Received: 20 February 2022 | Revised: 23 March 2023 | Accepted: 4 May 2023

DOI: 10.1002/agr.21829

RESEARCH ARTICLE

Agribusiness An International Journal WILEY

Farmer–buyer relationships and sustainable agricultural practices in the food supply chain: The case of vegetables in Chile

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Funding information
Netherlands Organisation for Scientific Research, Grant/Award Number: W 08.250.304

Abstract

This study investigates how the relationship between farmers and buyers affects the adoption of sustainable agricultural practices (SAPs) in the vegetable sector in Chile. Specifically, we focus on the dyadic relationships between farmers and different types of buyers, including besides lead firms, intermediaries, and wholesalers, which have received little attention in the scientific literature. Our analysis focuses on formal and informal contracts as governance forms between farmers and buyers, and explores the correlation between contract provisions (e.g., quality, quantity, and the provision of services), relationship attributes (i.e., satisfaction, trust, and opportunism) and adoption of SAPs. We gathered survey data from 352 vegetable farmers in Chile and employed analysis of variance and logit modeling for our analysis. Our findings indicate that small-scale farmers primarily engage with intermediaries using informal contracts, while medium-scale farmers trade with wholesalers through spot markets,

Abbreviations: ANOVA, analysis of variance; FAO, Food and Agriculture Organization; GLOBAL GAP, Good Agricultural Practice; INDAP, Instituto de Desarrollo Agropecuario/Institute of Agricultural Development; INRAE, Institut national de recherche pour l'agriculture, l'alimentation et l'environment/National Research Institute for Agriculture, Food and the Enviornment; ODEPA, Oficina de Estudios y Políticas Agrarias/Office of Agrarian Studies and Policies; SAG, Servicio Agrícola y Ganadero/Agricultural and Livestock Service; SAP, sustainable agricultural practice; UTZ, Certification that is part of the Rainforest Alliance.

and large-scale farmers with lead firms using formal contracts. We also found that farmers who traded through informal contracts, mainly with intermediaries, reported greater satisfaction in the farmer-buyer relationship than farmers trading through formal contracts. However, farmers engaging in informal contracts were less likely to adopt SAPs than farmers trading through formal contracts. Our results suggest that the governance form (contracts or spot market) adopted for the relationship between farmers and buyers influences the adoption of SAPs, while the impact of relationship attributes on SAP adoption is less clear. A deeper understanding of buyers and their relationship with farmers is essential to enhance policies encouraging SAP adoption in regional and local fresh food supply chains. [EconLit Citations: Q13, Q15, Q56].

KEYWORDS

Chile, contract elements, governance forms, relationship attributes, sustainable agricultural practices, vegetable supply chain

1 | INTRODUCTION

Scholars have recognized farmer-buyer relationships as essential for the transformation of food systems[1] (Dlamini-Mazibuko et al., 2019; Lees et al., 2020). This transformation has been characterized by economic growth, globalization, specialization, and coordination between business partners (e.g., farmers, retailers, processors, and input suppliers) and has enabled a consistent supply of products that meet high safety and quality standards (Bellemare & Lim, 2018; Mergenthaler et al., 2009). This modernization process was initially driven primarily by business partners who began coordinating their food supply chains, incorporating effective communication methods to reduce risk, uncertainty, and transaction costs in order to achieve mutual benefits (Dlamini-Mazibuko et al., 2019; Lees et al., 2020; Reardon et al., 2009). However, food supply chains' growth and specialization have also had negative impacts on the environment, such as soil degradation, water pollution, and deforestation (Rueda et al., 2017).

In the past few decades, awareness about strategies to help to reduce food supply chains' negative environmental impacts has increased. These strategies focus primarily on farmer-buyer relationships in which farmers are incentivized to implement production standards and certifications (e.g., organic certification, UTZ, rainforest alliance, and Global GAP), thereby facilitating their access to premium markets (Grabs & Carodenuto, 2021; Navarrete et al., 2020; Vanderhaegen et al., 2018). In fresh food supply chains, support strategies predominantly focus on farmers adopting specific sustainable agricultural practices (SAPs)[2] (e.g., organic fertilizers, integrated pest management and crop management) (De Marchi et al., 2019; Thomson et al., 2020).

[1]Food systems are perceived as the interaction of farmers with upstream and downstream value chains, linking input suppliers (i.e., R&D agricultural industries), wholesalers, processors, retailers, and consumers (Reardon et al., 2019).

[2]SAPs imply that "agriculture will have to be carried out to make the best use of available natural resources and inputs, and regenerate conditions for future production" (Leeuwis, 2004, p. 5).

Scholars have studied the adoption of SAPs from different perspectives, including a supply chain perspective. Supply chain research has mainly focused on the role of lead firms[3] and the governance forms used to coordinate with farmers to support their adoption of SAPs (Achabou et al., 2017; Freidberg, 2020). To successfully support this, lead firms implement hybrid governance forms (e.g., formal contracts) and promote close relationships with farmers by, for instance, building trust and creating mutual benefits (Dubbert et al., 2021; Freidberg, 2020; Touboulic et al., 2021; Veldwisch & Woodhouse, 2022). Thus, the literature has analyzed how contractual provisions (e.g., quality, price and payment schemes) and relationship attributes (e.g., trust and satisfaction) between farmers and lead firms can help farmers to adopt SAPs (Gualandris & Kalchschmidt, 2016). Thus far, however, scholars have paid limited attention to relations between farmers and other types of buyers (e.g., intermediaries and wholesalers) and even less attention to how these relationships with other buyers affect SAP adoption (Grabs & Carodenuto, 2021; Thorlakson, 2018).

The majority of farmers in developing and emerging economies work with intermediaries or wholesalers rather than with lead firms (Guarín, 2013; Mariyono et al., 2020), and only a limited number of farmers use SAPs (Calderon et al., 2022; Elgueta et al., 2020). Information is thus lacking on the relationships that farmers establish with other buyers and their SAP adoption. The vegetable production chain in Chile is one example of a supply chain where most produce is sold to other buyers rather than to lead firms and where negative environmental impacts are a significant problem. The majority of vegetable production in Chile is destined for the national market and only a small portion to export (ODEPA, 2020a; Schwartz et al., 2013), indicating less attention to (international) safety and sustainability standards. The Chilean vegetable market is characterized by different types of buyers such as intermediaries, wholesalers, and lead firms (the latter including supermarkets and agro-industries) (ODEPA, 2020a; Schwartz et al., 2013). This diversity of buyers provides a good opportunity to study how farmer-buyer governance forms and relationship attributes relate to SAP adoption and to find indications on how to improve SAP adoption amongst these farmers.

In our study we address the knowledge gaps on the role that key buyers (i.e., intermediaries, wholesalers, and lead firms) play related to SAP adoption by farmers in the vegetable sector in Chile. We explore how different farmer-buyer relationships are linked to different levels of SAP adoption. Specifically, this study aims to examine: (i) which farmer characteristics are related to each type of buyer; (ii) the type of governance form (spot market, informal contract, or formal contract) related to each type of buyer; and (iii) how contract forms (formal or informal) relate to specific contract provisions (e.g., quality, quantity and the provision of services), relationship attributes (i.e., satisfaction, trust, and opportunism) and different levels of SAP adoption by farmers. This study thus seeks to contribute to the literature by exploring different types of buyers, their relationships with farmers and SAP adoption. Moreover, beyond the case of Chile, this study aims to provide valuable insights to further SAP adoption in fresh food supply chains.

This paper is structured as follows. In Section 2, we present our theoretical framework and the literature on SAP adoption levels. In Section 3, we present an overview of the vegetable sector in Chile. In Section 4, we present our data collection process and the types of analyses carried out (e.g., analysis of variance [ANOVA] and logit model). In Section 5, we present our results and discuss the implications of the different farmer-buyer relationships and their different levels of SAP adoption in the vegetable sector in Chile. In Section 6, we present the conclusions of our study, discuss its limitations and present recommendations for future research.

2 | THEORETICAL FRAMEWORK

Studies in food supply chain literature show that lead firms support the adoption of SAPs only when they have formal contracts and close relationships with farmers (Freidberg, 2020; Lemma et al., 2020; Navarrete et al., 2020). In the case of the banana supply chain in Ethiopia, for example, Lemma et al. (2020) found that one way for a supply

[3]In buyer-driven chains, lead firms are "retailers or marketers of the final products that exert the most power through their ability to shape mass consumption via strong brand names" (Gereffi, 2011, p. 40).

chain to respond to sustainability requirements is through coordination between farmers and buyers. This coordination involves aligning several activities such as production, processing, and marketing. However, coordination works better if farmers and buyers maintain close ties and sustainable business relationships based on long-lasting, stable, and mutual advantages. Studies have found that lead firms trade with farmers through formal contracts (Bush et al., 2015; Freidberg, 2020; Ghadimi et al., 2016), in which contractual provisions require farmers to adopt SAPs (e.g., the intensity and types of inputs used) (Dubbert et al., 2021; Ghadimi et al., 2016; Thomson et al., 2020). However, Touboulic et al. (2021) stress that the pressure to adopt SAPs is effective only when there is a close, mutually trustworthy relationship between the lead firm and the farmer. A close relationship between the two is reflected in behavior that maintains or improves the strength of the relationship (Autry & Golicic, 2010; Tangpong et al., 2015).

Figure 1 depicts our study's theoretical framework. This is followed by an in-depth discussion of the types of buyers and the elements of this framework, exploring contractual provisions and relationship attributes and how these may relate to SAP adoption. In the next sections we will further explain the elements of our framework.

2.1 | Types of buyers

Different types of buyers operate in the vegetable supply chain in Chile. However, the largest quantities of vegetables are traded through three main types (apart from final consumers) as mentioned above: intermediaries, wholesalers, and lead firms (Gaitán-Cremaschi et al., 2020; ODEPA, 2020b; Schwartz et al., 2013). *Intermediaries* are familiar with their rural territory and operate at the local level. They buy small quantities of products from small-scale farmers at their farms. Intermediaries typically have verbal (informal) contracts and closer relationships with farmers. Moreover, they pay immediately in cash, based on the quality and quantity provided, and they occasionally use their own human resources to support harvesting. Intermediaries operate as merchants in street markets or

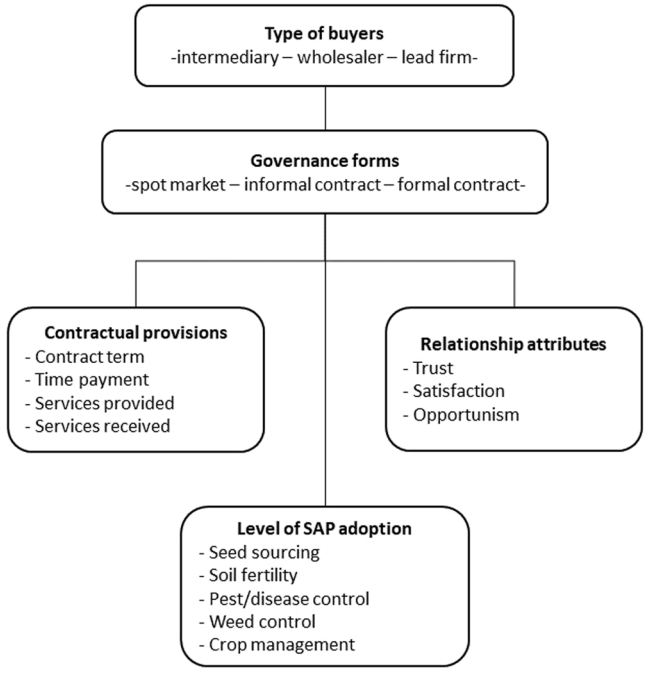

FIGURE 1 Theoretical framework.

farmers' markets (Gaitán-Cremaschi et al., 2020; ODEPA, 2020b; Schwartz et al., 2013). By contrast, *wholesalers* operate at the regional and national levels. They often have a fixed space in urban, public wholesale markets (Alam, 2018). They buy large quantities of products, and the terms of the transactions are basic, focused mainly on four attributes: price, size, color, and firmness. At times, wholesalers also specialize by product category. Usually, they buy from small to medium-scale farmers. Wholesalers do not have close relationships with individual farmers, and all their transactions take place in cash. They resell the products in wholesale markets in other regions or to lead firms (Balsevich et al., 2003; Gaitán-Cremaschi et al., 2020; ODEPA, 2020b; Schwartz et al., 2013). Lastly, *lead firms* include supermarkets and agro-industries. These generally operate through formal contracts to trade with medium to large-scale farmers. The terms of these contracts can be divided into two: quality and logistics. In relation to quality standards, lead firms can set the requirements according to international or national standards, including norms such as safety (usually, regarding SAPs and maximum residue levels of pesticides), size, color, shape, and level of damage. Regarding logistics, lead firms set requirements such as volume, frequency of delivery, fixed prices by month or year, payments in 30–90 days and fees for shelf placement (in the case of supermarkets). Lead firms have the infrastructure to process and store products, as well as the economic and human resources to support the entire supply chain and its processes (Gaitán-Cremaschi et al., 2020; ODEPA, 2020b; Schwartz et al., 2013).

2.2 | Governance forms

Governance forms represent different levels of integration and can range from spot markets and hybrid governance forms (e.g., contracts) to full vertical integration (i.e., intra-firm transactions) (Bellemare & Lim, 2018; Trienekens, 2011). However, the most common agricultural governance form in fresh food supply chains in developing countries is characterized by spot market transactions (e.g., farmers' or wholesale markets) and informal (verbal) contracts, while only a small portion of transactions are through formal (written) contracts (Keco et al., 2019).

Spot markets define the price of a product as a function of supply and demand, all in an environment of uncertainty with low specificity (e.g., quality and safety) and where the identity of the buyer is unknown (Mugwagwa et al., 2020; Prowse, 2012). Contracts emerge to avoid the uncertainties of spot market transactions and are defined as verbal or written commitments to provide an agricultural product under pre-agreed terms and conditions (e.g., price, quantity, and quality) (Bijman, 2008; Singh, 2000). Contracts can be divided into formal (written) and informal (verbal), as mentioned, though both essentially perform the same function (Beninger & Shapiro, 2019; Veldwisch & Woodhouse, 2022). Farmers and buyers trading through contracts have economic as well as social incentives to stabilize their transaction relationships (Bijman, 2008; Escobal et al., 2015). Contracts are seen as a tool to reduce transaction costs resulting from uncertainty, risk, market imperfections, and coordination failures (Abebe et al., 2013). Moreover, a large body of literature suggests that contracts can stimulate economic development, higher yields, crop diversity, access to new technology, and the adoption of SAPs (Bellemare & Lim, 2018; Bijman, 2008; Meemken & Bellemare, 2020).

2.3 | Contractual provisions

Contractual provisions are seen as a way to stabilize contracts (Escobal et al., 2015). Since buyers and farmers are aware of each other's bargaining skills and opportunistic behavior, they only engage in business if contractual conditions are specified (Beninger & Shapiro, 2019). Contractual provisions may relate to volume, quality, price, payment mechanisms, delivery requirements, contract length, and SAP adoption and can vary greatly across types of contracts (Barrowclough et al., 2019; Bijman, 2008). For example, in dyadic relationships between lead firms and farmers, lead firms usually incentivize farmers to adopt SAPs through formal contracts in order for them to access premium markets (De Marchi et al., 2019; Freidberg, 2020). Lead firms identify the main environmental issues at the

farm and transform these into standards that are included in the formal contracts as contractual provisions, along with an offer of a premium price if farmers fulfil those standards (Bolwig et al., 2010; Ghadimi et al., 2016). In some cases, farmers must demonstrate their compliance with standards through third-party certifications (e.g., organic farming certifications). Moreover, on other occasions, lead firms adopt mentoring-driven approaches, providing farmers technical or financial support for the adoption of SAPs (De Marchi et al., 2019; ODEPA, 2020b).

2.4 | Relationship attributes

Scholars have measured the attributes of farmer-buyer relationships using different concepts, such as trust, commitment, satisfaction, dependence, and power (Lees et al., 2020). In general, these farmer-buyer relationships are measured through constructs that aim to reflect the overall strength and continuity of those relations (Lages et al., 2005; Lees et al., 2020). One of the most common dimensions examined in the literature is trust (Lees et al., 2020). However, there is no consensus in the literature of what other dimensions "must" be measured alongside trust (Lees et al., 2020). In this study we will use trust (Gualandris & Kalchschmidt, 2016), satisfaction (Murphy & Sashi, 2018), and (non-)opportunistic behavior (Kang & Jindal, 2015; Touboulic et al., 2021) to measure the strength and continuity of farmer-buyer relationships.

"Trust" is a multidimensional construct and is defined as the belief that a business partner is both reliable and benevolent (Ganesan, 1994). "Reliable" is related to the belief that the partner has the necessary expertise to perform the corresponding activity both effectively and reliably (Ganesan, 1994). "Benevolent" refers to the confidence that the partner has good intentions and will not act only out of self-interest (Ganesan, 1994). Trust is viewed as a unique governance mechanism that promotes the voluntary exchange of assets and services between partners (Uzzi, 1996). It is associated with long-term relationships, reduced perceived risk, and reduced transaction costs (Batt et al., 2006). However, some factors such as coercive behavior, cultural dissimilarity, opportunism, and a lack of cooperation can threaten trusting relationships between business partners (Ali, 2021).

"Satisfaction" represents a summary of psychological states (e.g., rewarding, profitable, problematic, and frustrating) that rate the relationship experience (Lees, 2017). Through this lens, satisfaction can be defined as a positive affective state that emerges from the overall relationship with a business partner (Gorton et al., 2015). According to Geyskens et al. (1999), satisfaction encapsulates economic aspects of the business relationship (a relationship is satisfactory when it achieves financial results) and noneconomic aspects (a relationship is satisfactory when interactions are fulfilling, gratifying, and easy). When business partners are satisfied with their previous transactions, repeat transactions are more likely to occur (Murphy & Sashi, 2018). Hence, satisfaction supports long-term relationships, loyalty, and reputation (Otto et al., 2020).

"Opportunism" is defined as "self-interest seeking with guile" (Williamson, 1979, p. 234). It is deliberate, selfish behavior based on information distortion and reneging on agreements (Jap & Anderson, 2003), leading to feelings of deception in the exchange partner (Kang & Jindal, 2015). Opportunistic behavior can be expressed in different ways, such as exaggerating one's difficulties, withholding efforts, and even outright lying, the aim being to not honor previous agreements (Kang & Jindal, 2015). Opportunism is common in business relationships, usually when there are asymmetrical power relations between partners and/or where less powerful partners may be vulnerable to opportunistic behavior (Handley et al., 2019; Nyaga et al., 2013). This type of behavior heightens the potential for conflict and reduces the business relationship's lifetime (Gorton et al., 2015; Kang & Jindal, 2015).

2.5 | Level of SAP adoption

SAPs refer to practices that "make the best use of available natural resources and inputs, and regenerate conditions for future production" (Leeuwis, 2004, p. 5). These practices involve substituting synthetic resources produced

out-farm (i.e., fertilizers, insecticides, and herbicides) for on-farm resources to achieve the effective and efficient short and long-term use of natural resources (Taylor et al., 1993). Some examples of SAPs include holistic pest management, crop rotations, green manure, and cover crops (Kleijn et al., 2019; Taylor et al., 1993). Therefore, if SAPs imply using more on-farm resources to fertilize soil and control pests and weeds, farms will be more sustainable. However, because SAPs include practices for different farming production stages, the farms' sustainability levels are not bimodal; rather, they range from "low sustainability" to "high unsustainability" (Taylor et al., 1993). To quantitively analyze farms' sustainability levels, the literature proposes multiple sustainability indicators (Bockstaller et al., 2008; Gómez-Limón & Sanchez-Fernandez, 2010; Rigby et al., 2001; Waas et al., 2014). Based on Rigby et al. (2001), we specifically measure the sustainability level of agricultural practices used by farmers. Rigby et al. (2001) measure SAPs by identifying five stages of vegetable production (i.e., seed source, soil, pest/disease control, weed control, and crop management) which encompass different agricultural practices, ranging from the use of traditional seeds, synthetic fertilizers, organic fertilizers, and green manure to wildflower strips, beetle banks, synthetic pesticides, organic herbicides, resistant varieties, intercropping, and crop rotation.

3 | CASE STUDY: THE VEGETABLE SECTOR IN CHILE

In Chile, vegetable production is one of the country's main agricultural activities. In 2020 vegetable production occupied 77,000 ha and encompassed 34,000 farmers, distributed all over the country (ODEPA, 2020a). The sector mostly includes small-scale farmers (less than 5 ha), with a much smaller number of large-scale farmers (exceeding 300 hectares). The largest concentration of vegetable production is in the central zone of Chile, in the regions of Valparaiso, Metropolitana, O'Higgins, and Maule. These regions encompass approximately 54,000 hectares of vegetable production and produce around 70% of all the country's vegetables (ODEPA, 2020a). The main vegetables produced are sweet corn (*choclo*), onions, lettuce, tomatoes, and beans.

Vegetable production in Chile is characterized by the intensive use of chemical inputs (e.g., fertilizers and pesticides) (Altieri & Rojas, 1999; David et al., 2000), which negatively affects the environment (e.g., soil erosion, biodiversity loss, and water pollution) (Riquelme-Garcés et al., 2013). Additionally, the use of inputs has negatively impacted human health in Chile, especially that of farmers exposed to pesticides and of consumers through the high levels of pesticide residues in vegetables (Corral et al., 2017). This is reflected in the low use of SAPs in vegetable production in Chile, where less than 1% of the vegetables sold in 2017 had an organic certificate (ODEPA, 2017) and only 1.4% of the farmers (circa 1,800 smallholders) self-recognized themselves as "agroecological." However, the latter group sells their products without any corresponding certificate (INDAP, 2017).

In Chile, vegetables are mostly sold through spot markets and informal contracts. These two channels share 80% of total production and mainly cater to local demand, where the principal buyers are wholesalers and intermediaries (Schwartz et al., 2013). Most spot market transactions and an important point of sale for wholesalers take place in the Santiago wholesale market in the capital city. Most informal contracts are concentrated in transactions at the farm level, where the main buyers are intermediaries (Boitano, 2011; Gaitán-Cremaschi et al., 2020; Schwartz et al., 2013). On the other hand, formal contracts with supermarkets and agro-industries have a 20% market share and meet local and international demand (Gaitán-Cremaschi et al., 2020; Lakner et al., 2017; Schwartz et al., 2013). However, not all the transactions with supermarkets and agro-industries are through formal contracts, and a small percentage (4%) is carried out via informal contracts (ODEPA, 2020b). Chile's Office of Agrarian Studies and Policies (ODEPA) (2020b) found that the use of formal contracts by supermarkets and agro-industries depends on the firms' strategies (supply and demand) and crop types. Some crops are mainly acquired through formal contracts (e.g., tomatoes, chili peppers, celery, and broccoli); others are mainly acquired in spot markets (e.g., garlic, basil, sweet potatoes, and mushrooms); and others are acquired through formal contracts and spot markets (e.g., artichokes, onions, asparagus, and peas).

4 | METHODS

4.1 | Data collection

We collected the data for our study by conducting face-to-face surveys amongst 352 vegetable farmers in Chile. Each interview with farmer holders lasted 30–40 min. We conducted all our fieldwork in Chile's official language, Spanish. We visited most farmers in the field and at their homes, visiting approximately 5% at fairs. We selected these farmers randomly from contact lists provided by two main sources: organic organizations and private extension agricultural services[4] (the latter included conventional and organic farmers). Most of the farmers surveyed were identified from the contact lists (70%), and the others were approached through snowball sampling (30%). During the day-to-day interview practices, we used snowball sampling to complement the contact lists and achieve a sufficient number of observations per day. We asked farmers to recommend other farmers who mainly produce vegetables and who might also be willing to participate in the survey. The rule used for this snowball sampling was that farmers had to be at least one kilometer away from the farmer who suggested the new respondent.

The lead author and two enumerators were responsible for carrying out the surveys. On average, each enumerator conducted between two and three surveys per day. Farmers were contacted by phone to schedule an appointment for the survey. Hence, the fieldwork was mainly executed according to farmers' predisposition and availability to participate in the survey. We implemented the survey from October 2018 to April 2019 in four regions in Chile: Valparaiso, Metropolitana, O'Higgins, and Maule (Figure 2). Our sample is illustrative for the regions with the highest concentration of vegetable production in Chile, but not for other regions due to the differences in agroecological and socioeconomic conditions. Moreover, although our sample is not statistically representative of the population in Chile's central region, our descriptive statistics related to age, gender, and land, amongst others, match the results of previous studies on the vegetable sector in the central region of Chile (Boza et al., 2019).

The survey gathered information on six categories of data (for details, see Table 1): (1) type of buyers; (2) farmer characteristics; (3) governance forms; (4) relationship attributes; (5) contractual provisions; and (6) levels of SAP adoption. We identified the different types of buyers (intermediaries, wholesalers, and lead firms) from a literature review of studies carried out in Chile (Gaitán-Cremaschi et al., 2020; ODEPA, 2020b; Schwartz et al., 2013). The type of buyer refers to farmers' main buyers, that is, the buyer who purchases the largest quantity of products from the farmer. Farmer characteristics include information related to their capital, education, and gender, amongst other traits (Leite et al., 2014), information about the link that farmers have with other individuals or other organizations (e.g., beneficiary of the Institute of Agricultural Development-INDAP and membership in farmers' organizations) (Jara-Rojas et al., 2012), and whether farmers possess any organic certifications (Baumgart-Getz et al., 2012). Governance forms include the type of governance between farmers and main buyers: spot market, informal contract or formal contract (Trienekens, 2011). Relationship attributes refer to the three terms used to measure relationships: trust, satisfaction, and opportunism. We measured these three terms based on the farmers' perspective of the relationships with their buyers. For this, we used a Likert scale to qualify statements, ranging from 1 (*Totally disagree*) to 7 (*Totally agree*). The statements in the questionnaire were derived from a literature review of papers measuring the same terms in other contexts, for example, the fruit sector in Australia (Batt, 2003) and the vegetable sector in the Philippines (Batt et al., 2006). Contractual provisions refer to the agreed-on conditions or standards that are included in the contracts and that the farmers/buyers must comply with (e.g., price, volume and quality) and to other services that are provided or delivered but are not explicitly included in the contract, for example, transportation to points of sales (Bijman, 2008; Elder, 2016; Kersting & Wollni, 2012). Levels of SAP adoption refer to the sustainability levels of farmers' agricultural practices. We base our measurement on Rigby et al.'s work (2001) which allows comparing diverse agricultural practices across four sustainability

[4]The names of the organizations and extension agricultural services cannot be mentioned due to guarantees provided regarding the protection of personal data and anonymity.

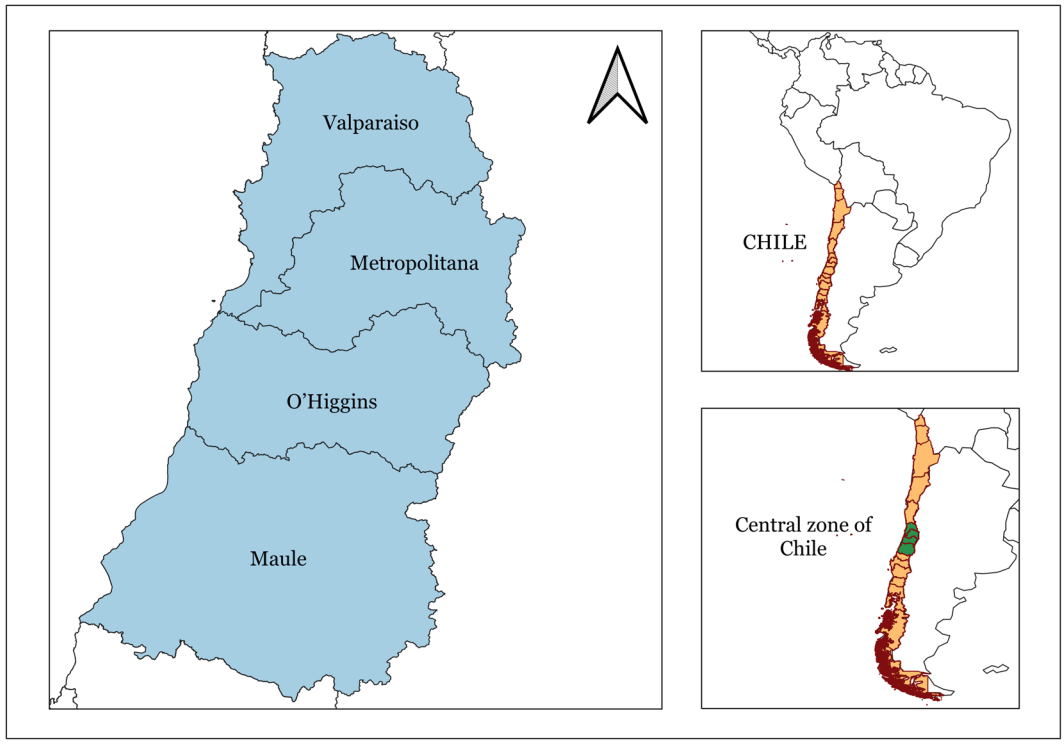

FIGURE 2 Research area.

dimensions. Agricultural practices cover five production stages as mentioned above (seed sourcing, soil fertility, pest/disease control, weed control, and crop management). The four sustainability dimensions are: the minimization of off-farm inputs; the minimization of nonrenewable inputs; the maximization of natural biological processes; and the promotion of local biodiversity. We scored each agricultural practice according to each sustainability dimension, obtaining a sustainability level score per stage. These scores can vary from −3 to +3, where ±3 indicates a strong negative/positive impact; ±2 indicates a medium negative/positive impact; ±1 is a moderate negative/positive impact; and a 0 implies no significant impact. The complete procedure for measuring the sustainability level is detailed in Benitez-Altuna et al. (2021).

4.2 | Description of farmers according to type of buyer

To describe the farmers according to each type of buyer, we tested whether the farmers' characteristics, governance forms, relationship attributes, and sustainability levels of their agricultural practices presented significant statistical differences in terms of types of buyers (i.e., intermediary, wholesaler, and lead firm). For this, we separated the variables into two groups, namely, continuous, and categorical variables. For each continuous variable we performed a nonparametric Kruskal–Wallis test (also known as a "one-way ANOVA on ranks") and a Dunn test. The Kruskal–Wallis test allows to identify if there is a significant relationship between the variable and one or more types of buyer. The significant relationship exists if the variable presents a p value less than 0.05. To identify with which type of buyer the tested variables had significant relationships, we conducted the Dunn test. For each categorical variable we performed a Pearson's χ^2 and Fisher's tests. These assess the independence between two categorical variables, in this case, the tested variables and the type of buyer. Specifically, these tests

TABLE 1 Variable description.

Category	Variable	Description	Unit
Type of buyers	Buyer-type	Who is your main buyer? Final consumer/ intermediary/wholesaler/lead firms (supermarkets and agroindustry)	4 categories
Farmers' characteristics	Age	Head of household's age	Years
	Experience	Head of household's years of experience in vegetable production	Years
	Gender	Head of household's gender	Female-male
	Education	Highest educational	7 categories
	Vegi-size (ha.)	Size of the land used for vegetable production	Hectares
	Tenure	What is the ownership status of your land? Rent/own/own + rent	3 categories
	Crop-variety	Farmers with only vegetable crops or farmers with vegetable and other crops	Yes-no
	Greenhouse	Use of greenhouse	Yes-no
	Assets	Number of assets: tractor, truck, pick-up, car and motorcycle	No. of assets
	Income-farm	Income from the farm	Percentage
	Income-total	Total monthly household income	8 categories
	INDAP	Household is beneficiary of INDAP[a]	Yes-no
	Member-Farm	The household head is a member of a farmer organization	Yes-no
	Member-Org	The household head is a member of a social organization	Yes-no
	Contacts	Number of people they can reach out to in case of an urgent problem on the farm	No. of contacts
	Type certification	Do you have one of the following organic certificates for the vegetables you produce? Participatory certification, third-party certification, certification in process, no organic certification	4 categories
Governance forms	Governance	Which type of contract do you have with your main buyer? spot market/informal (verbal) contract/formal (written) contract	3 categories
Relationship attributes	Trust	- I trust my main buyer	Likert scale from 1 to 7[a]
		- My main buyer is always honest	Likert scale from 1 to 7
		- My main buyer considers my interests	Likert scale from 1 to 7
		- I believe in the information provided by my main buyer	Likert scale from 1 to 7

TABLE 1 (Continued)

Category	Variable	Description	Unit
	Satisfaction	- There is a good cooperation between my main buyer and myself	Likert scale from 1 to 7
		- My main buyer meets my expectations	Likert scale from 1 to 7
		- My main buyer is quick to handle complaints	Likert scale from 1 to 7
	Opportunism	- A deal with my main buyer is risky	Likert scale from 1 to 7
		- My main buyer acts opportunistically	Likert scale from 1 to 7
Contractual provisions	Contract term	What is the term of the contract (days)?	No. of days
	Payment	On average, how many days does it take your main buyer to pay you?	No. of days
	Contract provisions	How many clauses does the contract with your main buyer have? (e.g., quality, price, quantity, payment method, delivery frequency)	No. of clauses
	Out-service	Do you provide some kind of service (out of contract) to your main buyer (e.g., classification or packaging)?	No. of clauses
	In-service	Does your main buyer provide you with some kind of service (out of contract) (e.g., payment in advance, inputs or technical assistance)?	No. of clauses
Sustainability level of agricultural practices	Seed	Seed sourcing	Numerical index
	Soil	Soil fertility	Numerical index
	Pest	Pest/disease control	Numerical index
	Weed	Weed control	Numerical index
	Crop	Crop management	Numerical index

[a]The Institute of Agricultural Development (INDAP), within the Chilean Ministry of Agriculture provides assistance to family farmers (INDAP, 2020).

[b]Likert scale 1 = *totally disagree*; 7 = *totally agree*.

compare the probability of trading with each type of buyer with respect to the probability of the categorical variables occurring. A p-value less than 0.05 in the Pearson's χ^2 and Fisher's tests indicates that the distribution of the types of buyers is related to the categorical variable to which it is compared. However, these tests do not identify for which type of buyer each variable had individual importance.

4.3 | Logit model

Logistic regression is formulated to predict and explain a binary categorical variable. It is a commonly used methodology in which the probability of a binary dependent variable (in this case, informal or formal contract) is a

function of a set of explanatory independent variables such as trust and contract provisions. Logistic regression aims to identify the independent variables that impact membership in the governance forms category or to classify observations into the defined groups, namely, informal and formal contracts (Hair et al., 2014). Our analysis aimed to estimate the impact of contractual provisions, relationship attributes, and sustainability levels of agricultural practices on the probabilities of farmers and buyers using informal or formal contracts. We encoded the binary dependent variable with the values 1 (informal contract) and 0 (formal contract). The general model can be expressed as

$$p(\textit{informal contract}) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} \ldots \beta_n X_{ni})}}. \quad (1)$$

In this model, p is the probability that an individual responds to the first category (informal contract) of the dependent variable; while β_0, β_1, β_2, β_n are the vectors of estimated coefficients associated with the exogenous variables X_{1i}, X_{2i}, X_{ni},. The latter represents the responses of the i participant for each of the n independent variables that are part of contractual provisions, relationship attributes, and sustainability levels of agricultural practices, which may be either quantitative or qualitative. The coefficients for the independent variables are estimated using either the logit value (expressed in terms of logarithms) or the odd value (expressed in terms of exponentiated logarithms) as follows:

$$Logit_i = \ln\left(\frac{prob_{event}}{1 - prob_{event}}\right) = \beta_0 + \beta_1 X_{1i} + \cdots + \beta_n X_{ni} \quad (2)$$

or

$$Odds_i = \ln\left(\frac{prob_{event}}{1 - prob_{event}}\right) = e^{\beta_0 + \beta_1 X_{1i} + \cdots + \beta_n X_{ni}}. \quad (3)$$

Both model formulations are equivalent and reflect the direction and magnitude of the relationship, but they are interpreted differently. The direction of the relationship (positive or negative) reflects the changes in the dependent variable (informal or formal contract) associated with changes in the independent variable. In the case of logit values, a positive coefficient means that an increase in the independent variable is associated with an increase in the predicted probability (informal contract = 1). On the other hand, exponential coefficients do not have negative values. Therefore, exponentiated coefficients above 1.0 reflect a positive relationship, while values below 1.0 represent a negative one (Hair et al., 2014). The magnitude of the coefficients answers the question: How much will the estimated probability change for each unit change in the independent variable? In this case, logit values are less useful, because the unit logged odds is a unit of measure which is hard to understand, illustrating how much the probabilities change. On the other hand, exponentiated coefficients directly reflect the magnitude of the change. Their impact is multiplied for each unit of change in the independent variable. Moreover, the exponentiated coefficients are helpful in assessing an independent variable's impact and in calculating the magnitude of the effects (Hair et al., 2014).

5 | RESULTS AND DISCUSSION

The following section presents our results and a discussion of the variable categories in the order presented in the Methods section above. Regarding the *type of buyers* trading in the vegetable sector in Chile, Table 2 shows that 22% of the farmers' main buyers in the sample were final consumers, 40% were intermediaries, 25% were wholesalers, only 9% were lead firms and the remaining 4% represented farmers' organizations, restaurants, and specialized stores.

TABLE 2 Type of buyers.

Category	Variables	Mean
Type of buyers	Final consumer	22%
	Intermediaries	40%
	Wholesalers	25%
	Lead firms	9%
	Others	4%

Table 3 details the measurements in the different variable categories for farmers trading with each type of buyer, as well as the results of the test (ANOVA) on the statistical differences between these groups. Concerning *farmer characteristics*, we did not find much difference between their age (52 on average) and farming experience (29 years on average), although farmers trading with intermediaries seem slightly older and a bit more experienced. However, farmers trading with intermediaries have less financial capital, while most farmers are INDAP beneficiaries (76%) and members (50%) of other social organizations such as sports groups, water communities and neighborhood councils. In terms of farmers trading with lead firms, there are more women farmers (14%), and farmers in this group have higher education levels in general, with a score of 5, meaning that these farmers completed high school. They also have larger vegetable farms (15 ha.) and the highest percentage (65%) of land tenure. Moreover, farmers trading with lead firms grow a higher percentage (24%) of other crops than vegetables (e.g., fruits and cereals), they have a greater number of assets (3) (e.g., tractors, trucks, pick-ups, cars and motorcycles), higher total household income, with a score of 4, which corresponds to 1,120,000 Chilean pesos (±1300 USD) and more people (5) that they can reach out to in case of problems on the farm. Farmers trading with intermediaries present the highest percentage (1%) of those with organic participatory system certificates, while farmers trading with lead firms present the highest percentage (7%) with third-party organic certificates and the highest percentage (10%) currently transitioning to achieve organic certificates. Lastly, farmers trading with wholesalers present the highest percentage (96%) of farmers without organic certificates. Although the measured differences between farmers trading with wholesalers and those trading with intermediaries were small, we can deduce some illustrative characteristics of the two groups. Farmers supplying wholesalers often score somewhere in the middle between farmers supplying intermediaries and lead firms. For example, farmers trading with wholesalers are a little bit older, have slightly more experience and are more often INDAP beneficiaries compared to farmers supplying lead firms. On the other hand, farmers supplying wholesalers have slightly larger farms and more assets compared to farmers trading with intermediaries.

Regarding *governance forms*, we found that transactions between farmers and intermediaries take place primarily through informal or verbal contracts (78%). Farmers and wholesalers mainly trade through spot markets (89%), and farmers and lead firms mostly use formal or written contracts (79%). Our findings indicate that governance forms may be linked to key farmer characteristics. For example, as discussed above, our results show that farmers trading with lead firms are characterized by exploiting more land and that they are more likely to be women, have higher educational backgrounds, own and rent a higher percentage of land simultaneously, have a higher number of assets and higher household income. Taking one important indicator as an example, our data indicate that farmers trading with intermediaries can be categorized as small-scale farmers who primarily use informal contracts, while farmers trading with wholesalers are medium-scale, mainly using spot market transactions. By contrast, farmers trading with lead firms are large-scale and primarily enter into formal contracts.

Our findings support previous research which found that trading with lead firms is conditioned upon farmers' financial capital and networking. Kariuki and Loy (2016) found that trading with lead firms is sensitive to production scale and networking in the case of vegetable production in Kenya. Similarly, Abdul-Rahaman and Abdulai (2020) found that one factor that affects participation in informal or formal contracts in the case of rice production in

TABLE 3 Descriptive statistics and description of farmers according to type of buyer.

Category		Descriptive statistics			Description of farmers according to type of buyer			
Number of farmers	Variables	Min.	Mean	Max.	Intermediary (x) 142	Wholesaler (y) 89	Lead firm (z) 29	Comparison significance
Farmers' characteristics	Age	24	52.68	91	53.27	53.1	52	E
	Experience	1	29.07	78	31.99	29.93	27.86	E
	Gender (Female)		21%		7%	9%	14%	F
	Education	1	4.56	7	4.34	4.4	5.14	B
	Vegi-size (ha.)	0.01	10.23	600	4.48	6.08	15.03	BC
	Tenure							
	Rent		43%		50%	47%	34%	F
	Owner		44%		41%	36%	31%	F
	Owner + Rent		13%		9%	17%	34%	F
	Crop-variety (yes)		30%		18%	18%	24%	F
	Greenhouse (yes)		49%		51%	47%	48%	E
	Assets	0	1.87	5	1.77	2.19	2.76	BC
	Income-farm	0%	79%	100%	86%	87%	92%	E
	Income-total	1	2.95	8	2.89	2.81	4.81	BC
	INDAP (yes)		70%		76%	72%	45%	F
	Member-farm (yes)		20%		13%	17%	38%	F
	Member-org (yes)		50%		50%	42%	48%	E
	Contacts	0	4.12	80	3.19	2.91	5.31	BC
	Type certification							
	Participatory		4%		1%	0%	0%	F

TABLE 3 (Continued)

Category Number of farmers	Variables	Descriptive statistics Min.	 Mean	 Max.	Description of farmers according to type of buyer Intermediary (x) 142	 Wholesaler (y) 89	 Lead firm (z) 29	 Comparison significance
	Third-party		2%		1%	0%	7%	F
	Transition		5%		3%	4%	10%	F
	None		89%		95%	96%	83%	F
Governance forms	Governance							
	Spot market		54%		22%	89%	7%	F
	Informal contract		39%		78%	11%	14%	F
	Formal contract		7%		0%	0%	79%	F
Contractual provisions	Contract term	0	62.02	365	78.63	2.62	279.59	D
	Payment	0	5.72	120	3.74	0.39	42.88	D
	Contract provision	0	1.42	7	2.01	0.31	4.52	D
	Out-service	0	0.66	4	0.98	0.11	1.83	D
	In-service	0	0.41	5	0.64	0.07	1.21	AC
Relationship attributes	Trust	1	5.51	7	5.51	5.22	5.16	E
	Satisfaction	1	5.74	7	5.86	5.3	5.15	B
	Opportunism	1	3.43	7	3.35	4.08	3.77	E
Sustainability level of agricultural practices	Seed	0	0.2	1	0.07	0.09	0.18	E

(Continues)

TABLE 3 (Continued)

Category Number of farmers	Variables	Descriptive statistics Min.	 Mean	 Max.	Description of farmers according to type of buyer Intermediary (x) 142	 Wholesaler (y) 89	 Lead firm (z) 29	 Comparison significance
	Soil	−3	−0.9	3	−1.42	−1.97	−1.46	E
	Pest	−3	−1.24	3	−1.76	−2.34	−1.07	C
	Weed	−3	−0.16	3	−0.35	−0.9	−0.72	E
	Crop	0	1.3	3	0.95	1.05	1.09	E

Note: We acknowledge the existence of two schools of thought, one that considers the Likert scale to be ordinal and the other interval for analytical purposes (Joshi et al., 2015). Moreover, there is evidence that parametric statistics can be used with Likert data without reducing the statistical power of the analyses (Norman, 2010).

Abbreviations: A, statistically significant difference between *x* and *y*; B, statistically significant difference between *x* and *z*; C, statistically significant difference between *y* and *z*; D, statistically significant difference between all buyers; E, nonstatistically significant difference between all buyers; F, statistically significant difference (Pearson's χ^2 and Fisher's tests).

Ghana is membership in farmers' organizations. Moreover, Ton et al. (2018), who performed a meta-analysis of production contracts, found that farmers who participate in formal contracts have significantly larger plots of land and more assets than the average farmer in the region. Furthermore, our results support the findings of Kariuki and Loy (2016), who found that formal contracts contain a higher percentage of farmers with farm certifications. Our results regarding farmers trading through informal contracts and spot markets support evidence from Abdul-Rahaman and Abdulai (2020), who compared these groups of farmers on a number of indicators. For instance, they found a similar level of education. Further, although our results did not find significant differences in age between farmers participating in spot markets and informal contracts, we partially corroborate that older farmers are more likely to use informal contracts (Abdul-Rahaman & Abdulai, 2020).

In terms of *contractual provisions*, Table 3 illustrates considerable differences between farmers trading with each type of buyer. Farmers trading with intermediaries are midpoint between contractual provisions in farmer-wholesaler spot-market transactions and farmer-lead firm transactions through formal contracts. Transactions with lead firms feature contracts with the longest duration (280 days), the most prolonged period to pay farmers (42 days), a larger number of contract provisions (e.g., quality, price, volume, payment plan, delivery frequency, and delivery place), a higher number of services provided by farmers which are not detailed in the contract (e.g., product sorting, packaging and delivery) and a higher number of services provided by lead firms which are not described in the contract (e.g., technical support, payment in advance, input provision and transportation support for product delivery). By contrast, transactions with wholesalers through spot markets do not have any contractual provisions on average.

The results of the logit model (see Table 4) with the binary dependent variable (governance forms) detail the relationships between the type of contract and contractual provisions, relationships attributes, and SAP variables.

TABLE 4 Comparing contractual provisions, relationship attributes and sustainable agricultural practice adoption by informal and formal contracts.

Category	Variables	Coefficient estimate	Confidence limits (2.5%–97.5%)		SE	*p* Value
Contractual provisions	Contract term	−0.018	−0.035	−0.001	0.008	0.035**
	Payment	−0.178	−0.292	−0.064	0.058	0.002***
	Contract provisions	−1.122	−2.040	−0.206	0.467	0.016**
	Out-service	0.838	−1.007	2.684	0.941	0.373
	In-service	−1.667	−3.287	−0.047	0.826	0.043**
Relationship attributes	Trust	−2.058	−3.848	−0.269	0.913	0.024**
	Satisfaction	2.982	0.687	5.279	1.171	0.010**
	Opportunism	0.453	−0.527	1.435	0.5	0.364
Sustainability level of agricultural practices	Seed	−4.596	−9.999	0.807	2.756	0.095*
	Soil	0.352	−0.264	0.969	0.314	0.262
	Pest	−0.815	−1.417	−0.215	0.306	0.007***
	Weed	1.228	0.095	2.361	0.577	0.033**
	Crop	0.264	−0.682	1.210	0.482	0.584
Mc Fadden pseudo R^2			0.8			

Note: Coefficient: To determine the direction of the relationship, a positive (negative) coefficient means that a change in the independent variable is more (less) likely associated to having an informal contract.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Contracts are encoded with the values 1—*informal contract* and 0—*formal contract*. The model estimates the odds or probabilities of achieving a 1 or a 0, where positive coefficients reflect a positive relationship with informal contracts and negative coefficients reflect a negative relationship with informal contracts. Table 4 shows that: informal contracts are less likely to be long-term; buyers take less days to pay farmers; there are less contractual provisions; and feature less services from buyers than formal contracts. However, Table 4 also reveals that farmers are more likely to provide services when using informal contracts.

These data on contractual provisions may have different explanations. Differences in contract terms can be explained by lead firms having contracts that encompass the entire agricultural year, while informal contracts with intermediaries are only for the harvest season, representing a difference of around six months in duration between these contracts (Gaitán-Cremaschi et al., 2020; ODEPA, 2020b). The large number of days lead firms take to pay can be explained by the quantity of product traded, implying much higher transaction costs for lead firms than for intermediaries or wholesalers and inducing a delay in payments by lead firms (Gaitán-Cremaschi et al., 2020; ODEPA, 2020b). In terms of contractual provisions, our results corroborate Ménard (2018) findings, namely, that informal contracts are mainly focused on price, quality, and volume, while formal contracts or lead firms are more likely to work with more standardized products demanding more specificity. These results can also be explained by the fact that formal contracts have become increasingly the norm for lead firms in Latin America, especially for supermarkets (Reardon et al., 2019). In this way, lead firms can enforce quality standards (e.g., appearance and size) and safety standards (e.g., presence of pathogens and pesticide residues) on farmers to protect consumer health (Cadilhon et al., 2012; Reardon & Berdegué, 2002). Meanwhile, the low scores on out-services and in-services in informal contracts may be explained by the intermittent relationship between wholesalers and farmers. This situation impedes having more contract provisions or closer relationships which could trigger more collaboration (e.g., service interchange) (Anderson & Weitz, 1992; Ganesan, 1994).

With respect to *relationship attributes*, Table 3 shows that farmers gave "trust" a score of 5.51 (out of 7) on average, meaning that most of the farmers "more or less agree" with the statement that they can trust their main buyers. Farmers scored "satisfaction" with a 5.74 on average, implying that most of the farmers "more or less agree" with the statement that they are satisfied with their key buyers. Farmers rated "opportunism" with a 3.43, which means that farmers "more or less disagree" with the statements that their main buyers behave opportunistically. However, Table 3 does not highlight much difference, in general, in terms of scores for trust, satisfaction and opportunism. That notwithstanding, on average, farmers have greater trust in intermediaries, they are more satisfied trading with this type of buyer, and they perceive intermediaries to be less opportunistic. By contrast, farmers trading with lead firms give these the lowest scores in terms of trust and satisfaction, while farmers perceive wholesalers as more opportunistic than intermediaries and lead firms. In addition, the logit model (Table 4) shows that farmers with informal contracts are less likely to trust their buyers but are more likely to be satisfied with the latter.

The results presented in Tables 3 and 4 may seem contradictory when we examine farmers' trust in intermediaries and in informal contracts. On the one hand, if we focus on the type of buyer, our results corroborate Kariuki and Loy's (2016) findings which indicate that informal contracts are supported by a high level of trust between farmers and intermediaries. On the other, if we focus on the governance form, our results contradict those same authors (Kariuki & Loy, 2016). This may be explained by the percentage of wholesalers who use informal contracts, as our findings show that farmers' trust in wholesalers is significantly lower, on average, than their trust in intermediaries.

The strong likelihood of farmers trusting their buyers when using formal contracts can be explained by the fact that most of these buyers with formal contracts are lead firms and that trust is higher in more homogenous societies (e.g., similar ethnicity, economy, and social status) (Zak & Knack, 2001). This may in fact be the case for transactions between large-scale farmers and lead firms. The higher level of trust between farmers and lead firms can also be explained by lead firms offering higher prices to farmers, which increases their price satisfaction which, in turn, is an antecedent for trust (Susanty et al., 2017). Surprisingly, our outcome is contrary to that of Peppelenbos' (2005) study which found that formal contracts create a context of institutional distrust in Chile.

Farmers' greater satisfaction with intermediaries as buyers or with the use of informal contracts is in line with Schwartz et al. (2013) and Thorlakson (2018), both of whom found that intermediaries have closer relationships with farmers, potentially implying a higher degree of satisfaction. Moreover, one element that may support farmers' satisfaction with intermediaries and informal contracts is the negotiation process to set product prices. In this case, both farmers and intermediaries start negotiations with the same information. Today, most farmers have a mobile phone and, before trading their products, they can call key informants to get pricing information. In this way, they have improved their bargaining power (Goyal & González-Velosa, 2013). Farmers' scant satisfaction with wholesalers (compared with intermediaries) can be explained by wholesalers' stronger bargaining position as perceived by farmers (Benton & Maloni, 2005). Wholesaling is usually quite concentrated by product category and time (Schwartz et al., 2013), often implying lower unit prices for farmers (Barrowclough et al., 2019; Cao & Mohiuddin, 2019). However, there is evidence that farmers continue to trade with wholesalers because they are the most profitable option when marketing expenses and management costs are considered (Barrowclough et al., 2019). Farmers' lower satisfaction with lead firms may be explained by lead firms having more power in the transaction with farmers. Elder and Dauvergne (2015) and Ruml and Qaim (2021) report that farmers do not have sufficient information about contracts. Similarly, Jiménez (2013) and Musara et al. (2018) report that farmers usually have to accept payment delays without any compensation and that they are marginalized from decision-making processes.

Regarding opportunism, one explanation of why farmers supplying intermediaries through informal contracts perceive their buyers as less opportunistic (compared to farmers supplying lead firms using formal contracts) may be that formal contracts are often very explicit, with little room for deviation, thus reinforcing farmers' perceptions regarding these buyers' opportunistic behavior (Poppo & Zenger, 2002). Moreover, the higher levels of opportunism perceived by farmers trading with wholesalers compared to other farmers can be explained by the low number of contacts these farmers have. According to McCarter and Northcraft (2007), individuals with more contacts will have more information; this includes information about other individuals' reputations which may lead to a more informed selection of business partners. Thus, partners with fewer contacts may perceive higher levels of opportunistic behavior.

In the case of the *sustainability level of agricultural practices*, Table 3 shows that the average scores for seed sourcing (Seed) and crop management (Crop) practices were positive (0.20 and 1.30, respectively), suggesting that the agricultural practices used in these stages have a moderate, although not significant, positive impact on the environment. On the other hand, we found that the average scores for types of fertilizer (Soil), pest/disease control (Pest) and weed control (Weed) practices were negative (−0.90, −1.24, and −0.16, respectively), suggesting that the practices used in these stages have a moderate negative impact on the environment. Although our results do not reveal a significant relation between sustainable practices and type of buyer, farmers trading with intermediaries have the highest sustainability scores in soil and weed control, while farmers supplying lead firms achieve the highest sustainability scores in the seed, pest, and crop categories. On average, farmers trading with wholesalers obtain the lowest sustainability scores. Moreover, Table 4 shows that farmers trading via informal contracts are more likely to use sustainable practices in weed control as well as in the soil and crop categories; however, the latter two are not statistically significant. Additionally, Table 4 shows that farmers trading through informal contracts are less likely to use more sustainable practices in the seed and pest categories.

These differences between the sustainability levels of agricultural practices may have diverse explanations. The higher incidence of farmers implementing sustainable practices in weed control when working with informal contracts can be explained by the fact that most buyers that trade using informal contracts are intermediaries, who are mainly supplied by small-scale farmers. Small-scale farmers usually control weeds manually, without using synthetic products, to save money (Gaitán-Cremaschi et al., 2020). In this case, SAP adoption is not an objective for these farmers; it is more a consequence of farm management choices. An explanation for the use of organic seeds by farmers trading with lead firms is that lead firms using formal contracts in Chile have a greater percentage of suppliers with organic certifications which implies the use of organic seeds (SAG, 2020). Moreover, according to

ODEPA (2020b), Chilean lead firms mainly use formal contracts to promote SAP adoption. However, SAP adoption, as required by these contracts, primarily focuses on reducing pesticide residues in vegetables to safeguard end-consumer health; it is not related to other environmental goals, such as increasing biodiversity or improving soil quality. In addition, the requirements applied by lead firms to farmers regarding pest/disease control contribute to ensure the safety standards required by the Agricultural and Livestock Service of Chile (SAG), standards that SAG applies primarily when inspecting medium to large-scale farmers (Gaitán-Cremaschi et al., 2020).

6 | CONCLUSIONS AND LIMITATIONS

6.1 | Conclusions

Our study has aimed to explore how different farmer-buyer relationships relate to different levels of SAP adoption in the vegetable sector in Chile. To this end, we have analyzed farmers related to each type of buyer, explored the governance forms used for buyer-farmer transactions and examined whether or not there is a relationship between the contract governance form (formal or informal) and: (a) contract provisions (e.g., quality, quantity and the provision of services); (b) farmer-buyer relationship attributes (i.e., satisfaction, trust, and opportunism); and (c) level of SAP adoption. Our aim has also included contributing to the literature on sustainable food supply chains by including intermediaries and wholesalers in the analysis as well as providing insights on whether or not and how contractual provisions, relationship attributes, and SAP adoption practices are related. Moreover, we wanted to contribute to knowledge of the potential role intermediaries, wholesalers, and lead firms play in farmers' adoption of SAPs.

We found that farmers trading with intermediaries through informal contracts are less likely to adopt SAPs. However, according to Thorlakson (2018), intermediaries may be interested in marketing sustainable products because of the overall low profit of marketing regular products. A report by the Food and Agriculture Organization (FAO) and National Institute for Agricultural Research (INRAE) (2021) presents cases where close relationships between intermediaries and smallholders lead to the adoption of SAPs. The main characteristics of these cases in India and the Republic of Korea are a transparent flow of information between farmers and intermediaries regarding prices and sales and an associativity of either the producers or the intermediaries. Moreover, these authors found that participatory guarantee systems with the active participation of farmers, intermediaries and consumers can be a mechanism to support the trade of sustainable products. In addition, our results demonstrate that farmers trading through informal contracts (mostly with intermediaries) are more likely to be satisfied with the relationship. Tewari et al. (2018) and Grabs and Carodenuto (2021) found that close relationships between intermediaries and farmers build collaboration and encourage both parties to mutually commit to pursuing SAP adoption.

In the case of farmers trading with wholesalers, we found that these actors are less likely to enter into contracts. In the case of farmers and wholesalers using informal contracts, farmers are less likely to adopt SAPs. A possible means to increase SAP adoption in the farmer-wholesaler relationship is the application of an auction system in public wholesale markets. Johnson et al. (2016) found that the auction system in Canadian wholesale markets promotes SAP adoption by farmers. On the one hand, an auction system can accredit the sustainability of wholesalers' operations, and, on the other, it can accredit the operations of farmers that have adopted SAPs. For example, this system could require the progressive adoption of SAPs, starting with basic practices (e.g., minimum pesticide residues in crops) and moving up to organic certifications. As a result, accredited wholesalers could demonstrate the quality of the products acquired, while accredited farmers would be informed about their products' quality (through SAP adoption) and price. This could also improve trust in the farmer-buyer relationship.

We also found that farmers trading with lead firms are more likely to adopt SAPs. Lead firms support this through formal contracts and/or certification schemes. SAP adoption related to lead firms focuses mainly on using organic seeds and sustainable practices to control pests and diseases. This limited scope of SAP adoption may be

related to traditional international certification schemes that primarily focus on improving the products' intrinsic quality but not on their environmental impact as such (Achabou et al., 2017). Moreover, we found that farmers are more likely to have lower satisfaction levels when trading through formal contracts and/or with lead firms. According to Ruml and Qaim (2021), even when farmers reported benefits from their relationships with lead firms, they were dissatisfied. However, Sahara and Gyau (2014) and Ruml and Qaim (2021) suggest that some ways to improve farmers' satisfaction include reducing information asymmetries regarding contractual provisions, reducing the number of days before payment, and providing quicker response to farmers' concerns. In this way, farmers might perceive a more balanced relationship and be willing to enter into contracts that include SAP adoption provisions.

Our research has also aimed to raise questions and open areas for further research focused on intermediary and wholesaler-farmer supply chains as sustainable alternatives to lead firm-farmer supply chains. Certainly, the promotion of intermediary and wholesaler-supply chains offers an opportunity to preserve local and regional supply chains and farmer diversity (Clapp & Moseley, 2020; Tewari et al., 2018). This also means that local and regional supply chains may become necessary in providing access to sustainable food for vulnerable populations (Clapp & Moseley, 2020). Furthermore, our research presents the idea of considering alternative supply chains, including intermediaries and wholesalers, when developing strategies to promote SAP adoption in fresh-food supply chains. Despite the relatively limited findings of our research, this study offers valuable insights which, though not conclusive, should be further researched.

6.2 | Limitations and future research

While the quantitative empirical approach adopted in this study can be considered a contribution to research on the relation between contracts, relationship attributes, and SAP adoption by farmers in developing countries and emerging economies, it may also be a limitation due to the lack of specific insights and depth of latent variables such as trust or satisfaction. Moreover, a limitation regarding the quantitative approach is the sample size, which restricts the statistical power of our analysis. The farmer perspective adopted in this research can be seen as a useful contribution, because most farmer-buyer relationship analyses focus only on buyers and their perspective. By contrast, farmers' perspectives can also be seen as a limitation for not including the buyers' perspective in the analysis. In addition, we acknowledge that other variables not currently considered (e.g., political/economic power and commitment) may also provide insights on the relationship attributes between farmers and buyers.

The theoretical framework which served as the basis for our logit analysis may have limitations related to endogeneity issues. As our framework follows the reasoning that a governance form is expressed as an *antecedent* of SAP adoption, we do not consider that SAPs may affect the governance form. We acknowledge that this framework may not be a *rule* for all cases and that SAP adoption by farmers can be affected by many factors across the supply chain. Further research is needed to address the possible causal relationships and the endogeneity issue implied in the adoption decision and its determinants, including other aspects of farmer-buyer relationships.

Moreover, future studies analyzing relationship attributes could implement in-depth interviews with both farmers and buyers to go beyond the relations examined in this study. Finally, in the context of Latin America and developing countries where most of fresh-food supply-chain transactions are through wholesalers and intermediaries, researchers should focus more on the (potential) role of these actors in SAP adoption amongst farmers. This should be addressed as there is a lack of insight in the literature on how to include wholesalers and intermediaries in sustainable food systems (Beninger & Shapiro, 2019).

ACKNOWLEDGMENTS

Special thanks to all the farmers interviewed for this study, to the Pontifical Catholic University of Valparaíso, our project partner, and to the HortEco team. This research forms part of the HortEco project (horticultural food

systems based on ecologically intensive production and socioeconomically sustainable value chains in the transition economies of Chile and Uruguay), funded by the Netherlands Organisation for Scientific Research [NWO-WOTRO] via grant [number W 08.250.304].

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

Abdul-Rahaman, A., & Abdulai, A. (2020). Vertical coordination mechanisms and farm performance amongst smallholder rice farmers in northern Ghana. *Agribusiness*, *36*(2), 259–280. https://doi.org/10.1002/agr.21628

Abebe, G. K., Bijman, J., Kemp, R., Omta, O., & Tsegaye, A. (2013). Contract farming configuration: Smallholders' preferences for contract design attributes. *Food Policy*, *40*, 14–24. https://doi.org/10.1016/j.foodpol.2013.01.002

Achabou, M. A., Dekhili, S., & Hamdoun, M. (2017). Environmental upgrading of developing country firms in global value chains. *Business Strategy and the Environment*, *26*(2), 224–238. https://doi.org/10.1002/bse.1911

Alam, M. (2018). Mango supply chain and value chain analysis from farm to market. *International Journal Supply Chain Management*, *7*(4), 7–12. https://doi.org/10.1093/hepl/9780199658015.003.0001

Ali, M. (2021). Factors determining the trust of vegetable farmers for intermediaries in Eastern Ethiopia. *Review of Agricultural and Applied Economics*, *24*(1), 64–75. https://doi.org/10.15414/raae.2021.24.01.64-75

Altieri, M. A., & Rojas, A. (1999). Ecological impacts of Chile's neoliberal policies, with special emphasis on agroecosystems. *Environment, Development and Sustainability*, *1*, 55–72.

Anderson, E., & Weitz, B. (1992). The use of pledges to build and sustain commitment in distribution channels. *Journal of Marketing Research*, *29*(1), 18–34.

Autry, C. W., & Golicic, S. L. (2010). Evaluating buyer-supplier relationship-performance spirals: A longitudinal study. *Journal of Operations Management*, *28*(2), 87–100. https://doi.org/10.1016/j.jom.2009.07.003

Balsevich, F., Berdegué, J. A., Flores, L., Mainville, D., & Reardon, T. (2003). Supermarkets and produce quality and safety standards in Latin America. *American Journal of Agricultural Economics*, *85*(5), 1147–1154.

Barrowclough, M., Boys, K., & Carpio, C. (2019). Benefits, challenges and trade-offs: Buyer and contract characteristics valued by small farm suppliers to wholesale marketing channels. *Journal of Agricultural and Resource Economics*, *44*(3), 605–623. https://doi.org/10.22004/AG.ECON.292334

Batt, P. J. (2003). Building trust between growers and market agents. *Supply Chain Management*, *8*(1), 65–78.

Batt, P. J., Concepcion, S. B., Hualda, L. T., Migalbin, L. R., Montiflor, M. O., Manalili, N. M., McGregor, M. J., Murray-Prior, R., & Rola-Runzen, M. F. (2006). Exploring the antecedents and consequences of trust between vegetable farmers and their preferred trading partners in Southern Mindanao. *Acta Horticulturae*, *699*, 91–102. https://doi.org/10.17660/ActaHortic.2006.699.9

Baumgart-Getz, A., Prokopy, L. S., & Floress, K. (2012). Why farmers adopt best management practice in the United States. A meta-analysis of the adoption literature. *Journal of Environmental Management*, *96*(1), 17–25. https://doi.org/10.1016/j.jenvman.2011.10.006

Bellemare, M. F., & Lim, S. (2018). In all shapes and colors: varieties of contract farming. *Applied Economic Perspectives and Policy*, *40*(3), 379–401. https://doi.org/10.1093/aepp/ppy019

Beninger, S., & Shapiro, S. J. (2019). A historical review of local intermediaries in impoverished contexts. *Journal of Macromarketing*, *39*(3), 238–251. https://doi.org/10.1177/0276146718815937

Benitez-Altuna, F., Trienekens, J., Materia, V. C., & Bijman, J. (2021). Factors affecting the adoption of ecological intensification practices: A case study in vegetable production in Chile. *Agricultural Systems*, *194*, 103283. https://doi.org/10.1016/j.agsy.2021.103283

Benton, W. C., & Maloni, M. (2005). The influence of power driven buyer/seller relationships on supply chain satisfaction. *Journal of Operations Management*, *23*(1), 1–22. https://doi.org/10.1016/j.jom.2004.09.002

Bijman, J. (2008). *Contract farming in developing countries: An overview* (working paper). Wageningen University. http://edepot.wur.nl/1763.

Bockstaller, C., Guichard, L., Makowski, D., Aveline, A., Girardin, P., & Plantureux, S. (2008). Agri-environmental indicators to assess cropping and farming systems. A review. *Agronomy for Sustainable Development*, *28*(1), 139–149. https://doi.org/10.1051/agro:2007052

Boitano, L. (2011). *Análisis de la cadena de distribución en la comercialización de productos frescos en chile: Frutas y hortalizas, Santiago de Chile*. Universidad de Chile.

Bolwig, S., Ponte, S., Du Toit, A., Riisgaard, L., & Halberg, N. (2010). Integrating poverty and environmental concerns into value-chain analysis: A conceptual framework. *Development Policy Review*, *28*(2), 173–194. https://doi.org/10.1111/j.1467-7679.2010.00480.x

Boza, S., Cortés, M., Prieto, C., & Muñoz, T. (2019). Vegetable growing in central Chile: Characterization and attitudes of small farmers. *Chilean Journal of Agricultural & Animal Sciences*, *35*(1), 57–67.

Bush, S. R., Oosterveer, P., Bailey, M., & Mol, A. P. J. (2015). Sustainability governance of chains and networks: A review and future outlook. *Journal of Cleaner Production*, *107*, 8–19. https://doi.org/10.1016/j.jclepro.2014.10.019

Cadilhon, J., Gálvez-Nogales, E., & López-Saavedra, V. (2012). Quality and safety management systems in fresh produce wholesale markets in Asia and Latin America. In P. J. Batt (Ed.), *IV International Symposium on Improving the Performance of Supply Chains in the Transitional Economies* (Vol. *1006*, pp. 103–110). Acta Horticulturae.

Calderon, R., García-Hernández, J., Palma, P., Leyva-Morales, J. B., Zambrano-Soria, M., Bastidas-Bastidas, P. J., & Godoy, M. (2022). Assessment of pesticide residues in vegetables commonly consumed in Chile and Mexico: Potential impacts for public health. *Journal of Food Composition and Analysis*, *108*, 104420. https://doi.org/10.1016/j.jfca.2022.104420

Cao, Y., & Mohiuddin, M. (2019). Sustainable emerging country agro-food supply chains: Fresh vegetable price formation mechanisms in rural China. *Sustainability*, *11*(10), 2814. https://doi.org/10.3390/su11102814

Clapp, J., & Moseley, W. G. (2020). This food crisis is different: COVID-19 and the fragility of the neoliberal food security order. *The Journal of Peasant Studies*, *47*(7), 1393–1417. https://doi.org/10.1080/03066150.2020.1823838

Corral, S. A., de Angel, V., Salas, N., Zúñiga-Venegas, L., Gaspar, P. A., & Pancetti, F. (2017). Cognitive impairment in agricultural workers and nearby residents exposed to pesticides in the coquimbo region of Chile. *Neurotoxicology and Teratology*, *62*, 13–19. https://doi.org/10.1016/j.ntt.2017.05.003

David, M. B. D. A., Dirven, M., & Vogelgesang, F. (2000). The impact of the new economic model on Latin America's agriculture. *World Development*, *28*(9), 1673–1688.

Dlamini-Mazibuko, B. P., Ferrer, S., & Ortmann, G. (2019). Examining the farmer-buyer relationships in vegetable marketing channels in Eswatini. *Agrekon*, *58*(3), 369–386. https://doi.org/10.1080/03031853.2019.1596824

Dubbert, C., Abdulai, A., & Mohammed, S. (2021). Contract farming and the adoption of sustainable farm practices: Empirical evidence from cashew farmers in Ghana. *Applied Economic Perspectives and Policy*, *45*, 487–509. https://doi.org/10.1002/aepp.13212

Elder, S. (2016). *Assessing the impacts of retail supply chains on food security and agricultural sustainability in the global south: The case of Walmart in Nicaragua* [Doctor of Phylosophy, The University of British Columbia].

Elder, S. D., & Dauvergne, P. (2015). Farming for Walmart: The politics of corporate control and responsibility in the global South. *The Journal of Peasant Studies*, *42*(5), 1029–1046. https://doi.org/10.1080/03066150.2015.1043275

Elgueta, S., Valenzuela, M., Fuentes, M., Meza, P., Manzur, J. P., Liu, S., Zhao, G., & Correa, A. (2020). Pesticide residues and health risk assessment in tomatoes and lettuces from farms of metropolitan region Chile. *Molecules*, *25*(2), 355. https://doi.org/10.3390/molecules25020355

Escobal, J., Favareto, A., Aguirre, F., & Ponce, C. (2015). Linkage to dynamic markets and rural territorial development in Latin America. *World Development*, *73*, 44–55. https://doi.org/10.1016/j.worlddev.2014.09.017

FAO-INRAE. (2021). *Facilitando sistemas alimentarios sostenibles. Manual para innovadores*. FAO.

Freidberg, S. (2020). Assembled but unrehearsed: Corporate food power and the 'dance' of supply chain sustainability. *The Journal of Peasant Studies*, *47*(2), 383–400. https://doi.org/10.1080/03066150.2018.1534835

Gaitán-Cremaschi, D., Klerkx, L., Duncan, J., Trienekens, J. H., Huenchuleo, C., Dogliotti, S., Contesse, M. E., Benitez-Altuna, F. J., & Rossing, W. A. H. (2020). Sustainability transition pathways through ecological intensification: An assessment of vegetable food systems in Chile. *International Journal of Agricultural Sustainability*, *18*(2), 131–150. https://doi.org/10.1080/14735903.2020.1722561

Ganesan, S. (1994). Determinants of long-term orientation in buyer-seller relationships. *Journal of Marketing*, *58*(2), 1–19.

Gereffi, G. (2011). Global value chains and international competition. *The Antitrust Bulletin*, *56*(1), 37–56.

Geyskens, I., Steenkamp, J. B. E. M., & Kumar, N. (1999). A meta-analysis of satisfaction in marketing channel relationships. *Journal of Marketing Research*, *36*(2), 223–238. https://doi.org/10.2307/3152095

Ghadimi, P., Azadnia, A. H., Heavey, C., Dolgui, A., & Can, B. (2016). A review on the buyer–supplier dyad relationships in sustainable procurement context: past, present and future. *International Journal of Production Research*, *54*(5), 1443–1462. https://doi.org/10.1080/00207543.2015.1079341

Gómez-Limón, J. A., & Sanchez-Fernandez, G. (2010). Empirical evaluation of agricultural sustainability using composite indicators. *Ecological Economics*, *69*(5), 1062–1075. https://doi.org/10.1016/j.ecolecon.2009.11.027

Gorton, M., Angell, R., Dries, L., Urutyan, V., Jackson, E., & White, J. (2015). Power, buyer trustworthiness and supplier performance: Evidence from the Armenian dairy sector. *Industrial Marketing Management*, *50*, 69–77. https://doi.org/10.1016/j.indmarman.2015.05.024

Goyal, A. (2013). Improving agricultural productivity and market efficiency in Latin America and the Caribbean: How ICTs can make a difference? *Journal of Reviews on Global Economics*, *2*, 172–182. https://doi.org/10.6000/1929-7092.2013.02.14

Grabs, J., & Carodenuto, S. L. (2021). Traders as sustainability governance actors in global food supply chains: A research agenda. *Business Strategy and the Environment*, *30*(2), 1314–1332. https://doi.org/10.1002/bse.2686

Gualandris, J., & Kalchschmidt, M. (2016). Developing environmental and social performance: the role of suppliers' sustainability and buyer–supplier trust. *International Journal of Production Research*, *54*(8), 2470–2486. https://doi.org/10.1080/00207543.2015.1106018

Guarín, A. (2013). The value of domestic supply chains: Producers, wholesalers, and urban consumers in Colombia. *Development Policy Review*, *31*(5), 511–530. https://doi.org/10.1111/dpr.12023

Hair, J., Babin, B., Anderson, R., & Black, W. (2014). *Multivariate data analysis* (7th ed., Pearson new international edition). Pearson (Pearson custom library). Available online at http://lib.myilibrary.com/detail.asp?id=527034

Handley, S. M., de Jong, J., & Benton, W. C. (2019). How service provider dependence perceptions moderate the power-opportunism relationship with professional services. *Production and Operations Management*, *28*(7), 1692–1715. https://doi.org/10.1111/poms.13013

INDAP. (2017). *Presentación para la Comisión Nacional de Agricultura Orgánica (CNAO)*. Mesa de Agroecología para la AFC. Mesa de Agroecología para la AFC. https://docplayer.es/82158138-Mesa-de-agroecologia-para-la-afc-indap-presentacion-para-la-comision-nacional-de-agricultura-organica-cnao-jueves-21-de-diciembre-de-2017.html

INDAP. (2020). *Quiénes somos*. https://www.indap.gob.cl/indap/qu%C3%A9-es-indap

Jap, S. D., & Anderson, E. (2003). Safeguarding interorganizational performance and continuity under ex post opportunism. *Management Science*, *49*(12), 1684–1701. https://doi.org/10.1287/mnsc.49.12.1684.25112

Jara-Rojas, R., Bravo-Ureta, B. E., & Díaz, J. (2012). Adoption of water conservation practices. A socioeconomic analysis of small-scale farmers in Central Chile. *Agricultural Systems*, *110*, 54–62. https://doi.org/10.1016/j.agsy.2012.03.008

Jiménez, L. (2013). *Percepción de los agricultores acerca del programa alianzas productivas de INDAP: Estudio de caso para las comunas de Linares y San Javier, región del Maule—Chile. Ingeniero agrónomo*. Escuela de Agronomía, Universidad de Talca - Chile. http://dspace.utalca.cl/handle/1950/9924

Johnson, R., Fraser, E., & Hawkins, R. (2016). Overcoming barriers to scaling up sustainable alternative food systems: A comparative case study of two Ontario-based wholesale produce auctions. *Sustainability*, *8*(4), 328. https://doi.org/10.3390/su8040328

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert scale: Explored and explained. *In British Journal of Applied Science & Technology*, *7*(4), 396–403. https://doi.org/10.9734/BJAST/2015/14975

Kang, B., & Jindal, R. P. (2015). Opportunism in buyer–seller relationships: Some unexplored antecedents. *Journal of Business Research*, *68*(3), 735–742. https://doi.org/10.1016/j.jbusres.2014.07.009

Kariuki, I. M., & Loy, J. P. (2016). Contractual farming arrangements, quality control, incentives, and distribution failure in Kenya's smallholder horticulture: A multivariate probit analysis. *Agribusiness*, *32*(4), 547–562. https://doi.org/10.1002/agr.21462

Keco, R., Xhoxhi, O., Skreli, E., & Imami, D. (2019). To contract or not contract: Implications for farmer–buyer trading relation performance. *International Journal on Food System Dynamics*, *10*(2), 151–161. https://doi.org/10.18461/IJFSD.V10I2.09

Kersting, S., & Wollni, M. (2012). New institutional arrangements and standard adoption: Evidence from small-scale fruit and vegetable farmers in Thailand. *Food Policy*, *37*(4), 452–462. https://doi.org/10.1016/j.foodpol.2012.04.005

Kleijn, D., Bommarco, R., Fijen, T., Garibaldi, L. A., Potts, S. G., & van der Putten, W. H. (2019). Ecological intensification: Bridging the gap between science and practice. *Trends in Ecology & Evolution*, *34*(2), 154–166. https://doi.org/10.1016/j.tree.2018.11.002

Lages, C., Lages, C. R., & Lages, L. F. (2005). The RELQUAL scale: A measure of relationship quality in export market ventures. *Journal of Business Research*, *58*(8), 1040–1048. https://doi.org/10.1016/j.jbusres.2004.03.001

Lees, N. (2017). *An investigation of relationship quality and supplier performance in New Zealand red meat supply chains* [Doctor of Philosophy, Lincoln University].

Lees, N., Nuthall, P., & Wilson, M. M. J. (2020). Relationship quality and supplier performance in food supply chains. *International Food and Agribusiness Management Review*, *23*(3), 425–445. https://doi.org/10.22434/IFAMR2019.0178

Leeuwis, C. (2004). *Communication for rural innovation. Rethinking agricultural extension* (3rd ed.). Blackwell Publishing Ltd.

Leite, A., Castro, R., de Jabbour, C., Batalha, M., & Govindan, K. (2014). Agricultural production and sustainable development in a Brazilian region (Southwest, São Paulo State). Motivations and barriers to adopting sustainable and ecologically friendly practices. *International Journal of Sustainable Development & World Ecology*, *21*(5), 422–429. https://doi.org/10.1080/13504509.2014.956677

Lemma, Z., Sripruetkiat, K., & Nitithanprapas, I. (2020). Factors affecting sustainability of business relationships in Ethiopia banana value chain. *Journal of the Austrian Society of Agricultural Economics*, *16*(5), 83–95.

De Marchi, V., Di Maria, E., Krishnan, A., & Ponte, S. (2019). Chapter 19: Environmental upgrading in global value chains. In Ponte, S., Gereffi, G., & Raj-Reichert, G. (Eds.), *Handbook on global value chains* (pp. 310–323). Edward Elgar Publishing. https://ebookcentral.proquest.com/lib/kxp/detail.action?docID=5968320

Mariyono, J., Waskito, J., Kuntariningsih, A., Gunistiyo, G., & Sumarno, S. (2020). Distribution channels of vegetable industry in Indonesia: Impact on business performance. *International Journal of Productivity and Performance Management*, *69*(5), 963–987. https://doi.org/10.1108/IJPPM-11-2018-0382

McCarter, M. W., & Northcraft, G. B. (2007). Happy together?: Insights and implications of viewing managed supply chains as a social dilemma. *Journal of Operations Management*, *25*(2), 498–511. https://doi.org/10.1016/j.jom.2006.05.005

Meemken, E. M., & Bellemare, M. F. (2020). Smallholder farmers and contract farming in developing countries. *Proceedings of the National Academy of Sciences*, *117*(1), 259–264. https://doi.org/10.1073/pnas.1909501116

Ménard, C. (2018). Organization and governance in the agrifood sector: How can we capture their variety? *Agribusiness*, *34*(1), 142–160. https://doi.org/10.1002/agr.21539

Mergenthaler, M., Weinberger, K., & Qaim, M. (2009). The food system transformation in developing countries: A disaggregate demand analysis for fruits and vegetables in Vietnam. *Food Policy*, *34*(5), 426–436. https://doi.org/10.1016/j.foodpol.2009.03.009

Mugwagwa, I., Bijman, J., & Trienekens, J. (2020). Typology of contract farming arrangements: A transaction cost perspective. *Agrekon*, *59*(2), 169–187. https://doi.org/10.1080/03031853.2020.1731561

Murphy, M., & Sashi, C. M. (2018). Communication, interactivity, and satisfaction in B2B relationships. *Industrial Marketing Management*, *68*, 1–12. https://doi.org/10.1016/j.indmarman.2017.08.020

Musara, J. P., Musemwa, L., Mutenje, M., Mushunje, A., & Pfukwa, C. (2018). Market participation and marketing channel preferences by small scale sorghum farmers in semi-arid Zimbabwe. *Agrekon*, *57*(1), 64–77. https://doi.org/10.1080/03031853.2018.1454334

Navarrete, S. D. S., Borini, F. M., & Avrichir, I. (2020). Environmental upgrading and the United Nations Sustainable Development Goals. *Journal of Cleaner Production*, *264*, 121563. https://doi.org/10.1016/j.jclepro.2020.121563

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in health sciences education*, *15*, 625–632. https://doi.org/10.1007/s10459-010-9222-y

Nyaga, G. N., Lynch, D. F., Marshall, D., & Ambrose, E. (2013). Power asymmetry, adaptation and collaboration in dyadic relationships involving a powerful partner. *Journal of Supply Chain Management*, *49*(3), 42–65.

ODEPA. (2017). *Comisión Nacional Hortícola*. Oficina de Estudios y Politicas Agrarias. Retrieved March 10, 2019, from http://www.odepa.gob.cl/wp-content/uploads/2017/12/presentacionOdepa191217.pdf

ODEPA (2020a). *Hortalizas frescas*. Oficina de Estudios y Politicas Agrarias. Retrieved June 7, 2021, from https://www.odepa.gob.cl/rubros/hortalizas-frescas

ODEPA. (2020b). *Uso de contratos en la agricultura nacional para hortalizas*.

Otto, A. S., Szymanski, D. M., & Varadarajan, R. (2020). Customer satisfaction and firm performance: Insights from over a quarter century of empirical research. *Journal of the Academy of Marketing Science*, *48*(3), 543–564. https://doi.org/10.1007/s11747-019-00657-7

Peppelenbos, L. (2005). *The Chilean miracle: Patrimonialism in a modern free-market democracy* [Doctor of Philosophy, Wageningen University].

Poppo, L., & Zenger, T. (2002). Do formal contracts and relational governance function as substitutes or complements? *Strategic Management Journal*, *23*(8), 707–725. https://doi.org/10.1002/smj.249

Prowse, M. (2012). Contract farming in developing countries: A review. *Agence française de développement* (p. 12). A savoir.

Reardon, T., Barrett, C. B., Berdegué, J. A., & Swinnen, J. F. M. (2009). Agrifood industry transformation and small farmers in developing countries. *World Development*, *37*(11), 1717–1727. https://doi.org/10.1016/j.worlddev.2008.08.023

Reardon, T., & Berdegué, J. A. (2002). The rapid rise of supermarkets in Latin America: Challenges and opportunities for development. *Development Policy Review*, *20*(4), 371–388.

Reardon, T., Echeverria, R., Berdegué, J., Minten, B., Liverpool-Tasie, S., Tschirley, D., & Zilberman, D. (2019). Rapid transformation of food systems in developing regions: Highlighting the role of agricultural research & innovations. *Agricultural Systems*, *172*, 47–59. https://doi.org/10.1016/j.agsy.2018.01.022

Rigby, D., Woodhouse, P., Young, T., & Burton, M. (2001). Constructing a farm level indicator of sustainable agricultural practice. *Ecological Economics*, *39*(3), 463–478. https://doi.org/10.1016/S0921-8009(01)00245-2

Riquelme-Garcés, A., González-Vallejos, F., Contreras-Luque, P., & Mazuela, P. (2013). Manejo del cultivo de hortalizas y su efecto en la sustentabilidad de un valle costero del desierto de Atacama, Chile. *Idesia (Arica)*, *31*(3), 113–117. https://doi.org/10.4067/S0718-34292013000300016

Rueda, X., Garrett, R. D., & Lambin, E. F. (2017). Corporate investments in supply chain sustainability: Selecting instruments in the agri-food industry. *Journal of Cleaner Production*, *142*, 2480–2492. https://doi.org/10.1016/j.jclepro.2016.11.026

Ruml, A., & Qaim, M. (2021). Smallholder farmers' dissatisfaction with contract schemes in spite of economic benefits: Issues of mistrust and lack of transparency. *The Journal of Development Studies*, *57*(7), 1106–1119. https://doi.org/10.1080/00220388.2020.1850699

SAG. (2020). *Certificacion de productos organicos*. Servicio Agricola y Ganadero. https://www.sag.gob.cl/ambitos-de-accion/certificacion-de-productos-organicos

Sahara, S., & Gyau, A. (2014). Contractual arrangements and commitment in the Indonesian supermarket channel. *British Food Journal*, *116*(5), 765–779. https://doi.org/10.1108/BFJ-03-2012-0070

Schwartz, M., Kern, W., & Hernández, M. (2013). *Diagnóstico y estrategia de desarrollo para el sector hortícola Chileno*. Trabajo preparado para la funsación de innovación agraria del Ministerio de Agricultura-Chile.

Singh, S. (2000). Contract farming for agricultural diversification in the Indian Punjab: A study of performance and problems. *Indian Journal of Agricultural Economics*, *55*(3), 283–294.

Susanty, A., Bakhtiar, A., Jie, F., & Muthi, M. (2017). The empirical model of trust, loyalty, and business performance of the dairy milk supply chain. *British Food Journal*, *119*(12), 2765–2787. https://doi.org/10.1108/BFJ-10-2016-0462

Tangpong, C., Michalisin, M., Traub, R., & Melcher, A. (2015). A review of buyer-supplier relationship typologies: Progress, problems, and future directions. *In Journal of Business & Industrial Marketing*, *30*(2), 153–170. https://doi.org/10.1108/JBIM-10-2012-0193

Taylor, D. C., Mohamed, Z. A., Shamsudin, M. N., Mohayidin, M. G., & Chiew, E. F. C. (1993). Creating a farmer sustainability index: A Malaysian case study. *American Journal of Alternative Agriculture*, *8*(4), 175–184.

Tewari, M., Kelmenson, S., Guinn, A., Cumming, G., & Colloredo-Mansfeld, R. (2018). Mission-driven intermediaries as anchors of the middle ground in the American Food System: Evidence from Warrenton, NC. *Culture, Agriculture, Food and Environment*, *40*(2), 114–123. https://doi.org/10.1111/cuag.12175

Thomson, A., Ehiemere, C., Carlson, J., Matlock, M., Barnes, E., Moody, L., & De Geus, D. (2020). Defining sustainability as measurable improvement in the environment: Lessons from a supply chain program for agriculture in the United States. In P. A. Khaiter, & M. G. Erechtchoukova (Eds.), *Sustainability perspectives: Science, policy and practice* (pp. 133–153). Springer International Publishing (Strategies for Sustainability).

Thorlakson, T. (2018). A move beyond sustainability certification: The evolution of the chocolate industry's sustainable sourcing practices. *Business Strategy and the Environment*, *27*(8), 1653–1665. https://doi.org/10.1002/bse.2230

Ton, G., Vellema, W., Desiere, S., Weituschat, S., & D'Haese, M. (2018). Contract farming for improving smallholder incomes: What can we learn from effectiveness studies? *World Development*, *104*, 46–64. https://doi.org/10.1016/j.worlddev.2017.11.015

Touboulic, A., Chiscksand, D., & Walker, H. (2021). Power in large buyer-small supplier relationships in sustainable supply chains. *Rivista Piccola Impresa*, *2*, 13–28.

Trienekens, J. (2011). Agricultural value chains in developing countries: A framework for analysis. *International Food and Agribusiness Management Review*, *14*(2), 51–82.

Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American Sociological Review*, *61*(4), 674–698.

Vanderhaegen, K., Akoyi, K. T., Dekoninck, W., Jocqué, R., Muys, B., Verbist, B., & Maertens, M. (2018). Do private coffee standards 'walk the talk' in improving socio-economic and environmental sustainability? *Global Environmental Change*, *51*, 1–9. https://doi.org/10.1016/j.gloenvcha.2018.04.014

Veldwisch, G. J., & Woodhouse, P. (2022). Formal and informal contract farming in Mozambique: Socially embedded relations of agricultural intensification. *Journal of Agrarian Change*, *22*(1), 162–178. https://doi.org/10.1111/joac.12461

Waas, T., Hugé, J., Block, T., Wright, T., Benitez-Capistros, F., & Verbruggen, A. (2014). Sustainability assessment and indicators: Tools in a decision-making strategy for sustainable development. *Sustainability*, *6*(9), 5512–5534. https://doi.org/10.3390/su6095512

Williamson, O. E. (1979). Transaction-cost economics: The governance of contractual relations. *The Journal of Law and Economics*, *22*(2), 233–261.

Zak, P. J., & Knack, S. (2001). Trust and growth. *The Economic Journal*, *111*(470), 295–321.

How to cite this article: Benitez-Altuna, F., Materia, V. C., Bijman, J., Gaitán-Cremaschi, D., & Trienekens, J. (2023). Farmer–buyer relationships and sustainable agricultural practices in the food supply chain: The case of vegetables in Chile. *Agribusiness*, 1–28. https://doi.org/10.1002/agr.21829

APPENDIX A

See Table A1

TABLE A1 The scores for each agricultural practice in relationship to the four sustainability dimensions based on the work of Rigby et al. (2001).

Production stage	Sustainability dimensions				Total
	Minimizes off-farm inputs	Minimizes nonrenewable inputs	Maximizes natural biological processes	Promotes local biodiversity	
Seed sourcing					
1 Conventional seed					0
2 Organic seed		1			1
3 Reused	1				1
4 Traditional	1				1
Soil fertility					
1 Conventional synthetic	−1	−1	−1		−3
2 Organic fertilizer purchased		1	1		2
3 Prepared organic fertilizer	2	2	1	3	8
Pest/disease control					
1 Chemical pesticides	−1	−1	−3	−3	−8
2 Organic pesticide purchased		1	1		2
3 Prepared organic pesticide	1	1	1	1	4
4 Preventive practices without chemicals	2	2	2	2	8
Weed control					
1 Chemical herbicides	−1	−1	−1	−1	−4
2 Organic herbicides purchased		1	1		2
3 Mechanical control	1	0.5	1	0.5	3
4 Preventive practices without chemicals	1	1	1	1	4
Crop management					
1 Crop rotation	0.5	0.5	1		2
2 Intercropping	1	1	1	1	4
3 Crop rotation + intercropping	1.5	1.5	2	1	6

Source: Based on Rigby et al. (2001).

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Daniel Gaitán-Cremaschi is a researcher at Universitat Autònoma de Barcelona. He obtained his PhD at Business Economics Group in Wageningen University (2016). He was awarded the 2021 Daniel Carrasco Fellowship edition in Spain. His research is focused on the analysis of the inter-connected drivers of rural vulnerability in Spain, to develop new country-wide and regional indexes for rural development diagnosis. He is also involved in exploring policy scenarios, together with multiple stakeholders, aimed at reducing rural vulnerability.

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