Influential Article Review - Evaluation of the Impact of Eco-innovation by Means of Sustainability Indicators

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This paper examines sustainability. We present insights from a highly influential paper. Here are the highlights from this paper: Innovative processes aimed at sustainable development or eco-innovations have received increasing attention during the past years despite the lack of theoretical and methodological approaches to analyzing their impact. This paper focuses on how sustainability indicators can be used to measure the effects of "non-technical" eco-innovations in the Sri Lankan tea plantation sector. After carrying out an experimental case study on a commercial tea plantation, we employed a combination of physical and monetary sustainability indicators to evaluate the initial results of the eco-innovation. It shows that innovations aimed at improving economic benefits often result in unintentional environmental and social benefits that support a lean-green relationship. It reveals the difficulty in having a standardized set of indicators to measure the impact of eco-innovations owing to the multidimensionality of sustainability. Hence, the case study suggests adopting broad sustainability indicators that represent the wholeness of the system while capturing the long-term impact. For our overseas readers, we then present the insights from this paper in Spanish, French, Portuguese, and German.

Keywords: Agriculture, Eco-innovation, Sri Lanka, Sustainability, Sustainability accounting, Sustainability indicators, Tea industry, Triple bottom line

SUMMARY

- The above analysis presents some interesting points for discussion. The results show that this process of eco-innovation improves the existing tea pruning process by reducing the environmental impact while improving societal and economic benefits. Further, this innovative method improves land productivity and agricultural resource utilization, two major problems envisaged by Forum for the Future in its «tea 2030 vision». SSTB actually lowers the frequency of pruning and improves the land productivity and resource use efficiency of tea plantations, thus lowering the operational cost and unit cost of production. Hence this method leads to sustainable agricultural practices by improving the ability of the agricultural systems to maintain crop productivity in the long run while at the same time producing environmental and social benefits . These types of investments do not require substantial capital investment or deployment of advanced technology or skilled labour. Hence, these «non-technological» innovations Organisation for Economic Co-operation and Development with minimum capital, technological or labour investments can be used to reduce the environmental and social impact while achieving economic benefits. Since most of the top tea

producing countries are developing countries with limited access to advanced technology and major constraints on large capital investments, these types of innovations have the potential to improve productivity with minimum investments. From another dimension, this study supports the «lean-green» concept in the agricultural industry since it uses less agricultural inputs to improve financial performance while preventing environmental burdens and contributing to social equity . This eco-innovation was not initially intended to bring about environmental or social improvements but to reduce crop loss in the pruning cycle. This makes the use of supplemental indicators essential . However, the use of supplemental indicators makes the inter-industry comparison of eco-innovations difficult as there are few common indicators. Further, we do not suggest that the intra-industry comparison is somewhat easier. Owing to the differences in many factors such as soil condition, weather patterns and labour practices, there will be difficulties in making intra-industry comparisons also. These differences call for the application of additional indicators. However, given the need for a manageable number of indicators that are simple and easy to apply , the use of multiple indicators could render the measurement process of eco-innovations complex and unmanageable. Hence, the selection of sustainability indicators to assess the impact of eco-innovations necessitates a trade-off between accuracy and manageability. On the other hand, the use of generic measures such as carbon storage can be too complex. This can be an important constraint for many small and medium sector enterprises in developing countries where the plantation agriculture industry plays a key role.

- Echoing a similar challenge that prior researchers have encountered, the present researchers too had a problem in selecting the appropriate sustainability indicators for the assessment of social dimension in eco-innovations. This is mainly because, so far, the social side of sustainability and hence the social sustainability indicators have received little attention . We used only simple and easy–to-implement indicators, but when a company advances it is necessary to move towards more complex indicators . Perhaps, the way forward can be the development of fuzzy multi-criterion decision-making methods to assess the impact of eco-innovations. On the other hand, most of the impact of eco-innovations are long term, particularly in the plantation agriculture industry. Therefore, in addition to the selection of a set of indicators there is the challenge to determine the suitable time frame for the assessment. This highlights the challenges faced in the development of indicators considering the main dimensions of sustainability indicators, i.e. unit of measurement, type of measurement, tracking period and measurement boundary .
- Our case study further highlights the difficulties in carrying out a priori cost-benefit analysis in terms of an investment appraisal Drury 2009; Environmental Protection Agency since eco-innovations would involve capital expenditure. This difficulty could arise owing to several reasons. One reason is the difficulty in monetizing some of the environmental and social impact.

HIGHLY INFLUENTIAL ARTICLE

We used the following article as a basis of our evaluation:

Gunarathne, A. D. N., & Peiris, H. M. P. (2017). Assessing the impact of eco-innovations through sustainability indicators: the case of the commercial tea plantation industry in Sri Lanka. Asian Journal of Sustainability and Social Responsibility, 2(1), 41–58.

This is the link to the publisher's website:
https://ajssr.springeropen.com/articles/10.1186/s41180-017-0015-6

INTRODUCTION

The recent expansion of economic activity has been accompanied by growing global environmental and social concerns (Organisation for Economic Co-operation and Development (OECD) 2009). While

posing many challenges, they also provide opportunities for businesses to engage in sustainability practices and transform their businesses so as to contribute to sustainable development (Schaltegger et al. 2017). In this context, innovation is increasingly becoming an important supportive vehicle for developing corporate sustainability management as a means both of survival and growth (Han et al. 1998; Schaltegger et al. 2017). Hence, innovation processes aimed at sustainable development (eco-innovations) have received increasing attention in recent years (Bossle et al. 2016; Marin and Lotti 2017; Provasnek et al. 2017). When pursuing sustainability initiatives including eco-innovations, the first issue to address is its assessment (Keeble et al. 2003). Since sustainability is a multidimensional concept, its measurement should consider and integrate economic, social and environmental aspects (Pope et al. 2004). Sustainability performance is a construct, and hence cannot be observed; it should therefore be anchored in observable reality by means of indicators (Escrig-Olmedo et al. 2017). Further, the measure of sustainability depends to a great extent on the indicators used (Boggia and Cortina 2010). Similarly, information plays a key role in the process of creating and diffusing sustainability innovations (Schaltegger et al. 2017). There should be mechanisms to assess the effectiveness of eco-innovations from economic, social and environmental perspectives. That is, there should be proper monitoring, measurement and evaluations regarding the progress towards the sustainability goals (Sroufe et al. 2002). However, the assessment of the impact of eco-innovations is still not adequately developed in industries such as plantation agricultureFootnote1 unlike in the manufacturing sector (Ariza et al. 2013). Innovations in the agriculture sector are of importance because the shrinking availability and the rising cost of land, labour, water and energy pose many challenges for the industry (UN Environment Programme (UNEP) 2008). With the constant growth of population there is pressure to increase agricultural yields, which often means the use of synthetic inputs that are not environmentally friendly such as pesticides or questionable such as genetically modified crops. In order to meet these rising environmental and sustainability challenges, the agriculture industry has yet to use innovation as a tool (Negny et al. 2012; Berdegue and Escobar 2002; Diederen et al. 2003). This case study presents an approach to improving the yield while being green and how to measure those improvements in the agriculture industry. As such, the paper presents how sustainability indicators can be used to measure the effects of eco-innovations from economic, environmental and social perspectives in the Sri Lankan tea plantation sector. The literature usually recommends that a company first begins with simple, easy-to-implement measures of resource efficiency before moving into more complex indicators (Krajnc and Glavič 2003). We therefore base this paper on the initial outcomes of an experimental case study conducted on a commercial tea garden using some selected sustainability measures.

The contributions of the paper are as follows: First, the paper adds to the growing body of sustainability assessment literature (see Hamilton and Atkinson 2006; Boggia and Cortina 2010; Escrig-Olmedo et al. 2017; Krajnc and Glavič 2003) by specifically focusing on eco-innovations. In doing so, this paper develops economic and environmental indicators and to a certain extent some social indicators to assess the impact of eco-innovations. The integration of ecological, social and economic aspects is very useful for extending innovation research to sustainable development (Rennings 2000). Second, the interdisciplinary nature of this study highlights the benefits for the plantation agriculture industry and for accounting (more broadly, business management) disciplines. This eco-innovation is based on the principles and behaviour of plant physiology and was primarily aimed at productivity improvements to derive economic gains, but eventually resulted in environmental benefits as a byproduct (Horbach et al. 2012; Organisation for Economic Co-operation and Development (OECD) 2009; Carrillo-Hermosilla et al. 2010). Hence, this study provides evidence on the lean-green relationship from the agriculture industry. From the perspective of the plantation agriculture industry, this study shows how “non-technical”eco-innovations can be used to reduce their environmental impact while achieving economic benefits. This is particularly important since innovation is lacking in this industry (Ariza et al. 2013; Berdegue and Escobar 2002; Diederen et al. 2003). These types of innovations do not require advanced technology or large amounts of capital investment. Hence it has the potential to foster productivity levels on the agricultural plantations sector irrespective of the degree of development and growing conditions. However, the magnitude of benefits will vary with local environmental conditions. Since most of the tea producing countries are developing countries with low levels of technological development and capital investment constraints, these types of eco-innovations have

the potential to improve productivity easily (Feder et al. 1985; Ongong and Ochieng 2013; Pretty et al. 2003). Since the plantation industry plays a significant economic role in these economies in terms of foreign exchange earnings and employment generation, the application and subsequent assessment of eco-innovation is of paramount importance in the face of intense pressure for better productivity and efficient resource utilization in achieving sustainable development. For the accounting discipline, this study expands the application of environmental and sustainability management accounting (EMA)Footnote3 beyond industries such as manufacturing or service where it is commonly used. Hence it shows the usability of EMA across a wide spectrum of industries provided the appropriate indicators and mechanisms are used to provide information for stakeholders.

The rest of the paper is organized as follows: The next section presents the concept of eco-innovation and its assessment through sustainability indicators. Section three provides an overview of the tea industry followed by section four on the method adopted in the case study. Sections five and six present the analysis and discussion of the study respectively. The last section provides the conclusions and directions for further research.

CONCLUSION

The purpose of this case study was to contribute to the body of knowledge on the assessment of eco-innovations by carrying out an experimental case study in the agricultural plantations industry. Innovations mainly aimed at enhancing economic gains can have an accidental impact on the environment. However the assessment of the impact of these eco-innovations is the challenge. Since due to the underdeveloped theoretical and methodological approaches to analyze these benefits (Rennings 2000; Peiris and Gunarathne, 2015), the study used the triple bottom line approach. In doing so physical and monetary sustainability information was used (Burritt et al. 2002, International Federation of Accountants (IFAC) 2005) to quantify these impacts. Yet there are many potential impacts that were not captured in the present paper. It is only when these impacts are considered that the full benefit of eco-innovations can be evaluated. This case study reveals the difficulty in having a standardized set of indicators to measure the impact of eco-innovations owing to the multidimensionality of sustainability. Further, this case study emphasizes that the problems associated with measuring sustainability are common to the assessment of eco-innovations as well. Hence there is a need for further development of sustainability indicators to make inter and intra industry comparisons of the eco-innovations meaningful. The way forward would be to adopt broad sustainability indicators that represent the wholeness of the system while capturing the long term impacts.

The findings of this case study can have several limitations. Since the study was carried out in a particular tea field with specific characteristics there is a need to replicate the study under different conditions and for different types of perennial crops. This study only presents the outcomes of this study covering 14 months. However, in the agricultural plantation sector there are long-term impacts across a variety of aspects. This creates a need to identify the benefits or impacts over longer time periods. In this study some of the broader benefits and/or different aspects were not measured due to various practical difficulties. For instance, many scholars have drawn attention to the quality of tea after pruning (see Grice 1985; Owuor et al. 1990; Ravichandran 2004; Ravichandran and Parthiban 1998b). However, the study did not observe some of the parameters as the purpose of this paper was to present the early results of the experiment. Hence it would be necessary to investigate these aspects in future studies.

APPENDIX

FIGURE 1
TEA BUSHES SUBJECTED TO HEDGE-ROW-EFFECT OVER TIME

Due to this hedge-row-effect, the formation of clustered tiny shoots causes difficulty in harvesting

FIGURE 2
PERIODIC PRUNING OF COMMERCIAL TEA

The right hand side of the picture shows how pruning causes a sudden loss of bush-canopy in tea gardens

FIGURE 3
TEA FIELDS 3 WEEKS AFTER PRUNING

Generally, pruned branches are removed and thorough weeding is done after pruning. This causes complete exposure of the ground to natural forces

FIGURE 4
INITIATION OF SSTB METHOD @120–140 DAYS FROM PRUNING

FIGURE 5
SSTB @ 160–180 DAYS

SSTB quickly allows developing a greater bush canopy cover

FIGURE 6
ADJOINING TREATMENT AND CONTROL PLOTS

SSTB (left) and CCTB (right) after 180 days from pruning. The picture clearly shows the difference in the development of canopy

FIGURE 7
GROUND BENEATH AT 08 MONTHS FROM PRUNING UNDER CONTROL PLOTS

The weed growth on exposed ground on tea inter-rows is in the range of 1000–1450 weed plants per m2. This, in turn, propagates chemical tolerant harmful weeds for tea

FIGURE 8
GROUND BENEATH AT 08 MONTHS FROM PRUNING UNDER TREATMENT PLOTS

The canopy cover of a tea bush is well developed optimizing resource usage while minimizing the growth of weeds

TABLE 1
ECONOMIC ANALYSIS OF THE CONTROL VS. TREATMENT PLOTS

	Time (in months)	Treatment [SSTB]	Control [CCTB]	% difference
Made tea yield (kg)	4	0	90	
	6	621	462	+34%
	10	1272	923	+38%
	14	2148	1509	+42%
Foliar spray wastage (%) [Note [a]]	4	60%	60%	0%
	6	10%	40%	−75%
	10	6%	30%	−80%
	14	2%	25%	−92%
Cost of weeding (Rs.) [Note [b]]	4	7050	7050	0%
	6	10,460	15,292	−32%
	10	22,410	34,200	−34%
	14	28,120	43,260	−35%

aThis is the waste of agricultural inputs when applied directly as watery droplets on crop foliage expecting a quick response. This was measured by subtracting the canopy cover of the tea bushes from the total area of the spray application

bThis represents the cost of herbicide chemicals and labour employed for manual weeding. The mix of these two cost components varies with time and also with the condition of the field. Hence an average figure has been used in this study

TABLE 2
ENVIRONMENTAL ANALYSIS OF THE TREATMENT VS. CONTROL PLOTS

	Time (in months)	Treatment [SSTB]	Control [CCTB]	% difference
Canopy area of a bush (m^2)	4	0.53	0.45	118%
	6	1.80	0.73	247%
	10	1.84	0.76	242%
	14	1.85	0.77	240%
Ground cover (%)	4	45%	39%	115%
	6	90%	40%	225%
	10	94%	56%	168%
	14	98%	70%	140%

TABLE 3
SOME BENEFITS OF ELIMINATING CHEMICAL WEEDING ON SSTB

Aspects	Quantification of the impact
Reduction of the exposure of sprayers to chemical weeding	12 man days of chemical weeding per hectare [Note]
Use of weedicide chemicals	
- Diuron	3.6/kg per hectare * 3 rounds
- Glufocinate Ammonium	4.5/l per hectare *3 rounds

This was calculated as 4 man days of sprayers per hectare per round of chemical weeding* 3 rounds during the period

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TRANSLATED VERSION: SPANISH

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

VERSION TRADUCIDA: ESPAÑOL

A continuación se muestra una traducción aproximada de las ideas presentadas anteriormente. Esto se hizo para dar una comprensión general de las ideas presentadas en el documento. Por favor, disculpe cualquier error gramatical y no responsabilite a los autores originales de estos errores.

INTRODUCCIÓN

La reciente expansión de la actividad económica ha ido acompañada de crecientes preocupaciones ambientales y sociales mundiales (Organización para la Cooperación y el Desarrollo Económicos (OCDE) 2009). Al mismo tiempo que plantean muchos desafíos, también ofrecen oportunidades para que las empresas participen en prácticas de sostenibilidad y transformen sus negocios para contribuir al desarrollo sostenible (Schaltegger et al. 2017). En este contexto, la innovación se está convirtiendo cada vez más en un importante vehículo de apoyo para el desarrollo de la gestión de la sostenibilidad corporativa como medio tanto de supervivencia como de crecimiento (Han et al. 1998; 2017). Por lo tanto, los procesos de innovación dirigidos al desarrollo sostenible (ecoinnovaciones) han recibido cada vez más atención en los últimos años (Bossle et al. 2016; Marin y Lotti 2017; 2017). Al llevar a cabo iniciativas de sostenibilidad, incluidas las ecoinnovaciones, la primera cuestión a abordar es su evaluación (Keeble et al. 2003). Dado que la sostenibilidad es un concepto multidimensional, su medición debe considerar e integrar aspectos económicos, sociales y ambientales (Papa et al. 2004). El rendimiento de sostenibilidad es una construcción, y por lo tanto no se puede observar; por lo tanto, debe anclarse en la realidad observable por medio de indicadores (Escrig-Olmedo et al. 2017). Además, la medida de sostenibilidad depende en gran medida de los indicadores utilizados (Boggia y Cortina 2010). Del mismo modo, la información desempeña un papel clave en el proceso de creación y difusión de innovaciones de sostenibilidad (Schaltegger et al. 2017). Debería haber mecanismos para evaluar la eficacia de las ecoinnovaciones desde perspectivas económicas, sociales y medioambientales. Es decir, debe haber un seguimiento, medición y evaluación adecuados sobre el progreso hacia los objetivos de sostenibilidad (Sroufe et al. 2002). Sin embargo, la evaluación del impacto de las ecoinnovaciones todavía no está adecuadamente desarrollada en industrias como la agricultura de plantacionesfootnote1 a diferencia del sector manufacturero (Ariza et al. 2013). Las innovaciones en el sector agrícola son importantes porque la reducción de la disponibilidad y el aumento del costo de la tierra, la mano de obra, el agua y la energía plantean muchos desafíos para la industria (Programa de las Naciones Unidas para el Medio Ambiente (PNUMA) 2008). Con el crecimiento constante de la población hay presión para aumentar los rendimientos agrícolas, lo que a menudo significa el uso de insumos sintéticos que no son respetuosos con el medio ambiente, como pesticidas o cuestionables como los cultivos modificados genéticamente. Para hacer frente a estos crecientes desafíos medioambientales y de sostenibilidad, la industria agrícola aún no ha utilizado la innovación como herramienta (Negny et al. 2012; Berdegue y Escobar 2002; 2003). Este estudio de caso presenta un enfoque para mejorar el rendimiento al mismo tiempo que es verde y cómo medir esas mejoras en la industria agrícola. Como tal, el documento presenta cómo se pueden utilizar indicadores de sostenibilidad para medir los efectos de las ecoinnovaciones desde perspectivas económicas, ambientales y sociales en el sector de las plantaciones de té de Sri Lanka. Por lo general, la literatura recomienda que una empresa comience primero con medidas simples y fáciles de implementar de eficiencia de los recursos antes de pasar a indicadores más complejos (Krajnc y Glavi. 2003). Por lo tanto, basamos este documento en los resultados iniciales de un estudio de caso experimental realizado en un jardín de té comercial utilizando algunas medidas de sostenibilidad seleccionadas.

Las contribuciones del documento son las siguientes: En primer lugar, el documento se suma al creciente cuerpo de la literatura de evaluación de la sostenibilidad (véanse Hamilton y Atkinson 2006; Boggia y Cortina 2010; 2017; Krajnc y Glaviá 2003) centrándose específicamente en las ecoinnovaciones. Al hacerlo, este documento desarrolla indicadores económicos y ambientales y, en cierta medida, algunos indicadores sociales para evaluar el impacto de las ecoinnovaciones. La integración de los aspectos ecológicos, sociales y económicos es muy útil para extender la investigación en innovación al desarrollo sostenible (Rennings 2000). En segundo lugar, el carácter interdisciplinario de este estudio pone de relieve los beneficios para la industria de la agricultura de plantaciones y para las disciplinas contables (más

ampliamente, de gestión empresarial). Esta ecoinnovación se basa en los principios y comportamientos de la fisiología vegetal y estaba dirigida principalmente a mejoras de la productividad para obtener beneficios económicos, pero finalmente dio lugar a beneficios ambientales como subproducto (Horbach et al. 2012; Organización para la Cooperación y el Desarrollo Económicos (OCDE) 2009; Carrillo-Hermosilla et al. 2010). Por lo tanto, este estudio proporciona evidencia sobre la relación lean-green de la industria agrícola. Desde la perspectiva de la industria de la agricultura de plantaciones, este estudio muestra cómo las "no técnicas"Footnote2eco-innovaciones pueden utilizarse para reducir su impacto ambiental y lograr beneficios económicos. Esto es particularmente importante ya que falta innovación en esta industria (Ariza et al. 2013; Berdegue y Escobar 2002; 2003). Este tipo de innovaciones no requieren tecnología avanzada ni grandes cantidades de inversión de capital. Por lo tanto, tiene el potencial de fomentar los niveles de productividad en el sector de las plantaciones agrícolas, independientemente del grado de desarrollo y las condiciones de cultivo. Sin embargo, la magnitud de los beneficios variará según las condiciones ambientales locales. Dado que la mayoría de los países productores de té son países en desarrollo con bajos niveles de desarrollo tecnológico y limitaciones de inversión de capital, este tipo de ecoinnovaciones tienen el potencial de mejorar la productividad fácilmente (Feder et al. 1985; Ongong y Ochieng 2013; 2003). Dado que la industria de las plantaciones desempeña un papel económico importante en estas economías en términos de ingresos en divisas y generación de empleo, la aplicación y evaluación posterior de la ecoinnovación es de suma importancia ante una intensa presión para una mejor productividad y una utilización eficiente de los recursos para lograr un desarrollo sostenible. Para la disciplina contable, este estudio amplía la aplicación de la contabilidad de gestión ambiental y sostenible (EMA)Footnote3 más allá de industrias como la fabricación o el servicio donde se utiliza comúnmente. Por lo tanto, muestra la usabilidad de la EMA en un amplio espectro de industrias siempre que se utilicen los indicadores y mecanismos apropiados para proporcionar información a las partes interesadas.

El resto del documento se organiza de la siguiente manera: La siguiente sección presenta el concepto de ecoinnovación y su evaluación a través de indicadores de sostenibilidad. La sección tres ofrece una visión general de la industria del té seguida de la sección cuatro sobre el método adoptado en el estudio de caso. Las secciones cinco y seis presentan el análisis y discusión del estudio, respectivamente. La última sección proporciona las conclusiones y las instrucciones para la investigación posterior.

CONCLUSIÓN

El objetivo de este estudio de caso fue contribuir al conjunto de conocimientos sobre la evaluación de las ecoinnovaciones mediante la realización de un estudio experimental de caso en la industria de plantaciones agrícolas. Las innovaciones destinadas principalmente a mejorar los beneficios económicos pueden tener un impacto accidental en el medio ambiente. Sin embargo, la evaluación del impacto de estas ecoinnovaciones es el desafío. Dado que debido a los enfoques teóricos y metodológicos subdesarrollados para analizar estos beneficios (Rennings 2000; Peiris y Gunarathne, 2015), el estudio utilizó el enfoque de triple resultado. Al hacerlo, se utilizó información sobre sostenibilidad física y monetaria (Burritt et al. 2002, Federación Internacional de Contadores (IFAC) 2005) para cuantificar estos impactos. Sin embargo, hay muchos impactos potenciales que no fueron capturados en el presente documento. Sólo cuando se considera estos impactos se puede evaluar todo el beneficio de las ecoinnovaciones. Este estudio de caso revela la dificultad de contar con un conjunto estandarizado de indicadores para medir el impacto de las ecoinnovaciones debido a la multidimensionalidad de la sostenibilidad. Además, este estudio de caso destaca que los problemas asociados con la medición de la sostenibilidad también son comunes a la evaluación de las ecoinnovaciones. Por lo tanto, es necesario seguir elaborando indicadores de sostenibilidad para que las comparaciones entre industrias y dentro de la industria sean significativas. El camino a seguir sería adoptar indicadores amplios de sostenibilidad que representen la totalidad del sistema y, al mismo tiempo, capturen los impactos a largo plazo.

Las conclusiones de este estudio de caso pueden tener varias limitaciones. Dado que el estudio se llevó a cabo en un campo de té particular con características específicas, es necesario replicar el estudio en diferentes condiciones y para diferentes tipos de cultivos perennes. Este estudio solo presenta los resultados

de este estudio que abarcan 14 meses. Sin embargo, en el sector de las plantaciones agrícolas hay impactos a largo plazo en una variedad de aspectos. Esto crea la necesidad de identificar los beneficios o impactos durante períodos de tiempo más largos. En este estudio algunos de los beneficios más amplios y/o diferentes aspectos no se midieron debido a diversas dificultades prácticas. Por ejemplo, muchos eruditos han llamado la atención sobre la calidad del té después de la poda (véase Grice 1985; 1990; Ravichandran 2004; Ravichandran y Parthiban 1998b). Sin embargo, el estudio no observó algunos de los parámetros, ya que el propósito de este documento era presentar los primeros resultados del experimento. Por lo tanto, sería necesario investigar estos aspectos en estudios futuros.

TRANSLATED VERSION: FRENCH

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

VERSION TRADUITE: FRANÇAIS

Voici une traduction approximative des idées présentées ci-dessus. Cela a été fait pour donner une compréhension générale des idées présentées dans le document. Veuillez excuser toutes les erreurs grammaticales et ne pas tenir les auteurs originaux responsables de ces erreurs.

INTRODUCTION

L'expansion récente de l'activité économique s'est accompagnée de préoccupations environnementales et sociales croissantes à l'échelle mondiale (Organisation de coopération et de développement économiques (OCDE) 2009). Tout en posant de nombreux défis, ils offrent également aux entreprises la possibilité de s'engager dans des pratiques de durabilité et de transformer leurs entreprises afin de contribuer au développement durable (Schaltegger et al., 2017). Dans ce contexte, l'innovation devient de plus en plus un important vecteur de soutien au développement de la gestion de la durabilité des entreprises comme moyen de survie et de croissance (Han et coll., 1998; Schaltegger et coll. 2017). Par conséquent, les processus d'innovation visant le développement durable (éco-innovations) ont reçu une attention croissante ces dernières années (Bossle et al., 2016; Marin et Lotti 2017; Provasnek et coll. 2017). Dans la poursuite d'initiatives de durabilité, y compris les éco-innovations, le premier problème à aborder est son évaluation (Keeble et al., 2003). Étant donné que la durabilité est un concept multidimensionnel, sa mesure devrait tenir compte et intégrer les aspects économiques, sociaux et environnementaux (Pope et al., 2004). La performance en matière de durabilité est une construction et ne peut donc pas être observée; elle devrait donc être ancrée dans la réalité observable au moyen d'indicateurs (Escrig-Olmedo et al., 2017). En outre, la mesure de la durabilité dépend dans une large mesure des indicateurs utilisés (Boggia et Cortina 2010). De même, l'information joue un rôle clé dans le processus de création et de diffusion d'innovations en matière de durabilité (Schaltegger et coll., 2017). Il devrait y avoir des mécanismes pour évaluer l'efficacité des éco-innovations du point de vue économique, social et environnemental. C'est-à-dire qu'il devrait y avoir un suivi, une mesure et des évaluations appropriés concernant les progrès réalisés dans la réalisation des objectifs de durabilité (Sroufe et al., 2002). Toutefois, l'évaluation de l'impact des éco-innovations n'est pas encore suffisamment développée dans des industries telles que l'agriculture de plantationnote1 contrairement au secteur manufacturier (Ariza et al., 2013). Les innovations dans le secteur agricole sont importantes parce que la diminution de la disponibilité et l'augmentation du coût des terres, de la main-d'œuvre, de l'eau et de l'énergie posent de nombreux défis à l'industrie (Programme des Nations Unies pour l'environnement (PNUE) 2008). Avec la croissance constante de la population, il y a des pressions pour augmenter les rendements agricoles, ce qui signifie souvent l'utilisation d'intrants synthétiques qui ne sont pas respectueux de l'environnement comme les pesticides ou les cultures douteuses telles que les cultures génétiquement modifiées. Afin de relever ces défis croissants en matière

d'environnement et de durabilité, l'industrie agricole n'a pas encore utilisé l'innovation comme outil (Negny et al., 2012; Berdegue et Escobar 2002; Diederen et coll. 2003). Cette étude de cas présente une approche pour améliorer le rendement tout en étant vert et comment mesurer ces améliorations dans l'industrie agricole. À ce titre, le document présente comment les indicateurs de durabilité peuvent être utilisés pour mesurer les effets des éco-innovations des perspectives économiques, environnementales et sociales dans le secteur sri-lankais des plantations de thé. La littérature recommande habituellement qu'une entreprise commence d'abord par des mesures simples et faciles à mettre en œuvre de l'efficacité des ressources avant de passer à des indicateurs plus complexes (Krajnc et Glavič 2003). Nous basons donc cet article sur les résultats initiaux d'une étude de cas expérimentale menée sur un jardin de thé commercial en utilisant certaines mesures de durabilité sélectionnées.

Les contributions du document sont les suivantes : Premièrement, le document s'ajoute à l'ensemble croissant de la documentation sur l'évaluation de la durabilité (voir Hamilton et Atkinson, 2006; Boggia et Cortina 2010; Escrig-Olmedo et coll. 2017; Krajnc et Glavič 2003) en se concentrant spécifiquement sur les éco-innovations. Ce faisant, ce document développe des indicateurs économiques et environnementaux et, dans une certaine mesure, certains indicateurs sociaux pour évaluer l'impact des éco-innovations. L'intégration des aspects écologiques, sociaux et économiques est très utile pour étendre la recherche sur l'innovation au développement durable (Rennings, 2000). Deuxièmement, le caractère interdisciplinaire de cette étude met en évidence les avantages pour l'industrie de l'agriculture de plantation et pour les disciplines comptables (plus largement, la gestion des entreprises). Cette éco-innovation est fondée sur les principes et le comportement de la physiologie végétale et visait principalement à améliorer la productivité pour tirer des gains économiques, mais a finalement entraîné des avantages environnementaux en tant que sous-produit (Horbach et al., 2012; Organisation de coopération et de développement économiques (OCDE) 2009; Carrillo-Hermosilla et coll. 2010). Par conséquent, cette étude fournit des preuves sur la relation vert-maigre de l'industrie agricole. Du point de vue de l'industrie de l'agriculture de plantation, cette étude montre comment les innovations « non techniques » de Note de bas de page2 peuvent être utilisées pour réduire leur impact environnemental tout en réalisant des avantages économiques. Cela est d'autant plus important que l'innovation fait défaut dans cette industrie (Ariza et coll., 2013; Berdegue et Escobar 2002; Diederen et coll. 2003). Ces types d'innovations ne nécessitent pas de technologie de pointe ou d'investissements importants. Par conséquent, elle a le potentiel de favoriser les niveaux de productivité dans le secteur des plantations agricoles, quel que soit le degré de développement et les conditions de croissance. Toutefois, l'ampleur des avantages variera en fonction des conditions environnementales locales. Étant donné que la plupart des pays producteurs de thé sont des pays en développement où les niveaux de développement technologique et les contraintes liées aux investissements en capital sont faibles, ces types d'éco-innovations ont le potentiel d'améliorer facilement la productivité (Feder et al., 1985; Ongong et Ochieng 2013; Pretty et coll. 2003). Étant donné que l'industrie des plantations joue un rôle économique important dans ces économies en termes de revenus en devises et de création d'emplois, l'application et l'évaluation subséquente de l'éco-innovation sont d'une importance capitale face à une pression intense pour une meilleure productivité et une utilisation efficace des ressources dans la réalisation du développement durable. Pour ce qui est de la discipline comptable, cette étude élargit l'application de la comptabilité de gestion de l'environnement et de la durabilité (EMA)Note de bas de page3 au-delà des industries telles que la fabrication ou le service où il est couramment utilisé. Par conséquent, il montre la facilité d'utilisation de l'ema dans un large éventail d'industries à condition que les indicateurs et le mécanisme appropriés soient utilisés pour fournir de l'information aux parties prenantes.

Le reste du document est organisé comme suit : La section suivante présente le concept d'éco-innovation et son évaluation à travers des indicateurs de durabilité. La section trois donne un aperçu de l'industrie du thé, suivie de la quatrième section sur la méthode adoptée dans l'étude de cas. Les sections cinq et six présentent respectivement l'analyse et la discussion de l'étude. La dernière section fournit les conclusions et les orientations pour d'autres recherches.

CONCLUSION

Le but de cette étude de cas était de contribuer à l'ensemble des connaissances sur l'évaluation des éco-innovations en réalisant une étude de cas expérimentale dans l'industrie des plantations agricoles. Les innovations visant principalement à accroître les gains économiques peuvent avoir un impact accidentel sur l'environnement. Toutefois, l'évaluation de l'impact de ces éco-innovations est le défi. Depuis sur la base des approches théoriques et méthodologiques sous-développées pour analyser ces avantages (Rennings 2000; Peiris et Gunarathne, 2015), l'étude a utilisé l'approche triple ligne de fond. Ce faisant, des renseignements sur la durabilité physique et monétaire ont été utilisés (Burritt et coll. 2002, Fédération internationale des comptables (FIAC) 2005) pour quantifier ces répercussions. Pourtant, il y a beaucoup d'impacts potentiels qui n'ont pas été pris en compte dans le présent document. Ce n'est que lorsque l'on considère ces impacts que l'on peut évaluer le plein bénéfice des éco-innovations. Cette étude de cas révèle la difficulté d'avoir un ensemble normalisé d'indicateurs pour mesurer l'impact des éco-innovations en raison de la multidimensionnalité de la durabilité. De plus, cette étude de cas souligne que les problèmes associés à la mesure de la durabilité sont également communs à l'évaluation des éco-innovations. Il est donc nécessaire de poursuivre le développement d'indicateurs de durabilité afin de rendre significatives les comparaisons entre les écosystèmes et les industries. La voie à suivre serait d'adopter des indicateurs généraux de durabilité qui représentent l'ensemble du système tout en captant les répercussions à long terme.

Les résultats de cette étude de cas peuvent avoir plusieurs limitations. Étant donné que l'étude a été réalisée dans un champ de thé particulier avec des caractéristiques spécifiques, il est nécessaire de reproduire l'étude dans différentes conditions et pour différents types de cultures vivaces. Cette étude ne présente que les résultats de cette étude couvrant 14 mois. Toutefois, dans le secteur des plantations agricoles, il y a des répercussions à long terme sur diverses aspects. Cela crée un besoin d'identifier les avantages ou les impacts sur de plus longues périodes de temps. Dans cette étude, certains des avantages et/ou différents aspects plus généraux n'ont pas été mesurés en raison de diverses difficultés pratiques. Par exemple, de nombreux chercheurs ont attiré l'attention sur la qualité du thé après l'élagage (voir Grice, 1985; Owior et coll. 1990; Ravichandran 2004; Ravichandran et Parthiban, 1998b). Cependant, l'étude n'a pas observé certains paramètres car le but de cet article était de présenter les premiers résultats de l'expérience. Par conséquent, il serait nécessaire d'étudier ces aspects dans les études futures.

TRANSLATED VERSION: GERMAN

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ÜBERSETZTE VERSION: DEUTSCH

Hier ist eine ungefähre Übersetzung der oben vorgestellten Ideen. Dies wurde getan, um ein allgemeines Verständnis der in dem Dokument vorgestellten Ideen zu vermitteln. Bitte entschuldigen Sie alle grammatikalischen Fehler und machen Sie die ursprünglichen Autoren nicht für diese Fehler verantwortlich.

EINLEITUNG

Die jüngste Ausweitung der Wirtschaftstätigkeit ging mit wachsenden globalen Umwelt- und Sozialproblemen einher (Organisation für wirtschaftliche Zusammenarbeit und Entwicklung (OECD) 2009). Sie stellen viele Herausforderungen dar und bieten Unternehmen auch die Möglichkeit, Nachhaltigkeitspraktiken zu praktizieren und ihre Unternehmen so umzugestalten, dass sie zu einer nachhaltigen Entwicklung beitragen (Schaltegger et al. 2017). In diesem Zusammenhang wird Innovation zunehmend zu einem wichtigen unterstützenden Instrument für die Entwicklung des Nachhaltigkeitsmanagements von Unternehmen als Mittel des Überlebens und des Wachstums (Han et al.

1998; Schaltegger et al. 2017). Daher haben Innovationsprozesse, die auf nachhaltige Entwicklung (Öko-Innovationen) abzielen, in den letzten Jahren immer mehr Beachtung gefunden (Bossle et al. 2016; Marin und Lotti 2017; Provasnek et al. 2017). Bei der Verfolgung von Nachhaltigkeitsinitiativen, einschließlich Öko-Innovationen, ist das erste Thema, das sich mit seiner Bewertung befasst (Keeble et al. 2003). Da Nachhaltigkeit ein multidimensionales Konzept ist, sollte ihre Messung wirtschaftliche, soziale und ökologische Aspekte berücksichtigen und integrieren (Papst et al. 2004). Nachhaltigkeitsleistung ist ein Konstrukt und kann daher nicht eingehalten werden; sie sollte daher durch Indikatoren in der beobachtbaren Realität verankert werden (Escrig-Olmedo et al. 2017). Darüber hinaus hängt das Maß der Nachhaltigkeit in hohem Maße von den verwendeten Indikatoren ab (Boggia und Cortina 2010). Ebenso spielen Informationen eine Schlüsselrolle bei der Schaffung und Verbreitung von Nachhaltigkeitsinnovationen (Schaltegger et al. 2017). Es sollte Mechanismen geben, um die Wirksamkeit von Öko-Innovationen aus wirtschaftlicher, sozialer und ökologischer Sicht zu bewerten. Das heißt, es sollte eine angemessene Überwachung, Messung und Bewertung der Fortschritte bei der Erreichung der Nachhaltigkeitsziele geben (Sroufe et al. 2002). Allerdings ist die Bewertung der Auswirkungen von Öko-Innovationen in Branchen wie der Plantagenlandwirtschaft noch immer nicht ausreichend entwickeltfootnote1 im Gegensatz zum verarbeitenden Gewerbe (Ariza et al. 2013). Innovationen im Agrarsektor sind von Bedeutung, da die schrumpfende Verfügbarkeit und die steigenden Kosten für Land, Arbeit, Wasser und Energie die Industrie vor viele Herausforderungen stellen (UN-Umweltprogramm (UNEP) 2008). Mit dem stetigen Bevölkerungswachstum besteht der Druck, die landwirtschaftlichen Erträge zu steigern, was oft die Verwendung synthetischer Inputs bedeutet, die nicht umweltfreundlich sind, wie Pestizide oder fragwürdigwie gentechnisch veränderte Kulturen. Um diesen wachsenden Umwelt- und Nachhaltigkeitsherausforderungen zu begegnen, muss die Landwirtschaft Innovation noch als Instrument einsetzen (Negny et al. 2012; Berdegue und Escobar 2002; Diederen et al. 2003). Diese Fallstudie stellt einen Ansatz zur Verbesserung des Ertrags bei gleichzeitiger Grünentwicklung dar und wie diese Verbesserungen in der Landwirtschaft gemessen werden können. Als solches stellt das Papier dar, wie Nachhaltigkeitsindikatoren verwendet werden können, um die Auswirkungen von Öko-Innovationen aus wirtschaftlicher, ökologischer und sozialer Sicht im sri-lankischen Teeplantagensektor zu messen. Die Literatur empfiehlt in der Regel, dass ein Unternehmen zunächst mit einfachen, einfach umzusetzenden Maßnahmen der Ressourceneffizienz beginnt, bevor es in komplexere Indikatoren übergeht (Krajnc und Glavié 2003). Wir stützen uns daher auf die ersten Ergebnisse einer experimentellen Fallstudie, die an einem kommerziellen Teegarten mit einigen ausgewählten Nachhaltigkeitsmaßnahmen durchgeführt wurde.

Die Beiträge des Papiers sind wie folgt: Erstens ergänzt das Papier die wachsende Zahl von Nachhaltigkeitsbewertungsliteratur (siehe Hamilton und Atkinson 2006; Boggia und Cortina 2010; Escrig-Olmedo et al. 2017; Krajnc und Glavié 2003), indem sie sich speziell auf Öko-Innovationen konzentrieren. Dabei werden in diesem Papier Wirtschafts- und Umweltindikatoren und bis zu einem gewissen Grad einige soziale Indikatoren zur Bewertung der Auswirkungen von Öko-Innovationen entwickelt. Die Integration ökologischer, sozialer und wirtschaftlicher Aspekte ist sehr nützlich, um die Innovationsforschung auf die nachhaltige Entwicklung auszudehnen (Rennings 2000). Zweitens hebt der interdisziplinäre Charakter dieser Studie die Vorteile für die Plantagenlandwirtschaft und die Rechnungslegungsdisziplinen (allgemeiner als Betriebswirtschaftslehre) hervor. Diese Öko-Innovation basiert auf den Prinzipien und dem Verhalten der Pflanzenphysiologie und zielte in erster Linie auf Produktivitätsverbesserungen ab, um wirtschaftliche Gewinne abzuleiten, führte aber letztlich zu Umweltvorteilen als Nebenprodukt (Horbach et al. 2012; Organisation für wirtschaftliche Zusammenarbeit und Entwicklung (OECD) 2009; Carrillo-Hermosilla et al. 2010). Daher liefert diese Studie Belege für die schlanke grüne Beziehung aus der Landwirtschaft. Aus Sicht der Plantagenlandwirtschaft zeigt diese Studie, wie "nicht-technische"Footnote2eco-Innovationen genutzt werden können, um ihre Umweltauswirkungen zu reduzieren und gleichzeitig wirtschaftliche Vorteile zu erzielen. Dies ist besonders wichtig, da es in dieser Branche an Innovation mangelt (Ariza et al. 2013; Berdegue und Escobar 2002; Diederen et al. 2003). Diese Art von Innovationen erfordern keine fortschrittliche Technologie oder große Mengen an Kapitalinvestitionen. Sie hat daher das Potenzial, das Produktivitätsniveau im Sektor der

landwirtschaftlichen Plantagen unabhängig vom Entwicklungsstand und den Wachstumsbedingungen zu fördern. Der Umfang der Vorteile wird jedoch je nach den örtlichen Umweltbedingungen variieren. Da die meisten Tee produzierenden Länder Entwicklungsländer mit geringen technologischen Entwicklungs- und Investitionsengpässen sind, haben diese Arten von Öko-Innovationen das Potenzial, die Produktivität leicht zu verbessern (Feder et al. 1985; Ongong und Ochieng 2013; Pretty et al. 2003). Da die Plantagenindustrie in diesen Volkswirtschaften eine bedeutende wirtschaftliche Rolle in Bezug auf Deviseneinnahmen und die Schaffung von Arbeitsplätzen spielt, ist die Anwendung und anschließende Bewertung von Öko-Innovationen angesichts des starken Drucks auf eine bessere Produktivität und eine effiziente Ressourcennutzung bei der Erreichung einer nachhaltigen Entwicklung von größter Bedeutung. Für die Buchhaltungsdisziplin erweitert diese Studie die Anwendung von Umwelt- und Nachhaltigkeitsmanagement-Buchhaltung (EMA)Footnote3 über Branchen wie das verarbeitende Gewerbe oder den Dienstleistungssektor, in denen sie häufig verwendet wird. Daher zeigt es die Nutzbarkeit der EMA in einem breiten Spektrum von Branchen, sofern die geeigneten Indikatoren und Mechanismen verwendet werden, um Informationen für die Interessenträger bereitzustellen.

Der Rest des Papiers ist wie folgt organisiert: Im nächsten Abschnitt wird das Konzept der Öko-Innovation und ihre Bewertung durch Nachhaltigkeitsindikatoren vorgestellt. Abschnitt 3 gibt einen Überblick über die Teeindustrie, gefolgt von Abschnitt 4 über die in der Fallstudie angewandte Methode. In den Abschnitten fünf und sechs werden die Analysen bzw. Diskussionen der Studie dargestellt. Der letzte Abschnitt enthält die Schlussfolgerungen und Richtungen für weitere Forschungsarbeiten.

SCHLUSSFOLGERUNG

Ziel dieser Fallstudie war es, durch eine experimentelle Fallstudie in der landwirtschaftlichen Plantagenindustrie einen Beitrag zum Wissen über die Bewertung von Öko-Innovationen zu leisten. Innovationen, die hauptsächlich auf die Steigerung wirtschaftlicher Gewinne abzielen, können unbeabsichtigte Auswirkungen auf die Umwelt haben. Die Bewertung der Auswirkungen dieser Öko-Innovationen ist jedoch die Herausforderung. Da aufgrund der unterentwickelten theoretischen und methodischen Ansätze, um diese Vorteile zu analysieren (Rennings 2000; Peiris und Gunarathne, 2015), die Studie verwendet die Dreifach-Gewinn-Ansatz. Dabei wurden physische und monetäre Nachhaltigkeitsinformationen (Burritt et al. 2002, International Federation of Accountants (IFAC) 2005) verwendet, um diese Auswirkungen zu quantifizieren. Dennoch gibt es viele potenzielle Auswirkungen, die in diesem Papier nicht erfasst wurden. Erst wenn man diese Auswirkungen berücksichtigt, kann der volle Nutzen von Öko-Innovationen bewertet werden. Diese Fallstudie zeigt, wie schwierig es ist, einen standardisierten Satz von Indikatoren zu haben, um die Auswirkungen von Öko-Innovationen aufgrund der Multidimensionalität der Nachhaltigkeit zu messen. Darüber hinaus betont diese Fallstudie, dass die Probleme im Zusammenhang mit der Messung der Nachhaltigkeit auch bei der Bewertung von Öko-Innovationen gemeinsam sind. Daher ist es notwendig, Nachhaltigkeitsindikatoren weiterzuentwickeln, um branchen- und brancheninterne Vergleiche der Öko-Innovationen sinnvoll zu machen. Der Weg nach vorn wäre die Annahme umfassender Nachhaltigkeitsindikatoren, die die Gesamtheit des Systems darstellen und gleichzeitig die langfristigen Auswirkungen erfassen.

Die Ergebnisse dieser Fallstudie können mehrere Einschränkungen haben. Da die Studie in einem bestimmten Teefeld mit spezifischen Merkmalen durchgeführt wurde, ist es notwendig, die Studie unter verschiedenen Bedingungen und für verschiedene Arten von mehrjährigen Kulturen zu replizieren. Diese Studie stellt nur die Ergebnisse dieser Studie über 14 Monate vor. Im Sektor der landwirtschaftlichen Plantagen gibt es jedoch langfristige Auswirkungen auf eine Vielzahl von Aspekten. Dies führt zu der Notwendigkeit, die Vorteile oder Auswirkungen über längere Zeiträume zu identifizieren. In dieser Studie wurden einige der umfassenderen Vorteile und/oder verschiedenen Aspekte aufgrund verschiedener praktischer Schwierigkeiten nicht gemessen. Zum Beispiel haben viele Gelehrte die Aufmerksamkeit auf die Qualität des Tees nach dem Schnitt gelenkt (siehe Grice 1985; Owuor et al. 1990; Ravichandran 2004; Ravichandran und Parthiban 1998b). Die Studie beachtete jedoch einige der Parameter nicht, da der Zweck

dieses Papiers darin bestand, die ersten Ergebnisse des Experiments zu präsentieren. Daher wäre es notwendig, diese Aspekte in zukünftigen Studien zu untersuchen.

TRANSLATED VERSION: PORTUGUESE

Below is a rough translation of the insights presented above. This was done to give a general understanding of the ideas presented in the paper. Please excuse any grammatical mistakes and do not hold the original authors responsible for these mistakes.

VERSÃO TRADUZIDA: PORTUGUÊS

Aqui está uma tradução aproximada das ideias acima apresentadas. Isto foi feito para dar uma compreensão geral das ideias apresentadas no documento. Por favor, desculpe todos os erros gramaticais e não responsacule os autores originais responsáveis por estes erros.

INTRODUÇÃO

A recente expansão da atividade económica tem sido acompanhada por crescentes preocupações ambientais e sociais globais (Organização para a Cooperação e Desenvolvimento Económico (OCDE) 2009. Ao mesmo tempo que representam muitos desafios, também oferecem oportunidades para as empresas se envolverem em práticas de sustentabilidade e transformarem os seus negócios de modo a contribuir para o desenvolvimento sustentável (Schaltegger et al. 2017). Neste contexto, a inovação está a tornar-se cada vez mais um importante veículo de apoio ao desenvolvimento da gestão da sustentabilidade das empresas como meio de sobrevivência e crescimento (Han et al. 1998; Schaltegger et al. 2017). Assim, os processos de inovação destinados ao desenvolvimento sustentável (eco-inovações) têm recebido cada vez mais atenção nos últimos anos (Bossle et al. 2016; Marin e Lotti 2017; Provasnek et al. 2017). Na prossecução de iniciativas de sustentabilidade, incluindo as eco-inovações, a primeira questão a abordar é a sua avaliação (Keeble et al. 2003). Uma vez que a sustentabilidade é um conceito multidimensional, a sua medição deve considerar e integrar aspetos económicos, sociais e ambientais (Papa et al. 2004). O desempenho da sustentabilidade é uma construção e, portanto, não pode ser observado; deve, portanto, ser ancorado numa realidade observável através de indicadores (Escrig-Olmedo et al. 2017). Além disso, a medida de sustentabilidade depende em grande medida dos indicadores utilizados (Boggia e Cortina 2010). Da mesma forma, a informação desempenha um papel fundamental no processo de criação e difusão de inovações de sustentabilidade (Schaltegger et al. 2017). Devem existir mecanismos para avaliar a eficácia das eco-inovações a partir das perspetivas económicas, sociais e ambientais. Ou seja, deve haver um acompanhamento, medição e avaliações adequados relativamente aos progressos no sentido dos objetivos de sustentabilidade (Sroufe et al. 2002). No entanto, a avaliação do impacto das eco-inovações ainda não está adequadamente desenvolvida em indústrias como a agricultura de plantaçãofootnote1, ao contrário do que acontece no sector manufatureiro (Ariza et al. 2013). As inovações no sector agrícola são importantes porque a diminuição da disponibilidade e o aumento do custo dos terrenos, da mão de obra, da água e da energia colocam muitos desafios à indústria (Programa das Nações Unidas para o Ambiente (PNUA) 2008. Com o crescimento constante da população, há pressão para aumentar os rendimentos agrícolas, o que muitas vezes significa a utilização de fatores de produção sintéticos que não são amigos do ambiente, como os pesticidas ou questionáveis, como as culturas geneticamente modificadas. Para responder a estes crescentes desafios ambientais e de sustentabilidade, a indústria agrícola ainda não usou a inovação como ferramenta (Negny et al. 2012; Berdegue e Escobar 2002; Diederen et al. 2003). Este estudo de caso apresenta uma abordagem para melhorar o rendimento, ao mesmo tempo que é verde e como medir essas melhorias na indústria agrícola. Como tal, o documento apresenta como os indicadores de sustentabilidade podem ser utilizados para medir os efeitos das eco-inovações a partir de perspetivas económicas, ambientais e sociais no sector da plantação de chá do Sri Lanka. A literatura geralmente recomenda que uma empresa comece com medidas simples e fáceis de implementar de eficiência de recursos antes de passar para

indicadores mais complexos (Krajnc e Glavič 2003). Por isso, baseamos este trabalho nos resultados iniciais de um estudo experimental de caso realizado num jardim de chá comercial utilizando algumas medidas de sustentabilidade selecionadas.

As contribuições do trabalho são as seguintes: Em primeiro lugar, o artigo acrescenta ao crescente corpo da literatura de avaliação da sustentabilidade (ver Hamilton e Atkinson 2006; Boggia e Cortina 2010; Escrig-Olmedo et al. 2017; Krajnc e Glavič 2003) focando-se especificamente nas eco-inovações. Ao fazê-lo, este trabalho desenvolve indicadores económicos e ambientais e, em certa medida, alguns indicadores sociais para avaliar o impacto das eco-inovações. A integração de aspetos ecológicos, sociais e económicos é muito útil para alargar a investigação em inovação ao desenvolvimento sustentável (Rennings 2000). Em segundo lugar, o carácter interdisciplinar deste estudo põe em evidência os benefícios para a indústria agrícola de plantação e para as disciplinas de contabilidade (mais amplamente, gestão empresarial). Esta eco-inovação baseia-se nos princípios e no comportamento da fisiologia vegetal e visou principalmente melhorar a produtividade para obter ganhos económicos, mas acabou por resultar em benefícios ambientais como subproduto (Horbach et al. 2012; Organização para a Cooperação e Desenvolvimento Económico (OCDE) 2009; Carrillo-Hermosilla et al. 2010). Por conseguinte, este estudo fornece provas sobre a relação verde-magra da indústria agrícola. Do ponto de vista da indústria agrícola da plantação, este estudo mostra como as inovações "não técnicas" Footnote2eco-innovations podem ser usadas para reduzir o seu impacto ambiental, ao mesmo tempo que conseguem benefícios económicos. Isto é particularmente importante, uma vez que falta inovação nesta indústria (Ariza et al. 2013; Berdegue e Escobar 2002; Diederen et al. 2003). Este tipo de inovações não requerem tecnologia avançada ou grandes quantidades de investimento de capital. Por conseguinte, tem o potencial de fomentar os níveis de produtividade no sector das plantações agrícolas, independentemente do grau de desenvolvimento e das condições de crescimento. No entanto, a magnitude dos benefícios variará em função das condições ambientais locais. Uma vez que a maioria dos países produtores de chá são países em desenvolvimento com baixos níveis de desenvolvimento tecnológico e restrições de investimento de capital, estes tipos de eco-inovações têm o potencial de melhorar facilmente a produtividade (Feder et al. 1985; Ongong e Ochieng 2013; Pretty et al. 2003). Uma vez que a indústria da plantação desempenha um papel económico significativo nestas economias em termos de ganhos cambiais e de geração de emprego, a aplicação e a subsequente avaliação da eco-inovação são de importância primordial face a uma intensa pressão para uma melhor produtividade e uma utilização eficiente dos recursos para alcançar um desenvolvimento sustentável. Para a disciplina contabilística, este estudo alarga a aplicação da contabilidade de gestão ambiental e de sustentabilidade (EMA)Footnote3 para além de indústrias como a indústria transformadora ou o serviço onde é comumente utilizado. Por conseguinte, mostra a utilização da EMA num vasto leque de indústrias, desde que sejam utilizados os indicadores e mecanismos adequados para fornecer informações às partes interessadas.

O resto do trabalho é organizado da seguinte forma: A próxima secção apresenta o conceito de eco-inovação e a sua avaliação através de indicadores de sustentabilidade. A secção três fornece uma visão geral da indústria do chá, seguida da secção 4 sobre o método adotado no estudo de caso. As secções cinco e seis apresentam a análise e discussão do estudo, respectivamente. A última secção fornece as conclusões e as direções para uma investigação mais aprofundada.

CONCLUSÃO

O objetivo deste estudo de caso era contribuir para o corpo do conhecimento sobre a avaliação das eco-inovações através da realização de um estudo experimental de caso na indústria das plantações agrícolas. As inovações destinadas principalmente a melhorar os ganhos económicos podem ter um impacto acidental no ambiente. No entanto, a avaliação do impacto destas eco-inovações é o desafio. Desde as abordagens teóricas e metodológicas subdesenvolvidas para analisar estes benefícios (Rennings 2000; Peiris e Gunarathne, 2015), o estudo usou a abordagem tripla da linha de fundo. Ao fazê-lo, foram utilizadas informações sobre sustentabilidade física e monetária (Burritt et al. 2002, Federação Internacional de Contabilistas (IFAC) 2005) para quantificar estes impactos. No entanto, há muitos impactos potenciais que não foram capturados no presente artigo. Só quando estes impactos são considerados é que se pode avaliar

o pleno benefício das eco-inovações. Este estudo de caso revela a dificuldade em ter um conjunto de indicadores padronizados para medir o impacto das eco-inovações devido à multidimensionalidade da sustentabilidade. Além disso, este estudo de caso sublinha que os problemas associados à medição da sustentabilidade são comuns também à avaliação das eco-inovações. Por conseguinte, é necessário um desenvolvimento mais aprofundado dos indicadores de sustentabilidade para tornar significativas as comparações inter-indústria e intra-indústria das eco-inovações. O caminho a seguir seria adotar amplos indicadores de sustentabilidade que representem a totalidade do sistema, capturando simultaneos os impactos a longo prazo.

As conclusões deste estudo de caso podem ter várias limitações. Uma vez que o estudo foi realizado num determinado campo de chá com características específicas, é necessário replicar o estudo em diferentes condições e para diferentes tipos de culturas perenes. Este estudo apresenta apenas os resultados deste estudo que abrange 14 meses. No entanto, no sector das plantações agrícolas, existem impactos a longo prazo em diversos aspetos. Isto cria a necessidade de identificar os benefícios ou impactos ao longo de períodos de tempo mais longos. Neste estudo, alguns dos benefícios mais amplos e/ou diferentes aspetos não foram medidos devido a várias dificuldades práticas. Por exemplo, muitos estudiosos chamaram a atenção para a qualidade do chá após a poda (ver Grice 1985; Owuor et al. 1990; Ravichandran 2004; Ravichandran e Parthiban 1998b). No entanto, o estudo não observou alguns dos parâmetros, uma vez que o objetivo deste trabalho era apresentar os primeiros resultados da experiência. Por conseguinte, seria necessário investigar estes aspetos em estudos futuros.