solution oriented actions that address new or previously unsolved problems"(Storer & Hyland, 2009). The value chain innovation literature identified different types of innovation and upgrading in supply chains such as chain innovation, process upgrading, product upgrading, marketing innovation, and functional innovation (Kaplinsky & Morris, 2000).

However, innovation has a double-edged sword and may reinforce the current unsustainable path leading to unexpected consequences due to the path dependent nature of technology, the incentives and the self referencing nature of regulations and institutions that governing private sector, society, the environment, and technology (Westley et al., 2011). It is thus necessary to know under what condition or combination of conditions innovation leads to sustainability. In addition, the traditional approaches to innovation assessment focus mainly on economic outcomes and fail to capture the ecological and social dimensions of sustainability.

The sustainability orientation in the assessment of innovation performance becomes increasingly important for achieve successful transformation towards sustainability. Depth understanding of causal conditions for fostering innovations that lead to sustainability is essential for developing new policy approaches, methods and practical tools to govern and stimulate innovation considering implications for social-ecological sustainability. The main research question of this study then is under what condition(s) innovation leads social-ecological sustainability in developing countries? This paper therefore develops indicators and method not only for measuring degree of innovation capacity but also for assessing social-ecological performance in developing country contexts. This paper empirically applied fuzzy comprehensive evaluation method to measure degree of innovation capacity and fuzzy set qualitative comparative analysis to examine the necessary and sufficient condition (s) for achieving social-ecological sustainability, by taking four cases that implemented governance reforms and CSR initiatives in Southwest Ethiopia.

The rest of the paper is organized as follows. The second section develops the analytical framework by reviewing theoretical and empirical literature. Research methodology of the study is discussed in third section while empirical results and analysis are described in fourth section. Concluding remarks is presented in final section.

ANALYTICAL FRAMEWORK

The social-ecological systems framework (SESF) initially proposed by (Ostrom, 2009) and further enhanced by Marshall (2015) is used for analyzing social ecological sustainability in this study. The SESF is an integrative framework allow for selecting the variables necessary to describe the dynamics in the social and ecological systems and the their interaction from different tiers in almost equal depth (Binder, Hinkel, Bots, & Pahl-Wostl, 2013). It also guide the assessment of sustainability as well as facilitating comparative analysis (Partelow, 2016).
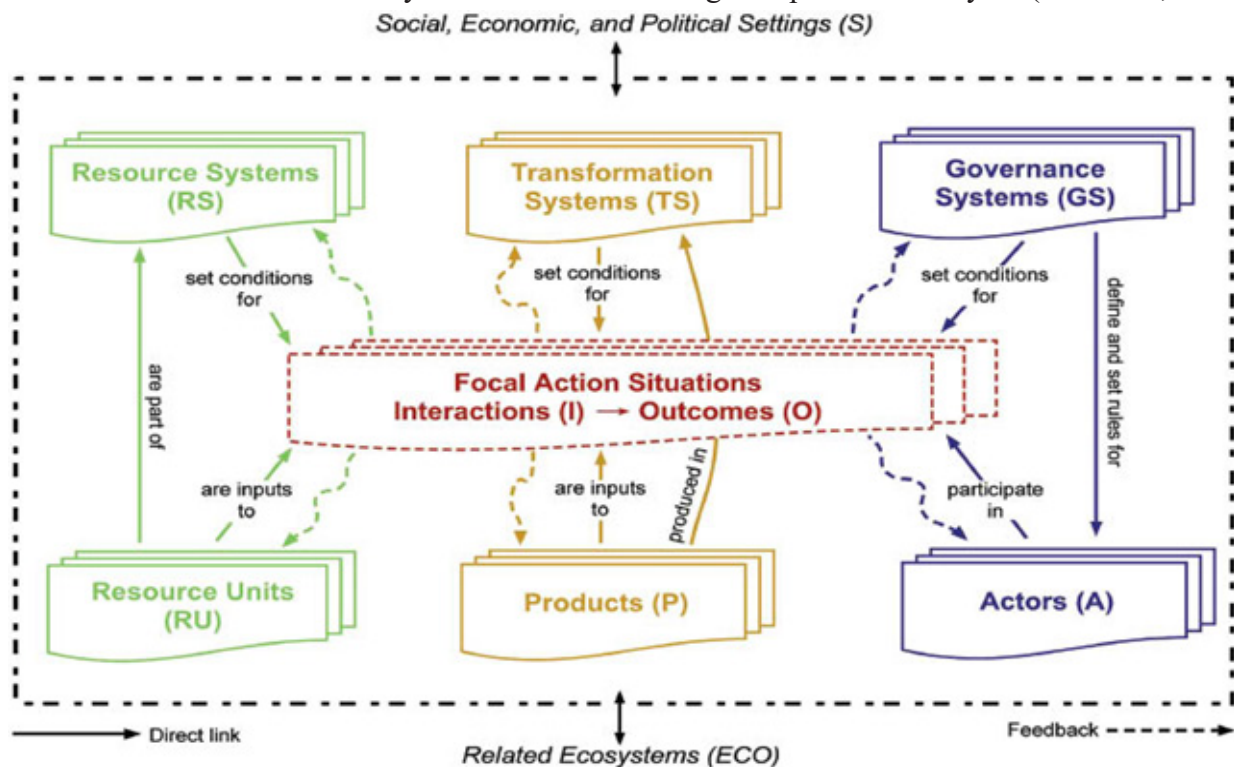

Figure 1: Social ecological system framework

Source: Marshall (2015)

McGinnis and Ostrom (2014) explained that the revised versions of SESF consists subsystems: resource systems (e.g. forest), resource units (RU e.g. tree), governance systems (GS), and actors(A) at higher level which contain multiple variables at the second tier as well as lower tiers. Action Situations are where all the action takes place as inputs are transformed by the actions of multiple actors into outcomes. SESF distinguishes its focal interest from its external environment which includes social, economic and political settings(S) and related ecosystems (ECO).

The concept Action Situation and Interactions in SESF represents dynamics and refer as social and environmental processes (such as information sharing, deliberation processes, investment, self-organizing, networking etc) through which interaction (I) lead to outcomes (Hinkel, Bots, & Schlüter, 2014). They help to understand different types of actions, activities and processes undertaken by actors and the interaction of these actions with other variables in determining social-ecological outcomes and dynamics of SESF. The outcomes in this framework include social performance measures (efficiency, equity, accountability, sustainability) and ecological performance measures (overharvested, resilience, biodiversity and sustainability). This study deals with biodiversity and sustainability outcome.

Successful transformation toward sustainability could be promoted by fostering innovation (Frances Westley, 2011). Olsson & Galaz (2012) have emphasized the need for integrating social and ecological considerations in the innovation processes to reinforce the resilience of ecological as well as social systems. It involves the combination of technology, governance, and ecosystem stewardship. Scholars have noted that promoting innovation is necessary to take advantage of new opportunities, to confront challenges and protect against risks of failure associated with innovation (Jones, Ludi, & Levine, 2010).

In order to overcome a range of fundamental challenge of chronic poverty, environmental degradation and weak competitiveness of value chain simultaneously in developing countries, numerous strategies and actions can be designed as alternative solution for tackling these challenges. Green governance reform and adoption CSR are two important actions/strategies used to promote innovation in forest resource governance and value chain in recent decadesrespectively. In order to understand causal conditions and identify multiple paths towards social ecological sustainability, we used Marshall (2015) enhanced SESF by incorporating transformation activities that promote value addition activities to resource units extracted from natural forest resources and products that are integrated to market economy.

GREEN GOVERNANCE REFORMS

With regard to governance, SESF framework indicates rule, property right and network structure as different characteristics of governance system and categorizes rules into operational, collective, and constitutional; property-rights systems into private, public, common, and mixed; and rule making and implementing organizations into government, private, community-based organizations and hybrid organizations from local, regional, national or international scale. The framework also added sub categories of rule in use and historical continuity in the list to consider different policy tools or instruments used and emerging governance in the analysis respectively. Kemp et al. (2005) argue that sustainability requires better governance that co-evolving societal processes and continuous changes in formal and informal institutions. Existing literature reveals that different forms of governance arrangement are emerging over recent decades. Lemos and Agrawal (2006) found that the hybrid, multi-level, and cross-sectoral nature of governance which increasingly rely on partnerships and market-based incentive instruments of environmental regulation are emerging forms of governance. Agrawal et al. (2008) found that new form of forest governance includes decentralization, concession, and certification and are the result of important social, economic, and political drivers. Similarly Study by Weiland and Dedeurwaerdere (2010) indicated a significant increase of forest governance by local community's organizations, civil society organizations and by market actors (certification) in developing countries in the past two decades.

Anderson et al. (2010) pointed out that adaptive capacity is a foundational dimension of environmental governance and its determinants such as institution building, trust building, and social learning are critical enabling factor for building multilevel governance systems for social-ecological system. Adaptability is the capacity of people in Social-ecological system (SES) to build and manage resilience through collective action (Folke, 2006; Walker, Holling, Carpenter, & Kinzi, 2004). According to Carl Folke (2002), adaptive management helps attaining resilience through undertaking different management practices and policies simultaneously, institutional and social learning, and continuously monitoring and regularly adjusting the rules and management decision for matching dynamics and handling uncertainty. According to Carl Folke et.al (2002) understanding of ecosystem dynamics, combing knowledge systems, self organization and nurturing diversity for reorganization and renewal are essential for enhance social-ecological resilience. Multilevel governance and institutional change, engagement of polycentric institutions, and flexible social networks, and linkage and interaction with vertical and horizontal institutions at different scale facilitates innovation and experiment that required enhances social-ecological resilience. In addition, Pahl-Wostl (2009) found that more complex and diverse governance regimes have a higher adaptive capacity. Newig and Fritsch (2009) found that a highly polycentric governance system comprising many agencies and levels of governance yields higher environmental outputs than monocentric governance. Some of existing have focused on identifying different component or characteristics of adaptive capacity (Jones et al., 2010) while others have dealt with its measurement issues (Mark & Zehra, 2013).

Devisscher (2010) pointed out that dynamic learning and, adaptive processes and consideration of context-specific factors such as endowment to livelihoods, institutions, legal frameworks, and equity enables sustainable ecological adaptation. Access to key resources, participation in the decision making process, and empowerment are key elements of building adaptive capacity (Jones et al., 2010). In addition, they noted that informed decision-making, appropriate measures, transparency, prioritization and flexibility of governing institutions are a crucial characteristic of adaptive capacity (Jones et al., 2010).

The sustainability requires use of mix of ecosystem management strategies and adaptation processes (Tahia, 2010). The ecosystem management strategies include reducing and managing existing threats, maintaining ecosystem structure and function, increasing the size and/or number of reserves, increasing habitat heterogeneity within reserves and between reserves, building in buffer zones to existing reserves, increasing connectivity, increasing landscape permeability, increasing and maintaining monitoring programs and integrating climate change into planning exercises and programmes. Flexible mechanisms and adaptation processes include regulatory plurality and economic instrument diversity, Strategic plans and policy integration, green Investment, research capacity, knowledge Sharing, and social Learning, adaptive governance and socio-institutional Change and technology and innovation. Conservation strategy contributes to natural ecosystem conservation by improving management, by identifying and increasing additional reserve areas, and by increasing habitat heterogeneity within reserve (Tahia, 2010). Taxonomy of conservation action identified by Salafsky et al (2008) include forest land protection, forest management, species management, education and awareness, law and policy, livelihood, economic and other incentives and external capacity building.

Reducing threats to biodiversity is one of the most synergetic strategies for enhancing ecosystems resilience and sustainability. Threats are any proximate human activities or processes that have caused, are causing or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes. . Threats include both underlying cause and direct threats Different type of direct threats has been identified by Salafsky et al. (2008). These include housing and settlement, commercial and industrial development, small-holder farming, agro-industry farming, Small-holder plantations, agro-industry plantation, Small holder grazing, ranching or farming, rock quarrying, roads and railroads, utility and service lines, hunting and collecting terrestrial animals, gathering terrestrial plants, logging, wood harvesting, scientific research, fire intensity/frequency, mowing grasses and thinning trees in the forest, and alien plant and animal species.

Different policy instruments have been used to conserve biodiversity and reduce threats. Existing literature revealed that there is a need for regulatory pluralism that uses full suits of existing incentive instruments and mix these with institutional arrangement for achieving desired biodiversity sustainability (Gunningham & Sinclair, 1998; Ring & Schlaack, 2011; Young & Gunninggham, 1996). Heterogeneous objectives of biodiversity conservation, lack of knowledge, multiple market failure for biodiversity valuation, complexity and externality of underlying cause and direct threats for biodiversity losses, presence of multiple constraints and the necessity of precautionary principle are main reasons for mixing of policy instrument (Ring & Schlaack, 2011). Young and Gunningham (1996) noted that the use of single instrument strategy approach is misguided because all instruments have their own strengths and weakness. Policy instrument can broadly be categorized as regulatory instruments, voluntary instrument, price based instrument, property right instruments, motivational, informational and educational instruments (Gunningham, 1996; Schlaack, 2011; Sinclair, 1998). Gunningham and Sinclair (1998) found that that mixing larger number of complementary instruments are key factors for obtaining of superior return from mix of instruments.

VALUE CHAIN INNOVATION

Value chain innovation is defined as "a change (incremental or radical) within the supply chain network, supply chain technology, or supply chain processes (or combinations of these) that can take place in a company function, within a company, in an industry or in a supply chain in order to enhance new value creation for the stakeholder'' (Arlbjørn et al., 2011). The introduction of innovation requires the development of innovation capacity. A number of studies have shown that there is strong association between strategic CSR and innovation capacity (Asongu, 2007; Commission, 2008; Ubius et al., 2009). CSR is defined as a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis (Commission of the European (2002). The commission(2002) mentioned that CSR can contribute to innovation capacity and performance through innovation resulting from engagement with other stakeholders; identifying business opportunities through addressing societal challenges; environmental management, and creating work places that are more conducive to innovation. Rama, Milano, Salas and Liu (2009) examined capacity development for collective action and institutional change and found that CSR can contribute to capacity development by enhancing individual, organizational, collaborative and enabling environment.

Green investment stimulates not only the adoption of cleaner production processes, new designs and ideas, and more efficient use of the end-products but it also enhances ecological functions and services by promoting different mechanism including organic production, fair trade, eco-tourism, certification and labeling schemes ecologically certified production, sustainable management of forests, corporate social responsibility (e.g. private and public businesses monitoring compliance with ethical standards and international norms); green public procurement and Socially responsible investment /SRI (Tahia, 2010). According to Halme and Laurila (2009) CSR can contribute to sustainable development by promoting integration, innovation and engaging philanthropy. CSR innovation emphasizes on the development of new business models for solving social and environmental problems and seeks to develop new products or services that provide solutions to problems. Halme and Laurila (2009) argued that the strategically oriented approach (integration and CSR innovation) yield more substantial social outcomes than charity and philanthropy.

Based on literature review and their case studies, Damite and Vallejo (2014) found that the level of innovation capacity is determined by the breadth, depth and integration of technological efforts and identified eight innovation practices in building innovation capacity that are resulted from implementation of CSR initiatives in Ethiopia. These innovation practices are innovation platform learning, relational capability, human skill and competency building, technological upgrading, global institutional arrangement, marketing capability, local cluster networking and policy support, and green capability. Table 1 presents causal conditions and major innovation practices identified by Authors. For purpose of necessity analysis, we categorize these innovation practices into four causal conditions for sustainability outcome.

Table 1
Causal conditions and major innovation practices

Causal Conditions	Major Innovation practices
Innovation platform Learning(Q)	Engagement with Stakeholders
	Co-development of action plan and strategy
	Implementation& participatory learning
	Upgrading Enabling Environment
Technological Upgrading(T)	Training, Human Skill& Competence building
	Government policy supports: Macroeconomic stability & Innovation policy framework Innovation supportive services delivery, institutional & legal framework, Institutions, networking and cluster interaction
	Product upgrading, Process upgrading
Business model	Relational Capability

Causal Conditions	Major Innovation practices
Innovation(B)	Horizontal linkage formation, Vertical integration, process integration
	Marketing Capability: Market research effort, distribution networks & management product differentiation, Promotional campaign
	Global institutional arrangement Set up of local requisite institutions, Use and engagement with multicultural expert Groups, Set up of monitoring and standard institution, Openness, investment climate and export promotion
Green governance innovation(G)	Environmental management tools, community forest management, Certification & eco-label Environmental knowledge & information provision, Environmental monitoring, audit and compliance, reduction in pressure on the natural resource and use of energy, Property right, market creation, Environmental regulation ,Habitat preservation

Source: (Damite & Vallejo, 2014)

RESEARCH METHODOLOGY
1.CASE SELECTION CRITERIA AND DATA COLLECTION

The selection of priority forest areas for case study is based on the following criteria. First, the case has launched and implemented adaptation initiatives that are focused on forest biodiversity and surrounding community. Second, the case has implemented innovative CSR models such as fair trade, value chain development and business model to promote innovation and integrate marginalized producers from developing countries to national and international markets. Third, implementation of new governance system to manage natural forest resources is another criterion. Based on these criteria we selected three cases from Bonga priority forest area and one case from Bench Maji priority forest areas for our study. The selection of forest management unit and value chains was done after consultation and discussion with experts from zone and woreda agricultural and rural development department in particularly the forest conservation desks and after collection and compilation of relevant information from secondary sources regarding projects, forest and value chains. We collected both primary and secondary sources. Focus group discussions and semi structured interviews were used for primary data collection. The field guideline was prepared for this purpose. Focus group discussions were conducted with group composed of executives of forest conservation groups, forest users, natural resource conservation experts from Zone &district, NTFP business group/cooperatives, and local government bodies (kebel administrator, kebel manager, development agent). The focus group discussions and interviews were conducted with stakeholders from Matap forest conservation cooperative, Agama forest conservation cooperative, Keyakello forest coffee cooperative, Kuti forest coffee cooperative, Meda forest user group for Bonga case. The focus group discussions and interviews were made with Kontire Berhane forest conservation group, Mehal Sheko coffee cooperative, and with Wakura forest user group for Bench Maji priority forest case.

The discussion were focused various issues ranging from identifying and evaluating current status of threats, identifying and evaluating different incentive mechanisms used by projects, types of innovation and business model introduced, and ecosystem conservation and management strategies promoted by projects.

Data was also collected through questionnaire on innovation capacity scorecard that ask respondents to rate the level of progress of innovation practice in their activities and its relevance to development of innovation capacity using five point likert scale. Collection and review of documents both from project and other secondary sources and key informant interviews with managers of projects, cooperative-Union managers and executive of board, experts from Agricultural and Rural Development Office (ARDO), and Forest user Groups (FUGs), and forest conservation manager were also used to identify the strategies or mechanisms applied by programs/projects. In addition, data was collected using biodiversity scorecard questionnaire to assess status of biodiversity conservation.

2.METHOD FOR SUSTAINABILITY ASSESSMENT

Todd and Brann (2007) mentioned that although the use of different statistical methods in counterfactual-based approach provide strong evidence for causality and for estimate the scale of impact attributable to the intervention, this approach has a number of weakness including too expensiveness, high expertise requirements, and complete and comprehensive baseline dataset requirements. Margoluis, Stem, Salafsky & Brown (2009) found that quantitative design (experimental, quasi-experimental and non experimental design) as well as qualitative design is often not feasible to use counterfactual or experimental designs in real world situation because projects such as conservation operate in complex and dynamic contexts. In addition, they pointed out that evaluation in conservation is not only measuring effectiveness but it also about the engagement of the conservation community.

Due to weakness of statistical method for assessing sustainability, we combined three methods for our analysis. First, fuzzy comprehensive evaluation method is a popular methods applied in sustainability and innovation capacity evaluation study. Duceya & Larson (1999) used fuzzy evaluation for comparing alternative scenarios and selecting rational forest management decision for sustainability, equity, and ecosystem health and mentioned that this technique addresses areas of uncertainty, ambiguity, and dissent in the decision process and help to incorporate multiple objectives, and identify knowledge gaps and areas of disagreement besides its simplicity and flexibility in application. Mendoza and Prabhu (2003) described the application of fuzzy method for forest sustainability assessment and mentioned that it offers an analytical framework that help to obtain unique measure, index or degree of sustainability and address general types of uncertainties that characterize sustainability assessments such as ambiguity, generality, and vagueness. The authors also noted that the selection of plausible indicators, the selection of appropriate aggregation method and proper elicitation of expert knowledge are important issues in sustainability assessment fuzzy evaluation methods. Fuzzy models provide a novel approach to support decision-making regarding sustainable development (Cornelissen, den Berg, Koops, Grossman, & Udo, 2000). Andriantiatsaholiniaina, Kouikoglou and Phillis (2004) developed sustainability assessment fuzzy evaluation (SAFE) and used to provide quantitative measures of human, ecological and overall sustainability using fuzzy logic reasoning and basic indicators of environmental integrity, economic efficiency, and social welfare from Greece and America and noted that SAFE is a practical tool for decision-making and policy design at the local or regional levels as well as attacking the problem of sustainable development systematically.

There are four key steps for fuzzy comprehensive assessment method. These steps are setting the evaluation index system, establishing evaluation set, determining weight set, evaluating matrix of single factor, and aggregating results.

A. Setting the Evaluation system and selecting indicators

From reviewed literature on social-ecological resilience, on conservation and sustainable use of forest biodiversity, relevant indicators for social-ecological sustainability was identified and presented in Table 2.

Table 2
Metrics for Social-ecological sustainability from literature

Dimension	Indicator(s)
Economic and livelihoods	improvement in income
	Livelihood diversification
	Market access
	Production
Ecological	status of quality of biodiversity
	Reduction in threats, increase in forest area and improvement in forest density
	extent of certification impact on forest biodiversity conservation
	habitat preservation &ecosystem services
	sustainability forest resource use & harvesting
	social empowerment and change in governance, social relation & behavior
Social change	availability of institutional arrangement
	enforcement and compliance of environmental law

Source: ITTO (2003) and Guillermo A Mendoza and Ravi Prabhu (2003)

B. Establishing Evaluation Set

The second component is determining linguistic terms and remark /assessment scale for attributes of evaluation factors. Assume that assessment scale for sustainability success rating and relative importance of each indicator can be divided into five levels and usually expressed by V. V denotes the comment set and V= { V_1, V_2, V_3, V_4, V_5 } Where V_1= very high, V_2= high, V_3=modest, V_4= marginal and V_5= poor with corresponding score of 5,4, 3,2, and 1, respectively.

C. Determine the weighting set

Since various indicators have different contribution to sustainability progress it is necessary to give the corresponding weights according to their importance. Suppose that W denotes the weight vector of indices of first grade indicators and expressed by = $(W_1, W_2, ..., W_K)$, $\sum_{i=1}^{k} w = 1$, KK_j ($1,2,...,K$) represents the weighting of K_j and $0 \leq w_i \leq 1$. The relative importance of attributes of factor is evaluated using the linguistic term very high, high, medium, low and very low with corresponding score of 5, 4, 3,2, and 1, respectively.

D. The aggregation method

We used the weighted linear combination (average) method to aggregate the final index. Then the final result of the degree of sustainability is evaluated using the following guideline. Table 3 indicates linguistic variables and score range for sustainability success.

Table 3
Linguistic variables and corresponding Score range for sustainability success (Z)

Linguistic variable (progress towards sustainability)	Z Score range	%
poor	< 1.2	< 25
marginal	1.3 < z < 2.5	26 <z < 50
modest	2.6< Z <3.5	51 <z < 70
good	3.6 < Z < 4.2	71 < z < 84
Optimal	>4.2	>84

3. METHOD FOR MEASURING INNOVATION CAPACITY

Innovation capacity is a multidimensional entity. The level of innovation capacity depends up on the breadth, depth and integration of technological effort. Breadth is the coverage of technological effort among relevant dimensions. In this study we identified eight dimensions categorized into enabling and core processes. The depth of technological effort refers to the level of investment made or the level or stage of development in activities performed in respective dimension while integration of technological effort is the level of relevance of technological effort to the development of innovation capacity. The general formula for computing innovation capacity is given by $IC = \sum_{B=1}^{k} D_s * I_s$

Where IC = innovation capacity, D_s = depth of technological effort, Is= integration of technological effort and B = Breadth of technological effort.   Following and (Yu-ChengLin, Lin, & Chiang, 2011), we applied fuzzy comprehensive evaluation method for measuring the level of innovation capacity. The innovation capacity scorecard was designed and given to evaluation team to rate the progress or performance of each practice and the importance weight attached to each innovation practices using a score of 5-point Likert Scale.

Second, Biodiversity scorecard is a qualitative approach that is used to measure biodiversity conservation status. Biodiversity status, threat status and protection and management status are three criteria used for measuring conservation success (Venner, 2008). While threat status is measured using threat reduction index method developed by Nick Salafsky and Richard Margoluis(2001), other two criteria are scored by forest management and user groups. This method is not only cost effective but it also addresses the limitations of traditional biological indicators approach. The approach has four important components: change in habitat areas, resource sustainability index, threat reduction index and future conservation success (monitoring and response).

Third, sustainability outcomes are influenced by complexity conditions. In this respect, fuzzy set qualitative comparative analysis (QCA) is appropriate methodological approach, because it addresses causal complexity by searching for conditions or combinations of necessary or sufficient conditions for an outcome of interest. QCA is a case based method which helps to identify and understand different combinations of factors that are necessary or sufficient for a successful outcome in a given context (Befani, 2016). Thus it has certain unique strengths including qualitatively assessing impact and identifying multiple pathways to achieving the change. It helps to generate robust findings about what makes the difference for success in different contexts, and generalize those findings. QCA method requires availability of appropriate theories of change, identifying at least 3 to 5 cases and collecting data across all cases for all conditions. The main principle of QCA is the examination of set theoretic relationships between causally relevant conditions and a clearly specified outcome in terms of necessity and/or sufficiency. It requires the analysis of necessary and sufficient conditions to produce the some outcome (ELLIOTT, 2013). Necessary conditions are conditions that are required to produce the outcome. All cases that exhibit the outcome also exhibit a necessary condition. Though, necessary conditions may not be enough by itself. Sufficient conditions are conditions that always lead to the outcome. So cases that exhibit the sufficient condition will also exhibit the outcome. Equi-finality means that there are multiple paths or solutions to the same outcome.

In fsQCA, consistency and coverage are parameters of model fitting. Consistency represents the extent to which a causal combination leads to an outcome. Consistency ranges from 0 to 1. Coverage represents how many cases with the outcome are represented by a particular causal condition. Since we are assuming that the causal conditions lead to the outcome, it only makes sense to calculate coverage for rows that have high consistency. Rows with low consistency violate our assumption that the causal condition leads to the outcome. Unlike regression which gives us the magnitude and direction of effect of a variable, net of other variables included in the model, fsQCA model focuses on what conditions lead to a given outcome.

There are different variant of QCA. The original crisp-set variant uses either present or absent for each condition that is represented by a value of 1 or 0, respectively. In this study we applied fuzzy set Qualitative Comparative Analysis (fsQCA), which allows conditions to be somewhere on a scale between fully absent and fully present (represented by values between 0 and 1). We used fuzzy command in fsQCA in Stata 14 for our analysis.

Due to the interpretational and representation problems in inclusion of large number of conditions in a QCA analysis, we decided to include four conditions by aggregating market orientation, and global institutional arrangement with value chain restructuring condition as well as local institutional reform, policy support, and training and skill development with technological upgrading. Green governance reform and innovation platform learning are also included in the analysis.

EMPIRICAL RESULTS AND ANALYSIS
1. CONTEXTS

The forests investigated in this study are located in Kafa and Bench-Maji Zones of Southern, Nations, Nationalities and Peoples' Regional State, Ethiopia. The sheko natural forest is one of the regional priority forest areas located at altitude ranging 1000-1849m in Shako woerda. According to the Woerda agricultural office, the average annual rain fall ranges from 1500 to 1800 mm and the annual temperature of the district ranges from 20°C-25°C. The Bonga forest is national priority forest area located at altitude raning 1600-3000m in kafa zone and its mean annual rain fall ranges from 1710 mm to 1892 mm and mean temperature from 18°c to 20°c.

The existing evidence reveals that Bonga natural forest reduced from 163,260 hectare in 1990 to 78,607 hectares in 2001 and further reduced to 69,361 hectares in 2008 registering 12% total loss of natural forest. The data for sheko natural forest revealed that it reduced from 99,160 hectare to 49,690 in 2001 and further reduced to 30,000 hectare in 2008.The loss of natural forest was about 40% from 2001 to 2008. During 1990-2008 periods, the loss of natural forest in sheko (69%) is higher compared to Bonga priority forest area (57%). In addition, the loss of natural forest (deforestation rate) in Bonga has decreased from 52% in 1990-2001 to 12% in 2001-2008. Similarly, deforestation rate in Sheko decreased from 50% in 1990-2001 to 39.6% in 2001-2008.

[1]Details of QCA method can be found in Befani Barbara (2016)

In order to tackle numerous challenges facing residents in southwest Ethiopia a number of innovative initiatives and multiple reforms have launched since 2000. First, the current government of Ethiopia has adopted market-oriented development models and made multiple reforms and changes in macroeconomic policies. The government has adopted a federal system of governance, giving the regional states and local community much more power to control their natural resources and implement their development activities. Commendable efforts have been made to change step by step the institutional conditions and the sectoral policies and strategies through multiple reforms and programs, including the decentralization of forest and natural resource management, liberalization, provision of environmental policy, forest policy and regulation, conservation strategies, and establishment of environmental agencies at the federal, regional and local levels. Second, the FARM AFRICA/SOS Sahel project was focused on providing forest user rights to communities and introducing joint or participatory forest management to improve the efficiency and effectiveness of forest utilization and conservation. Along with these efforts a number of policy reforms including decentralization of forest management and community-based natural resource management have been carried out with the aim of increasing local participation and benefit to the local community in natural resource control, management and use. The integrated approaches have aimed to both improve the livelihood of community and promote the conservation of biodiversity in the region using a mix of economic incentives and institutional arrangement measures along with the government forest regulation in southwest coffee forests. Third, the strengthening of the community cooperatives project financed by United States Agency for International Development (USAID) and implemented by Agricultural Cooperative and Development International (ACDI) and the Honey Value Chain Development Programme by the Netherlands Development Organization(SNV) through support to the Business Organizations and Access to Market programme (BOAM) has mainly focused on improving the business and institutional conditions for developing value chain and marketing of Forest coffee and forest honey and Bee product, respectively. Fourth, the NTFP South-West program has engaged both in the provision of forest user rights and improving business and institutional conditions for NTFP development and commercialization along with a participatory forest management approach designed to contribute to sustainable forest management and poverty alleviation. Fifth, PPP project by GTZ and the Conservation and use of wild population of coffee Arabica in the montane rainforests of Ethiopia (COCE project), on the other hand, focused on the forest coffee value chain development and conservation of the genetic diversity of wild Arabica coffee and promotion of NTFP certification to increase public understanding and awareness of the real value of biodiversity and conservation of the natural environment of Arabica coffee. These projects aimed at not only establishing Kafa biosphere reserve by the United Nations Educational, Scientific and Cultural Organization (UNESCO) but also enhancing the adaptive capacity of local communities for sustainable forest resource use and management and developing value chain integration and the introduction of new technology. They also aimed at linking remote forest-dependent people to regional, national and global market chains through new market arrangements.

2. RESULTS FOR EVALUATION OF CAUSAL CONDITIONS

Table 4 presents the results of fuzzy evaluation of causal conditions for four cases. The results revealed that four cases have different degree of membership for causal condition as well as for sustainability outcome. While Cooperative–Appenic Chain has almost fully membership, Bench Maji Forest coffee Cooperative-Union has low degree of membership.

Table 4
Fuzzy Evaluation Results for causal condition and sustainability

Cases		Causal Conditions			
	Sustainability	Innovation platform(Q)	Business model Innovation(B)	Technology upgrading (T)	Green govern innovation (G)
Kefa forest coffee-Buyer chain (KFCU)	0.68	0.83	0.66	0.61	0.67
Bench Maji Forest Coffee coffee-union(BMFCU)	0.49	0.55	0.44	0.52	0.42
Kafa Forest Honey cooperative-union (KFHU)	0.66	0.64	0.6	0.64	0.64
Cooperative –Appenic Chain	0.77	0.76	0.79	0.8	0.74

Source: own computation

3.RESULTS OF CASE STUDIES

The study is based on the empirical analysis of f two domestic and two globally linked chains that produces and sales one non-timber forest product, either coffee or honey.

A.   KAFA FOREST COFFEE UNION (KFCU)-ORIGINAL FOODS CHAIN

KFCU was established in 2004 with the assistance from Sustainable Poverty Alleviation in Kafa(SUPAK), a nationality NGO promoting poverty alleviation in the Kaffa Zone. KFCU started operations by re-organizing the working methods of 4,200 farmers into a farmers' union. Through the support of Agricultural cooperative Ethiopia program of VOCA-USAID that focused on strengthening cooperatives, the members of KFCU increased to 6,493 farmers, organized in 26 cooperatives by 2010. By the end 2015, the number of cooperative increased to 43 with 10583 members.

Supports from VOCA-USAID, Technoserve-Ethiopia (financed by the Bill Gates Foundation, and GTZ-Public–Private Partnership project helped this chain to introduce innovations in their activities. Innovation introduced in this chain includes:

a) Product upgrading: Unlike the conventional coffee product with grade Jimma 5, coffee supplied through KFCPCU has its own brand name "forest coffee". The differentiation of forest coffee is based on the sources of raw material supply i.e. the coffee is produced from natural forest and garden farming. The idea was originated by Germany Company who first purchased the forest coffee. In addition, the quality of forest coffee has significantly improved compared to non-member producers. The union has engaged in exporting dry processed coffee since 2004

b) Process upgrading/ innovation: Change in harvesting techniques: The quality of coffee product from cooperatives was very poor until 2003. They reap both red and green raw coffee by stripping together. More recently, most farmers pick up only red cherries and consequently, major changes have observed in quality of coffee from cooperative. There is strict follow up and monitoring not only from cooperatives but also the development agents, besides proving extension and advisory services to farmers and cooperatives. Drying coffee on ground had been practiced by all farmers until 2003. There is a significant change in coffee drying techniques. Significant number of farmers now use mesh wires or raised beds for drying coffee. Some farmers have introduced and used beds made from local material- bamboo. The improvement in coffee drying methods enhanced quality of coffee. Third, until recently, the coffee from cooperatives has been processed by dry processing methods. The coffee processing activities have been outsourced to private dry processing plants. More recently, with support from Technoserve-Ethiopia, three cooperatives have introduced new wet processing machinery. The new wet processing technology helped the cooperatives to engage in value adding activities as wet processed coffee has better quality. By 2015, the union has established own coffee hulling industry worth 5 million birr and helped the establishment of 7 coffee washing stations in of cooperatives and in the process of establishing 9 additional coffee washing stations in vicinity of member cooperatives.

c) Chain upgrading: Coffee cooperatives have established new value chain structure and changed the chain leader (now- collective organization /union (the chain leader), chain governance (general assembly, management board, general manager, and other staffs) and flow of chain information system. It also changed the supply chain management by semi vertical integration through collective ownership. In addition, strategic chain alliance has been established with foreign buyer -Original Foods. The union provides different services to its member cooperatives including marketing, processing, and business services. The new forest coffee chain is short, strict in traceability, and more transparent than conventional coffee chain. The establishment of the cooperative union enabled members to directly export their coffee without involving in national auction since 2004. This is the result of policy decision on part of government to improve the enabling environment for cooperatives.

d) Market innovation: KFCCU has established marketing networks both for domestic and foreign markets. In addition, majority of member cooperatives (76%) have gained group certification from certifiers. Two type of certification-FLO (fair trade) and IMO (organic) group certifications have helped the cooperatives/union to access global niche markets since 2004. The operational procedure of supply chain management (traceability) has significantly improved. Moreover, the forest coffee product has been promoted using different promotional mixes. In particularly, the promotion of wild coffee by GEO Magazine with Geo-TV crew has contributed much for its recognition in international market. The union has also introduced new packing system that follows the standards and key marks as agreed with its customers. Apart from that the union has owned its brand name "forest coffee". New distributional channels have been established for regional and national markets. Moreover, it has formed long lasting business relations with coffee buyers in different countries. With regard to economic sustainability, the capital of the union has increased from 200,000 Birr in 2004 to 10.2 million Birr in 2015. The union has got a total net profit of 20.86 million Birr over last 7 year with no loan default history.

e) Environmental upgrading: Eco-organizational innovation: New environmental management tools have been introduced. The forest coffee value chain included the environmental issue as the opportunity in its business and changed institutions, chain structure and flow of information system. The establishment of forest management groups and networks, preparation & implementation of forest management plans and application of new monitoring and evaluation techniques are new organizational forms that targeted for achieving forest sustainability. Value chain management has strictly implemented. Internal control systems and traceability are key tools for value chain management. The certification and eco-label scheme has used for management, monitoring & evaluation of the sustainability of value chain and forest resource. As to the contribution to forest & environmental sustainability, KFCU has participated in the effort to conserve natural forests in Kafa Zone since 2007 in collaboration with different projects and established and supported Participatory Forest Management Systems (PFMs). It has established 49 participatory forest management groups that integrate 19591 forest users (47% female) occupying 36, 847 ha natural forest area. Trainings to PFM & Cooperative members on environmental issues have been provided. It also established and supported youth reproductive health (RH) clubs in order to disseminate RH knowledge, provide services and supply materials to reduce population pressure on the forests.

B. BENCH MAJI FOREST COFFEE COOPERATIVE -UNION (BMFCU)

BMFCU was reestablished through integration of 14 cooperatives with members of 4948 and with initial capital of 201,000 ETB in 2005 by the cooperative promotion office in Bench Maji zone. Supports on variety of training and skill development on production processing techniques,participatory forest management, Utz Kapeh and Organic standards certification, supply of processing material and tools as well as establishing quality testing laboratory from NTFP Southwest project I and II, and USAID/Fintrac has helped this chain to introduce some innovation in their activities. Incremental changes are observed in this chain. In fact, the differentiation of product from mainstream coffee chain has been achieved. The increment change is also achieved in chain development. The cooperatives have an umbrella organization- the union which led the chain in domestic market. This chain failed to introduce market innovation due to lack strategic foreign partners. As consequences, most of forest coffee delivered to union sold in domestic market. Due to trainings on new production and harvesting techniques, incremental changes in quality of product have been observed. Farmers engaged in using new production and harvesting techniques. However, slight improvement in product processing is observed due to lack of supply of necessary equipment, facilities and materials such as dry beds, spare parts. Similarly, the introduction of eco-innovation to this chain is insignificant. Introduction and enforcement of certification & eco-label scheme, property right partition, environmental management tools and environmental regulation are rarely practiced in this value chain.

C.   KAFA FOREST HONEY COOPERATIVE–UNION (KFHU)

KFHU is an umbrella organization established in Kafa zone in 2008 by seven honey and beeswax producers' cooperative members to link them to domestic markets. Supports from SOS Sahel Community Initiative Promotion Project (CIP) and SNV Ethiopia-Honey & beeswax value chain development have helped this chain to introduced innovation in their activities.

a) Product upgrading: Honey producers now supply significantly improved products i.e. processed honey and processed beeswax to buyers. The union now packages its products in three different sizes, ranging from 3/4 kilogram to three kilograms of honey

b) Process innovation/upgrading: Unlike their traditional practices, more than 25% of producer farmers have started using new production and harvesting techniques. In addition, new beehives made from NTFPs such as bamboos are introduced to minimize costs for producers. The cooperatives and union also engaged in processing bee products using processing and electrical extracting equipments. They also use of improved post harvest handling technique to enhance quality. But the quality of product is not yet developed for export markets.

c) Chain upgrading: Changes have been made on structure and organization of honey value chain in study area. Forest honey and beeswax production and marketing chain is reorganized by the project activities. It is not managed by arm length /market transaction/ but by executives of cooperatives and union who guided by contracts and bylaws. Thirty two Product collection and processing centre has been established within 2 or 3 kebels. This has minimized a huge transaction costs for producers and improved the quality of products. The producers now supply the table honey to the processing centre and not bring chunk honey in jars.

New relationships among honey producers have been established. Cooperative development is one of institutional changes that enhance the bargain power of poor producers in remote rural areas. It also reduces transaction cost for producers which including searching for market information, negotiation with traders, etc. The establishment of union is another chain structure that provides very important services to cooperatives and its members. These services include among others, forming linkages with associations at national level such as EHBPA, EHPEA are new form of relationships that have enabled the union not only access markets, but also developing providing relevant knowledge and information. Unlike the conventional honey value chain which governed by arm length, the new value chain is managed by new rules (bylaws) and board members chosen in democratic manner from member cooperatives. Working with different actors from government organization, private firms, local NGOs, international NGOs such as SOS-sahel, and the like have helped to form new networks with these actors. This has significantly improved the learning of honey producers and community members, the flow of information and enhanced social capital.

d) Market innovation: Honey from Kafa has obtained new brand, namely forest honey. This product differentiation strategy is not based on final product but rather on the types of flowers and their sources (natural forest). Unlike the conventional marketing methods through personal contacts, promotions of forest honey have conducted using mixes of promotion methods. Four promotion campaigns have been conducted through TV and radio. In addition, promotions through written materials such as brochures and leafs are also carried out. Promotion of forest honey is further done through participating in exhibitions in Hawasa and Dire Dawa towns. Participation in international trade fair and sending sample product to companies in foreign countries including Norway and Netherlands are method used to promote the product. In addition, new distribution channels were established for regional and national markets. The Union has established four selling branches in main capital cities (Addis ababa, Hawassa, Bonga and Bahir Dar) which distribute and sell its products to supermarkets, hotels, bars, consumers and organizational clients. Further, the union now uses new packaging materials (plastic) and introduced three different packaging sizes.

D. FOREST CONSERVATION NTFP COOPERATIVES-APINEC PLC CHAIN

Apinec Agro industry PLC is a joint venture company established in 2004 between Apinect Apiculture Trading, Trichilla ABC and Clootwijick Apiaries BV. The company engaged in production, processing, and marketing of organic honey/wax and other non timber forest products including forest (organic) coffee and Ethiopian cardamom. It has 100 hectares nuclear farm plots in Kafa zone and engaged in cultivation of organic honey in its own farm plots. The company produces a minimum of 80 tones of honey from its own 2000 modern hives.

Supports from four initiatives- Ethiopia-Honey & beeswax value chain development project, Community Initiative Promotion Project (CIP), Apenic agro-processing project, and Participatory forest management projects have promoted innovation in this chain. Different kinds of innovation introduced are discussed as follow.

a) Product upgrading: This chain has introduced both significantly improved products as well as new products for the country. While significantly improved products are organic mono and poly floral liquid honey and organic beeswax, newly introduced products include propolis and medicinal honey from stingless bee.

b) Process innovation: Nearly half of the Producers use modern production system and better harvesting system. As results, they bring comb honey to regional processing centers which are equipped with necessary equipments, facilities and personnel. Some of farmers engaged in construction of beehives. There are farmers who are able to transfer bees from three traditional beehives to one modern hive. In central processing centre, the chain uses modern and advanced product processing technology which adjusts the moisture content to standard level.

c) Market innovation: Besides selling its products through domestic channels, the company has established market networks with four foreign market partners. It also has engaged in e-marketing. Promotional using websites are in place.

d) Chain Upgrading: This is newly established vertical integrated value chain for domestic and international market focusing natural forest honey and other non timber forest products. It is directly linked from producers to clients. The chain structure is easy and very short. This chain provides a number of technical and business services to its suppliers. For instance, Apinec agro Industry Company provides financial loan up to 200,000 Ethiopian Birr free of interest charge. Different organizations have been developed in apiculture sector at various governance levels. Organizational developments at federal level include multi-stakeholders forum (CG), Apiculture health & safety regulation department, Apiculture research institute, Ethiopian Honey Bee producers and exporters association, National Apiculture Board, and Apiculture resource Development Inspection Authority with their respective plans, policies and regulations. In addition to these sectoral institutional changes, institutional arrangement made with EU and other countries are new relationships.

e) Environmental upgrading: New environmental management groups and networks established. Devolution of management of forest to communities and new institutional arrangements (contracts) with forest management groups are made. Organic certification and eco-label scheme are new practices that directly contribute to for sustainability of environment and value chain.

4,RESULT FOR BIODIVERSITY CONSERVATION

Table 5 presents the results for biodiversity conservation scorecard assessed by resource user and community forest management group. The results indicate that biodiversity conservation in KFCU and Cooperative-Appenic chains is more effective than KFHU and BMFCU chains. The difference in sustainability outcome might be explained by differences in different kinds of innovation introduced in these chains.

Table 5
Result for biodiversity conservation

Forest management Group	Value chain	Forest area (ha)	Biodiversity Quality Status	Threat Reduction Status	Protection/ Management Status	Overall conservation Status
Kayakello	KFCU	1225	88.8	74	85	82.43
Agama	Coop-Appenic	1241	81.39	97	95	91.13
Matap	KFHU	215	90	79	70	79.66

Forest management Group	Value chain	Forest area (ha)	Biodiversity Quality Status	Threat Reduction Status	Protection/ Management Status	Overall conservation Status
Wacha	KFHU	449.5	86.5	88	70	81.5
keja	KFCU	419.25	83	88	80	83.66
Kuti	KFCU	2131	87.8	76	75	82.49
Wakura	BMFCU	230	86.7	73	80	79.9
Konter Berhan	BMFCU	10,000	80	52	30	54

Green = very Good, Blue = good), White = moderate, Yellow = Marginal, Red = poor

Source: own computation

5, EVALUATION RESULTS FOR SUSTAINABILITY INDEX

Table 6 presents the summary of evaluation results of the progress toward sustainability. The results indicated that the economic/livelihood achievement is at moderate level of success for KFHU and KFCU while it is marginal and good for BMFCU and Appenic-cooperative chain respectively. The results showed that the ecological performance is good for KFCU, KHU and Appenic-cooperative cases while it is moderate effectiveness for BMFCU case. With regards to social outcome, BMFCU registered marginal progress while the KFCU and KFHU achieved moderate level progress. A good level progress was achieved by cooperative-Appenic chain.

Table 6
Result of sustainability Evaluation by Expert and business Groups

Sustainability dimension	Sustainability performance (%)			
	KFCU	BMFCU	KHU	Coop-Appenic
Economic and livelihoods	65.6	50.4	63.2	74.8
Ecological	74.3	51.5	73.5	80.9
Social	67.5	40.3	64.5	76.5
Overall sustainability Index	68.4	49	66.3	76.8

Source: own Computation

The result for overall sustainability shows that cooperative-Appenice chain achieved a good progress towards sustainability, followed by KFCU and KHU which recorded moderate level progress. However, BMFCU achieved marginal progress to sustainability. The result reveals that significant variations were observed in economic, social and ecological performance among chains.

6. RESULT FOR FUZZY SET QUALITATIVE COMPARATIVE ANALYSIS

The result from running fsQCA in Stata 14 is presented in table 7. The configuration QBTG accounts 75% while configuration QbTg accounts 25%. Innovation platform learning, value chain restructuring, technology upgrading and green governance innovation are represented by Q, B,T, and G, respectively.

Table 7
Results from Fuzzy set qualitative comparative Analysis

best fit	Freq.	Percent	Cum.
QBGT	3	75.00	75.00
QbgT	1	25.00	100.00
Total	4	100.00	

Coincidence Matrix

	S	Q	B	G	T
S	1.000				
Q	0.988	1.000			
B	0.992	0.988	1.000		
G	1.000	1.000	0.980	1.000	
T	0.977	0.984	0.980	0.976	1.000

Sufficiency and Necessity Matrix

	S	Q	B	G	T

S	1.000	0.988	0.950	0.950	0.965
Q	0.924	1.000	0.885	0.888	0.910
B	0.992	0.988	1.000	0.972	0.980
G	1.000	1.000	0.980	1.000	0.976
T	0.977	0.984	0.949	0.938	1.000

. fuzzy S Q B G T settest(yyy yyn) sigonly greater(col1) conval(.700) common

Y-CONSISTENCY vs N-CONSISTENCY

Set	YCons	NCons	F	P	No. Best Fit
QBGT	1.000	0.553	12.45	0.039	3

Y-Consistency vs. Set Value

Set	YConsist	Set Value	F	P	NO. Best Fit
QbgT	0.979	0.700	241.17	0.001	1

Final Reduction Set

Coverage

Set	Raw Coverage	Unique Coverage	Solution Consistency
B*G*T	0.912	0.000	1.000
Q*B*G	0.931	0.019	1.000

Total Coverage = 0.931

Solution Consistency = 1.000

The overall solution can be written as B*G*T + Q*B*G →S Where * represents and; + = or; Q = innovation platform; G = green governance innovation; S= sustainability; B = value chain/business innovation

The Coincidence result shows that value chain restructuring(B), innovation platform learning (Q), green governance reform(G) and technological upgrading T) have high coincidence score with outcome and are sufficient for predicting sustainability outcome. The result also indicates that configuration QBTG is significantly more consistent than 0.700 at the 0.05 level. From Minimum Configuration Reduction result we have two causal configurations or paths for sustainability to occur. The first path shows that simultaneous presence of business model innovation, technological upgrading, and green governance innovation is sufficient condition for achieving sustainability. The second path for achieving sustainability is the simultaneous presence of business model innovation, green governance innovation and innovation platform. The result has a coverage of 0.93 and consistence of 1, indicating that the model has high empirically significance. The result indicates that two conditions – value chain/business model innovation and green governance innovation are common for two paths, indicating that they are necessary conditions for achieving social-ecological sustainability.

CONCLUSION

Although previous research has advanced our understanding of different types of innovation, it lacks analysis of how combining different kinds of innovation produce sustainability outcome. This study explores the combination of different kinds of innovation and innovation platform in building configuration for outstanding sustainability performance. To further our understanding of these complex patterns of causal interrelationships, this study applies fsQCA to small cases from Ethiopia. The results not only foster our scientific understanding of which kinds of innovation are relevant for sustainability and how these innovations are combined to achieve outstanding sustainability. The study found that combing value chain innovation and green governance innovation either with technological upgrading or innovation platform learning are sufficient conditions for achieving social-ecological sustainability. The analysis revealed that innovation in green governance and in value chain are necessary conditions for sustainability. The finding implies that there are different paths and combination of innovation for achieving same sustainability outcome. Government in developing countries needs to select path and takes policy measures to enhance causal conditions for innovation capacity for different kinds of innovations. This study also demonstrates the usefulness of fuzzy set qualitative comparative analysis (fsQCA) for identifying complex conjectural paths and relevant necessary and sufficient conditions for outstanding social-ecological sustainability. Analyzing necessary and sufficient conditions for each dimensions of sustainability with more cases will be agenda for future research.

REFERENCE

Agraw al, A., Chhatre, A., & Hardin, R. (2008). Changing governance of the world's forests. science, 320(5882), 1460-1462.

Anderson, B. N., Keilor, V., Howarth, A. R. W., & Walker, L. R. (2010). Springer Series on Environmental Management.

Andriantiatsaholiniaina, L. A., Kouikoglou, V. S., & Phillis, Y. A. (2004). METHODS Evaluating strategies for sustainable development: fuzzy logic reasoning and sensitivity analysis. Ecological Economics, 48, 149-172. Retrieved from www.elsevier.com/locate/ecolecon

Arlbjørn, J. S., de Haas, H., & Munksgaard, K. B. (2011). Exploring supply chain innovation. Logistics research, 3(1), 3-18.

Asongu, J. J. (2007). Innovation as an Argument for Corporate Social Responsibility. Journal of Business and Public Policy, 1(3), 1-21. Retrieved from isites.harvard.edu/fs/docs/icb.topic747719. files/Supplemental Reading Folder/Innovation.pdf

Befani, B. (2016). PATHWAYS TO CHANGE: EVALUATING DEVELOPMENT INTERVENTIONS WITH QUALITATIVE COMPARATIVE ANALYSIS (QCA).

Binder, C. R., Hinkel, J., Bots, P. W., & Pahl-Wostl, C. (2013). Comparison of frameworks for analyzing social-ecological systems. Ecology and Society, 18(4), 26.

Brundtland, G., Khalid, M., Agnelli, S., Al-Athel, S., Chidzero, B., Fadika, L., . . . de Botero, M. M. (1987). Our common future (\'brundtland report\').

Commission, E. (2002). Corporate Social Responsibility:A business contribution to Sustainable Development. Retrieved from Brussels: ropa.eu/europeaid/communication-commission-concerning-corporate-social-responsibility-business-contribution_en

Commission, E. (2008). European Competitiveness Report 2008. Retrieved from ///C:/Users/student/AppData/Local/Temp/cr-2008-final_4058.pdf

Cornelissen, A. M. G., den Berg, J. v., Koops, W. J., Grossman, M., & Udo, H. M. J. (2000). Assessment of sustainable development: a novel approach using fuzzy set theory. Retrieved from www.erim.eur.nl

Damite, D., & Vallejo, B. (2014). Developing Comprehensive innovation capacity Audit Framework for sustainable Value chains. Paper presented at the, Paper to be presented at 12th Globelics International Conference, 29th – 31st October 2014 Addis Ababa Ethiopia.

Duceya, M. J., & Larson, B. C. (1999). A fuzzy set approach to the problem of sustainability. Forest Ecology and Management, 115, 29-40.

ELLIOTT, T. (2013). Fuzzy Set Qualitative Comparative Analysis.

Ferrer, M., Hyland, P., & Bretherton, P. (2009, 8 – 10 June). The role of relational capabilities in developing the capacity for supply chain innovation. Paper presented at the 7th ANZAM Operations, Supply Chain and Services Management, Adelaide, Australia.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. Global Environmental Change, 16, 253–267. doi:doi:10.1016/j.gloenvcha.2006.04.002

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C., & Walker, B. (2002). Resilience and Sustainable Development:Building Adaptive Capacity in a World of Transformations. Ambio, 31(5), 4. Retrieved from http://www.ambio.kva.se

Frances Westley, P. O., Carl Folke, ...van der Leeuw. (2011). Tipping Toward Sustainability: Emerging Pathways of Transformation. Ambio, 40, 762-780. doi:10.1007/s13280-011-0186-9

Gunningham, N., & Sinclair, D. (1998). Regulatory Pluralism: Designing Policy Mixes for Environmental Protection. LAW & POLICY, 21(1), 49-76. Retrieved from http://www.greeneconomics. net/Gun-RegulPlural.pdf

Hall, A. (2005). Capacity development for agricultural biotechnology in developing countries: an innovation systems view of what it is and how to develop it. Journal of International Development, 17(5), 611.

Halme, M., & Laurila, J. (2009). Philanthropy, Integration or Innovation? Exploring the Financial and Societal Outcomes of Different Types of Corporate Responsibility. Journal of Business Ethics, 84, 325-339. doi:10.1007/s10551-008-9712-5

Herrmann, K. K. (2004). Corporate social responsibility and sustainable development: the European Union initiative as a case study. Indiana Journal of Global Legal Studies, 11(2), 205-232.

Hinkel, J., Bots, P. W., & Schlüter, M. (2014). Enhancing the Ostrom social-ecological system framework through formalization. Ecology and Society, 19(3), 51.

ITTO. (2003). Manual for Application of Criteria and Indicators for Sustainable Management of natural Tropical Forests.

Jones, L., Ludi, E., & Levine, S. (2010). Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level (pp. 8): Oversea Development institute.

Kaplinsky, R., & Morris, M. (2000). A Handbook for Value Chain Research IDS working Paper. Sussex, UK: IDS.

Kemp, R., Parto, S., & Gibson, R. B. (2005). Governance for sustainable development: moving from theory to practice. International Journal of Sustainable Development, 8(1-2), 12-30.

Kurian, N. (2011). Innovations or Gridlocks? Institutional Dynamics in Natural Resource Governance in India's Northeast. Retrieved from

Lemos, M. C., & Agrawal, A. (2006). Environmental governance. Annual review of environment and resources, 31(1), 297.

Margoluis, R., Stem, C., Salafsky, N., & Brown, M. (Eds.). (2009). Design Alternatives for Evaluating the Impact of Conservation Projects (Vol. 22): Wiley Periodicals, Inc.

Mark, P., & Zehra, Z. (2013) Measuring adaptive capacity: application of an indexing methodology in Guyana Environment, Politics and Development Working Paper Series, : Department of Geography,King's College of London.

Marshall, G. (2015). A social-ecological systems framework for food systems research: accommodating transformation systems and their products. International Journal of the Commons, 9(2).

Martin, G. (2012). Motivating and Enabling Value Chain Innovation in Canada's Agri-Food Industry: Value Chain Management Centre.

McGinnis, M. D., & Ostrom, E. (2014). Social-ecological system framework: initial changes and continuing challenges. Ecology and Society, 19(2), 30.

Mendoza, G. A., & Prabhu, R. (2003). Fuzzy methods for assessing criteria and indicators of sustainable forest management. Ecological Indicators, 3, 227-236. doi:doi:10.1016/j.ecolind.2003.08.001

Mendoza, G. A., & Prabhu, R. (2003). Qualitative multi-criteria approaches to assessing indicators of sustainable forest resource management. Forest Ecology and Management, 174(1), 329-343.

Moon, J. (2007). The contribution of corporate social responsibility to sustainable development. SUSTAINABLE DEVELOPMENT-BRADFORD-, 15(5), 296-306.

Murty, T. S. (2009). Forests Source Book Practical Guidance for Sustaining Forests in Development Cooperation World Bank—WWF Alliance for Forest Conservation and Sustainable Use. Natural Hazards, 48(2), 315-316.

Newig, J., & Fritsch, O. (2009). Environmental governance: participatory, multi-level–and effective? Environmental Policy and Governance, 19(3), 197-214.

NICK, S., DANIEL, S., ALISON J., S., CRAIG, H.-T., RACHEL, N., STUART H. M., B.SHEILA, O. C. (2008). A Standard Lexicon for Biodiversity Conservation:Unified Classifications of Threats and Actions. Conservation Biology. doi: 10.1111/j.1523-1739.2008.00937.x

Olsson, P., & Galaz, V. (2012). Social-ecological innovation and transformation . . Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. science, 325(5939), 419-422.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. Global Environmental Change, 19(3), 354-365.

Partelow, S. (2016). Coevolving Ostrom's social–ecological systems (SES) framework and sustainability science: four key co-benefits. Sustainability Science, 11(3), 399-410.

Rama, D., Milano, B. J., Salas, S., & Liu, C.-H. (2009). CSR Implementation: Developing the Capacity for Collective Action. Journal of Business Ethics, 85, 463–477. doi:10.1007/s10551-008-9737-9

Ring, I., & Schlaack, C. S. (Eds.). (2011). Justifying and Assessing Policy Mixes for Biodiversity and Ecosystem Governance: Helmholtz Centre for Environmental Research.

Salafsky, N., & Margoluis, R. (2001). Threat Reduction Assessment: a Practical and Cost-Effective Approach to Evaluating Conservation and Development Projects. Conservation Biology, 13(4), 830–841. Retrieved from http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.1999.98183.x/pdf

Schreckenberg, E. M. K. (2005). NTFP commercialization in Mexico and Bolivia: Innovation and Adaptation for Success. Paper presented at the A Future Beneath the Trees: International Symposium, Victoria, Canada.

Schultz, L., Folke, C., Österblom, H., & Olsson, P. (2015). Adaptive governance, ecosystem management, and natural capital. Proceedings of the National Academy of Sciences of the United States of America, 112(24), 7369-7374.

Storer, M., & Hyland, P. (2009). Dynamic Capabilities and Innovation in Supply Chains. Paper presented at the CINET 2009.

Tahia, D. (2010). Ecosystem based Adaptation in Africa,Rationale, Pathways, and Cost Estimate:Sectoral Report for the AdaptCost Study. Retrieved from http://www.unep.org/climatechange/adaptation/Portals/133/documents/AdaptCost/10%20EBA_AdaptCost_Final.pdf

Todd, D., & Brann, J. (2007). Impact Evaluation Information Document No. 1,GEF IMPACT EVALUATION,Approach Paper. Retrieved from http://www.thegef.org/gef/sites/thegef.org/files/documents/InfoDoc1_Approach%20Paper.pdf

Ubius, U., Alas, R., & Vanhala, S. (2009). Innovation and corporate social Responsibility in Estonian organization. Problems and Prospectives in Management, 7(1), 11. Retrieved from http://businessperspectives.org/journals_free/ppm/2009/PPM_EN_2009_01c_Ubius.pdf

Venner, M. (2008). A Biodiversity Scorecard Approach to Assessing Conservation Status & Protection and Management: The Nature Conservancy.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzi, A. (2004). Resilience, Adaptability and Transformability in Social-Ecological Systems. Ecology and Society, 9(2)(5). Retrieved from http://www.ecologyandsociety.org/vol9/iss2/art5

Weiland, S., & Dedeurwaerdere, T. (2010). Change in forest governance in developing countries–in search of sustainable governance arrangements. International Journal of the Commons, 4(2).

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., Sendzimir, J. (2011). Tipping toward sustainability: emerging pathways of transformation. Ambio, 40(7), 762-780.

Young, M. D., & Gunninggham, N. (1996). Mixing Instruments and Institutional Arrangements for Optimal Biodiversity Conservation", Biodiversity Incentive measures. Paper presented at the OECD International Conference. http://www.southwestnrm.org.au/sites/default/files/uploads/ihub/conservation-outside-nature-reserves-10_0.pdf

Yu-ChengLin, Lin, C.-T., & Chiang, H.-S. (2011). FUZZY INNOVATIVE CAPABILITIES INDEX: AN INNOVATIVE CAPABILITIES AUDIT FRAMEWORK. Paper presented at the bai-Conference, Tawain.