The importance of **entrepreneurship and innovation** for smallholder vegetable farmers in West Java, Indonesia

Etriya Etriya

Propositions

1. Entrepreneurial orientation and innovation have become essential for smallholder farmers to benefit from the fast-changing environments.
   (This thesis)

2. Networks that are rich in business information are precious resources for smallholder farmers in developing countries.
   (This thesis)

3. Improving digital literacy enables smallholder farmers to use cost-efficient technologies, such as mobile devices, to access broader markets and reduce food loss.

4. Protecting genetic diversity helps breeders to develop high-quality crops for promoting food security.

5. Negative and critical comments are bitter to swallow, but they can significantly improve scientific papers.

6. A Ph.D. is more than an academic journey; it is a life journey.

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Etriya Etriya

Wageningen, 18th of December 2020

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Etriya Etriya

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Table of contents

List of tables

List of figures

Chapter 1

Introduction

1.1 Background

Entrepreneurship and innovation are considered essential for farmers to enhance agricultural products' value and sustain their farm businesses. Entrepreneurial and innovative farmers may contribute to the rural economy by producing food, creating employment, generating income, and creating more added value for agricultural products (Carter and Rosa, 1998; Grande et al., 2011; Pindado Tapia, 2017). Therefore, agricultural development policy is suggested to encourage farmers to be more entrepreneurial and innovative to provide a more considerable contribution to the rural economy (Gollin, 2018).

Farmers in developing countries are mostly smallholder farmers operating farms less than two hectares (Hazell et al., 2010). They face the pressure of business environmental changes (hereafter shortened as *environmental changes*) emerging from globalization and agrifood market transformation, i.e., the growth of modern food retail and fresh-food exporters (Pindado and Sánchez, 2017; Poole, 2017; Reardon et al., 2009; Reardon et al., 2014). Entrepreneurial farmers show alertness to environmental changes and seek opportunities coming out of these changes (Dias et al., 2019a; Dias et al., 2019b; Fitz-Koch et al., 2018; Grande et al., 2011; McElwee and Bosworth, 2010). They tend to be the first in the market, bear more risks, be more innovative to meet market demands, earn good incomes, and expand their farm businesses (Grande et al., 2011; Shadbolt and Olubode-Awosola, 2016). For instance, more entrepreneurial farmers prefer to participate in new markets, such as supermarkets and international markets, and fulfill these demands by introducing high-value crops (Sahara et al., 2015; Suprehatin, 2019). In contrast, less entrepreneurial farmers tend to be risk-averse, reluctant to change their usual farm practices, and prefer to engage with long-standing buyers through traditional market channels (Hernández et al., 2015; Marra et al., 2003; Shadbolt and Olubode-Awosola, 2016). They are less adaptive to environmental changes that may cause them to remain small, continue subsistence farming, and earn smaller incomes.

Small farms may find it challenging to reach economies of scale; however, applying specific innovations, such as using high-yield seeds, may improve farm productivity (Barrett et al., 2010; Gollin, 2018; Hazell et al., 2010). Small farms are potentially viable if they produce high-value crops (e.g., horticulture) for modern markets, such as specialty markets or supermarkets (Gollin, 2018), which offer higher prices than traditional markets. For instance, to meet a supermarket's demand, small farms might produce high-value crops using organic farming techniques, applying crop rotation, and using resistant-varieties selection (Thapa, 2010). Therefore, producing high-value crops on relatively small farms can improve smallholder farmers' income in developing countries (Gil et al., 2019; Suprehatin, 2019).

Accordingly, the application of innovations enables smallholder farmers to meet the market demands for high-quality products and, eventually, improve farm performance (Hazell et al., 2010; Wiggins et al., 2010).

Farmers are suggested to be more entrepreneurial to benefit from changing environments (Morris et al., 2017; Pindado and Sánchez, 2017; Vesala and Vesala, 2010). Entrepreneurial farmers keep monitoring the changes in markets and consumer preferences (Grande, 2011; Verhees et al., 2012). These changes also encourage entrepreneurial farmers to innovate by developing new products or improved products or improving business processes, logistics, and marketing to satisfy market demands (Hulsink, 2005; Vik and McElwee, 2011). Farmers are also suggested to engage in business networks to better adapt to environmental changes. Business networks refer to a set of actors and relations providing farmers with technological and market information and access to essential resources (e.g., inputs, credit, and marketing facilities) (Hanneman and Riddle, 2005; Spielman et al., 2011; Vik and McElwee, 2011). Furthermore, farmers are encouraged to perceive business environmental changes as sources of opportunities and reconfigure such changes into a pattern that forms an entrepreneurial opportunity (Baron, 2006; Pindado Tapia, 2017). Thus, business environmental changes may stimulate farmers to be more entrepreneurial, innovative, engaging in more extensive networks, and becoming more alert to opportunities.

In Indonesia, vegetable producers are dominated by smallholder farmers with an average farm size of approximately 0.55 hectares (KEMENTAN, 2012b). Most of them produce low-value vegetables (i.e., vegetables with relatively low prices and are abundant in traditional markets, such as cabbage and carrots). However, some of them already produce high-value ones (i.e., vegetables with relatively high prices, but are relatively rare in traditional markets, such as sweet peppers and lettuce) to meet supermarkets' demands or export markets (Hernández et al., 2015; Maspaitella et al., 2018). Farmers producing high-value vegetables tend to be younger, have higher education, have better access to infrastructure (e.g., roads) and information technologies (e.g., internet connection and mobile phones), and actively participate in farmer groups/cooperatives than those producing low-value vegetables (Maspaitella et al., 2018; Suprehatin, 2019). These high-value oriented farmers are also more efficient in allocating farm resources and receiving more profits than those participating in traditional market channels (Hernández et al., 2015).

This thesis's main objective is to understand what mechanisms allow smallholder farmers in West Java, Indonesia, to adapt to and benefit from the environmental changes. This thesis focuses on the importance of entrepreneurship and innovation enabling smallholder farmers to enhance farm performance and identify opportunities.

1.2 Research questions

The rapid transformation of global and local markets creates environmental changes (Meeus and Hage, 2006) that shorten business product life cycles and make business models obsolete faster (Van de Ven and Poole, 1995). Consequently, it is challenging to foresee market trends (Covin and Slevin, 1989; Teece et al., 1997). Furthermore, farms operating in changing environments may face volatile prices, fierce competition, and difficulties accessing essential resources (Caruana et al., 2002; Pindado and Sánchez, 2017; Shirokova et al., 2016). Farmers are motivated to revitalize their market propositions, business models, and products by engaging in entrepreneurial activities that help them stay competitive (Dias et al., 2019a; Dias et al., 2019b; Fitz-Koch et al., 2018; Pindado et al., 2018).

The rural studies focus on the effect of environmental changes (e.g., supermarkets' growing food demands) on smallholder farmers' livelihood (Hazell et al., 2010; Hernández et al., 2015; Sahara et al., 2015; Wiggins et al., 2010). However, current research has not adequately addressed what mechanisms make smallholder farmers benefit from these environmental changes. Furthermore, it remains unclear how smallholder farmers discover and identify opportunities emerging from these situations. Consequently, there is a need to investigate what factors allow smallholder farmers to adapt to and benefit from these environmental changes. Successful or failed adaptation will be reflected in their farm performance. Hence, the main research question of this thesis is formulated as follows:

The main research question (RQ)*: What factors enable smallholder farmers to enhance farm performance and, ultimately, identify opportunities in changing environments?*

This thesis attempts to enrich our knowledge about entrepreneurship and different types of innovations conducted by smallholder farmers. The literature suggests that enhanced farm performance can be realized by improving entrepreneurial orientation and developing innovations (Gellynck et al., 2015; Grande et al., 2011; Leitgeb et al., 2011; Pindado et al., 2018), changing farmers from conventional commodity producers into entrepreneurs focusing on creating value through innovations (Sher et al., 2019).

Previous studies reveal that entrepreneurial orientation allows farmers in developing countries to innovate and enhance farm performance when facing favorable environment (e.g., the development of logistic infrastructure) or unfavorable environments (e.g., rural poverty or plant-disease attack) (Barzola Iza et al., 2019; Gellynck et al., 2015; Sher et al., 2019; Yessoufou, 2017). However, these studies are not conclusive in explaining what makes smallholder farmers in developing countries adapt to environmental changes, immensely to benefit from opportunities and challenges coming from the agrifood market transformation, such

as the growth of modern markets or price volatility in traditional markets (Pindado and Sánchez, 2017).

Past research on innovation in the agricultural sector mainly focuses on innovation adoption, such as experimenting with new seeds or new farming technologies introduced by suppliers or research institutes (Pannell and Zilberman, 2020). To some extent, farmers may also involve in the process of innovation generation, such as formulating substitutions for chemical farm inputs using local resources or experimenting with local adaptations for new farming technologies (Hoffmann et al., 2007; Leitgeb et al., 2011; Leitgeb et al., 2012). Although farmers may involve in one/both of these types of process innovation, it remains unclear the extent to which entrepreneurial oriented farmers (i.e., proactive and risk-taking farmers) tend to use ready-to-use innovations (i.e., innovation adoption) or develop innovations to find solutions themselves (i.e., innovation generation) (Damanpour and Wischnevsky, 2006). In turn, it is also not clear whether innovation adoption or innovation generation has a more significant impact on the introduction of product innovations (i.e., new or improved products) (Damanpour and Aravind, 2006). Drawing from the literature on entrepreneurship and innovation management, Chapter 2 of this thesis seeks to provide a better understanding of the degree to which entrepreneurial oriented farmers tend to generate and adopt innovations to meet the market demands and, to what extent each of these two process innovations contributes to product innovation. Therefore, this thesis investigates the subsequent relationships between entrepreneurial orientation, innovation adoption, innovation generation, and product innovation. Eventually, successful process innovation and product innovation may be reflected in enhanced farm performance. Accordingly, the research question is as follows:

Research question 1 (RQ1): *In what way do entrepreneurially oriented farmers deploy innovation adoption and innovation generation to introduce product innovations, and does this enhance farm performance?*

Farmers may differ in their response to environmental changes. Previous studies found that some farmers could adapt to the changes by participating in modern markets, developing innovations, or linking to networks (Gellynck et al., 2015; Maspaitella et al., 2018; Spielman et al., 2011; Vik and McElwee, 2011). In contrast, others were unable to adapt to the changes by being reluctant to adopt innovations (Suprehatin, 2019) or giving up producing high-value crops (Carletto et al., 2010). Farmers' adaptability to environmental changes may depend on their entrepreneurship degree (i.e., more entrepreneurial vs. less entrepreneurial farmers) (Antoncic and Hisrich, 2003) and their access to networks (Spielman et al., 2011; Vik and McElwee, 2011).

Smallholder farmers fundamentally have limited resources (e.g., farmland or capital) to operate their farms (Hazell et al., 2010; Wiggins et al., 2010). However, it

remains unclear what enables smallholder farmers to adapt to environmental changes and develop innovations when they lack resources. The literature indicates that linking to a specific type of networks potentially enlarges farmers' access to essential resources and information (McElwee and Bosworth, 2010; Pratiwi and Suzuki, 2017). Numerous studies have investigated the importance of networks on farmers' livelihood (Hoang et al., 2006; Spielman et al., 2011; Warriner and Moul, 1992; Wu and Zhang, 2013). However, these studies pay little attention to the contribution of network content – information discussed between actors in the networks (Burt, 1997b) – to farm businesses. This thesis explores network content in terms of business ties, technology ties, and network heterogeneity. Business ties refer to relationships between actors in the networks exchanging information related to markets and opportunities (Lechner et al., 2006). Technology ties refer to relationships between actors in the networks exchanging information related to technologies and problem-solving (Ahuja, 2000a). Network heterogeneity refers to the diversity of actors' roles in the networks (Renzulli et al., 2000).

We investigate whether the business ties, technology ties, and network heterogeneity combined with entrepreneurial orientation may help smallholder farmers to develop innovations, although scarce resources. This thesis presumes that more entrepreneurial farmers link to more types of network content than those who are less entrepreneurial. Furthermore, linking to networks allows firms to gain positive performance (Walter et al., 2006); therefore, this thesis expects that linking to more types of network content may help smallholder farmers innovate and improve farm performance. Thus, Chapter 3 of this thesis analyzes the impact of network content on farm performance by, firstly, examining the types of network content of more entrepreneurial farmers compared to less entrepreneurial ones and, secondly, the impact of network content on farm performance (i.e., innovative performance and financial performance). The research question is formulated as follows:

Research question 2 (RQ2): *What types of networks (i.e., network content in terms of business and technology ties and network heterogeneity) are linked to more entrepreneurial farmers, and what types of networks improve farm performance?*

Smallholder farmers are encouraged to enhance farm performance and identify opportunities beyond their existing farm activities to benefit from the environmental changes (McElwee and Bosworth, 2010; Pindado et al., 2018). Opportunity identification refers to a process through which entrepreneurs use their knowledge and capabilities to obtain and evaluate information arising from the environments (Shane, 2000) and then reconfigure the information into a meaningful pattern (Baron, 2006). As entrepreneurs, smallholder farmers are eager to identify opportunities by interpreting the environmental changes to turn the existing business into a new business model (Dias et al., 2019a; Morgan et al., 2010). Hence,

environmental changes potentially provide abundant opportunities for farmers to be identified and exploited.

The literature suggests that experience plays a vital role in allowing entrepreneurs to identify opportunities (Hsieh et al., 2007). The experience contains rich knowledge enabling entrepreneurs to understand environmental changes better and translate them into opportunities (Baron, 2006; Venkataraman, 1997). Smallholder farmers in developing countries may find it difficult to access resources; however, experience linking to business partners (i.e., modern markets, suppliers, and supporting organizations) might help farmers understand the market better. Moreover, environmental changes may also stimulate farmers to be more entrepreneurial oriented by being proactive and bear more risks (Gellynck et al., 2015; Pindado et al., 2018).

To our knowledge, the existing literature inadequately explains what factors enable smallholder farmers to identify opportunities coming from environmental changes. Experience and entrepreneurial orientation may help farmers alert on opportunities (Lumpkin and Dess, 1996; Pindado and Sánchez, 2019; Ucbasaran et al., 2009). This thesis expects that entrepreneurial orientation helps farmers be market pioneers by predicting market trends and identifying opportunities (Grande et al., 2011; Verhees et al., 2012). Entrepreneurial orientation serves to transform knowledge integrated into farmers' experience into profitable opportunities. This thesis argues that farmers' experience requires entrepreneurial orientation to be able to identify opportunities. Therefore, Chapter 4 of this thesis focuses on examining the mediating effect of entrepreneurial orientation between farmers' experience and opportunity identification. This chapter addresses the following research question:

Research question 3 (RQ3): *what is the impact of entrepreneurial orientation on the relationships between smallholder farmers' experience and opportunity identification?*

1.3 Theoretical framework

Business environments are acknowledged to have an impact on firms' strategies and performance. The literature suggests that the elements of organizational task environments consist of munificence (i.e., supports from the environments for firms to keep growing), complexity (i.e., the degree of environment's heterogeneity and concentration), and dynamism (i.e., the level of intensity and uncertainty of changes) (Dess and Beard, 1984). Dynamic environments are characterized by rapid changes in business climates and difficulties in predicting market trends (Covin and Slevin, 1989; Teece et al., 1997). Firms operating in dynamic environments may face

challenges in volatile prices, fierce competition, and difficulties accessing essential resources (Caruana et al., 2002; Shirokova et al., 2016). The impacts of the environment on firms are varied. On the one hand, dynamics in economic trends and regulation might encourage firms to create new ventures or help firms realize success. On the other hand, changing environments could also threaten firms' survival due to insufficient resources or a lack of managerial skills (Covin and Slevin, 1989). Thus, changing environments provide firms with opportunities or threats, potentially influencing firms to achieve their goals.

Changes may cause high costs; therefore, firms should reduce the negative impacts of changes (Teece et al., 1997). Firms are suggested to build their capabilities to adapt and even benefit from changing business environments (Chandler, 1990; Prahalad and Hamel, 1990; Teece et al., 1997) and develop entrepreneurial strategies (Covin and Slevin, 1989; Lumpkin and Dess, 1996). Changing environments require firms to make organizational responses by developing specific management capabilities (i.e., firms' abilities to adapt to the changes and manage resources efficiently), such as intensively scanning the markets and monitoring competitors (Teece et al., 1997). Furthermore, in changing market environments, firms must understand customers better by developing adaptable process innovations and introducing product innovations (Slater and Narver, 1995).

Smallholder farmers in developing countries face changing environments, including those in Indonesia (Reardon et al., 2009; Reardon et al., 2015). They need to be adaptive to these changes to sustain their farm businesses. To better understand what factors enable smallholder farmers to benefit from the environmental changes and gain enhanced performance, this thesis uses the following concepts. First, the literature acknowledges that entrepreneurship is closely related to innovation. This stream of study addresses innovation as a consequence of entrepreneurship. For instance, entrepreneurial orientation leads firms to increase innovation generation and adoption (Pérez-Luño et al., 2011). Other studies prove that entrepreneurial orientation enables firms to produce and introduce product innovation to the markets (Avlonitis and Salavou, 2007; Li and Atuahene-Gima, 2001; Parisi et al., 2006). Second, smallholder farmers may find it difficult to improve performance due to physical resource limitations. However, linking to networks may help farmers access essential resources beyond their farms (Hoang et al., 2006; Spielman et al., 2011). Third, smallholder farmers may benefit from environmental changes if they can identify opportunities coming from changing situations. Therefore, the ability to identify opportunities allows farmers to expand their farm businesses further. The following sections provide the concepts of entrepreneurial orientation, innovation, networks, and opportunity identification used in this thesis to analyze how smallholder farmers perform better in the changing environments.

1.3.1 Entrepreneurial orientation

Environmental changes make future profits from the existing business challenging to be predicted (Hamel, 2000; Van de Ven and Poole, 1995). Entrepreneurial orientation serves as a means for firms to stay competitive when dealing with environmental changes and helps firms gain enhanced performance (Lumpkin and Dess, 1996; Wiklund and Shepherd, 2003, 2005). Entrepreneurial orientation enables firms to anticipate future market demands and excel over competitors by taking proactive and risky efforts to develop innovations. As a result, entrepreneurial orientation allows firms to maintain competitiveness (Lumpkin and Dess, 1996). Furthermore, firms are suggested not only to manage existing business operations but also to seize opportunities. Entrepreneurial orientation enables firms to face the fast-changing competitive environments and meet the future market demands by continually scanning market changes, fast responding, and exploiting emerging opportunities for being the first mover in the market. The first mover has the advantages of targeting premium market segments, setting higher prices (Madsen, 2007), and potentially being at the top of market participants' minds. Consequently, entrepreneurial orientation facilitates firms to achieve superior performance (Dess et al., 2011).

The literature acknowledges that entrepreneurship can be viewed as firm-level behavior, which explains the entrepreneurial processes that are depicted in the strategic positioning of the firm (Covin and Slevin, 1991) or entrepreneurial orientation (Lumpkin and Dess, 1996; Miller, 1983). Entrepreneurial orientation refers to organizations' strategic processes in making entrepreneurial decisions and taking actions (Lumpkin and Dess, 1996; Rauch et al., 2009). Entrepreneurial orientation could reflect the firm's top-level management's preference, beliefs, and behaviors in making strategic decisions (Covin et al., 2006).

The conceptualization of entrepreneurial orientation is derived from the studies of Mintzberg (1979) and Khandwalla (1977). They suggest that some firms tend to take more risks and be more proactive in seizing opportunities than other firms. The entrepreneurial orientation concept was then formalized by Miller (1983) and operationalized by Covin and Slevin (1989). Entrepreneurial orientation is reflected by the dimensions of innovativeness, proactiveness, and risk-taking (Covin and Slevin, 1989; Miller, 1983). Innovativeness refers to a firm's tendency to develop innovations aiming to revitalize and improve its market propositions. Proactiveness refers to a firm's tendency to foresee future market demands and initiate actions over competitors to meet the demands. Risk-taking refers to a firm's tendency to allocate a large portion of essential resources to pursue entrepreneurial opportunities (Covin and Slevin, 1989; Lumpkin and Dess, 1996; Miller, 1983).

The literature suggests that entrepreneurial orientation is context-specific. It depends on the external environment (e.g., favorable or harsh) (Covin and Slevin,

1989; Shirokova et al., 2016), industry setting (e.g., high-tech or low-tech) (Pérez-Luño et al., 2011), sector (e.g., agriculture) (Grande et al., 2011; Verhees et al., 2012), or country (developed or developing) (Boso et al., 2013; Gunawan et al., 2016; Shirokova et al., 2016). Studies suggest that entrepreneurial orientation helps farmers in developing countries sustain their farm businesses and enhance farm performance (Barzola Iza et al., 2019; Gellynck et al., 2015; Sher et al., 2019; Yessoufou, 2017).

1.3.2 Innovation

Environmental changes encourage firms to renew their products and the way they serve markets by developing innovations. Innovation is generally defined as forming new ideas or practices in firms. Innovation can be reflected as advancing technological processes or production methods, creating new products, or improving existing products (Damanpour and Wischnevsky, 2006; Wischnevsky et al., 2011). This thesis addresses innovation as technological innovation consisting of process innovation and product innovation (Gopalakrishnan and Damanpour, 1994, 1997; Utterback and Abernathy, 1975).

Process innovation refers to new methods of production, new ways of commodity handling (Schumpeter, 1934), or new technological changes (i.e., techniques, systems, equipment), which are used to produce existing or new products (Meeus and Edquist, 2006). Product innovation refers to new goods, improved-quality products (Schumpeter, 1934), new material products (Meeus and Edquist, 2006), or product differentiation, which are new to the markets (Damanpour and Aravind, 2006). Process innovation allows firms to enhance efficiency by reducing production/operational costs or delivery lead time and raising flexibility. Product innovation allows firms to meet market demands or serve new markets (Boer and During, 2001). The newness of process innovation covers the firm level, while product innovation's newness covers the market or industry level (Damanpour and Aravind, 2006). Consequently, these two types of technological innovation enable firms to build competitive advantage (Jones and Tang, 2000).

Scholar distinguishes process innovation in terms of innovation generation and innovation adoption (Damanpour and Wischnevsky, 2006; Gopalakrishnan and Damanpour, 1994). Innovation generation refers to conditions in which firms internally generate technological processes or products new to the markets. Innovation adoption refers to the assimilation of knowledge and technological processes discovered and introduced by other organizations, new to the firms (Damanpour and Wischnevsky, 2006). Innovation generation explores new knowledge, while innovation adoption exploits existing knowledge (March, 1991a). Both innovation generation and innovation adoption may result in new or improved products (Wischnevsky et al., 2011).

Farmers show involvement in process innovation by conducting experiments and adopting innovations to produce product innovation (Hoffmann et al., 2007; Leitgeb et al., 2011). Numerous studies emphasize that many farmers, including smallholder farmers in developing countries, are involved in process innovation through innovation adoption (Llewellyn and Brown, 2020; Pannell and Zilberman, 2020). Smallholder farmers consider short-term returns, upfront costs, relative advantages, and extension services' quality before adopting innovations (Llewellyn and Brown, 2020). Afterward, farmers test the innovations' feasibility and adapt them to be suitable to local circumstances (Leitgeb et al., 2011). Accordingly, innovation adoption allows farmers to assimilate knowledge or technologies from external sources to improve farm processes.

Besides adopting innovation, farmers may also generate their innovations by conducting experiments using formal/informal approaches. The reasons for farmers to conduct experiments are gaining economic benefits; improving farm techniques, production systems, and farm management to increase yields or reduce losses; and better using local resources (Hoffmann et al., 2007; Leitgeb et al., 2011; Leitgeb et al., 2012). To innovate, farmers gather knowledge from farmer-to-farmer learning or share with researchers and extension agents at workshops or farmers' field schools (Leitgeb et al., 2011). Thus, conducting experiments allow farmers to generate new knowledge and keep learning to better adapt to environmental changes (Leitgeb et al., 2012).

1.3.3 Networks

Environmental changes may motivate firms to search for essential resources from their networks. A network consists of actors and a set of relations (i.e., linkages between actors) (Hanneman and Riddle, 2005; Wasserman and Faust, 1994). Relations are essential in networks serving as channels to share and exchange valuable resources between actors, such as information, knowledge, advice, capital, and problem solving (Hoang and Antoncic, 2003; Lin, 2001). Information shared in networks may consist of information about markets and how to understand and meet customer needs. These types of information allow firms to identify opportunities. Networks may also support firms to realize these opportunities by giving access to essential resources (e.g., technologies, financial and human capital, distribution channels), reducing risks or costs (Elfring and Hulsink, 2003; Hoang and Antoncic, 2003). When facing environmental changes, linking to networks may enable farmers to access essential resources that are needed to identify and use opportunities emerging from these changes (DeRosa et al., 2019; McElwee and Bosworth, 2010; Vik and McElwee, 2011).

One of the networks' elements is content that refers to the information, issues, or advice discussed or exchanged between actors (Burt, 1997b; Hoang and Antoncic,

2003). This thesis emphasizes the importance of network content for farmers as information and knowledge related to business or technologies discussed between farmers and their contacts. Therefore, we operationalize network content as business ties and technology ties. Business ties refer to linkages between actors (i.e., ties) that provide information related to markets and opportunities (Lechner et al., 2006), while technology ties refer to ties that provide information about new technologies in processes or products (Ahuja, 2000a). Information related to business and technologies may help farmers understand and meet market demands (Phillipson et al., 2004). Furthermore, farmers may obtain local knowledge (relatively more tacit) and expert knowledge (relatively more explicit) from diverse types of contacts in their networks, defined as the level of network heterogeneity (Esparcia, 2014; Renzulli et al., 2000). Therefore, this thesis also considers network heterogeneity as part of network content, providing farmers with non-redundant information (i.e., various types of information) and essential to developing innovations and access more markets (Burt, 2001).

1.3.4 Opportunity identification

Entrepreneurs tend to be alert to opportunities emerging from environmental changes and anticipative to seize these opportunities (Kirzner, 1997; Lumpkin and Dess, 1996). Opportunities are defined as situations in which new or improved products, services, raw materials, organizing methods, or resource combinations have higher potential market value than the production costs (Casson, 1982; Kirzner, 1973; Shane and Venkataraman, 2000). Opportunities can help entrepreneurs create new value creation by better meeting market demands (Ardichvili et al., 2003; Eckhardt and Shane, 2013; Wood and Williams, 2014). Furthermore, opportunities can be created by using new information and market inefficiency due to information asymmetries (Drucker, 1985).

This thesis investigates opportunity identification using the opportunity discovery concept. This concept pays attention to the presence, discovery, and exploitation of opportunities (Shane and Venkataraman, 2000). This concept addresses opportunities as phenomena, where not all people are alert to their presence (Kirzner, 1997; Shane and Venkataraman, 2000). Opportunities may arise from market gaps when supply and demand in the markets do not meet the equilibrium point (Kirzner, 1997) or emerge in imperfectly competitive markets (Alvarez and Barney, 2004, 2007), which result in surpluses, shortages, or misallocated resources (Shane and Venkataraman, 2000). These disequilibrium situations may create certain information that is apparently unrelated (Baron, 2006). Entrepreneurs are alert to the presence of the opportunities emerging from these disequilibrium situations (Kirzner, 1973; Shane and Venkataraman, 2000). They discover opportunities by reconstructing the apparently-unrelated information into a meaningful pattern (Baron, 2006), and exploit these opportunities by transforming

their available resources into new products/services (Kirzner, 1973; Shane and Venkataraman, 2000). Thus, the opportunity discovery concept emphasizes entrepreneurs' alertness and actions to respond to the presence of opportunities (Alvarez and Barney, 2007; Kirzner, 1997).

This thesis assumes that environmental changes create opportunities that are ready to be discovered. More entrepreneurial farmers are presumed to be more alert to the opportunities emerging from the agrifood market transformations than those who are less entrepreneurial. Therefore, more entrepreneurial farmers are expected to discover and pursue more opportunities than less entrepreneurial ones.

1.4 Research context

For decades, agriculture is vital for Indonesia's economy, contributing to economic growth and providing many people's income. Agriculture accounted for approximately 14% of GDP in 2018 (FAO, 2018; Statistics-Indonesia, 2019a), and the average growth rate of GDP contributed by agriculture was 3.40% between 2017-2019 (Statistics-Indonesia, 2019c). The total land area for agriculture is approximately 32% of the total land area in Indonesia. Furthermore, this sector provides jobs for 33 percent of Indonesia's labor force, particularly in rural areas (FAO, 2018). Indonesia's total agricultural households were approximately 27.22 million, consisting of 15.81 million small farms, with a size of smaller than 0.5 hectares on average (Statistics-Indonesia, 2018). Within 2013-2018, the number of smallholder farmers increased, with a growth rate of approximately 10.95% (Statistics-Indonesia, 2018). However, the average size of small farms tends to decrease over the last 30 years (Reily, 2018); similar situations are found in many other countries (Fan et al., 2013; Hazell et al., 2007).

The share of food spending (including fresh food) in modern markets in Indonesia has increased by approximately 30% in 2007 (Minot et al., 2015). Sales of the retail food industry, including supermarkets, approximately grow up to 8.9% in 2019 (GAIN, 2019). This situation leads these modern markets to find continuous supplies from farmers. Changes in customer demands for high-value products and ongoing consolidation among supermarkets give them more power over farmers (Reardon et al., 2009; Reardon et al., 2012). This situation has increased the pressure on smallholder farmers. The environments in which they operate are changing quickly toward modern markets with larger supermarkets that serve customers who are more demanding and appreciate value-added food products (Minot et al., 2015). Most smallholder farmers find it challenging to meet modern markets' requirements for high-quality standards and specific logistics (Fan et al., 2013). However, some smallholder farmers who are entrepreneurial and innovative can meet the modern markets' requirements by producing high-value products, including vegetables.

These farmers can overcome their limitations by engaging in farmer groups to learn from experts or peers how to improve farm productivity or produce high-value crops (Maspaitella et al., 2018; Pratiwi and Suzuki, 2017). These farmers benefit from participating in the modern markets by getting technical support to produce the required products and secure outlets for their products.

The horticultural sector is one of Indonesia's critical agricultural sectors, providing an average GDP growth rate of 5.35% between 2017 and 2019 (Statistics-Indonesia, 2019c). Consumers in Indonesia spent 15 percent (in urban areas) and 17 percent (in rural areas) of their food budget on fruit and vegetables in 2010 (Reardon et al., 2015). Producing horticultural products provides farmers with higher returns per hectare than producing staple crops, such as rice (Reardon et al., 2015). Therefore, horticultural crops could be categorized as high-value crops, which potentially provide high farm income.

West Java is one of Indonesia's main horticulture production areas, mainly producing vegetables and contributing to 35% of the national vegetable production (KEMENTAN, 2017a; Natawidjaja et al., 2007). The empirical research for this thesis has been conducted in vegetable farms in West Java, where farmers face environmental changes in terms of the rapid growth of modern markets (e.g., food retail/supermarkets, exporters, and food processors) and the competition from foreign vegetable producers.

Vegetable farmers in West Java are mostly smallholders. The average farm size of vegetable farmers in West Java was 0.55 hectares, and the average farmer age was 43.50 years (KEMENTAN, 2012b). Most vegetables are produced on open fields, while some medium/high-value ones are produced in greenhouses or on farms with plastic shades. Most farmers sold their products through village traders, which dominated the traditional market channels in West Java (Hernández et al., 2015). Since 1990, the vegetable demands of modern markets (e.g., supermarkets, food processors, and export markets) in the cities of West Java (e.g., Jakarta and Bandung) have increased, and vegetable farmers started to participate in the supply chains of these modern markets. Most farmers were organized by farmer groups or cooperatives that collected and delivered vegetables to supermarkets/ exporters/food processors via dedicated or specialized wholesalers. These farmers earned market shares between 11% to 15% and received net revenues that were 10% to 30% higher than those who participated only in the traditional market channels (Natawidjaja et al., 2007).

Entrepreneurial orientation is contextual and may work better in the situation of dynamic business environments (Covin and Slevin, 1989; Shirokova et al., 2016), including fast-changing markets, increasing global competitiveness, and shortened product life cycles (Kreiser et al., 2001; Wiklund and Shepherd, 2003). Therefore,

West Java, where smallholder farmers face rapid environmental changes, is well suited for studying entrepreneurship and innovation.

1.5 Research methods

This thesis uses primary data that were gathered with two surveys. To determine the study populations, we gathered a list of vegetable farmers from several sources, including local authorities, extension agents/agricultural officials, and cooperative managers. The preliminary study was conducted in 2011 to pre-test the questionnaire by conducting in-depth interviews with six experts from a farmer cooperative, a farmer group, a non-governmental organization, and an agricultural university between May and December 2011. Based on these interviews, five regions in West Java, i.e., Pangalengan Bandung, Cisarua West Bandung, Warung Kondang Cianjur, Pacet Cianjur, and Bogor (Figure 1.1), were purposively selected for the survey based on the following criteria: variation of vegetable types, diversity of technologies, and access to diverse actors in the vegetable sector (Table 1.1). While vegetable production was our main area of interest, the survey areas are mostly in the commercial zones for vegetable production (e.g., Pangelengan dan Cisarua) (Hernández et al., 2015) and close to big cities (e.g., Bandung, Bogor, and Jakarta).

Table 1.1. Farm description in the survey areas

Region	Number of observations		Average farm size (hectare)		Vegetable type	Farm technology
	2012	2016	2012	2016		
Pangalengan, Bandung	70	97	3.65	1.78	Potato, leafy vegetables	Open field, greenhouses
Cisarua, West Bandung	28	35	1.05	1.96	Sweet pepper, mushroom	Hydroponic in greenhouses
Warung Kondang, Cianjur	95	-	0.68	-	Tomatoes, leafy vegetables, broccoli	Open field
Pacet, Cianjur	36	75	0.78	0.55	Lettuce, celery	Organic farming, open field with plastic shades
Bogor	39	-	0.80	-	Japanese soya bean, leafy vegetables	Organic farming, open field with plastic shades
Garut	-	95		1.90	Tomatoes, leafy vegetables	Open field
Total	268	302	1.53	1.53		

The first survey was conducted in 2012, involving 282 respondents that were administered using face-to-face interviews. Due to incomplete answers and too small farm size (below 0.05 ha), 14 observations were excluded, yielding 268 observations for the data analyses (Table 1.1). This survey was used to test the research questions of Chapters 2 and 3 (RQ1 and RQ2), measuring the variables of entrepreneurial orientation, innovation adoption, innovation generation, product innovation, network types, and farm performance.

Entrepreneurial farmers may not be satisfied to only focus on operating their current farms. They tend to seize more opportunities beyond their current farm businesses, using their past experiences. Therefore, the second survey conducted in 2016 investigates the effect of entrepreneurial orientation and farmers' experience on opportunity identification (RQ3). This survey interviewed 320 respondents in four regions of West Java, i.e., Pangalengan Bandung, Cisarua West Bandung, Garut, and Pacet Cianjur (Figure 1.1). These regions were selected based on the criteria of technology variations (e.g., farms that used greenhouses, open fields, or plastic shades) and market channel variations (e.g., traditional versus modern market channels). After data cleaning, this thesis maintained 302 usable observations for further analyses (Table 1.1).

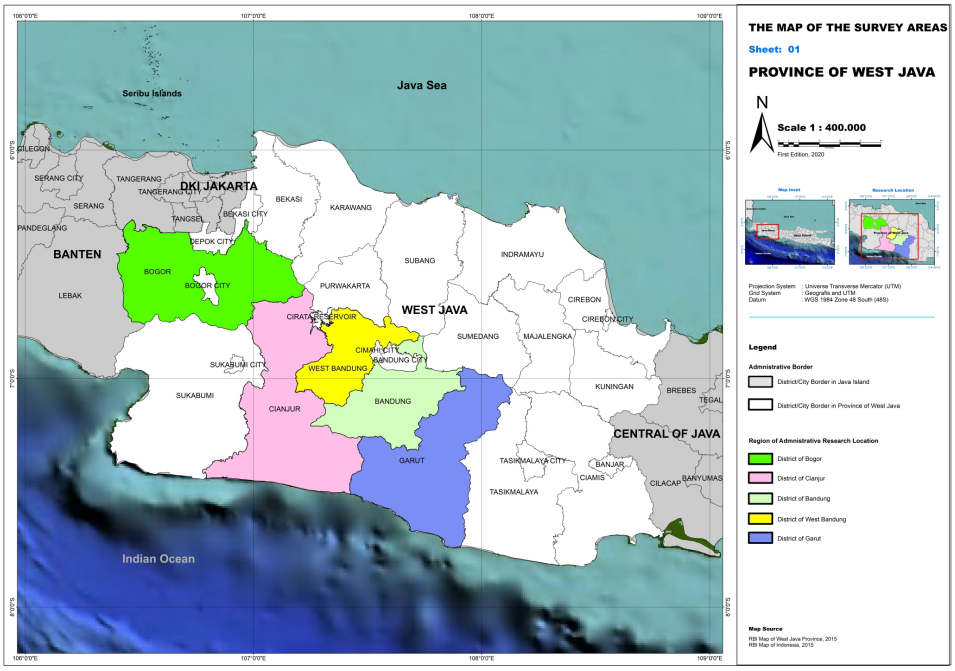

Figure 1.1 The survey areas

The entrepreneurship literature suggests to use the concept of entrepreneurship (e.g., entrepreneurial orientation) at different levels; from the firm/company level to the level of smaller firms, or to the level of the individual entrepreneur, which is more relevant for "everyday entrepreneurship" (Welter et al., 2016), such as agricultural entrepreneurship. Agricultural entrepreneurship may represent "everyday entrepreneurship," which is contextual and mostly consists of small businesses (Pindado and Sánchez, 2019; Welter, 2011), especially in developing countries (Barzola and Dentoni, 2020; Yessoufou et al., 2018). In the view of agricultural entrepreneurship, farmers play roles not only as managers but also as entrepreneurs (McElwee and Bosworth, 2010). Therefore, this thesis used the farmer as the unit of analysis with the assumption that the farmer – as the farm leader – represents his/her farm, consistent with the concept of entrepreneurial orientation, which assumes the firm as the unit of analysis (Covin and Wales, 2019; Lumpkin and Dess, 1996; Wiklund and Shepherd, 2005). Smallholder farmers can also be assumed as the founders of their farms, which can be considered similar to small independent firms. The firm's strategic orientation and performance may reflect the founders (McGee and Peterson, 2019; Rauch et al., 2009). Accordingly, this thesis's unit of analysis is the farmers who are assumed to be the founders and the owners-managers representing their farms.

Objective measures were used to examine the dependent variables farm performance (i.e., farm revenues in Chapters 2 and 3, innovative and financial performance in Chapter 3) and opportunity identification (Chapter 4). Objective measures were also used to examine the independent variables product innovation (Chapter 2), network content and network heterogeneity (Chapter 3), farmers' experience (Chapter 4), and the control variables farm size, farmer age, and education. The management literature acknowledges that objective measures have advantages in providing factual information, reflecting the real world closely, and having lower risk at a common method bias. Common method bias refers to respondents' tendency to provide similar responses to different survey questions, such as similar scores for questions on the Likert scale (Andersén, 2010; Andrews et al., 2006). Therefore, using objective measures may reduce this potential bias.

We chose West Java for the survey area because West Java is one of Indonesia's main vegetable production areas contributing to approximately 20% of national vegetable production (DIRJEN-HORTIKULTURA, 2015). To indicate the representatives of our study samples, in Table 1.2, we present the demographic description of farmers in West Java in our surveys in 2012 (n = 268) and 2016 (n = 302), compared to the last governmental survey, which was held in 2011 (n = 232,068) (KEMENTAN, 2012b). The average farmer age of our survey in 2012 is 44.07 years and 47.61 years in 2016, which is only slightly higher than the average farmer age of the government survey (i.e., 43.50 years). However, our surveys' average farm size is approximately three times larger than the average farm size in

the government's survey. Our survey's average farmers' education level is approximately two times higher than the average farmers' education in the government survey. The reason for these differences can be found in the fact that our survey areas are close to big cities (Figure 1.1), which might cause the farmers in these areas to have better access to education and modern markets than those who live in more remote areas of West Java.

Table 1.2. Demographic description of farmers in West Java: this thesis' surveys vs. government's survey

Indicator	Unit	Average score		
		This thesis's survey		Government's survey
		2012 [a]	2016[b]	2011[c]
Farmer age	Year	44.07	47.61	43.50
Farm size	Hectare	1.53	1.53	0.55
Education	Year	8.23[d]	9.33[e]	4.57[f]

[a] n = 268
[b] n = 302
[c] n = 232,068 (KEMENTAN, 2012b)
[d] It is equal to the third year in junior high school
[e] It is equal to the first year in high school
[f] It is equal to the fifth year in elementary school

This thesis not only uses objective, but also used subjective measures (i.e., perceptual data), consisting of variables of entrepreneurial orientation (Chapter 2, 3, and 4), innovation adoption, and innovation generation (Chapter 2) by using a seven-point Likert scale. Subjective measures might suffer from the problem of a common method bias (Andersén, 2010; Andrews et al., 2006); therefore, this thesis performed the marker variable test (Chapter 2) (Podsakoff et al., 2003) and Harman's one-factor test (Chapter 4) (Harman, 1976; Podsakoff and Organ, 1986) to check the presence of this potential bias. The results indicate that no substantial common method bias was found in this thesis's subjective-measured variables.

PLS-SEM analysis was performed to test the research models and hypotheses of Chapter 2 and Chapter 4. PLS-SEM analysis is suitable to test the structural models involving both reflective construct (i.e., a latent variable that the measured items are regarded to be caused by that latent variable) and formative one (i.e., a latent variable that the measured items are regarded to be the cause of the latent variable) (Garson, 2016). The relationships of these two types of constructs were measured as indirect effects with subsequent relationships (Chapter 2) and mediating effects (Chapter 4) (Hair et al., 2017). The research model and hypotheses of Chapter 3 were examined using the Mann-Whiney tests and the OLS regression analyses. In this study, farmers' entrepreneurial degree was categorized into two groups (i.e., more entrepreneurial vs. less entrepreneurial farmers) using cluster analysis based on the level of entrepreneurial orientation (Avlonitis and Salavou, 2007; Klastorin,

1983). We then performed the Mann-Whitney tests to examine the difference between these two groups regarding the use of networks (i.e., business ties, technology ties, and network heterogeneity). Afterward, OLS regression analyses were performed to analyze the impact of entrepreneurial orientation degrees and networks on farm performance.

1.6 Thesis outline

This thesis is presented as follows. Chapter 2 provides a research framework to understand better innovation's role in facilitating entrepreneurial-oriented smallholder farmers to perform better when facing environmental changes (i.e., dynamic agrifood markets). This chapter builds subsequent relationships to analyze if entrepreneurial orientation enhances innovation adoption and generation. In turn, if innovation adoption and generation enhance product innovation (i.e., new and improved products); eventually, if product innovation enhances farm performance.

Chapter 3 investigates the importance of farmers' entrepreneurial degree, determined by their entrepreneurial orientation to distinguish more entrepreneurial farmers versus less entrepreneurial ones. Furthermore, we analyze the importance of farmers' network content (i.e., business ties, technology ties, and network heterogeneity) in enhancing farm performance.

Chapter 4 further investigates smallholder farmers' adaptation to environmental changes by identifying opportunities beyond their current farm business. This chapter focuses on the mediating role of entrepreneurial orientation between farmers' experience (linking to modern markets, suppliers, and supporting organizations) and opportunity identification.

Chapter 5 discusses the findings of this thesis and provides the main conclusions. This chapter also elaborates on this thesis's contributions to the literature and provides the managerial and policy implications and suggestions for further research. Figure 1.2 depicts the structure of the thesis outline.

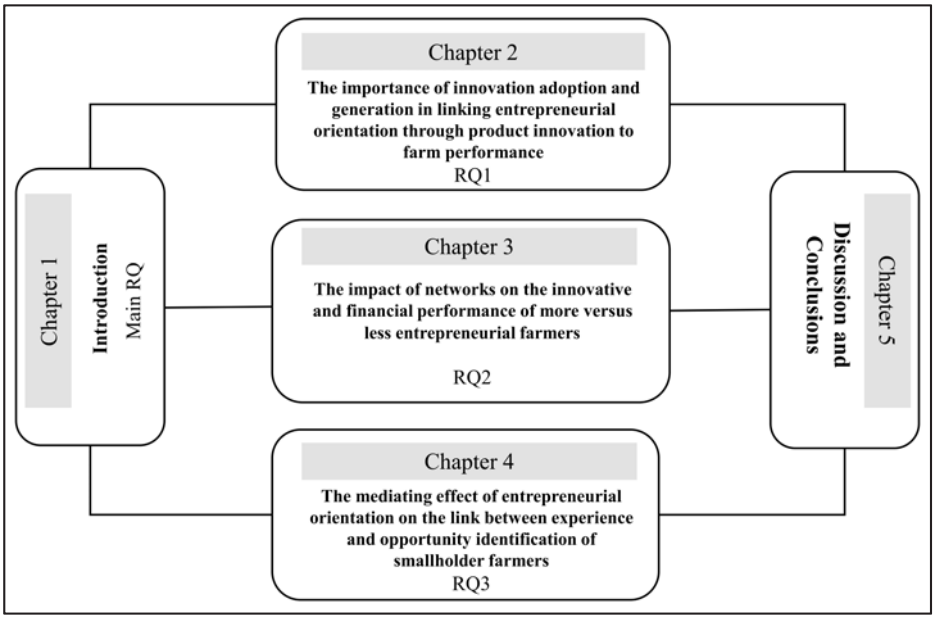

Figure 1.2 Thesis outline

Chapter 2

The importance of innovation adoption and generation in linking entrepreneurial orientation through product innovation to farm performance

This chapter is based on:

Etriya, E., Scholten, V.E., Wubben, E.F.M., Kemp, G.M., and Omta, S.W.F. 2018. The importance of innovation adoption and generation in linking entrepreneurial orientation with product innovation and farm revenues: the case of vegetable farmers in West Java, Indonesia. *International Food and Agribusiness Management Review* 21:7, 969-987.

2.1 Introduction

Agrifood market transformation has significantly changed farmers' business environments in emerging economies, increasing the importance of modern markets, such as modern food retail, food processors, and export markets in Indonesia (Natawidjaja et al., 2007; Reardon and Barrett, 2000; Sunanto, 2013). Although these modern markets require stricter arrangements than traditional markets, they provide farmers with new opportunities to participate in markets. In this market transformation, competitiveness and performance may depend on farmers' abilities to adapt to changes in the business environment (Mirzaei et al., 2016; Shadbolt and Olubode-Awosola, 2016).

However, it is not clear if entrepreneurial farmers who are proactive and risk-taking, including those in certain regions of Indonesia, respond to agrifood market transformation, either by adopting innovations developed by other parties, such as research institutes (Sunding and Zilberman, 2001), or by actively researching and generating innovations themselves (Hoffmann et al., 2007; Leitgeb et al., 2011). Both innovation processes may result in new or improved products, indicating product innovation (Carletto et al., 2010; Sahara et al., 2015), which, in turn, may impact farm performance. However, considering the differences in organizational conditions that facilitate the processes of adopting or generating innovations (Damanpour and Wischnevsky, 2006; Pérez-Luño et al., 2011), it is not clear how farmers innovate in the context of agrifood market transformation. Therefore, this chapter addresses the following research question: in what way do entrepreneurially oriented farmers deploy innovation adoption and innovation generation to introduce product innovations, and does this enhance farm performance?

This chapter builds on the literature on entrepreneurship and innovation management. The effect of entrepreneurial orientation on firm performance may vary with the entrepreneurs' innovative capabilities (Jantunen et al., 2005) and by the business environment (Covin and Slevin, 1989; Shirokova et al., 2016). Some claims entrepreneurially oriented farmers are more proactive in exploiting market opportunities and taking risks to renew market offerings by introducing product innovation (Grande et al., 2011; Verhees et al., 2012). The innovativeness dimension of entrepreneurial orientation can be elaborated by the innovation process concept, positing that product innovations may come from either innovation generation or innovation adoption (Damanpour and Wischnevsky, 2006; Pérez-Luño et al., 2011). This chapter draws on prior studies demonstrating that entrepreneurial orientation affects innovation generation or innovation adoption (Pérez-Luño et al., 2011), entrepreneurial orientation is vital for firms in developing countries (Boso et al.,

2013; Shirokova et al., 2015), and entrepreneurial orientation enhances farm performance (Grande et al., 2011; Verhees et al., 2012). Farm performance can be demonstrated by financial performance indicators such as revenues, as suggested by Micheels and Gow (2015). We use farm revenues to indicate farm performance. This chapter aims to investigate in a dynamic agrifood market if entrepreneurial orientation enhances both innovation adoption and generation and if both of these actions enhance product innovation and, eventually, farm revenues.

This chapter is organized as follows: It begins with developing the theoretical framework of entrepreneurial orientation, innovation, and farm revenues, followed by developing the conceptual model and hypotheses. Next, the Methods section explains our sample of Indonesian vegetable farmers, measurements, validations, and data analyses. This section is followed by the Results section that provides test results and hypotheses tests. This chapter discusses and concludes with the main findings, including the contributions, implications, limitations of our study, and future research suggestions. When relevant, this chapter uses the terms farm and firm interchangeably, indicating the same research unit. Similarly, when relevant, our study considered the farmer as representing his/her firm. With few exceptions, the farms in our sample can be typified as so-called simple organizations, where the individual entrepreneur owns and manages the firm (Miller, 1983).

2.2 Theoretical framework and hypotheses

Entrepreneurial orientation represents a strategy-making process that enables firms to achieve a competitive advantage by exploring and exploiting new market opportunities (Miller, 1983; Pérez-Luño et al., 2016). Since entrepreneurial orientation works better in a dynamic business environment (Covin and Slevin, 1989), entrepreneurial orientation is expected to excel in rapidly developing countries and markets for both firms (Boso et al., 2013; Gunawan et al., 2016) and farmers (Grande et al., 2011; Verhees et al., 2012). This chapter expands on prior studies that investigate entrepreneurial orientation and innovation (Avlonitis and Salavou, 2007; Pérez-Luño et al., 2011) and follows comparable studies (Hult et al., 2004; Rhee et al., 2010) by integrating proactiveness and risk-taking as dimensions of entrepreneurial orientation in anticipating innovations.

Firms face challenges and opportunities when confronted with the transformation of the business environment (Boso et al., 2013; Reardon et al., 2009). Firms with higher entrepreneurial orientation levels are considered to be more proactive and comprehensive when scanning their business environments (Miles et al., 1978) and exploiting their knowledge (Lumpkin and Dess, 1996). Proactiveness relates to the striving for first-mover advantages, responsiveness to market signals, and taking initial actions by venturing into the unknown (Rauch et al., 2009). Proactive firms

benefit from being the first movers in the market by having an opportunity to set up brand recognition (Lumpkin and Dess, 1996) and potentially achieve enhanced performance (Lumpkin and Dess, 2001).

The literature on entrepreneurial orientation suggests that firms with risk-taking behaviors seek new opportunities and aim for high returns by creating a large amount of debt, allocating a large number of essential resources, investing in cutting-edge technologies, or introducing product innovations to new markets (Lumpkin and Dess, 1996). Entering new markets or partaking in a market transformation helps entrepreneurial firms deal with potential costs. They may consist of market research costs to forecast the success of new or improved products (Falkner and Hiebl, 2015; Gilmore et al., 2004) or investment in developing processes and product innovations (Brustbauer, 2014; Falkner and Hiebl, 2015). As a result, these firms face risks, such as creating losses. Hence, entrepreneurially oriented firms also typically bear more risks, reflecting on their courage to take considerable risks to seize new opportunities (Lumpkin and Dess, 1996).

Regarding outcomes, entrepreneurially oriented firms are believed to pursue successful outcomes in risky situations (Lumpkin and Dess, 1996), but the evidence is inconclusive on experiencing positive outcomes. The literature on entrepreneurship presumes that risk-taking firms/farms can seek out and transform new opportunities into superior performance, which can be reflected by their financial performance, such as profits or business growth (Shadbolt and Olubode-Awosola, 2016). However, evidence of the influence of risk-taking on performance is mixed (Shadbolt and Olubode-Awosola, 2016). For instance, as a dimension of entrepreneurial orientation, Rauch et al. (2009) found that firms with a tendency to bear risks also have enhanced firm performance. In contrast, Naldi et al. (2007) found that, among family firms, firms that take risks have decreased performance. Similarly, an empirical study conducted among dairy farmers in New Zealand found that farmers who perceive themselves as risk-seekers take almost the same risks as either risk-neutral or risk-averse ones. However, risk-seeking farmers perform worse because they are less capable of managing risks (Shadbolt and Olubode-Awosola, 2016). These findings suggest that risk-taking farmers cannot be described only by their braveness in taking risks. Instead, risk-taking farmers are best described as those who can demonstrate success in taking and managing risks and thereby realize superior performance.

Although risk-taking may not enhance firm performance, an elaboration of risk-taking and proactiveness can potentially enhance product innovativeness and product performance, indicating firm performance (Avlonitis and Salavou, 2007). Innovativeness is suggested as a dimension of entrepreneurial orientation (Lumpkin and Dess, 1996) that may help proactive and risk-taking firms realize higher performance. This chapter places innovation in the context of farmers'

entrepreneurial orientation, which is consistent with the conceptualization of innovation as 'creative destruction,' suggesting that entrepreneurship is an essential innovation source leading to new economic activities and enhanced revenues (Drucker, 1985; Schumpeter, 1961). Therefore, we define innovation as a consequence of entrepreneurial orientation, which may help farmers enhance farm revenues.

Previous studies show that entrepreneurial orientation helps farmers achieve better performance in the long run and enables farmers to expand their farm business (Grande et al., 2011; Verhees et al., 2012). This chapter considers the comprehensive innovation concept by elaborating on the new role of innovation in the relationship between entrepreneurial orientation and enhanced farm performance, especially farm revenues, by developing subsequent relationships in a structural model. This chapter posits that proactive and risk-taking farmers (i.e., entrepreneurially oriented farmers) use innovation adoption and innovation generation to produce product innovations, resulting in enhanced farm revenues.

2.2.1 Innovation adoption and innovation generation

The innovation management literature distinguishes between the innovation process and the resulting innovation output. Within the innovation process, one may distinguish between innovation adoption and innovation generation (Gopalakrishnan and Damanpour, 1994, 1997), whereas innovation output consists of product innovation and process innovation (Utterback and Abernathy, 1975). How firms developing an innovation process or output can be viewed through the approach of innovation systems. The innovation systems approach refers to processes where information and knowledge are created, exchanged, and used by various actors involved in a system and result in the development and diffusion of innovations (Spielman et al., 2011). For the agricultural sector in developing countries, innovation systems are conceptualized as the process of institutional learning and changes and the relationship between the innovations and the institutional environment where innovation development takes place (Biggs, 1990; Spielman et al., 2011). Innovations are developed by exchanging information and knowledge among farmers, farmers' organizations/cooperatives, researchers, or private companies to respond to (socio-economic) environmental changes (Spielman et al., 2011). In addition to farmers, we acknowledge the role of other actors involved in agricultural innovation systems; however, this chapter mainly focuses on how farmers develop innovations on their farms through either adoption or generation to produce product innovations.

To adapt to market changes, firms enhance their effectiveness and competitiveness by either adopting or generating innovations (Damanpour and Wischnevsky, 2006). Innovation adoption refers to innovation processes that enable firms to be more

effective and competitive by assimilating products, services, or technologies new to the firm. Innovation generation refers to innovation processes that promote the creation and implementation of products, services, or technologies that are new to the market (Damanpour and Wischnevsky, 2006). Innovation adoption exploits current opportunities or seeks out existing advantages by following somewhat predictable steps; innovation generation combines creating an idea and its commercial development by involving an uncertain process (Damanpour and Wischnevsky, 2006; March, 1991b). Consequently, innovation adoption is preferred as a short-term strategy to satisfy market needs quickly. In contrast, innovation generation is preferred as a long-term strategy to anticipate future market needs (Pérez-Luño et al., 2011). This chapter deploys innovation adoption, innovation generation, and product innovation to analyze the innovativeness of farms.

2.2.2 Entrepreneurial orientation enhancing innovation adoption

The dimension of proactiveness refers to the willingness to initiate an action or a tendency to be a first-mover by anticipating future needs (Lumpkin and Dess, 1996). To respond to changes in the environment, proactive firms are alert to opportunities and search for new possibilities to satisfy future market needs earlier than their competitors (Miller, 1983; Pérez-Luño et al., 2011). Proactive firms may rely on existing knowledge to select and assimilate innovations available in the market or create new knowledge by developing innovations (Pérez-Luño et al., 2011). Innovation adoption is a process of acquiring information, introducing (new or existing) knowledge, and assimilating knowledge into firms through learning (Damanpour and Wischnevsky, 2006; Spielman et al., 2011). The innovation adoption process is relatively fast because innovation adoption utilizes current knowledge for internal learning (Damanpour and Wischnevsky, 2006; Pérez-Luño et al., 2011). Hence, proactive firms tend to adopt innovations to satisfy market demands quickly.

Entrepreneurially oriented farmers are more willing to take risks and to explore market opportunities proactively. Vegetable farmers in West Java, Indonesia, face a dynamic business environment with the growth of modern food retail and export markets. These markets require farmers to provide non-local vegetables (Reardon et al., 2009), such as Japanese vegetables, or higher-quality local vegetables, such as organic vegetables. To quickly fulfill the market demand for new products, entrepreneurially oriented farmers may capture this opportunity by adopting innovations developed elsewhere, such as by research institutes or seed companies (Diederen et al., 2003). Before investing in innovation through innovation adoption, farmers assess the risks by searching for information on potential costs (including switching costs) and benefits of the innovation from their own or other farmers'

experiments (Diederen et al., 2003; Marra et al., 2003). Hence, proactive and risk-taking farmers (i.e., entrepreneurially oriented farmers) anticipate and adapt to market changes by adopting innovations. Therefore, our hypothesis is the following:

H1: Farmers who are more entrepreneurially oriented will adopt more innovations.

2.2.3 Entrepreneurial orientation enhancing innovation generation

Innovation requires firms to be proactive in predicting future needs and take considerable risks (Avlonitis and Salavou, 2007). The literature suggests that the proactive and risk-taking dimensions of entrepreneurial orientation may stimulate innovation adoption and also innovation generation. When proactive firms need to adapt to the dynamics of customer needs, it is claimed that firms cannot rely merely on innovation adoption (Pérez-Luño et al., 2011; Pérez-Luño et al., 2016). Proactive firms with forward-looking vision tend to generate innovation to address future competition (Avlonitis and Salavou, 2007). Firms may anticipate new market demands by generating innovations. Innovation generation does not mean that firms generate completely new products themselves, but they may continuously improve an existing product, including improving the product design. In this case, firms must develop knowledge to help them adapt to changes in customer preferences (Pérez-Luño et al., 2011). To benefit from pioneering new products, risk-taking firms may take on a large amount of debt to invest in new technologies to be used in generating innovations (Lumpkin and Dess, 1996). Hence, proactiveness and risk-taking may stimulate firms to generate innovations.

The innovation generation of farmers combines farmers' ideas with their existing knowledge (Leitgeb et al., 2012) and capabilities to produce innovations (Gopalakrishnan and Damanpour, 1997). The process of generating innovations can be described as farmer experiments (Leitgeb et al., 2011). Farmer experiments are usually conducted with an informal research approach, resulting in local innovations (Hoffmann et al., 2007). These experiments are conducted on small plots with local resources as the main inputs (Leitgeb et al., 2012) for developing well-adapted varieties, crop or animal breeding, plant protection, new production systems, or farm equipment (Hoffmann et al., 2007). Outcomes of farmer experiments are assessed by observations and comparisons considering the complexity of farm systems (Leitgeb et al., 2012). An alternative approach to conducting farmer experiments is the formal research approach that follows a formal research design. To better respond to market changes, the synergy of applying both research approaches is encouraged, either by farmers themselves or in collaboration with researchers (Hoffmann et al., 2007). In summary, through farmer experiments, innovation generation is an essential means of learning to

anticipate and adapt to changing markets (Hoffmann et al., 2007; Leitgeb et al., 2012).

Farmers' proactiveness may stimulate the process of generating innovations in recognizing market opportunities and risk-taking in investing necessary resources (Grande et al., 2011). Therefore, we expect that proactive and risk-taking farmers (i.e., entrepreneurially oriented farmers) will generate more innovations in response to market changes. Therefore, our hypothesis is the following:

H2: Farmers who are more entrepreneurially oriented will generate more innovations.

2.2.4 Product innovation

Product innovation is defined as new technology or the assimilation of technologies that provide new products to the market (Avlonitis and Salavou, 2007; Utterback and Abernathy, 1975). Product innovation may represent different innovativeness degrees, ranging from radical to merely incremental (Avlonitis and Salavou, 2007). Radical product innovation is perceived as new to the world or the sector, while incremental product innovation is perceived as new to the firm. Therefore, product innovation includes any changes that lead to new production techniques or improvement of existing products (Katila and Ahuja, 2002; Parisi et al., 2006), including product upgrades, modifications, and extensions (Li and Atuahene-Gima, 2001). Thus, product innovation encompasses new products and improved existing products with different degrees of innovativeness (Avlonitis and Salavou, 2007).

The need to adapt to changing market demands may stimulate farmers to either adopt innovations (Adesina and Baidu-Forson, 1995) or generate innovations by improving the existing ones (Hoffmann et al., 2007; Leitgeb et al., 2012), both of which may result in either new or improved products (Sunding and Zilberman, 2001). In the case of vegetable farmers in West Java, some were willing to meet the export markets' increasing demands for sweet peppers in the late 1990s. To produce this type of vegetable, the farmers adopted seeds from Dutch seed companies and learned greenhouse technology from a Dutch university. This innovation adoption process resulted in the production of sweet peppers, which were relatively new to the farmers and domestic markets. Over time, the demand for both export and domestic markets for sweet peppers increased, similar to the situation in Thailand (Schipmann and Qaim, 2010); however, the prices of imported farm inputs also increased. Some farmers looked for a substitution for the imported farm inputs by conducting experiments, such as formulating plant nutrition from local ingredients or constructing greenhouses from local materials. This innovation generation process resulted in sweet peppers that were well-adapted to the local environment, as indicated by Hoffmann et al. (2007) and Leitgeb et al. (2012). Hence, innovation

adoption and innovation generation will enhance new or improved products. Therefore, our hypothesis is the following:

H3: Innovation adoption (a) and innovation generation (b) will enhance product innovation of farmers.

2.2.5 Farm revenues

Firms' abilities to recognize and respond to market transformation might be reflected in product innovation (Szymanski et al., 2007) and firm performance (Micheels and Gow, 2015). To fulfill the rapidly changing demands of the dynamic market, entrepreneurially oriented firms may generate and launch product innovations in the form of differentiated products, extra attributes, or product extensions (Walter et al., 2006), all of which have potential commercial values (Banbury and Mitchell, 1995). The success of product-innovation commercialization can be described in terms of financial performance, such as higher sales or revenues (Szymanski et al., 2007). For farms, revenues refer to amounts earned from sold farm-products (Argilés and Slof, 2001), representing the value of products produced on the farm (Severini et al., 2017). By introducing product innovations into the market, entrepreneurially oriented farmers may enjoy the first-mover benefit (Micheels and Gow, 2015) to enhance revenues from either higher prices or sell more of the innovative products (i.e., new or improved products). For instance, premium prices for new vegetables or improved local vegetables in the market could increase farmers' opportunities to enhance revenues. This chapter posits that product innovation will lead farms to enhance farm revenues. Therefore, our hypothesis is the following:

H4: Product innovation will enhance farm revenues.

2.3 Methods

Suitable testing grounds for the structural model were found in the dynamic business environment of West Java. West Java is one of the most densely populated provinces in Indonesia, where the demand for vegetables has increased in both modern and traditional markets (Natawidjaja et al., 2007; Sunanto, 2013). The ongoing market transformation had already doubled the sales of vegetables and fruits in the decade between 1994-2004 (Natawidjaja et al., 2007; Sahara and Gyau, 2014). Because modern markets require vegetables with strict quality characteristics, vegetable farmers in West Java have adapted themselves by producing vegetables with specific innovations, such as organic or greenhouse farming. Hence, the setting of vegetable farmers in West Java provides researchers with an opportunity to better understand the generic relationships among

entrepreneurial orientation, innovation adoption and innovation generation, product innovation, and farm revenues for the agricultural sector, especially in the context of agrifood market transformation in developing countries.

The questionnaire was pre-tested through in-depth interviews with experts from a farmer cooperative, a farmer group, a non-governmental organization, and an agricultural university to increase the validity of items used in the questionnaire. Based on in-depth interviews and results from a prior study by Natawidjaja et al. (2007), five regions in West Java were selected for a survey (i.e., Pangalengan Bandung, Cisarua West Bandung, Pacet Cianjur, Warung Kondang Cianjur, and Bogor) by deploying the following criteria: diversity in vegetable types and variation in farm innovations.

We first used the list of 3,732 vegetable farmers in the five regions provided by local authorities, extension agents, and cooperative managers as the population database. After rechecking the list with farmer-group chairpersons in villages, we found the list was not updated. Some farmers on the list were not available, could not be contacted, or were not producing vegetables. Similar difficulties in accessing an updated study population from local authorities also occurred in a previous study conducted in West Java (Gunawan et al., 2016). Then, we found 1,263 vegetable farmers on the updated list, used as the sampling frame. Using proportional quota sampling, we tried to contact all farmers on the list in each region. We finally obtained 282 farmers who could be reached systematically or who were willing to participate in the survey. The data set was collected through face-to-face interviews. Fourteen cases were excluded due to missing data on revenues or due to small farm size (less than 0.05 ha), which yielded a final sample size of 268 farmers. This final sample size represented a response rate of 21.2 % of the target population.

2.3.1 Measurements

This section presents the operationalization of independent and dependent variables, which consist of reflective and formative constructs. Each construct was evaluated based on reliability and validity. The *construct reliability* of the reflective construct is determined by (1) loadings of construct-to-items that should be higher than cross-loadings of constructs (Chin, 2010), (2) Cronbach's Alpha (CA), which represents internal construct consistency that should be higher than 0.70 (Nunnally, 1978), and (3) the composite reliability (CR), suggested being higher than 0.60 (Hair et al., 2011). The *construct validity* of the reflective construct is determined by the discriminant validity of constructs, calculated by the average variance extracted (AVE), indicating the amount of variance explained by the construct. AVE should be higher than 0.50, and the square root of AVE values (Table 2.1, the bold diagonal) should be higher than correlations among constructs (Chin, 2010). The *construct reliability* of the formative construct is demonstrated by the variation inflation

factor (VIF) that should be lower than 10, indicating the absence of collinearity (Field, 2009).

2.3.1.1 Independent variable

2.3.1.1.1 Entrepreneurial orientation

The concept of entrepreneurial orientation assumes firms as the unit of analysis. Accordingly, our study took the farmer as representing the firm because a farm shows characteristics of a simple organizational form, where the individual entrepreneur owns and manages the firm (Miller, 1983). Additionally, most farms embody an entrepreneurial firm' characteristics, which has a flexible structure meaning that the entrepreneur manages the firm, allocates the resources, and organizes production activities through direct supervision (Douma and Schreuder, 2008). One may characterize farms in West Java, mostly having a simple and undiversified organizational structure. Our survey investigated how many of them embodied the characteristics of an entrepreneurial firm.

To measure entrepreneurial orientation, we used the dimensions of proactiveness and risk-taking, consisting of six items in total (Covin and Slevin, 1989). All items were measured with a seven-point semantic-differential scale, adapted from Covin and Slevin (1989). One may measure entrepreneurial orientation using a multidimensional construct (Lumpkin and Dess, 1996). However, this chapter followed the argument suggesting entrepreneurial orientation as a unidimensional construct because all dimensions should be highly correlated (Wiklund and Shepherd, 2005). A principal component factor analysis (PCA) of the six items was conducted to test this argument. The analysis revealed that all six items were loaded on a single factor, with a total variance of 60.43% and an eigenvalue of 3.63. This construct exhibits good reliability and validity (CA = 0.87, factor loadings ≥ 0.72, CR = 0.90, AVE = 0.60, square root AVE = 0.77 > correlations among the constructs) (Table 2.1). We concluded that entrepreneurial orientation is reliable and valid as a unidimensional construct.

2.3.1.2 Dependent variables

2.3.1.2.1 Innovation adoption

We assessed farmers' innovation adoption based on three items: adopting new seeds, new farming techniques, and new farm inputs, adapted from Diederen et al. (2003). In West Java, farmers typically source these three items from input suppliers, research institutes, or farmer groups. We used a seven-point Likert scale ranging from 1 (not at all) to 7 (a great extent) to rate the extent to which they adopted the items in the period 2009-2011. The construct exhibits adequate reliability and validity (CA = 0.78, factor loadings ≥ 0.82, CR = 0.87, AVE = 0.69, square root AVE = 0.83 > correlations among the constructs) (Table 2.1).

2.3.1.2.2 Innovation generation

We assessed innovation generation by farmers based on three items adapted from Hoffmann et al. (2007) and Van der Veen (2010): generating new fertilizers, new pesticides (especially for bio-pesticides and bio-fertilizers, both of which were formulated from local-based ingredients), and new farming techniques. We used a seven-point Likert scale ranging from 1 (not at all) to 7 (a great extent) to rate the degree to which the farmers generated or developed (by themselves) the three items from 2009 to 2011. This measure, see Table 2.1, posits good reliability and validity (CA = 0.80, factor loadings ≥ 0.76, CR = 0.88, AVE = 0.70, square root AVE = 0.84 > correlations among the constructs). Potential collinearity (0.66) is indicated for the correlation between entrepreneurial orientation and innovation generation (Table 2.1). The variance inflation factor (VIF) scores (tested using the ordinary least squares (OLS) regression analysis) did not confirm this potential collinearity. The VIF scores were higher than 2.5 for both constructs but far below the threshold of 10, indicating the absence of collinearity (Field, 2009).

2.3.1.2.3 Product innovation

To operationalize product innovation, we used a formative construct with objective and subjective measures as items that indicate new and improved products. We used two items to indicate new products: the number of new products and the type of high-value vegetables; and two items to indicate improved products: number of new varieties and the degree of product changes. Respondents were asked to indicate the number of new products and the new varieties they have cultivated and sold in the market from 2009 to 2011, respectively. High-value vegetables provide high economic returns per unit of farm size or per unit of weight (CGIAR, 2006). This item was measured by using a dummy variable (1 = high-value vegetable; 0 = otherwise). The degree of product changes contains a perceptual question related to improved products (Avlonitis and Salavou, 2007; Covin and Slevin, 1989; Utterback and Abernathy, 1975). This item was measured using a seven-point-semantic-differential scale with a neutral midpoint (Covin and Slevin, 1989) measuring the extent to which the existing products have improved from the previous ones. The formative construct of product innovation (Table 2.2) exhibits good reliability (VIF scores of the four items ranged from 1.09 to 1.36, indicating the absence of collinearity).

2.3.1.2.4 Farm revenues

Vegetable farmers in West Java usually cultivate various types of vegetables on their farms (Natawidjaja et al., 2007), representing the agricultural sector's general characteristics, which usually produce multiple crops in the same season (Just and Pope, 2001). To assess farm performance, we used objective measures as suggested by Micheels and Gow (2015); objective measures have the advantage of being less prone to common method bias than subjective measures (Andersén, 2010). A previous study recognized that many farmers, especially smallholder farmers, lacked accounting information because they have no legal obligation to make financial statements (Argilés and Slof, 2003). We found a similar situation among farmers in West Java. That forced us to examine financial performance differently. Because only a few farmers could or wanted to share financial records, our study relied on recall data. Consequently, we arrived at incomplete information on the production costs of vegetables. The farmers' ability to recall quantities and prices of sold vegetables proved much better than their ability to recall the amount and value of each vegetable's specific farm inputs. Consequently, the value of net farm revenues or farm profitability could not be derived. Alternatively, we operationalized farm revenues as gross farm revenues. Adapted from the concept of total revenues (Mankiw, 2003), the value of farm revenues was calculated as the sum of gross revenues from all vegetables produced in a year (2011), formulated as follows:

$$\text{Gross farm revenues} = \sum_{i=1}^{n} P_i \times Q_i$$

Where P_i is vegetable prices, and Q_i is vegetable quantities sold.

Farm revenues were measured as a construct that was reflected by three items: gross revenues and gross revenues per unit of farm capital, in terms of farmland (revenues/ha) (adapted from Nuthall (2011), and Shadbolt and Olubode-Awosola (2016)), and per employee (revenues/employee) (adapted from Nuthall (2011)). This construct, see Table 2.1, shows strong reliability and validity (CA = 0.75, factor loadings ≥ 0.71, CR = 0.86, AVE = 0.68, square root AVE = 0.82 > correlations among the constructs).

Table 2.1. Measurement for reflective constructs and inter-construct correlations

Constructs and items	Factor loadings	CA	CR	AVE	1	2	3	4
1. Entrepreneurial orientation		0.87	0.90	0.60	**0.77**			
Proactive on initiating changes	0.74							
Proactive on being a pioneer	0.80							
Proactive over competitors	0.80							
Risk-taking on new projects	0.79							
Risk-taking on achieving goals	0.80							
Risk-taking on being a first-mover	0.72							
2. Innovation adoption		0.78	0.87	0.69	0.49**	**0.83**		
Adopting new seeds	0.82							
Adopting new farming techniques	0.84							
Adopting new farm inputs	0.83							
3. Innovation generation		0.80	0.88	0.70	0.66**	0.20**	**0.84**	
Generating new fertilizers	0.85							
Generating new pesticides	0.76							
Generating new farming techniques	0.89							
4. Farm revenues		0.75	0.86	0.68	0.44**	0.21**	0.27**	**0.82**
Gross revenues	0.71							
Gross revenues per hectare	0.86							
Gross revenues per employee	0.89							

CA = Cronbach's Alpha; CR = Composite Reliability, AVE = average variance extracted. The bold numbers on the diagonal are the square root of the average variance extracted. Below the diagonal are correlations among the constructs.

** Significant at the $p < 0.01$

* Significant at the $p < 0.05$

Table 2.2. Measurement for formative construct and inter-construct correlations

Construct and items	Variation inflation factor (VIF)	Entrepreneurial orientation	Innovation adoption	Innovation generation	Farm revenues
Product innovation		0.63**	0.57**	0.38**	0.37**
Number of new products	1.36				
High-value vegetables	1.09				
Number of new varieties	1.28				
Improving the existing products	1.14				

** Significant at the $p < 0.01$

* Significant at the $p < 0.05$

2.3.1.3 Control variable

This chapter used control variables for farm size and farmer age. Farm size is a proxy of farm resources that allows farmers to conduct trials or experiments for innovations (Mariano et al., 2012). Larger farms adopt more innovations, such as new farm inputs and new equipment (Feder, 1985). Hence, farm size is likely to be

positively correlated with innovation adoption, innovation generation, and product innovation. We operationalized farm size by the size of farmland (hectares) dedicated to vegetable production. Farmer age is a proxy of human resources, which indicates older farmers are likely to be more risk-averse than younger farmers. Therefore, one may expect that older farmers will be less innovative than young ones (Adesina and Baidu-Forson, 1995). Thus, farmer age is likely to be negatively correlated with innovation adoption, innovation generation, and product innovation. We operationalized farmer age by taking the age of the farmer (years).

2.3.2 Data analysis

To test our hypotheses, we performed a data analysis by partial least squares (PLS) as a component-based structural equation modeling approach, which requires less stringent assumptions concerning variable distribution and error terms (Diamantopoulos and Winklhofer, 2001; Henseler et al., 2009). To carry out the data analyses, we used SmartPLS 3. (Ringle et al., 2015).

To assess the potential of common method bias, we used the marker variable test (Podsakoff et al., 2003). We used networks with governmental institutes as the marker variable because it was a subjective measure, similar to other main variables, with low correlations with the dependent variables. The marker variable consisted of four (seven-point-Likert scale) items measuring farmer networks with government officers, government financial agencies, government administrative agencies, and top officials in government (Li and Atuahene-Gima, 2001). The assessment demonstrated that adding the marker variable to the structural model did not substantially change the structural model's path coefficients, as required. To conclude, the test indicated no substantial common method bias in our data.

2.4 Results

The descriptive statistics of our model show that the average gross revenue per hectare is 13,082 USD (standard deviation (s.d.) = 23,377). The indicators of entrepreneurial orientation are positively and significantly correlated with the indicators of innovation adoption and generation. Regarding the control variables, the average farm size in the sample is 1.53 hectares (s.d. = 3.04), which is above average for vegetable farms in West Java. The control average age of the farmers in the sample is 44.07 years (s.d. = 11.16), roughly similar to the average age of vegetable farmers in the general population.

The reliability and validity of the structural model were evaluated using the variance explained, requiring R^2 values > 0.10 (Falk and Miller, 1992) and the significance of all path estimates as the core of the PLS analysis (Chin, 2010). Results demonstrate

that for the four endogenous variables, all constructs reached the R^2 threshold of 0.10, ranging from 0.13 to 0.45 (Figure 2.1).

Figure 2.1 presents the effects of the main and control variables on the structural research model. The standardized path coefficients (β) indicate the degree to which exogenous variables contributed to the explained variance of the endogenous variables, using bootstrap estimation. Bootstrapping of 500 resamples of the PLS estimation was then used to derive the path coefficients, standard errors, and t-statistics of the structural research model (Chin, 1998) (Figure 2.1).

The results support hypothesis 1 that entrepreneurial orientation enhances innovation adoption ($\beta = 0.49$, $p < 0.01$), and the results support hypothesis 2 that entrepreneurial orientation enhances innovation generation ($\beta = 0.62$, $p < 0.01$). Furthermore, the results support hypothesis 3a that innovation adoption enhances product innovation ($\beta = 0.50$, $p < 0.01$) and support hypothesis 3b that innovation generation enhances product innovation ($\beta = 0.28$, $p < 0.01$). Finally, the results also support hypothesis 4 that product innovation enhances farm revenues ($\beta = 0.29$, $p < 0.01$). To conclude, the results confirmed all hypotheses related to the structural research model.

Regarding the control variable, the results show that larger farm size corresponds to higher innovation generation ($\beta = 0.10$, $p < 0.05$), and younger farmers correspond to higher the innovation adoption ($\beta = -0.12$, $p < 0.05$). The results also confirmed that larger farm size corresponds to higher farm revenues ($\beta = 0.14$, $p < 0.01$). Interestingly, in this extensive research model, neither farm size nor farmer age is directly significantly correlated with product innovation. Furthermore, counter to the expectation, farmer age is not significantly correlated with innovation generation. The results imply that physical assets, such as farm size, and human resources, such as younger age, enable farmers to realize innovations via innovation generation and adoption, respectively, and farm size correlates with better performance (Grande et al., 2011).

To assess the overall model fit, we calculated the overall goodness-of-fit (GoF) index of the research model. The GoF index = 0.51 is higher than the GoF of the single-factor model (Henseler and Sarstedt, 2013; Sirén et al., 2012). The measure of standardized root mean square residual (SRMR) = 0.10 is in the range of suggested cut-offs (Garson, 2016) (Figure 2.1). One may conclude that the structural research model fits the data.

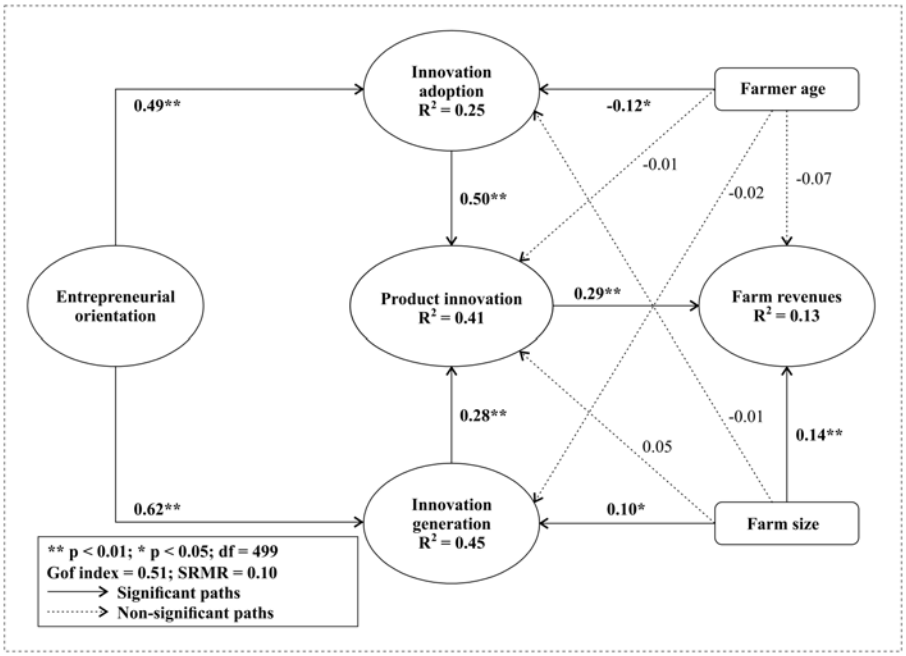

Figure 2.1. Results for the research model

2.5 Discussion

This chapter investigates in a dynamic agrifood market if entrepreneurial orientation enhances innovation adoption and generation and if both of these actions enhance product innovation and, eventually, farm revenues. First, this study positively answers the research questions, providing evidence that entrepreneurial orientation via different innovation processes leads farmers to introduce product innovations and perform better. Although entrepreneurial orientation may directly impact performance, this relationship cannot capture the whole scenario (Shirokova et al., 2016). The results regarding the structural research model show that all main effects are substantial and highly significant. The inclusion of innovation processes adds significantly to the explanation of how entrepreneurial orientation enhances performance (Pérez-Luño et al., 2011; Pérez-Luño et al., 2016), especially in a dynamic farm business environment (Mirzaei et al., 2016; Shadbolt and Olubode-Awosola, 2016). Therefore, we may derive that entrepreneurial orientation needs further articulation regarding innovation processes and output and in terms of enhancing revenues in the context of agricultural sectors (Grande et al., 2011) and developing countries (Boso et al., 2013; Gunawan et al., 2016; Shirokova et al., 2016).

Our findings indicate that farmers may follow a series of processes to enhance their farm revenues. Farmers seem to monitor the environment and predict the market needs before taking risks in innovative projects to produce innovative outputs for changing markets, enhancing farm revenues. Therefore, enhanced farm revenues may indicate farmers' success in understanding, adapting to, and satisfying markets by being entrepreneurially oriented and innovative, deploying innovation adoption or innovation generation, and introducing product innovation. We built on a current debate in the literature regarding how entrepreneurial orientation affects farm revenues. We presented a more detailed view of the relationships between entrepreneurial orientation, innovation adoption, innovation generation, product innovation, and, ultimately, their effects on farm revenues.

Our results demonstrate that proactiveness and risk-taking (the items) characterize entrepreneurial orientation (the construct) of vegetable farmers in a dynamic business environment in West Java, with growing modern food retail and export markets. The results add to the knowledge of countries gathered from farmers in more mature markets, such as the Netherlands (Verhees et al., 2012) or Norway (Grande et al., 2011). Thus, it was concluded that entrepreneurial farmers who are proactive and risk-taking seek innovation to anticipate changes in the future (De Lauwere, 2005). For our reflective construct, entrepreneurial orientation (Table 2.1), we used the dimensions of proactiveness and risk-taking, comprised of six items (Covin and Slevin, 1989). The data set on Indonesian farmers shows that entrepreneurial orientation is also a unidimensional construct in dynamic agrifood markets in developing countries, featuring risk-taking on projects, goal achievement, and first-mover advantages, in addition to proactiveness to be a pioneer and initiate change.

The contribution of entrepreneurial orientation, especially risk-taking, to the realization of product innovations may be explained, to some extent, by resource allocation for innovation generation. Previous studies acknowledge innovation generation by farmers as local innovations that represent incremental innovation (Hoffmann et al., 2007; Micheels and Gow, 2015), such as modifications to farm practices or equipment (Van der Veen, 2010). Farmers take part in innovation generation employing uncertain farm experiments (Hoffmann et al., 2007) that require farmers to allocate resources already in use, such as time, parts of farmland, labor, farm inputs, and money. Thus, in terms of innovation generation, entrepreneurially oriented farmers are risk-taking, focusing on possible future benefits, carefully assessing the costs and potential additional benefits of an investment (Abadi Ghadim et al., 2005; Marra et al., 2003). This chapter identified the formulation of new fertilizers, pesticides, and farming techniques as recognized innovation generation processes.

Our study also shows that entrepreneurial orientation enhances innovation adoption. For high-technology sectors, it is no surprise to find evidence that entrepreneurial orientation greatly enhances innovation generation (Pérez-Luño et al., 2011). Similar to agricultural sectors in developing countries, innovation adoption plays an important role (Bandiera and Rasul, 2006; Mariano et al., 2012). Agricultural innovations were conventionally developed via public sector R&D, and diffusion took place via (orchestrated) extension networks (Pant and Hambly-Odame, 2010). Demand for new crops, such as non-local vegetables, could be fulfilled quickly by adopting seeds developed by seed companies or research institutes (Carletto et al., 2010). Data set from the five regions in West Java selected for the survey shows that most farmers adopt seeds, farm inputs, and new farming techniques from external sources. Here, farmer age restricts innovation adoption, indicating that older farmers tend to decline to adopt innovations.

As hypothesized, the results show that innovation adoption and innovation generation, enhance product innovation in the dynamic agrifood industry context of West Java. The formative construct product innovation reflects the number of new products, high-value vegetables, new varieties, and improved existing products (Table 2.2). An original and interesting outcome from the data is that the control variables do not relate directly to the variable product innovation but impact product innovation only through innovation generation, taking into account farm size as a proxy of farm resources. The control variable also affects product innovation through innovation adoption, taking into account farmer age as a proxy for human resources. The results confirm that product innovation enhances farm revenues as a robust reflective construct, developed due to deficient information on vegetables' production costs. This result may explain the different effects of entrepreneurial orientation on innovations.

2.6 Conclusions

The transformation of the agrifood market in developing countries stimulates farmers to enhance performance by seizing market opportunities. This chapter investigates in a dynamic agrifood market if entrepreneurial orientation enhances innovation adoption and generation and if both actions enhance product innovation and, eventually, farm revenues. The study was carried out in West Java, geographically near Jakarta (the urban area), providing a dynamic business environment for entrepreneurially oriented Indonesian vegetable farmers (Natawidjaja et al., 2007; Sahara et al., 2015). The results confirm each of the four hypotheses and the related structural research model. First, entrepreneurial orientation enhances innovation adoption and innovation generation; second, innovation adoption and generation enhance product innovation; and third, product

innovation enhances farm revenues. Overall, the findings indicate that subsequent relationships among entrepreneurial orientation, innovation adoption, innovation generation, and product innovation are essential in enhancing farm revenues.

Entrepreneurial orientation enables farmers to innovate by risk-taking and being proactive in anticipating demand, either through adopting available products, services, or technologies that are new to the firm (innovation adoption) or through researching and developing their own techniques, fertilizers, or pesticides (innovation generation). Both of these options provide new or improved products. Our results support studies demonstrating entrepreneurial orientation enhances innovation and firm or farm performance (Avlonitis and Salavou, 2007; Boso et al., 2013; Grande et al., 2011; Pérez-Luño et al., 2011). Our study of both innovation adoption and innovation generation combined with the dynamic agrifood context in a developing country adds significantly to the knowledge regarding how entrepreneurial orientation enhances performance, especially farm revenues. Based on extensive empirical research, we conclude that the elaboration of the innovation dimensions (i.e., innovation adoption, innovation generation, and product innovation) provides additional insights into the relationship between entrepreneurial orientation and farm revenues.

More specifically, this chapter benefits from a wide and deep database and contributes to the literature by providing insights on the entrepreneurial orientation-innovation-performance relationships in a specific context. The literature on farm entrepreneurship is mainly focused on the direct effects of entrepreneurial orientation on farm performance (Grande et al., 2011). However, in general, the relationship between entrepreneurial orientation and firm performance is complex (Dess et al., 1997a; Moreno and Casillas, 2008), with reviews continually suggesting to take into account different applications of key constructs (Rauch et al., 2009). A promising research line involves organizational efforts that aim for innovation adoption and generation (Pérez-Luño et al., 2011) and product innovation (Avlonitis and Salavou, 2007). There is an indication that the entrepreneurial orientation-performance relationship is contextual, where entrepreneurial orientation does not seem to directly enhance firm performance in developing countries (Shirokova et al. (2015). This chapter succeeded in developing and confirming a structural research model incorporating entrepreneurial orientation, innovation, and farm revenues as subsequent relationships in a developing country's agricultural sector.

This chapter has implications for farmers as well as for policymakers. In terms of dynamic agrifood markets, this chapter encourages farmers to pursue market opportunities by taking both innovation adoption and generation seriously when aiming at product innovations and performance enhancement. Farmers adapt to the business environment by taking risks and pioneering markets with innovations to

stay competitive. Farmers should be critical when analyzing how to pursue market opportunities, either through short-term innovation adoption or through longer term innovation generation, by considering the nature and consequences of both innovation processes (Pérez-Luño et al., 2011). The results show that both innovation processes positively impact product innovation and farm revenues. Thus, policymakers are encouraged to provide farmers with information about business forecasts that could help them anticipate changes in their business environment and prevent a one-sided approach in stimulating farmers' innovativeness.

Regarding the limitations, one should interpret our findings with caution. In general, our results show that entrepreneurial farmers, who are proactive and risk-taking, adopt or generate more innovations, produce more product innovation, and in turn, enhance farm revenues. However, the evidence on the influence of risk-taking on firm/farm performance is inconsistent (Naldi et al., 2007; Shadbolt and Olubode-Awosola, 2016). For instance, by confirming the measures of perceptual risk preference (attitude to risks) with actual risks, Shadbolt and Olubode-Awosola (2016) found that risk-seeking farmers performed worse than risk-neutral and risk-averse farmers. In this chapter, we measured risk-taking with perceptual measures (Covin and Slevin, 1989), which may limit our findings in explaining the positive impact of risk-taking on innovations, and eventually on farm revenues. Therefore, we suggest future studies on entrepreneurial orientation elaborate on perceptual measures of risk-taking (e.g., Covin and Slevin (1989) with actual measures of risks taken by firms (e.g., Lee et al. (2001), and with measures of risk management strategies (e.g., Shadbolt and Olubode-Awosola (2016).

Next, this chapter studied the relationships of entrepreneurial orientation, innovations, and farm performance. However, one may still question whether entrepreneurial and innovative farmers realize profits or not. Farm profitability, as an indicator of farm performance (Nuthall, 2011), could not be used in this chapter due to the absence of data on costs. We suggest future studies consider farm profitability measures, such as operating profit margin or return on assets (Shadbolt and Olubode-Awosola, 2016). It will be necessary to develop methods for collecting the data of farm production costs and capital investment, to obtain the profitability measures, especially from farmers who lack financial records.

Another limitation of this chapter is related to the sample selection. With the five selected areas in West Java, the farmer population used was based on lists provided by local authorities or extension agents. However, during fieldwork, it was discovered that many farmers, especially young farmers, were not on any of these lists. One may argue that the sample might be biased towards an over-representation of farmers with government support. A study is needed to improve the sampling method in developing countries, such as Indonesia, which might suffer

from incomplete data availability (Gunawan et al., 2016). West Java is near the capital city, Jakarta, which allows farmers in West Java to benefit from better access to information, technology, and logistics than farmers in other provinces in Indonesia. Although West Java cannot represent the whole country of Indonesia, the rapid growth of modern markets in areas near West Java (Minot et al., 2015) is similar to situations in other developing countries as well, which makes West Java an interesting study location of entrepreneurial orientation and innovations in changing markets, in line with Covin and Slevin (1989). We recommend similar studies that apply the structural research model to farmers in flexible vs. protected sub-sectors, especially in rural areas in other countries that express similar dynamic markets.

A final limitation of this chapter is related to the relatively simple specification of the context caused by the partial analysis adopted in this study. As in any study, due to our objective of investigating the subsequent relationships of entrepreneurial orientation, innovations, and farm performance, constructed in a structural model, an extensive database was needed. We then went in-depth to gather data on specific variables and reported concisely. In adopting or generating innovations, farmers may rely on other stakeholders as innovation sources (Biggs, 1990). Hence, we suggest further studies to consider innovation systems incorporating farmer social networks. We also suggest farmers collaborate with diverse stakeholders, such as scientists (Hoffmann et al., 2007) and upstream or downstream partners (Micheels and Gow, 2015), as these contextual variables might impact farm innovativeness and farm performance.

Chapter 3

The impact of networks on the innovative and financial performance of more versus less entrepreneurial farmers

This chapter is based on:

Etriya, E., Scholten, V.E., Wubben, E.F.M., and Omta, S.W.F. 2019. The impact of networks on the innovative and financial performance of more entrepreneurial versus less entrepreneurial farmers in West Java, Indonesia. *NJAS–Wageningen Journal of Life Sciences* 89.

3.1 Introduction

Farmers play an essential role in sustaining economic development in rural areas (Carter and Rosa, 1998; Grande et al., 2011). Over two-thirds of rural people in developing countries are smallholder farmers who have or operate farms less than two hectares in size (IFPRI, 2005). Despite this small size, together, they produce 80 percent of the food supply in these countries (FAO, 2017). Many smallholder farmers recognize the emergence of food supply chains for domestic or international markets that offer reasonable prices but require high-quality products in sufficient quantity and delivered on time (FAO, 2017). For instance, Indonesian farmers face a rising demand for vegetables from modern food retail/supermarkets, food processors, and food exporters (Natawidjaja et al., 2007; Sahara et al., 2015; Sunanto, 2013). To survive and stay competitive, farmers are expected to adapt to changes and have entrepreneurial and innovative capabilities (McElwee and Bosworth, 2010). More entrepreneurial farmers may perceive these market changes as opportunities, while other farmers may perceive them as threats.

Farm entrepreneurship of smallholder farmers in the developing world has received little attention in the entrepreneurship literature and rural studies. Previous studies addressing the farmers' entrepreneurial strategies primarily focused on the developed countries' context (Dias et al., 2019b; Fitz-Koch et al., 2017). The farmers in these countries generally operate large farms, have adequate access to resources, and link to wider networks than smallholder farmers in developing countries.

The need for entrepreneurship and identifying opportunities in changing environments is recognized by conventional farmers (Salamon, 1992) and smallholder farmers (Yessoufou et al., 2018). While some farmers failed to adapt to market changes (Carletto et al., 2010), others could adapt by adopting or generating innovations (Gellynck et al., 2015; Leitgeb et al., 2011). However, the literature offers few conceptual models to explain the difference. This chapter expects that the ability to adapt to market changes or even create new markets may depend on farmers' entrepreneurship degree and their access to networks.

More entrepreneurial farmers are more alert to opportunities and better understand the market (Grande et al., 2011; Verhees et al., 2012). More entrepreneurial farmers are expected to be able and willing to take risks and are more proactive (De Lauwere, 2005). Therefore, entrepreneurship provides farmers a basis to adapt to or anticipate market changes by seizing opportunities and satisfying new market demands (Grande et al., 2011; Vik and McElwee, 2011). As a result, more entrepreneurial farmers can create more added value (Grande et al., 2011) and sustain enhanced performance (Vik and McElwee, 2011).

Linking to the appropriate networks is suggested to be an essential skill that helps farmers to identify and pursue opportunities (DeRosa et al., 2019; McElwee and Bosworth, 2010). Networks may provide farmers with relevant information about market needs and then help farmers transform information into new or improved products to satisfy market demands (Phillipson et al., 2004). When information is widely available, farmers can rely on networks close to the farm, e.g., with other farmers, relatives, or neighbors (Darr and Pretzsch, 2008). However, to adapt to market changes, such networks may not be enough. A farmer with a heterogeneous network has contacts with more diverse types of information and knowledge sources (Renzulli et al., 2000). Therefore, linking to more heterogeneous networks could provide the farmer with more diverse information about emerging opportunities (Darr and Pretzsch, 2008).

Prior studies have shown how farmers benefit from networks to acquire information (Isaac, 2012) and how networks positively influence learning (Darr and Pretzsch, 2008; Pratiwi and Suzuki, 2017), innovation (Spielman et al., 2011), and farm performance (Thuo et al., 2013). However, these studies mainly focus on network structure and relations without incorporating the information content shared in the networks. We focus on network content as information and the knowledge obtained and exchanged between actors (i.e., farmers) and their contacts (Hoang and Antoncic, 2003). We study networks in terms of business ties, technology ties, and network heterogeneity. Business ties refer to the relationships between actors in the networks that share information about markets and business opportunities (Lechner et al., 2006). Technology ties refer to ties that share information related to new technologies, including problem-solving and potential new products (Ahuja, 2000a). More entrepreneurial farmers (engaging in technology and business ties and linking to heterogeneous networks) are potentially more innovative and could have higher financial farm performance than less entrepreneurial ones. Taking the concept of entrepreneurial orientation and network content, we aim to (1) identify the entrepreneurial degree of farmers, (2) compare the network content (i.e., business ties, technology ties, and network heterogeneity) of farmers, and (3) examine the impact of the entrepreneurial degree and network content on farm performance in West Java, Indonesia. We address the following research questions: what types of network content are linked to more entrepreneurial farmers, and what types of network content improve farm performance?

This chapter is organized as follows. The next section presents the theoretical framework elaborating on the farmers' entrepreneurial orientation, network content, and farm performance. Afterward, we describe the operationalization of measures and data analyses in the methods section, followed by the section presenting the results and testing hypotheses. This chapter ends with a discussion of the results and the implications and potential avenues for further research.

3.2 Theoretical framework and hypotheses

3.2.1 Entrepreneurial farmers and networks

Entrepreneurship refers to value creation and opportunity identification from the business environment (Baron, 2006). The literature acknowledges opportunity as the critical element of entrepreneurship, which refers to a future situation that is desirable and feasible to achieve (Shane, 2000; Shane and Venkataraman, 2000; Stevenson and Jarillo, 1990). An entrepreneur is an individual who seizes an opportunity, pursues it by creating a new venture or a new project (Bygrave and Hofer, 1992), and focuses on achieving business growth (Stevenson and Jarillo, 1990). Unlike managers concerned with managing and allocating available resources, entrepreneurs are willing to go beyond currently available resources by seizing and pursuing valuable opportunities (Kaish and Gilad, 1991; Shane, 2000). Likewise, entrepreneurially oriented firms can adapt to rapid changes in the environment (e.g., technologies, consumers, economic trends, social values, regulatory standards) by being alert to opportunities and being creative and innovative. In contrast, non-entrepreneurial oriented firms (i.e., administrative oriented firms) may perceive the environment changes as potential threats (Stevenson and Gumpert, 1985). Hence, the desire to pursue opportunities makes entrepreneurs differ from managers.

It might be argued that smallholder farmers are less entrepreneurial for three reasons. First, with the assumption of perfect market competition, smallholder farmers are usually perceived as price takers who produce non-differentiated products, making them less competitive and have less bargaining power towards buyers (Kahan, 2013; McElwee and Bosworth, 2010). Second, smallholder farmers lack economies of scale compared to large-scale farmers (Wiggins et al., 2010). Third, smallholder farmers face high transaction costs when engaging in modern markets (e.g., supermarkets, food processors, and export markets) that are more concentrated and require demanding standards. Smallholder farmers may find it challenging to adapt to modern markets' growth and meet their requirements of consistently high quality, certain quantity, and traceability due to limited resources (Hazell et al., 2010). However, smallholder farmers may benefit from linking to modern markets. When sourcing from smallholder farmers is the best option for buyers of modern markets, some buyers arrange contractual agreements with smallholder farmers and commit to investing in providing farm inputs, technical assistance, and financial support to enhance the quality, quantity, and reliability of supplies (Reardon et al., 2005). Therefore, smallholder farmers may benefit from linking to modern markets by having secure outlets for their products and learning innovations.

Although smallholder farmers own and manage a limited number of resources (e.g., farmland) compared to large-scale farmers, they potentially have advantages to adapt to market changes for the following reasons. First, smallholder farmers are efficient users of resources (Wiggins et al., 2010), which is depicted in studies reporting that small farms produce higher yields per hectare than larger farms in some developing countries (Eastwood et al., 2010; Hazell et al., 2010; Heltberg, 1998). Second, modern science is concerned with improving agricultural productivity, including that for small farms (Hazell et al., 2010). Particular farm innovations are suitable for small farms, such as applying new seeds using specific technology in fertilization, water control, crop protection, and organic cultivation (Hazell et al., 2010; Wiggins et al., 2010). These situations may stimulate smallholder farmers to meet market demands by adopting innovations.

Linking to networks is suggested as a top-level skill that helps farmers overcome their disadvantages and enhance their potential to identify and pursue opportunities (DeRosa et al., 2019). Farmers who link to broader and diverse networks may access more resources, such as social capital and social embeddedness. These resources help farmers identify opportunities by providing information and knowledge vital to developing innovations in anticipating future market demands. For instance, networks allow smallholder farmers to learn new farm technologies (Bandiera and Rasul, 2006). When participating in modern markets, networks also help smallholder farmers decrease search and transaction costs by providing access to information and monitoring contractual agreements (Barrett, 2004). Furthermore, networks may also provide information related to markets (Phillipson et al., 2004). Thus, networks help farmers access more resources, better understand the markets, and pursue opportunities by developing innovations.

Entrepreneurial small firms are adaptive to business environmental changes (Avlonitis and Salavou, 2007) or create changes in the markets. Small farms might have a similar potential to small firms, as they are more flexible to market changes (Carter and Rosa, 1998; Phillipson et al., 2004) or may anticipate changes in the markets. For instance, vegetable farmers in Thailand (together with other actors) initiated changes in the sweet pepper supply chain by introducing this vegetable into traditional markets, previously marketed in supermarkets or export markets (Schipmann and Qaim, 2010).

More entrepreneurial farmers may show the capability to manage farm resources, take and manage more risks (Shadbolt and Olubode-Awosola, 2016), identify opportunities, formulate business strategies, develop innovations, and engage in networks (McElwee and Bosworth, 2010; Vik and McElwee, 2011). Consequently, more entrepreneurial farmers may explore more benefits from the existing technologies, create more value for the existing products, develop new products,

and diversify farm businesses (De Lauwere, 2005). These characteristics fit with entrepreneurial orientation. Less entrepreneurial farmers, by contrast, may show characteristics of waiting for the actions of other firms (i.e., being followers) (De Lauwere, 2005), playing it safe to avoid high risks (Shadbolt and Olubode-Awosola, 2016), or being reluctant to exploit new opportunities with uncertainties (Avlonitis and Salavou, 2007). Less entrepreneurial farmers might have difficulty adapting to environmental changes. For instance, farmers in Guatemala had access to global markets, but some were unable to keep adopting innovations by discontinuing producing high-value crops for export markets. These farmers may lack the capacity to deal with the complex technologies required by global markets or may be unable to manage risks (Carletto et al., 2010). This situation might discourage less entrepreneurial farmers from seizing opportunities from market changes.

Entrepreneurial orientation provides a basis for firms to make an entrepreneurial decision with specific entrepreneurial aspects in terms of styles, methods, and practices that facilitate the ability to seize opportunities (Covin and Slevin, 1989; Lumpkin and Dess, 1996; Martins, 2016). Entrepreneurial orientation is part of the internal firm capabilities, consisting of proactiveness and risk-taking, facilitating firms to innovate in achieving better performance (Atuahene-Gima and Ko, 2001). Our study uses entrepreneurial orientation, reflecting the entrepreneurial farmers' skills (McElwee and Bosworth, 2010) as a basis to distinguish between more entrepreneurial farmers and less entrepreneurial ones (Avlonitis and Salavou, 2007).

Entrepreneurs may search for information on opportunities from non-traditional sources, such as from their sparse networks (Kaish and Gilad, 1991). Likewise, to better understand the market and satisfy the market demands, farmers are suggested to develop skills in linking to networks that provide access to resources through social capital and social embeddedness (McElwee and Bosworth, 2010). We expect that more entrepreneurial farmers benefit from their networks by identifying valuable opportunities.

Networks refer to a set of actors (individuals or organizations) around a certain actor and a specific set of relations between the actors (Hoang and Antoncic, 2003; Renzulli et al., 2000). Networks share essential resources for firms in terms of information, advice (Hoang and Antoncic, 2003), and knowledge (Gunawan et al., 2016). Entrepreneurial firms use the information and knowledge shared in the networks to identify opportunities and protect their resources (Elfring and Hulsink, 2003), and solve problems (Ripollés et al., 2012). Entrepreneurial firms may identify opportunities from alertness to existing opportunities from market changes with expected returns or judgment/belief regarding new opportunities with unknown returns (Kirzner, 1992; Klein, 2008). To pursue the (expected or unknown) returns of opportunities, entrepreneurial firms can engage in diverse networks to obtain

valuable information and resources from knowledgeable contacts (Greve and Salaff, 2003). A focus on pursuing opportunities may make networks of more entrepreneurial firms differ from less entrepreneurial firms. Likewise, we expect that the network content of more entrepreneurial farmers may be different from less entrepreneurial farmers.

The literature acknowledges networks as necessary social resources either for individuals or for organizations (Burt, 1992) because networks have a facilitative role in various inter-organizational contexts (Gulati, 1999), serve as sources of resources and information (Ahuja, 2000a), and are media to transfer resources (Hoang and Antoncic, 2003). The valuable resources embedded in the networks have a social capital function, which is defined as the economic returns gained through social exchanges and relations (Fafchamps and Minten, 1999; Lin, 1999). Important aspects of social capital are serving information flow and channeling access to resources (Lin, 1999).

The valuable resources shared in the networks may be in the form of non-redundant information (Burt, 2001) or beneficial information (Claro et al., 2003; Renzulli et al., 2000). Non-redundant information refers to dissimilar information shared from non-redundant information sources. These sources link to less cohesive contacts (i.e., contacts who are weakly tied to each other) and non-structurally equivalent contacts (i.e., contacts who are linked to a different source of information) (Burt, 2001). An actor may obtain non-redundant information or beneficial information from linking to networks that share specific types of information (e.g., business ties or technology ties) (Hoang and Antoncic, 2003) or from linking to heterogeneous relationships (i.e., network heterogeneity) (Renzulli et al., 2000). When facing market changes, networks may provide firms with relevant information related to new opportunities. Furthermore, networks help firms digest new information by improving information credibility and interpretability (Uzzi, 1996).

The network content focuses on the resources embedded and shared in the networks. The resources consist of tangible resources (e.g., capital) and intangible resources (e.g., information, advice, know-how, and problem solving) (Hoang and Antoncic, 2003). We focus on network content as information and knowledge obtained and exchanged between actors and their contacts. For farmers, the network content may explain what types of information are essential to undertake innovation and enhance farm performance when facing market changes. We investigate network content based on discussion topics (i.e., business ties and technology ties) and network relations (i.e., network heterogeneity).

Business ties or technology ties can be in the form of collaboration networks (i.e., ties where the focal actor collaborates with his/her contacts in business activities or R&D projects) (Ahuja, 2000a) or external networks (i.e., ties without any cooperation between the focal actor and his/her contacts) (Zhang and Cui, 2017).

For farmers, collaboration networks in business and technology usually exist in farmer groups or cooperatives.

3.2.1.1 Business ties

Business ties refer to the relationships between the actors involved in the networks that share information about markets and business opportunities (Lechner et al., 2006). Business ties consist of relations with competitors, governmental agents, and universities or relations with actors involved in a business transaction, such as buyers and suppliers (Lechner et al., 2006). Engaging with different actors provides different benefits. Ties to suppliers help firms gain knowledge, problem-solving, and new combinations from various components or inputs. Ties to buyers are vital information sources about changes in market preference. These ties help firms detect new market needs and new market niches, so firms can rapidly adapt to market changes. Ties with universities help firms collaborate with other firms in sharing management practices and innovations (McElwee, 2006). Business ties also help actors in the networks face uncertainties in the business environment (Gulati, 1999), such as helping the firm make joint plans with its suppliers or buyers (Claro et al., 2003). Thus, business ties with suppliers, buyers, and competitors provide firms with channels to access beneficial information related to opportunities (Brown and Butler, 1995).

Because more entrepreneurial farmers focus on seizing new opportunities, we expect to have more business ties than their counterparts. Thus, the hypothesis proposed is as follows:

H1: More entrepreneurial farmers will have more business ties than less entrepreneurial farmers.

3.2.1.2 Technology ties

Technology ties refer to the relationships between actors involved in the networks that transfer and share information and knowledge related to technologies, such as information about new products and problem-solving (Ahuja, 2000a) and new or combinatory knowledge (Singh et al., 2016). Technology ties enable the focal actor in the networks to solve problems together with the suppliers or buyers (Claro et al., 2003). The information shared in technology ties may also support innovation activities in the firm, such as the process of product development (Håkansson et al., 1999).

Because more entrepreneurial farmers are likely to be more innovative, we expect to have more technology ties than their counterparts. Thus, the hypothesis proposed is as follows:

H2: More entrepreneurial farmers will have more technology ties than less entrepreneurial farmers.

3.2.1.3 Network heterogeneity

The concept of network heterogeneity is derived from the network range concept, which describes the characteristic diversity of a firm's or an individual's contacts (Marsden, 1990). The greater the network range, the less redundant information one can obtain (Renzulli and Aldrich, 2005). Network heterogeneity presents the degree of characteristic dissimilarity between alters of ego (i.e., contacts of the focal actor) or describes the diversity of the actor's contacts (Renzulli et al., 2000; Zheng and Zhao, 2013). Heterogeneous contacts come from dissimilar environments, which causes the contacts to have diversity in their perception of information. Therefore, heterogeneous contacts may provide a broader range of information (Granovetter, 1973; Scholten, 2006) or non-redundant information.

The literature acknowledges that heterogeneous networks are the critical resources to access broader knowledge by providing firms with the opportunity to indirectly link with contacts beyond the direct contacts (Renzulli et al., 2000). The more heterogeneous the networks, the more diverse the information obtained (Blau, 1977). Heterogeneous networks enrich the information and encourage information assimilation (Podolny and Page, 1998), leading to new knowledge (Powell and Brantley, 1992).

In the agricultural context, diverse actors within the networks provide various resources for farmers in terms of information and capital (Isaac, 2012). Interactions with diverse actors, such as research institutes, buyers, and suppliers, bring diverse information and resources (Spielman et al., 2011). By assimilating information and resources, heterogeneous networks facilitate the learning process that promotes innovation (Spielman et al., 2011; Thuo et al., 2013) and provides resources for firms to identify opportunities (Renzulli et al., 2000).

As opportunities and innovations are essential for more entrepreneurial farmers, we expect to have more heterogeneous networks than their counterparts. Thus, the following hypothesis is proposed:

H3: More entrepreneurial farmers will have more heterogeneous networks than less entrepreneurial farmers.

3.2.1.4 Farm performance

Farm performance may represent the ability of farmers to turn the resources into positive outcomes. The outcomes can be reflected in the form of innovations developed by farmers (i.e., innovative performance) or revenues (i.e., financial performance).

Entrepreneurship is an important driver to achieve innovative performance (Bessant and Tidd, 2009) by seizing opportunities for creating value (Drucker, 1985). Innovative performance represents a firm's ability to create or respond to market changes (Schoonhoven et al., 1990). Entrepreneurial firms may initiate the market changes as the 'creative destruction' (Schumpeter, 1934) by foreseeing future market demands and then take more risks to formulate new products that are 'new to the world' (i.e., radical innovation) (Lumpkin and Dess, 1996). Entrepreneurial firms may also respond to the market changes by improving the existing products that are 'new to the industry' (i.e., incremental innovation) (Tidd et al., 2005). Similarly, prior studies suggest that more entrepreneurial farmers are concerned with developing innovations to introduce new products (Pannekoek et al., 2005) or improved products to meet the market demands (Leitgeb et al., 2011). Consequently, more entrepreneurial farmers may allocate more resources to innovate and achieve higher innovative performance than less entrepreneurial farmers. Thus, the following hypothesis is proposed:

H4a: More entrepreneurial farmers will show a higher level of innovative performance than less entrepreneurial farmers.

More entrepreneurial farmers are expected to be more innovative and proactive; therefore, they will use their networks more actively to gain enhanced performance (Grande et al., 2011). More entrepreneurial farmers are more focused on searching for novel information, accessed through their networks (DeRosa et al., 2019; Moreno and Casillas, 2007). This focus will help farmers satisfy market needs and use their networks to access farm inputs more efficiently to create added value for their customers (Knudson et al., 2004), resulting in enhanced revenue (Micheels and Gow, 2015). Therefore, we expect that more entrepreneurial farmers will achieve higher financial performance than less entrepreneurial farmers. Thus, the following hypothesis is proposed:

H4b: More entrepreneurial farmers will show a higher level of financial performance than less entrepreneurial farmers.

3.2.2 Networks and farm performance

3.2.2.1 Business ties and farm performance

The topics discussed within the business ties focus on market trends, business opportunities, and market intelligence (Lechner et al., 2006). The literature suggests that business ties provide firms with several resources. First, business ties share market information about existing situations and future trends that may include information about opportunities (Boso et al., 2013). Business ties share market information that may not exist in open markets, such as product information and credible partners (Jantunen et al., 2005). Second, business ties help firms quickly

respond to market demands by providing access to advice, resources, and problem-solving (Boso et al., 2013; Hoang and Antoncic, 2003). When facing new markets, business ties provide firms with learning, resources, and inside information about the markets (Li and Zhou, 2010). When dealing with rapid changes in the industry, business ties support firms to adapt to changes (Jantunen et al., 2005). Third, business ties provide broad access to contacts' resources and capabilities within the ties, which enrich firms with new knowledge (McElwee, 2006). Therefore, business ties help firms learn by assimilating new knowledge with existing knowledge (Jantunen et al., 2005).

Long-term relationships with suppliers or customers may enhance the firm's innovative performance (Uzzi, 1997). Information from customers is vital for firms to create new products or improvements (Von Hippel, 1978). Similarly, business ties with suppliers and buyers provide farmers with opportunities to predict market trends and anticipate future market demands. Therefore, business ties allow farmers to meet market demands by introducing new vegetables or improvements to the existing vegetables. Thus, the following hypothesis is proposed:

H5a: Business ties will positively influence innovative performance.

The main interest of firms connecting in business ties is to increase the economic benefits, which can be achieved in two ways. First, business ties coordinate the exchanges through collaboration (Ghosh and John, 1999). Collaboration then improves logistic coordination, which reduces the transaction costs in terms of customer acquisitions and distribution costs. Business ties reduce transaction costs by accelerating searches, strengthening trust, and transferring information (Jantunen et al., 2005). The interaction results in mutual trust between parties, which may reduce business partners' opportunistic behavior (Luo, 2008; Park and Luo, 2001). Furthermore, business ties reduce transaction costs by developing trust and improving communication (Dess et al., 1997b). Therefore, trust and communication within business ties may facilitate trades without formal contractual agreements (Woolcock and Narayan, 2000). Business ties also help firms achieve economies of scale. By pooling the resources belong to the actors in the ties, business ties may reduce the costs per unit of output (Luo, 2008; Park and Luo, 2001). Therefore, business ties may enhance firms' financial performance by decreasing transaction costs and achieving economies of scale.

Business ties provide firms with information about market demands, which creates opportunities (Lin, 1999). Business ties also help farmers negotiate with input suppliers, creditors, and processing firms (Meurs, 2001). A prior study reported that ties to customers or suppliers could directly influence financial performance (Hoang and Antoncic, 2003). Thus, business ties help firms access resources that may enhance firm performance (Hoang and Antoncic, 2003).

In the context of agriculture, business ties are one of the essential resources for farmers to develop farm businesses and discover business opportunities (Spielman et al., 2011) by providing organizational resources and facilitating knowledge transfer (Shirokova et al., 2016). Business ties allow farmers to transform ideas into new venture creation (Grande, 2011; Lawson and Samson, 2001). Hence, business ties that provide economic benefits and market information may help farmers enhance financial performance. Thus, the hypothesis is proposed as follows:

H5b: Business ties will positively influence financial performance.

3.2.2.2 Technology ties and farm performance

Primarily through collaboration networks, Ahuja (2000a) suggests that technology ties enhance innovative performance through the following four mechanisms: (1) resource and knowledge sharing, (2) knowledge spillover, (3) complimentary, and (4) economies of scale. First, technology ties transfer and share resources and knowledge to access physical assets, knowledge, and skills developed together with other firms. Second, technology ties provide a firm with access to gain knowledge spillover and reconstruct the knowledge to form combinatory knowledge, which is useful for the innovation process. The combinatory knowledge includes know-how, technical break-through, different angles to see problems, or the specific approaches of one firm compared to another (Ahuja, 2000a; Singh et al., 2016). Knowledge and information are exchanged by frequent communication, intense interactions, and focus on specific topics (Rowley et al., 2000). Third, technology ties help a firm gain complementary skills from different firms. By elaborating on other firms' competence, the firm can focus and improve its knowledge and finally enhance its innovative performance. Fourth, by becoming involved in a collaborative project, technology ties help firms gain economies of scale by increasing the return proportion of the innovation output, especially for a large investment (Rogers, 1995). Hence, technology ties channel different resources and provide various methods, which may enhance their innovative performance.

The function of knowledge spillovers in technology ties can be made through inter-firm collaboration as collaborative linkages. These linkages are sustained, focused, and intense interactions that involve the exchange of information. Sustained interactions are frequent communication. Focused interactions mean that the relations will be used to communicate a specific type of topic of collaboration. Intense interactions imply that collaborative firms have a great incentive and opportunity to share information (Rowley et al., 2000). In the agricultural context, technology ties may improve innovative performance by collaborating with other farms, buyers, suppliers, or supportive actors. Thus, technology ties may provide farmers with essential resources to develop innovations that yield new or improved products (Spielman et al., 2011). Thus, the following hypothesis is proposed:

H6a: Technology ties will positively influence innovative performance.

Firms with rich social capital that engage technology ties have broad access to diverse resources for seizing entrepreneurial opportunities. First, technology ties through inter-firm collaboration provide firms with information, knowledge, and complementary resources to share the risks between the firms in the ties (Lee et al., 2001; Pennings and Harianto, 1992). Furthermore, inter-firm collaboration through technology ties helps firms access external know-how (Pennings and Harianto, 1992). Second, technology ties with universities or research institutes help firms build knowledge that may be difficult for firms to develop by themselves. Furthermore, universities or research institutes provide technical resources and consultancy services for firms to help solve problems (Lee et al., 2001). Managing efficient networks in technology ties can enhance firm performance by providing firms with various information and capabilities and by reducing the costs of redundancy, complexity, and conflict (Baum et al., 2000). Therefore, technology ties help firms adopt technology and, ultimately, enhance financial performance (Ahuja, 2000b; Lechner et al., 2006). Hence, technology ties provide firms with rich resources to pursue opportunities and eventually enhance firm performance.

In the agricultural context, technology ties provide opportunities for farmers to gain competitive advantages over rival firms by gaining information and resources to enhance added value by producing new or improved products and, thus, enhance financial performance. The following hypothesis is thus proposed:

H6b: Technology ties will positively influence financial performance.

3.2.2.3 Network heterogeneity and farm performance

Networks play a vital role in innovation development by channeling the exchange of complex information. Heterogeneous networks provide diverse information and knowledge (Mailfert, 2007), which help firms identify ideas and opportunities (Kontinen and Ojala, 2011) and, in turn, stimulate firms to innovate (Mailfert, 2007). For farmers, linking to heterogeneous networks allow them to access advanced information and knowledge. For instance, participating in workshops conducted by a cooperative allows farmers to discuss and share the latest knowledge in farming practices and business with experts (Faysse et al., 2012).

Low redundancy between contacts in heterogeneous networks enhances the value of the firms' information obtained from the networks (Granovetter, 1973). For instance, linking to market-related networks supports farmers in improving their production system. Connecting to government agencies supports farmers in exchanging information, sharing costs, and adopting a new farming system. The government may also support the farmers experiencing financial problems in applying the new farming system (Nelson et al., 2014). A study reported that the more heterogeneous the partners in an alliance are, the higher the firm's innovative

performance (Capaldo, 2007). In a similar vein, another study indicated that the more heterogeneous the networks' contacts are, the greater the possibility the farmers have to enhance their innovative performance (Isaac, 2012). Thus, the following hypothesis is proposed:

H7a: Network heterogeneity will positively influence innovative performance.

The more heterogeneous the networks, the more diverse information and resources a firm could gain from its contacts, it will help the firm perform better. Previous studies found that firm performance is enhanced when the firms are linked to wider external networks or more diverse networks (Lee et al., 2001; Zheng and Zhao, 2013).

Different types of contacts bring different types of information or advice on innovation. This diverse information potentially contributes to positive returns to the firm's social capital (Renzulli et al., 2000). Heterogeneous networks facilitate disseminating complex information and, ultimately, help farmers enhance their farm performance (Isaac, 2012; Thuo et al., 2013). Furthermore, heterogeneous networks facilitate farmers to access cheaper and more diverse resources than those available in the market (Mailfert, 2007). A study showed that linking to heterogeneous contacts within an alliance improves the firm revenue (Baum et al., 2000). Thus, heterogeneous networks may help farmers gain higher financial performance by providing information, advice, and resources. The hypothesis is proposed as follows:

H7b: Network heterogeneity will positively influence financial performance.

3.3 Methods

3.3.1 Context

West Java is the main vegetable production area in Indonesia and contributes to 35 percent of the national vegetable production (KEMENTAN, 2017a; Natawidjaja et al., 2007). The average farm size of vegetable farmers in West Java was 0.55 hectares, and the average farmer age was 43.50 years old (KEMENTAN, 2012a). Based on market values, three types of vegetables are produced in West Java, consisting of low-value vegetables (e.g., cabbage and carrots), medium-value vegetables (e.g., tomatoes and potatoes), and high-value vegetables (e.g., sweet peppers and lettuce). Most farmers sold their products individually to traditional market channels via village traders, which dominated the traditional market systems in West Java (Hernández et al., 2015).

In the 1990s, the vegetable demands of modern markets (e.g., supermarkets, food processors, and export markets) in the cities around West Java (e.g., Jakarta and

Bandung) rose, farmers started to participate in the supply chains of these modern markets. Most farmers were organized by farmer groups or cooperatives that collected and delivered vegetables to supermarkets/exporters/food processors via dedicated or specialized wholesalers. These farmers could earn market shares between 11-15 percent and received net revenues 10-30 percent higher than those who participated only in the traditional market channels (Natawidjaja et al., 2007).

3.3.2 Data

A study on vegetable farmers was conducted to understand whether the entrepreneurial degree and network content affect farm performance. The study population was defined as farmers (i.e., owners and managers) producing vegetables in the form of leaves, fruit, tubers, or flowers in the West Java area between 2009-2012. Vegetable farmers in West Java were selected as our study population because they can access actors in the vegetable supply chains. The actors consist of participants involved in transaction activities, such as suppliers, buyers in modern and traditional markets, and participants who provide business and innovation support, such as research institutes and universities (Natawidjaja et al., 2007).

To pre-test the questionnaire, preliminary in-depth interviews were conducted with six experts from a farmer cooperative, a farmer group, a non-governmental organization, and an agricultural university between May and December 2011. Based on the interviews, five regions in West Java (i.e., Pangalengan Bandung, Cisarua Bandung, Warung Kondang Cianjur, Pacet Cianjur, and Bogor) were purposively selected for the survey based on the following criteria: variation of vegetable types, diversity of technologies, and access to diverse actors in the vegetable sector.

To determine the study population, we compiled a list of vegetable farmers from several sources, including local authorities, extension agents/agricultural officials, and cooperative managers, which yielded 3,732 vegetable farmers. Afterward, we verified the list through farmer-group chairpersons in villages, and they confirmed that the list did not fit with the existing situation in 2011-2012. Some farmers on the list did not produce vegetables anymore or had moved to other areas. To update the list, these farmer-group chairpersons then recommended other farmers producing vegetables in their villages, but their names were not available on the list. A previous study conducted in West Java experienced similar difficulties finding an accurate, comprehensive, and updated study population from local authorities (Gunawan et al., 2016). We obtained 1,263 vegetable farmers on the updated list as the basis for the sampling frame. We found that not all farmers on the list could be contacted due to incomplete addresses, so probability sampling was not possible. Therefore, we chose the quota sampling method, which was proportional to the number of farmers

in each selected region (i.e., 27 percent in Pangalengan Bandung, 10 percent in Cisarua Bandung, 35 percent in Warung Kondang Cianjur, 13 percent in Pacet Cianjur, and 15 percent in Bogor). This sampling method could give sufficient statistical power to identify group differences (Bornstein et al., 2013). We obtained a total sample of 282 farmers who were available and responded positively to our survey participation requests.

We first developed the questionnaire in English. We then carefully translated the questionnaire into the Bahasa Indonesia language. To reduce bias due to language translation, we discussed the questionnaire intensively with experts from an agricultural university regarding the questionnaire's language and the content. Afterward, we pre-tested the questionnaire with a few farmers to obtain more insights and make corrections before the final version was used for the interviews. Next, the survey was conducted through face-to-face interviews in Bahasa Indonesia, administered from January to August 2012. To better understand the details of farming processes, the local language (i.e., Sundanese) was also used during the interviews, especially for explaining farming practices. In data compilation, we carefully translated some data still in Sundanese into Bahasa Indonesia. Twenty observations were excluded for the data analyses due to missing data on networks and gross revenues or small farm size (less than 0.05 ha). The final sample size was 262 respondents.

Most of the farms in developing countries represent the 'simple firms' (Miller, 1983) type of farms, which is generally run by the owner-managers. Simple firms are typified as small firms with a simple structure, and the power to make decisions is centralized with the leaders. The firms are organized with a few staff members, less differentiated business units, and coordinated by direct supervision. The power and knowledge of the leaders may reflect the entrepreneurial degree of the firms. These characteristics make the role of the leaders vitally crucial for the firms (Miller, 1983). Likewise, farms in West Java demonstrated similar characteristics with simple firms. We used the farmer as the unit of analysis with the assumption that the farmer – as the farm leader – represents his/her farm, consistent with the concept of entrepreneurial orientation, which assumes the firm as the unit of analysis (Covin and Wales, 2019; Lumpkin and Dess, 1996; Wiklund and Shepherd, 2005).

3.3.2.1 Measurements

3.3.2.1.1 Innovative performance

Developing innovations for farms involves experiments. The experiments refer to farmers' research activities to generate information, namely 'farmers' experiments,' which are acknowledged to contribute to agricultural innovations (Leitgeb et al., 2011). Farmers' experiments aim at testing hypotheses or attempting new

innovations, such as evaluating the suitability of new technologies before the farmers fully apply them. Farmers' experiments are usually conducted on small plots of land. The experiment plot indicates the R&D input to produce innovative outputs (Hagedoorn and Cloodt, 2003), such as new products (Gunawan et al., 2016). On these plots, farmers conduct activities, such as trials for new varieties, new farm inputs (e.g., pesticides or fertilizers), or new technology (e.g., using screen shade or plastic tunnel). This chapter used the plot size for the experiments (m^2) as a proxy to estimate innovative performance. Due to a skewed distribution, the plot size data were transformed by the formula log (X_i + 1).

3.3.2.1.2 Financial performance

The success of product commercialization can be seen from enhanced sales or revenues (Szymanski et al., 2007), representing a firm's financial performance. In the context of agriculture, revenues demonstrate the value of the output produced on the farm (Argilés and Slof, 2001) and indicate a farmer's ability to convert farm inputs into financial output (Bojnec and Latruffe, 2009). This chapter operationalized financial performance as gross farm revenues, which refer to the total sales of farm productions accounted for when the transaction has occurred (Argilés and Slof, 2001). Based on the concept of total revenue (Mankiw, 2003), financial performance was measured as the sum of the gross revenues from all vegetables produced in a year (2011), which is formulated as follows:

$$Gross\ farm\ revenues = \sum_{i=1}^{n} P_i \times Q_i$$

P_i is the vegetable price, Q_i is the vegetable quantity sold, and i is the type of vegetable.

This measure was transformed by the formula log (Xi) due to a skewed distribution.

3.3.2.1.3 Entrepreneurial degree

Entrepreneurial orientation was used to distinguish the farmers' entrepreneurial degree. This chapter incorporated three items from the dimension of proactiveness and three items from the dimension of risk-taking (Table 3.1), measured on a seven-point Likert scale (Covin and Slevin, 1989). The entrepreneurial orientation literature usually includes innovativeness dimension as part of entrepreneurial orientation (Wiklund and Shepherd, 2005). In our research models, we employed the innovation-related variable (i.e., innovative performance) as the consequence of being more entrepreneurial (Drucker, 1985). To avoid redundancy with innovative performance, we excluded innovativeness dimension from the entrepreneurial orientation construct. We follow the general rule to test the relationships of entrepreneurial orientation with other variables/constructs that are mutually exclusive (Covin and Wales, 2019).

3.3.2.1.4 Networks

In this chapter, a network refers to a group of people with whom the farmer discusses their farm business. Our study focuses on the egocentric network analysis that examines the relations surrounding each individual as an actor, which is different from the total networks involving all engaged actors (Marsden, 1990). The name-generator technique was employed to gather the data for the egocentric analysis. The name-generator technique asked the respondent to identify several names of contacts with whom they discussed their farm and what topics were discussed (Wasserman and Faust, 1994). The respondents were asked to identify a maximum of seven names as the most important contacts. This approach is suggested to avoid recall accuracy problems (Burt and Ronchi, 1994; Greve and Salaff, 2003). The questions were as follows: (1) "Could you indicate people with whom you discussed your farm business? (2) "Could you indicate the relationship type of each contact, e.g., a relative, fellow farmer, extension agent, supplier, or buyer?" We categorized the network variables into business ties, technology ties, and network heterogeneity based on these questions.

Network content: **business ties, technology ties**, **and network heterogeneity**. Network content refers to the type of information or topics discussed between the actor and his/her contacts related to farm businesses. We divided the network content based on the discussion topics (i.e., business ties and technology ties) and based on the diversity of the network relations (i.e., network heterogeneity). Business ties and technology ties were adapted from the concept of the relational mix (Lechner et al., 2006). These types of ties may be relevant to the context of agriculture in developing countries (Spielman et al., 2011).

The question measuring network content was an open question; consequently, a respondent may mention more than one topic discussed with his/her contacts. For instance, a farmer's discussion topics with a buyer may be related to both technology development and business opportunities. Only the first answer was considered network content because the first answer described the farmer's primary concern. We assumed that the primary topic was the most important. Each topic was then categorized and coded into business ties (1 = business ties; 0 = otherwise) or technology ties (1 = technology ties; 0 = otherwise). Other topics related to routine farm activities were excluded from our study (Table 3.3). Because one relationship represented one topic, we made sure that the number of contacts (i.e., network size) was equal to the number of topics (network content) (Lechner et al., 2006). Finally, the ***business ties*** were measured by counting the proportion of business ties to network size. The ***technology ties*** were measured by counting the proportion of technology ties to network size.

To measure network heterogeneity, we first identified the following five types of network relations when a contact linked to a focal actor (i.e., the farmer): *horizontal*

networks came from fellow farmers, relatives, or friends; *upstream networks* came from input suppliers; *downstream networks* came from buyers; *sponsorship networks* came from research institutes or universities (Table 3.3). Although the contacts may have more than one relation type when dealing with the focal actor, as both a buyer and a relative, we considered only one relation by taking the respondent's first answer as his/her primary relation. To calculate the network heterogeneity, we followed the formula suggested by Renzulli et al. (2000), adapted from the Herfindal-Hirschiman coefficient method (Cohen and Sullivan, 1983).

$$Heterogeneity = 1 - [(horizontal/total)^2 + (upstream/total)^2 + (downstream/total)^2 + (sponsorship/total)^2]$$

A zero score of heterogeneity represents a completely homogeneous network, while a score close to one indicates a more heterogeneous network (Renzulli et al., 2000).

3.3.2.1.5 Control variables

Farmer age, farm size, and education were used as the control variables. The farmer age describes the human capital, whereas the farm size describes the physical assets of farms. Years of formal education was used as a proxy of human capital (Renzulli et al., 2000) or farmers' knowledge. Education equips farmers with knowledge and skills, which may help them learn new technologies or enhance financial performance. Higher formal education levels enable farmers to be more adaptive to environmental changes and better choose technologies (Huffman, 2020). We expect that younger farmers, larger farm size, and longer durations of (formal) education correspond to higher innovative and financial performance.

3.4 Results

We conducted the tests for construct validity and reliability of entrepreneurial orientation. The principal component analysis (PCA) was performed to extract the underlying entrepreneurial orientation factors, consisting of six items. One factor was extracted, explaining 60.75 percent of variance with factor loadings of the items ranging from 0.72 to 0.81 (Table 3.1). The reliability test shows that Cronbach's alpha of entrepreneurial orientation is 0.86, which meets the suggested threshold of 0.70 (Nunnally, 1978). Thus, both results confirm the validity and reliability of entrepreneurial orientation as a construct.

Table 3.1. Entrepreneurial orientation: construct validity and reliability

Items	Factor loadings[1]	Cronbach's alpha
Entrepreneurial orientation		0.86
Proactive on initiating changes	0.75	
Proactive on being a pioneer	0.81	
Proactive over competitors	0.81	
Risk-taking on new projects	0.79	
Risk-taking on achieving goals	0.80	
Risk-taking on becoming a first-mover	0.72	

[1]Based on Principal Component Analysis

A cluster analysis was performed to identify the farmers' entrepreneurial degree. Cluster analysis aims to classify units, so the similarity between units within groups is greater than between units in different groups (Klastorin, 1983). Farmers were categorized based on a composite variable of entrepreneurial orientation. This composite variable was standardized to avoid the potential effect of a scale difference between items (Ketchen and Shook, 1996). The K-mean cluster analysis was used to efficiently use computer resources in identifying different clusters (Avlonitis and Gounaris, 1999). We tested for two, three, and four clusters. The results show that the scores for the distance between cluster centers were 4.14 for two clusters, 2.01 for three clusters, and 1.30 for four clusters. The choice of two clusters provides the acceptable solution based on the maximum external heterogeneity (between cluster) and internal homogeneity (within a cluster) (Klastorin, 1983), and based on *a priori* theory (Ketchen and Shook, 1996). The two-cluster solution categorized farmers into groups, namely: more entrepreneurial farmers (n = 106; 40.46 percent) and less entrepreneurial farmers (n = 156; 59.54 percent). The difference between these two groups towards the items of entrepreneurial orientation is presented in Table 3.2.

Table 3.3 presents the distribution of the network content of farmers based on the discussion topics. Although both groups of farmers were interested in discussing topics related to routine farm activities, more entrepreneurial farmers seem to be more interested in topics related to markets and new technologies compared to less entrepreneurial farmers.

Table 3.2. Farmer profiles based on entrepreneurial orientation

Items	Factor loadings[1]	More entrepreneurial farmers			Less entrepreneurial farmer			Mann-Whitney U[2]
		Mean	s.d.	Mean rank	Mean	s.d.	Mean rank	
Proactive on initiating changes	0.75	4.50	2.31	186.56	1.63	1.17	94.09	2,431**
Proactive on being a pioneer	0.81	3.45	1.92	191.22	1.19	0.50	90.92	1,937**
Proactive over competitors	0.81	3.83	1.29	189.75	2.01	0.76	91.92	2,093**
Risk-taking on new projects	0.79	3.89	1.75	192.71	1.42	0.79	89.91	1,780**
Risk-taking on achieving goals	0.80	5.27	1.62	198.72	2.02	1.11	85.82	1,142**
Risk-taking on becoming a first-mover	0.72	4.23	1.81	182.33	2.13	1.09	96.96	2,880**

[1]Based on Principal Component Analysis.
[2]Based on the Mann-Whitney test using mean rank differences due to non-normal data distribution.
More entrepreneurial farmers (n = 106), Less entrepreneurial farmers (n = 156)
** $p < 0.01$; * $p < 0.05$

Table 3.3. Network content of farmers based on discussion topics

Discussion topics	More entrepreneurial farmers (percent)	Less entrepreneurial farmers (percent)
Business ties		
Organization activities (in farmer groups or cooperatives).	3.43	0.52
Access to finance (e.g., credits from banks or soft loans from governments).	4.74	0.73
Markets (e.g., access to new markets or new market requirements).	33.99	10.11
Farm inputs (e.g., access to farm input suppliers).	14.38	3.34
Technology ties		
New technologies in farm inputs (e.g., new seeds), farming practices (e.g., hydroponic farming or organic farming), crop protection (e.g., integrated pest management), and equipment (e.g., greenhouse construction, drip irrigation, or sprinkle irrigation).	13.23	3.65
Non-business/non-technology ties		
Routine farm activities (e.g., planting, weeding, fertilizing, spraying pesticides, or harvesting).	30.23	81.65
Total	100.00	100.00

Table 3.4 compares the network relations of more entrepreneurial and less entrepreneurial farmers to measure network heterogeneity. More entrepreneurial farmers have more contacts with upstream, downstream, and sponsorship networks, whereas less entrepreneurial farmers have more contacts with horizontal networks (i.e., fellow farmers). The results indicate that more entrepreneurial farmers link to more heterogeneous networks than their counterparts, which confirmed the descriptive statistics (Table 3.5). These results indicate that more

entrepreneurial farmers may access more non-redundant information from diverse network relations than less entrepreneurial farmers.

Table 3.4. Network content of farmers based on network relations

Network relations	More entrepreneurial farmers			Less entrepreneurial farmers			Mann-Whitney U[1]
	Mean	s.d.	Mean ranks	Mean	s.d.	Mean ranks	
Horizontal	0.38	0.30	83.26	0.76	0.30	164.28	3,155**
Upstream	0.11	0.17	155.98	0.02	0.06	114.87	5,673**
Downstream	0.38	0.27	161.70	0.20	0.27	110.98	5,066**
Sponsorship	0.13	0.22	154.03	0.01	0.05	116.19	5,879**

[1]Based on the Mann-Whitney test using mean rank differences due to non-normal data distribution.
More entrepreneurial farmers (n = 106), Less entrepreneurial farmers (n = 156)
** $p < 0.01$; * $p < 0.05$

Table 3.5 provides descriptive statistics of the network content, farm performance, and control variables of both more entrepreneurial and less entrepreneurial farmers. The network contents of both groups are significantly different, where more entrepreneurial farmers have more business ties, technology ties, and heterogeneous networks than less entrepreneurial farmers. Therefore, the hypotheses H1, H2, and H3 were confirmed. Regarding farm performance, more entrepreneurial farmers have higher innovative performance and financial performance than their counterparts. Therefore, the hypotheses H4a and H4b were confirmed. Furthermore, more entrepreneurial farmers have larger farm sizes, better education, and higher farm performance than less entrepreneurial farmers; however, they do not significantly differ in farmer age.

Most vegetable farmers in West Java are nearly fully commercial (Hernandez et al., 2015), as are the farmers participating in our study. The general characteristics of vegetables are perishable, which means that it is impossible to keep them longer for family consumption. The market value of vegetables varies among the different types. High-value vegetables (i.e., vegetables that give high economic return per unit of farm size or per unit of weight (GFAR, 2005) – representing product innovation – usually have premium prices and are marketed in modern markets. Low-value vegetables usually have highly volatile prices and are marketed in traditional markets. The tendency of more entrepreneurial farmers to produce high-value vegetables may explain the significant difference in the financial performance between more entrepreneurial farmers and less entrepreneurial farmers (Mann-Whitney U = 2,606; $p < 0$ .01). The average financial performance (i.e., gross farm revenues) of more entrepreneurial farmers was 6.40 times higher than that of less entrepreneurial farmers (Table 3.5).

Table 3.5. Network content and farm performance of more entrepreneurial and less entrepreneurial farmers

	Variables	More entrepreneurial farmers			Less entrepreneurial farmers			Mann-Whitney U[1] (000)
		Mean	s.d.	Mean ranks	Mean	s.d.	Mean ranks	
1	Innovative performance[2] (hectare)	0.12	0.19	179.52	0.03	0.12	98.87	3,178**
2	Financial performance[3] (000 USD)	30.04	56.70	184.92	4.70	14.32	95.21	2,606**
3	Farmer age (year)	44.17	9.57	133.30	43.72	12.15	130.28	8,077
4	Farm size (hectare)	2.90	4.31	179.03	0.57	1.00	99.21	3,230**
5	Education (year)	10.89	4.00	178.98	6.47	2.65	99.24	3,235**
6	Business ties	0.57	0.30	181.59	0.17	0.29	97.46	2,958**
7	Technology ties	0.12	0.21	150.19	0.03	0.11	118.80	6,287**
8	Network heterogeneity	0.44	0.20	171.81	0.20	0.23	104.11	3,995**

[1]Based on the Mann-Whitney test using mean rank differences due to non-normal data distribution.
[2]Innovative performance was measured as the plot size for experiments (transformed in logarithm for the linear regression analyses).
[3]Financial performance was measured as gross revenues (transformed in logarithm for the linear regression analyses).
More entrepreneurial farmers (n = 106), Less entrepreneurial farmers (n = 156)
** p <0 .01; * p <0 .05

One may question to what extent more entrepreneurial farmers received economic benefits from their farms. To illustrate this, we consider the minimum wages of laborers in West Java, which was 1,286,421 IDR or 95.58 USD per month in 2011 (West-Java-Governor, 2010), as the opportunity cost for farmers working on their farms. On average, entrepreneurial farmers earned 30,040 USD for gross farm revenues per year (Table 3.5), or 19,011.37 USD per hectare per year, equal to 1,584.28 USD per hectare per month. The repeated survey conducted in 2016 for the same farmers showed that entrepreneurial farmers earned profits approximately 13 percent of their gross revenues. We assumed the same proxy in 2011, so more entrepreneurial farmers earned profits approximately 205.96 USD per hectare per month, which was 2.15 times higher than the minimum wages of laborers of companies. On average, more entrepreneurial farmers managed a 2.90-hectare farm size (Table 3.5), so farmers could earn profits of approximately 597.28 per month, which was 6.25 times higher than the minimum wages of companies' laborers. This result indicates that working on farms gives entrepreneurial farmers a higher income than working on non-farms.

Farm-size growth could indicate the business growth of farmers. The average farm-size growth (2009-2011) of more entrepreneurial farmers was 27.51 percent, which was almost two times higher than that of less entrepreneurial farmers (i.e., 14.41

percent). In addition to producing vegetables, 51.89 percent of the more entrepreneurial farmers and 32.69 of the less entrepreneurial farmers run other (farm/non-farm) businesses. Furthermore, 21.70 percent of the more entrepreneurial farmers and 26.92 percent of the less entrepreneurial farmers earned extra incomes from other jobs. It seems that more entrepreneurial farmers tend to pursue opportunities by enlarging or diversifying their farm businesses. In contrast, less entrepreneurial farmers tend to be involved in other jobs to secure their livelihood.

3.4.1 Entrepreneurial degree, network content, and farm performance

We performed regression analyses to test the hypotheses related to farm performance, reflected by innovative performance and financial performance. Significant positive correlations were found between the variables of network content and the variables of farm performance. The correlation coefficients of all variables range from 0.00 to 0.59, and among independent variables range from 0.00 to 0.53 (Table 3.6), indicating the absence of multicollinearity.

Table 3.6. Correlation matrix of variables

	1.	2.	3.	4.	5.	6.	7.
1. Innovative performance							
2. Financial performance	0.59**						
3. Farm size	0.40**	0.47**					
4. Farmer age	-0.00	-0.10	0.04				
5. Education	0.43**	0.52**	0.34**	-0.14*			
6. Business ties	0.52**	0.48**	0.26**	-0.02	0.44**		
7. Technology ties	0.15*	0.07	0.07	-0.08	0.20**	-0.08	
8. Network heterogeneity	0.45**	0.37**	0.18**	-0.07	0.33**	0.53**	0.31**

$n = 262$
** $p < 0.01$; * $p < 0.05$

Table 3.7 reports the results of the linear regression analyses for innovative and financial performance. We first entered the control variables for both linear regression models resulting in a significant share of variance in farm performance (Model 1: $R^2 = 0.26$, $F = 30.90$, $p < 0.01$; Model 3: $R^2 = 0.37$, $F = 51.04$, $p < 0.01$). Farm size and education positively influence innovative performance (Model 1: β of farm size = 0.29, $p < 0.01$; β of education = 0.34, $p < 0.01$), as well as financial performance (Model 3: β of farm size = 0.34, $p < 0.01$; β of education = 0.40, $p < 0.01$). Farmer age neither has a significant influence on innovative performance nor financial performance.

Next, we entered the main variables (i.e., entrepreneurial degree, business ties, technology ties, and network heterogeneity) into the models, which significantly increase the variance explained of innovative performance (Model 2: $adj\text{-}R^2$ = 0.43, F-change = 20.40, $p < 0.01$) and financial performance (Model 4: $adj\text{-}R^2$ = 0.46, F-change = 11.89, $p < 0.01$). These findings indicate that enhanced farm performance can be reached by enlarging farm size or having higher formal educations and by being more entrepreneurial and linking to networks.

Hypothesis 4a and 4b expect more entrepreneurial farmers to have a higher level of farm performance. The results in Table 3.7 show that more entrepreneurial farmers have higher innovative performance (Model 2: β = 0.25, $p < 0.01$) and higher financial performance (Model 4: β = 0.25, $p < 0.01$) than less entrepreneurial farmers. These results support hypotheses H4a and 4b.

We tested the effect of network content (business ties, technology ties, and network heterogeneity) on farm performance. We predicted a positive relationship between business ties and innovative performance (hypothesis H5a), and between business ties and financial performance (hypothesis 5b). The results show that business ties indeed positively influence innovative performance (Model 2: β = 0.22, $p < 0.01$) as well as financial performance (Model 4: β = 0.13, $p < 0.05$). Hence, hypotheses H5a and 5b were supported. We also expected that technology ties positively influence innovative performance (hypothesis H6a) and financial performance (hypothesis H6b). However, the results demonstrate that technology ties neither influence innovative performance nor financial performance (Table 3.7). Thus, hypotheses H6a and H6b were not supported.

Finally, we predicted that network heterogeneity positively influences innovative performance (hypothesis H7a) and financial performance (hypothesis H7b). The results reveal that network heterogeneity positively influences innovative performance (Model 2: β = 0.14, $p < 0.05$), but it does not influence financial performance. Thus, only hypothesis H7a was confirmed.

Table 3.7. Linear regression: Farm performance

	Innovative performance[1]		Financial performance[2]	
	Model 1	Model 2	Model 3	Model 4
	β	*β*	*β*	*β*
Control variables				
Farmer age	0.03	0.01	-0.06	-0.09
Farm size	0.29**	0.20**	0.34**	0.26**
Education	0.34**	0.08	0.40**	0.21**
Main variables				
Entrepreneurial farmer[3]		0.25**		0.25**
Business ties		0.22**		0.13*
Technology ties		0.02		-0.08
Network heterogeneity		0.14*		0.09
R-square	0.26	0.44	0.37	0.47
Adj R-square	0.26	0.43	0.36	0.46
F	30.90**	28.89**	51.04**	32.38**
F-change		20.40**		11.89**

[1]Innovative performance was measured as the plot size for experiments (transformed in logarithm).
[2]Financial performance was measured as gross revenues (transformed in logarithm).
[3]Cluster membership in a binary construct: 1 refers to more entrepreneurial farmers, 0 refers to less entrepreneurial farmers.
$n = 262$
** $p < 0.01$; * $p < 0.05$

3.4.2 Robustness checks

We conducted analyses to check the classic assumptions of the linear regression models of innovative performance and financial performance. The data were checked by using the variance inflation factor (VIF), tolerance statistics (1/VIF), and correlation coefficients to detect the presence of collinearity between variables (Field, 2009). The individual scores of VIF were lower than ten, and the average VIF was not substantially greater than 1 (average VIF = 1.58). All scores of the tolerance statistics were higher than 0.20. The individual correlations between independent variables were not too high, ranging from 0.00 to 0.53 (Table 3.6). The highest correlation coefficient was 0.53 ($p < 0.01$) between business ties and network heterogeneity. The three indicators confirm that collinearity was not a problem for the models. Next, the Breusch-Pagan test shows that the assumption of homoscedasticity was met for the linear regression model of innovative performance (Chi-Square = 0.84, $p = 0.36$) and financial performance (Chi-Square = 1.99, $p = 0.16$).

3.5 Discussion

This chapter's main objective is to examine the impact of entrepreneurial degree and network content on farm performance in adapting to market changes. The results show that more entrepreneurial farmers differ from less entrepreneurial farmers based on demographic characteristics and network content. More entrepreneurial farmers engage in a more significant number of business ties and relate to more heterogeneous networks than less entrepreneurial farmers. Regarding the demographic characteristics, more entrepreneurial farmers show a higher education level and larger farm size, but they do not show significant differences in age than less entrepreneurial farmers. The tested models show that more entrepreneurial farmers and business ties increase both innovative and financial performance; network heterogeneity only increases innovative performance. A remarkable note is that technology ties do not influence either innovative or financial performance. These findings underline the importance of more entrepreneurial farmers, business ties, and network heterogeneity in promoting farm performance.

The results posit that more entrepreneurial farmers have better innovative performance compared to less entrepreneurial farmers (hypothesis H4a), which is in line with findings of prior studies on SMEs in Indonesia (Gunawan et al., 2016) and Greece (Avlonitis and Salavou, 2007). These results imply that more entrepreneurial farmers who are proactive and willing to bear more risks make greater use of experimental plots and have stronger innovative and financial performance than less entrepreneurial farmers. Table 3.5 indicates that the portion of the plot size to farm size of more entrepreneurial farmers was 4.14 percent (0.12 hectares over 2.90 hectares), which was slightly lower than their counterparts of 5.26 percent (0.03 hectares over 0.57 hectares). These portions may indicate that more entrepreneurial farmers may take more risks by enlarging their experiment plots because they have relatively large farm sizes as resources to innovate, five times higher than their counterparts' farm sizes. It was too risky for less entrepreneurial farmers to enlarge their experiment plots, which might reduce their farm size to produce vegetables for generating income.

We found that business ties support farmers to improve innovative performance (hypothesis H5a) as well as financial performance (hypothesis H5b). This finding is supported by a previous study conducted in Ethiopia that showed that less access to business ties inhibits farmers from innovating (Spielman et al., 2011). Network content, especially business ties, potentially provide different types of information and resources, such as knowledge and learning (Spielman et al., 2011), business advice (Arregle et al., 2015), access to capital (Hoang and Antoncic, 2003), or business resources (Arregle et al., 2015). This information and resources may enable farmers to pursue innovative performance by identifying opportunities and

better understanding the market demands, then translating them into innovations (Fafchamps and Minten, 1999). Afterward, this set of information and resources signal farmers to allocate resources to innovate and then introduce the outcomes to the markets. Therefore, the impact is finally reflected in their innovative performance and is ultimately depicted in their financial performance.

Although technology ties support farmers with technology-related information, including problem-solving (Ahuja, 2000a), we do not find evidence that technology ties stimulate farmers to innovate (hypothesis H6a) or increase financial performance (hypothesis H6b). The technology-related information introduced by these ties may not yet be ready to be applied or may require expensive investment to be realized (Eisenhardt and Schoonhoven, 1996; Lechner et al., 2006). Therefore, the positive impact of technology ties is not expressed by the existence of both innovative and financial performance. We presume that the positive impact on farm performance might be seen in the long run. The innovation can be demand-driven (Stefano et al., 2012), so business ties have a more significant effect on farm performance.

Heterogeneous networks provide access to different types of information that make farmers more open-minded in recognizing business opportunities or in accepting new approaches and innovations in agricultural practices (Polman and Slangen, 2008; Spielman et al., 2011). Each network relation provides specific types of information. Downstream and upstream networks can provide access to information beyond transaction activities, such as making a plan to reduce market risks, channeling the latest technologies (Claro et al., 2006), reducing information costs and negotiation costs, and also facilitating access to modern markets (Lu et al., 2008). Horizontal networks provide farmers access to knowledge and information related to new technologies, such as farmer-to-farmer extension programs (Kiptot and Franzel, 2014). Farmers learn and observe innovations or experiments conducted by their fellow farmers, relatives, or neighbors as a reference before adopting an innovation (Bandiera and Rasul, 2006). Connecting to sponsorship networks helps farmers to learn and adapt formal research methods in addition to their informal research methods, such as collaboration in generating improved or local-adapted innovations (Hoffmann et al., 2007). This diverse type of information and support from various contacts may explain why network heterogeneity enables farmers to pursue innovative performance (hypothesis H7a). Managing heterogeneous networks might be difficult and costly for farmers; therefore, we presume the impact on financial farm performance might be seen in the long run.

Farm size and education of farmers lead to both higher innovative and financial performance (Table 3.7). A larger farm size may provide farmers with more space to conduct trials and experiments (Feder, 1985). A larger farm size could also help farmers bear more risks because they may have sufficient space to grow vegetables

as their income source (Marra et al., 2003). Therefore, farm size is vital to gain both enhanced innovative and financial performance. We used the duration of formal education as a proxy of farmers' knowledge, which positively influences financial performance, but not innovative performance. This situation may indicate that formal education helps farmers better understand market needs and resource allocation, ultimately realizing enhanced revenues. Although the knowledge gathered during formal education might serve as a basis for farmers to design trials and experiments properly (Leitgeb et al., 2012), formal education has a time lag. It is not the only source of farmers' knowledge. Farmers may also learn from non-formal education, such as training (Pratiwi and Suzuki, 2017) or observations of other farmers' experiments (Bandiera and Rasul, 2006). These two sources of knowledge, which are not included in this chapter, might influence farmers to innovate. We recommend future studies to include non-formal education as one of the predictors for innovative performance.

3.6 Conclusions

The empirical results of this chapter demonstrate that more entrepreneurial farmers can face market changes by linking to business ties and heterogeneous networks that potentially contain non-redundant information, which helps these farmers achieve a higher farm performance. The results show that more entrepreneurial farmers have more business ties, technology ties, and heterogeneous networks than less entrepreneurial farmers. We further incorporate the entrepreneurial degree and network content into the analysis of farm performance. We find that more entrepreneurial farmers, business ties, and network heterogeneity enhance innovative performance and financial performance. We highlight the importance of entrepreneurial degree and business ties in enhancing innovative and financial performance, whereas network heterogeneity is especially crucial for farmers to enhance innovative performance.

We acknowledge that our study has some limitations. First, we conducted our study using a single type of farmers – vegetable farmers – in West Java, who tend to be closer to public research institutes or universities and also have more market choices than other types of farmers in other areas. This choice may have limited the generalization of our findings to other types of farmers. Second, our study uses a cross-section design that cannot capture the dynamics of farmers' networks, entrepreneurial degree, innovation, and farm performance. We suggest that future studies use a longitudinal or panel data design, which would provide more comprehensive insight into these variables' dynamics. Third, we used plot size for experiments as the indicator for innovative performance, which indicates R&D inputs (Hagedoorn and Cloodt, 2003). Because innovative performance may cover

other indicators, such as new products (Hagedoorn and Cloodt, 2003) or new improvements, our findings may limit innovative performance interpretation. We suggest that different types of indicators be combined to reflect innovative performance as a construct that indicates farm performance. Fourth, this study focuses on network content as an information type without considering other resources shared in the networks, such as intangible and tangible assets. Finally, this chapter's study population might suffer from interest bias from the agricultural officials or cooperative managers who provided the farmer list. Availability bias might also occur from sample selection due to incomplete farmer addresses, making it difficult for us to reach all the farmers on the list. We suggest that future studies improve collecting data methods, reducing the potential bias, and better representing the population.

This chapter contributes to a better understanding of network content differences between more entrepreneurial farmers and less entrepreneurial ones. Previous studies suggest that entrepreneurship is crucial for farmers to adapt to changes in the business environment (Grande et al., 2011; Phillipson et al., 2004). To address these changes, farmers need to be entrepreneurial and engage in networks (Phillipson et al., 2004). We argue that entrepreneurial farmers with extensive networks build up social capital (Boso et al., 2013), helping them develop innovations and achieve better performance. To our knowledge, few studies pay attention to incorporating farmers' entrepreneurial degree and networks to face changes in the business environment. Our findings indicate that farmers' innovations are more demand-driven than supply-driven, reflecting from business ties, which have a more significant impact on innovative and financial performance than technology ties. We recommend that policymakers help farmers engage with people or organizsations that provide business information, stimulating farmers to translate market demands by developing innovations.

Chapter 4

The mediating effect of entrepreneurial orientation on the link between experience and opportunity identification of smallholder farmers

This chapter is based on:

Etriya, E., Scholten, V.E., Wubben, E.F.M., and Omta, S.W.F. 2020. The mediating effect of entrepreneurial orientation on the link between experience and opportunity identification of smallholder farmers. (To be Submitted).

4.1 Introduction

Farmers in developing countries face more competitive business environments. Agricultural markets tend to be more market-oriented and even more liberal (Dias et al., 2019a; Dias et al., 2019b), which may harm most smallholder farmers. For instance, Indonesian vegetable smallholder farmers comply with modern markets' strict requirements to provide high-quality products (Hernández et al., 2015; Reardon et al., 2012) and face fierce competition from local farmers and foreign producers (imported vegetables). Imported vegetables from China, Myanmar, Australia, and United States have penetrated Indonesian vegetable markets in terms of supermarkets, wholesale markets, and even traditional markets (Natawidjaja et al., 2007; Statistics-Indonesia, 2019b). The value of imported vegetables to Indonesia increased 11.40 percent per year in 2010-2017 (Statistics-Indonesia, 2019b). The prices of imported vegetables are often lower than the local ones, making local vegetables less competitive. Furthermore, the prices of some local vegetables, such as chilies and shallots, tend to be highly volatile, contributing to the national inflation rate (KEMENTAN, 2017b). The price volatility might increase on farmers (Pindado and Sánchez, 2017) caused by the competition with local farmers or foreign producers. When vegetable prices decrease far below the production costs, smallholder farmers are suffered from getting significant losses. Thus, Indonesian smallholder farmers deal with competitive markets due to modern markets' strict requirements, price volatility, and fierce competition with local and foreign producers.

The impacts of environmental changes on farmers are still debatable in the literature. On the one hand, smallholder farmers may show vulnerability to market changes, making them unwilling to keep innovating due to difficulties in either managing market risks (Carletto et al., 2010) or reaching cost efficiency (De Wolf and McElwee, 2007). On the other hand, environmental changes could also encourage farmers to develop their entrepreneurial skills by participating in market-based activities (Alsos et al., 2011; Carter, 1999; Grande et al., 2011), developing more innovations (Spielman et al., 2011), or involving in farmers' experiments (Alsos et al., 2014; Leitgeb et al., 2011). Although changes may be perceived as threats, this situation may also be seen as a source of opportunities (Cohen and Winn, 2007; Lumpkin and Dess, 2001). For instance, market changes may motivate farmers to reorganize and reconfigure their business models and initiate new markets (Dias et al., 2019a; Morgan et al., 2010). Thus, environmental changes potentially provide abundant opportunities for farmers to be identified and exploited.

In facing the rapid changes, farmers are suggested to be adaptive and take benefit from an entrepreneurial orientation to anticipate future demands (Grande et al., 2011; Lumpkin and Dess, 1996), be alert to opportunities, and committed to the process of transforming opportunities into value creation (Stevenson, 2000). Furthermore, an experience that contains plentiful knowledge potentially helps entrepreneurs identify opportunities (Hsieh et al., 2007). The literature varies in explaining the role of experience for entrepreneurs. On the one hand, the experience is often seen as contra-productive to entrepreneurs. More experience gives a more cognitive bias to old ways of doing (dominant logic, path dependency, and makes the firm inert). More experiences also make firms less flexible in adopting new insight because existing frameworks of reference from experience are used. Other problems may arise from experiences, such as bounded rationality, local search, and neighborhood search, which do not provide much new insight (Overall, 2016). On the other hand, some studies found that entrepreneurs benefit from their experience by enabling them to understand the dynamics in their environments better and interpret them as opportunities (Baron, 2006; Venkataraman, 1997). In developing countries, many smallholder farmers may find it difficult to access physical or financial resources. However, entrepreneurial ones may utilize intangible resources, such as market experience, which promotes the linking to business partners as a means to identify opportunities. More experience with the markets, which consists of experience linking to customers, suppliers, or supporting organizations, provides farmers with knowledge accumulations related to the market trends and market needs (Baron, 2006). This knowledge helps farmers better understand how to perceive market changes as opportunities (Venkataraman, 1997) by configuring these random events into meaningful patterns (Baron, 2006).

Changes are acknowledged as a natural process in life, potentially yielding both profitable opportunities and individuals seeking those opportunities (Venkataraman, 1997). Because entrepreneurs can build specific patterns from the changes in markets and technologies to identify opportunities (Baron, 2006), entrepreneurial oriented farmers may also see these changes as sources of opportunities. They are encouraged to adapt to the changes by identifying and translating the changes into entrepreneurial opportunities, evaluating and choosing the profitable opportunity, and eventually transforming this selected one into new businesses or improvements of their current business (Ardichvili and Cardozo, 2000; Dess et al., 1997b; Vik and McElwee, 2011).

The literature suggests that prior information and knowledge integrated with experience may help entrepreneurs identify opportunities (Baron, 2006; Shane, 2000). Knowledge integrated with the experience helps firms process information efficiently by improving understanding of information (Ucbasaran et al., 2009) and configuring apparently unconnected information into meaningful patterns (Baron,

2006). For instance, experience with knowledge related to technologies and markets might help farmers identify opportunities beyond their current businesses. Furthermore, being entrepreneurial oriented may also encourage farmers to identify opportunities by taking risks to anticipate future demands and excel towards competitors.

Opportunity-identification processes tend to be contextual (Javadian and Singh, 2018; Methorst et al., 2017), depending on industry sector characteristics. A sector may explain how entrepreneurs interconnect with customers, suppliers, competitors, policymakers, and other actors to seize opportunities; however, the entrepreneurship literature pays little attention to the sector's importance to form the entrepreneurship processes (De Massis et al., 2018). The economic and environmental characteristics of the agricultural sector are unique compared to other sectors (Pindado and Sánchez, 2017). Agricultural activities rely on land as a primary production factor and weather conditions that cause variations in crop yields and prices. Agricultural activities also involve biological processes that affect environments (Britz et al., 2012; Trnka et al., 2011). Furthermore, agricultural products are generally perishable and bulky and require specific handling for distribution along the supply chains. Consequently, these characteristics may shape distinctive entrepreneurship processes (McElwee and Bosworth, 2010; Pindado and Sánchez, 2017). To our knowledge, few studies in entrepreneurship take into account the agricultural sector as the primary context (Dias et al., 2019b; Fitz-Koch et al., 2018), particularly in developing countries that are mainly operated by smallholder farmers (Lowder et al., 2016).

Most entrepreneurship studies in agriculture are carried out within developed countries (Dias et al., 2019b), which are institutionally established (Bunkus et al., 2020; Fitz-Koch et al., 2018). In contrast, entrepreneurs in developing countries deal with insufficient infrastructure and changing institutional settings, such as limited information communications and ineffective regulations (Boso et al., 2013; Tang, 2010). As a result, compared to those in the developed world, entrepreneurs in developing countries may face different drivers or constraints (Boso et al., 2013; Welter, 2011), such as globalization or market integration that may have significant impacts on smallholder farmers (Fitz-Koch et al., 2018). To date, the body of literature does not adequately explain what factors enable smallholder farmers to identify opportunities emerging from environmental changes in developing country settings. We assume that environmental changes as sources of opportunities (Cohen and Winn, 2007; Venkataraman, 1997). Therefore, this chapter offers a framework that incorporates farmers' experience as sources of knowledge with entrepreneurial orientation to explain the mechanisms of how smallholder farmers identify opportunities in the context of the agricultural sector of a developing country.

Several studies on agricultural entrepreneurship have considered the role of farmers' knowledge in identifying opportunities (Barzola Iza and Dentoni, 2020; Fitz-Koch et al., 2018; Methorst et al., 2017; Pindado et al., 2018; Sher et al., 2019). However, these studies have paid little attention to how entrepreneurial-oriented smallholder farmers utilize knowledge integrated with their experience to be alert to opportunities coming from environmental changes. Experience and entrepreneurial orientation may allow farmers to identify opportunities (Lumpkin and Dess, 1996; Pindado et al., 2018; Ucbasaran et al., 2009). This chapter posits that entrepreneurial orientation helps farmers pioneer markets by predicting market trends and identify opportunities (Barzola Iza and Dentoni, 2020; Grande et al., 2011; Verhees et al., 2012). Entrepreneurial orientation serves as a way to transform knowledge integrated with farmers' experience into profitable opportunities. We argue that farmers' experience requires entrepreneurial orientation to be able to identify opportunities. Therefore, this chapter addresses the following research question: what is the impact of entrepreneurial orientation on the relationships between smallholder farmers' experience and opportunity identification?

Since the agricultural sector in Indonesia (as one of the developing countries) faces emerging markets and changing institutions (Minot et al., 2015), this situation may provide a suitable setting for examining how smallholder farmers identify opportunities through mediation mechanisms of entrepreneurial orientation. Entrepreneurial orientation works better in a dynamic and changing environment (Covin and Slevin, 1989; Shirokova et al., 2016), including the vegetable sector in West Java, Indonesia (Hernández et al., 2015; Natawidjaja et al., 2007). Hence, this chapter investigates the mediating effect of entrepreneurial orientation on the relationships between experience and opportunity identification among vegetable farmers in West Java, Indonesia. This chapter includes farmers' experience in linking to modern markets, suppliers, and supporting organizations.

The contribution of this chapter is as follows. First, this chapter contributes to the literature of rural studies by adopting approaches developed in the strategic entrepreneurship literature (i.e., opportunity identification (Baron, 2006; Shane and Venkataraman, 2000) and entrepreneurial orientation (Lumpkin and Dess, 1996; Miller, 1983) to analyze how smallholder farmers stay competitive in changing environments. Second, this chapter contributes to the opportunity identification literature by expanding this theory's relevance to smallholder farmers' context in dealing with environmental changes. We used the theory of entrepreneurial orientation to analyze how the knowledge integrated with farmers' experience helps smallholder farmers identify opportunities. The literature acknowledges that opportunity identification and knowledge play a critical role in agricultural entrepreneurship (Lans et al., 2017; Pindado et al., 2018; Seuneke et al., 2013). Hence, this chapter advances the literature of rural studies and agricultural

entrepreneurship by addressing the mechanisms enabling smallholder farmers to identify opportunities beyond their existing farm businesses.

This chapter begins with developing the theoretical framework of opportunity identification, experience, and entrepreneurial orientation, followed by developing the research model and hypotheses. Next, Section 4.3 explains the sample of Indonesian vegetable farmers and details the variables employed and the structural model used. Section 4.4 presents the empirical results for the tests of measurement and structural model. Section 4.5 discusses the main findings, and Section 4.6 closes this chapter with contributions, limitations, implications, and potential avenues for further research.

4.2 Theoretical framework

4.2.1 Opportunity identification

Businesses face changing environments that make the product life cycle meet the mature stage faster (Hamel, 2000). Consequently, firms need to renew their products or services by continuously seizing new opportunities to stay competitive (Wiklund and Shepherd, 2005). Opportunities refer to conditions where combinations of resources have a potential market value higher than their production costs (Casson, 1982; Shane and Venkataraman, 2000), meet the technology and market feasibility (Eckhardt and Shane, 2013), and satisfy market demands better (Wood and Williams, 2014). Entrepreneurs are the ones alert to opportunities (Kirzner, 1997). They proactively predict and anticipate potential changes in the future by renewing their business propositions and continuously identifying new opportunities (Lumpkin and Dess, 1996). Afterward, entrepreneurs exploit the opportunities by creating values and bringing them into the market (Ardichvili et al., 2003). Hence, entrepreneurs are alert and adaptive to environments by anticipating changes, identifying opportunities, and realize them into fruition.

Scholar defines entrepreneurship as the concern to pursue opportunities (Stevenson and Jarillo, 1990) and as the process to seek and exploit opportunities (Venkataraman, 1997). As the pursuit of opportunities, entrepreneurship refers to 'the process by which individuals–either on their own or inside organizations–pursue opportunities without regard to the resources they currently control' (Stevenson and Jarillo, 1990: 23). As opportunity seeking, entrepreneurship is defined as 'a scholarly field seeks to understand how opportunities to bring into existence future goods and services are discovered, created, and exploited, by whom, and with what consequences.' (Venkataraman, 1997: 120). By these definitions, opportunities become the core of entrepreneurship, including

opportunity identification (e.g., opportunity discovery and opportunity recognition) as one of the main interests in entrepreneurship studies (Brown et al., 2001; Shane and Venkataraman, 2000). Both definitions imply that opportunities are identified by entrepreneurs who are not only as individuals but also as firms (Brown et al., 2001; Stevenson, 2000).

Entrepreneurs show a strong tendency on the opportunity and put it as the starting point to create, deliver, and capture value. Their strategic orientation is driven by seizing more opportunities beyond currently controlled resources, and they are committed to pursuing those opportunities (Brown et al., 2001; Stevenson, 1983). Entrepreneurs identify then select the right opportunities to create values (Stevenson and Gumpert, 1985). To manage the risks from exploiting opportunities, entrepreneurs allocate a small number of resources in multiple steps. They use less their resources but employ more outsourced resources, such as financial capital, human capital, or intellectual capital, accessed through renting or subcontracting (Starr and MacMillan, 1990; Stevenson, 1983). Hence, entrepreneurs tend to be opportunity-driven than resource-driven (Brown et al., 2001).

This chapter investigates opportunity identification using the opportunity discovery concept. This concept pays attention to the presence, discovery, and exploitation of opportunities (Shane and Venkataraman, 2000). This concept addresses opportunities as phenomena, where not all people are alert to their presence (Kirzner, 1997; Shane and Venkataraman, 2000). Opportunities may arise from market gaps when supply and demand in the markets do not meet the equilibrium point (Kirzner, 1997) or emerge in imperfectly competitive markets (Alvarez and Barney, 2004, 2007), which result in surpluses, shortages, or misallocated resources (Shane and Venkataraman, 2000). These disequilibrium situations may create certain information that is apparently unrelated (Baron, 2006). Entrepreneurs are alert to the presence of the opportunities emerging from these disequilibrium situations (Kirzner, 1973; Shane and Venkataraman, 2000). They discover opportunities by reconstructing the apparently-unrelated information into a meaningful pattern (Baron, 2006), and exploit these opportunities by transforming their available resources into new products/services (Kirzner, 1973; Shane and Venkataraman, 2000). Thus, the opportunity discovery concept emphasizes entrepreneurs' alertness and actions to respond to the presence of opportunities (Alvarez and Barney, 2007; Kirzner, 1997).

Entrepreneurship is the pursuit of opportunities (Stevenson, 1983; Stevenson and Jarillo, 1990) is in line with the concept of opportunity alertness suggested by Kirzner (1973). Alertness refers to identifying opportunities believed to exist, which come from apparently unrelated events (Baron, 2006). Not everybody is alert to the presence of entrepreneurial opportunities (Kirzner, 1973). The ability to identify opportunities is an essential factor that distinguishes entrepreneurs from non-

entrepreneurs. Entrepreneurs are more alert to the presence of opportunities arising from market imperfections that potentially create economic benefits compared to their counterparts (Kirzner, 1973). Therefore, alertness is a necessary condition for opportunity identification (Ardichvili et al., 2003).

Opportunity identification refers to the process where individuals or organizations believe in finding new ideas on products or business models (Grégoire and Shepherd, 2015). Opportunities may come from: (1) the generation of new information that leads to new technologies, (2) information asymmetries that make the market imperfect, and (3) changes in politics and demography that lead to utilization of alternative resources (Drucker, 1985). Market imperfections can be caused by inefficiency in firms, externalities, imperfect pricing mechanisms, and information asymmetries, all of which are potential sources of opportunities that lead to new business models and technological innovations (Cohen and Winn, 2007).

The agricultural sector in developing countries is predominantly operated by smallholder farmers (Hazell et al., 2010). They may find it challenging to adapt to environmental changes and exploit opportunities (Grande et al., 2011; Wiggins et al., 2010). However, entrepreneurial farmers – like other business owners – aim to improve income and maximize profits (Dias et al., 2019a; Windle and Rolfe, 2005). They potentially contribute to pursuing opportunities by involving in generating innovations to create new products or new business models for new markets (Dias et al., 2019b; Pindado and Sánchez, 2017) by applying new technologies that allow small farms to achieve higher productivity (Micheels and Nolan, 2016). As the agricultural sector in many countries turns to be market-oriented (Giannakis and Bruggeman, 2015; Reardon et al., 2009), this situation encourages farmers to be more entrepreneurial. For instance, entrepreneurial farmers attempt to meet the market demands by producing high-quality food for modern markets or providing specialty agricultural products for a niche market, such as organic products (Dias et al., 2019b; Gellynck et al., 2012). The ability to identify opportunities is one of the critical capabilities for farmers (Grande et al., 2011; McElwee and Bosworth, 2010) to pursue successful farms (Phelan and Sharpley, 2012) by turning the opportunities into either new businesses or improved current businesses (Fitz-Koch et al., 2018; Hawkins et al., 1993).

4.2.2 Experience and opportunity identification

Opportunities emerge from knowledge distribution in society. The experience contains past and current interactions and communication among people, which may involve exchanges of some activities regarding enrollment, persuasion, consultation, or involvement. These exchanges may facilitate entrepreneurial processes that enable opportunity creation, such as new ventures or new products

(Erikson and Korsgaard, 2016). When knowledge is unequally distributed, resource allocation is needed, and entrepreneurial opportunities arise as the solution (Hayek, 1945).

Knowledge plays a vital role in the study of entrepreneurial opportunities. Entrepreneurs can make links among specific knowledge and further turn the links into profitable opportunities (Venkataraman, 1997). The extensive experience provides entrepreneurs a framework or a prototype that links and builds unrelated trends or events into a pattern leading to opportunities (Baron, 2006). Experience with rich knowledge of specific markets or industries enables entrepreneurs to search for new patterns for a prototype as potential opportunities. Knowledge gathered from experience enables entrepreneurs to make decisions and solve problems faster. In facing existing problems or decisions, entrepreneurs who have positive experience tend to involve in shortcut cognitive processes compared to those who have negative ones (Baron, 2008). Furthermore, entrepreneurs who experience positive results can improve their capacity to access essential resources to identify opportunities (Baron, 2008). For instance, the experience of getting success or failures in the markets contains prior knowledge about market needs, which may help entrepreneurs understand the markets better and find innovative solutions. These solutions may lead to being valuable opportunities (Baron, 2006).

4.2.3 The mediating role of entrepreneurial orientation

Entrepreneurial orientation is one of the essential concepts of entrepreneurship studies, which explains firms' attempts to identify and realize opportunities (Wiklund and Shepherd, 2005). Entrepreneurial orientation indicates an entrepreneurship degree of firms (Brown et al., 2001; Miller, 1983), which serves as a strategic managerial process in making decisions (Lumpkin and Dess, 1996). The forward-looking perspective of entrepreneurial orientation may stimulate firms/entrepreneurs to identify and exploit opportunities that emerge due to environment or market changes (Wiklund and Shepherd, 2003). In identifying and realizing opportunities, entrepreneurs may face high risks and uncertainties. Therefore, entrepreneurial orientation helps firms bear more risks (Lumpkin and Dess, 1996, 2001) by acquiring and considering relevant information and knowledge. Hence, entrepreneurial orientation prepares entrepreneurs to face uncertainties and changing environments by identifying opportunities beyond current businesses (Shane and Venkataraman, 2000).

Entrepreneurial orientation is a strategic orientation that includes decision-making styles, methods, and practices (Lumpkin and Dess, 1996). Entrepreneurial orientation represents a combination of proactiveness and risk-taking that may result in innovation (Avlonitis and Salavou, 2007; Pérez-Luño et al., 2011). Entrepreneurial-oriented firms are adaptive to market changes by being proactive

over future demands. They are committed to investing many essential resources to be the first in the market ahead of the competitors (Lumpkin and Dess, 1996) to gain high returns from opportunities (Wiklund and Shepherd, 2003, 2005).

Proactiveness in entrepreneurial orientation focuses on seeking promising opportunities to anticipate future market demands. Proactive entrepreneurs routinely scan changes in their business environments to detect potential future demands of current markets. Afterward, they formulate novel solutions for the problems, leading to new opportunities (Dess and Lumpkin, 2005). Keeping monitoring the markets and being sensitive to the market needs may allow entrepreneurs to identify opportunities (Ardichvili et al., 2003).

Risk-taking in entrepreneurial orientation shows entrepreneurs' courage to seek opportunities in new and uncertain situations that potentially yield big profits or losses (Dess and Lumpkin, 2005). Risk-taking entrepreneurs do not mean they are gambling. They do research and assess risk factors to reduce uncertainty and apply practices that have been successful in other situations (Dess and Lumpkin, 2005). Likewise, entrepreneurial farmers are suggested to bear more risks in identifying and exploiting opportunities (Vik and McElwee, 2011).

Entrepreneurial orientation expresses how entrepreneurs use knowledge to identify opportunities (Wiklund and Shepherd, 2003) by responding to external environment stimuli (Lumpkin and Dess, 1996). Knowledge is a valuable, unique, and inimitable resource that enables entrepreneurs to stay competitive (Wiklund and Shepherd, 2003). Knowledge helps entrepreneurs anticipate more precisely the potential market value of opportunities caused by environmental changes (Cohen and Levinthal, 1990). Similarly, entrepreneurial orientation facilitates farmers' experience in identifying opportunities by making farmers know better where to search for opportunities, estimate better the market value of opportunities, and eventually obtain the valuable opportunities (Cohen and Levinthal, 1990; Grande et al., 2011).

Previous studies acknowledge the role of experience in opportunity identification processes (Baron, 2006; Ucbasaran et al., 2009). The experience contains knowledge that facilitates entrepreneurs to identify opportunities by providing awareness and information to configure opportunities (George et al., 2016). Experience with prior information serves as a means for entrepreneurs to understand, interpret, and elaborate new information (e.g., new technologies) with prior information (e.g., experience with customers), potentially leading to opportunity identification (Shane, 2000). Experience enhances knowledge accumulation (Tang, 2010). Thus, experience allows entrepreneurs to connect and make sense of new information with prior information in identifying opportunities.

Knowledge and prior information can be integrated with an experience that enables entrepreneurs to understand, predict, explain, and use new information (Shane, 2000). The experience encourages the learning processes by enabling entrepreneurs to recognize the specific patterns of prior information (Baron, 2006; Ucbasaran et al., 2009). Furthermore, entrepreneurs may also learn from feedback on past decisions, including failure or success (Ucbasaran et al., 2009). Experience related to failure may activate learning and adaptation (McGrath, 1999). Failure may come from entrepreneurs' inability to keep updating ongoing changes in the potential markets. In contrast, success may result from entrepreneurs' efforts to monitor their potential markets continuously (Baron, 2006). Thus, experience allows entrepreneurial firms to identify potentially valuable opportunities through the learning processes by configuring apparently unrelated information from various events into specific patterns or evaluating past failure or success (Baron, 2006; Ucbasaran et al., 2009).

The experience contains tacit knowledge integrated with action, commitment, and involvement of the human mind and body. The experience also involves cognitive and technical elements (Nonaka, 1994). The experience creates knowledge by transforming tacit knowledge into other forms of tacit one and then transfer it through entrepreneurs' interactions. For instance, an entrepreneur introduces and communicates a new product to the market. The market actors (e.g., customers or users) make sense of the product by buying, adjusting, using, or not buying. Afterward, the entrepreneur may learn from the market actors' responses and feedbacks to the products. Hence, the experience allows entrepreneurs to create knowledge by communicating tacit knowledge to the market actors (Nonaka, 1994).

Linking to business partners, such as suppliers, buyers, or supporting organizations, helps entrepreneurs deal with uncertainties from changing environments and benefit from these situations by identifying opportunities (Burt, 1997a; Elfring and Hulsink, 2003). Furthermore, linking to these partners allows entrepreneurs to access knowledge and resources faster and more efficiently (Walter et al., 2001). In the situation of smallholder farmers, they link to suppliers, buyers, or supporting organizations that are relatively bigger in sizes than the farmers. The literature describes this type of relationship as asymmetric (Lambrecht et al., 2015).

The asymmetric relationship concept reflects inequalities in size, power, and capabilities between actors who participated in the relationship because one of the actors owns or manages more considerable resources. Consequently, these bigger actors have more influence over their counterparts (Blomqvist et al., 2005; Mouzas and Ford, 2004). Smaller actors may find difficulties maintaining this asymmetric relationship, mainly to keep their capabilities to grow, stay in a competitive position, and create value (Colurcio, 2009; Johnsen and Ford, 2006). However, this asymmetric relationship may also positively influence the smaller actors by

allowing them to assimilate external knowledge and practices provided by the bigger actors (Blomqvist et al., 2005) and enable the smaller actors to develop their knowledge (Lambrecht et al., 2015). Most relationships between farmers and their business partners may be unequal; however, these asymmetric relationships may provide potential sources of opportunities and are considered essential for innovation processes (Lambrecht et al., 2015).

Entrepreneurial orientation and entrepreneurial skills enable farmers to identify opportunities when facing changing environments (Alsos et al., 2011; Grande et al., 2011). Knowledge and information integrated with experience may also be crucial for farmers to deal with rapid changes in agrifood markets. Entrepreneurial oriented farmers tend to be proactive over current customer needs and future market demands, bear more risks to satisfy market demands (Grande et al., 2011; Verhees et al., 2012), and solve customer problems related to quality or logistics (Natawidjaja et al., 2007). They may solve customer problems by communicating or exchanging tacit knowledge to modern markets or supporting organizations. Farmers may also experience success or failure in participating in modern markets, linking to suppliers, or linking to supporting organizations. Experiencing failure enables entrepreneurs to identify opportunities by learning and understanding what causes the failures (Ucbasaran et al., 2009).

Experience may provide firms with knowledge about technology or markets that allows entrepreneurs to identify valuable solutions to a problem (Hsieh et al., 2007). Experience with market knowledge provides entrepreneurs with knowledge of customer needs, market characteristics, and ways to satisfy customer problems. Furthermore, market knowledge may also involve information about supplier relationships, sales approaches, or capital specific to different markets (Von Hippel, 1988). Therefore, market knowledge allows entrepreneurs to formulate the right solutions to customer problems (Baron, 2006; Shane, 2000). Market knowledge supports technological knowledge on how to serve markets, mainly how new technologies can be used to develop new products (Shane, 2000). In anticipating future demands or responding to competitors' actions, technological knowledge helps entrepreneurs formulate product innovation at particular costs and create its market value (McEvily and Chakravarthy, 2002). Furthermore, supporting organizations may act as knowledge providers or knowledge agents that provide technological learning and knowledge sharing to farmers (Gellynck et al., 2015).

Farmers' experience involving asymmetric relationships with buyers of modern markets may provide the farmers with the accumulation of knowledge and information about the market trends. Linking to modern markets is essential for smallholder farmers to understand the market demands and then help them translate and meet the demands effectively and efficiently (Lambrecht et al., 2015). For instance, through formal/informal contractual agreements, the buyers of

modern markets support smallholder farmers with technical assistance and training, helping them understand to meet the market requirements. Entrepreneurial orientation then facilitates farmers to utilize their knowledge accumulated in their experience to identify opportunities by anticipating the future market demands and taking more risks. We expect that entrepreneurial orientation enables smallholder farmers who have experience in linking to modern markets to identify more opportunities. The hypothesis is as follows:

H1: Entrepreneurial orientation mediates the relationship between farmers' experience in linking to modern markets and opportunity identification.

Experience in linking to suppliers is part of managerial experience that allows entrepreneurs to access technologies and innovations (Orser et al., 2007) and provide entrepreneurs with knowledge about industry characteristics (Delmar and Shane, 2006). Experience in linking to suppliers also helps entrepreneurs understand better how to fulfill market demands, allowing entrepreneurs to identify opportunities (Tang, 2010). Moreover, commitment and interactions with suppliers are essential for entrepreneurs to deal with customer requirements or cash flow problems (Morris, 2015; Uy et al., 2013).

Collaborations with big companies as suppliers indicate asymmetric relationships that allow farmers to assimilate knowledge in the collaborations (Blomqvist et al., 2005; Lambrecht et al., 2015). Smallholder farmers may benefit from their close relationships with suppliers to access new knowledge needed to develop innovations. Therefore, these asymmetric relationships between farmers and suppliers may stimulate innovation processes (Lambrecht et al., 2015). Furthermore, entrepreneurial orientation allows smallholder farmers to use knowledge accumulation in the experience through the asymmetric relationships with suppliers, helping them better understand the industries they operate in and better serve their markets. We expect entrepreneurial orientation to enable smallholder farmers who have experience in linking to suppliers to identify more opportunities. The hypothesis is as follows:

H2: Entrepreneurial orientation mediates the relationship between farmers' experience in linking to suppliers and opportunity identification.

Some smallholder farmers have experience in linking to supporting organizations, another type of asymmetric relationships, such as universities, research institutes, or NGOs. These supporting organizations allow farmers to explore and obtain new knowledge and resources to develop technological innovations and practices (Cofré-Bravo et al., 2019). We expect that entrepreneurial orientation facilitates smallholder farmers who have experience in linking to supporting organizations to identify more opportunities. The hypothesis is as follows:

H3: Entrepreneurial orientation mediates the relationship between farmers' experience in linking to supporting organizations and opportunity identification.

Figure 4.1 describes our research model, including the three formulated hypotheses. This model emphasizes the role of entrepreneurial orientation in mediating the relationships between farmers' experience and opportunity identification.

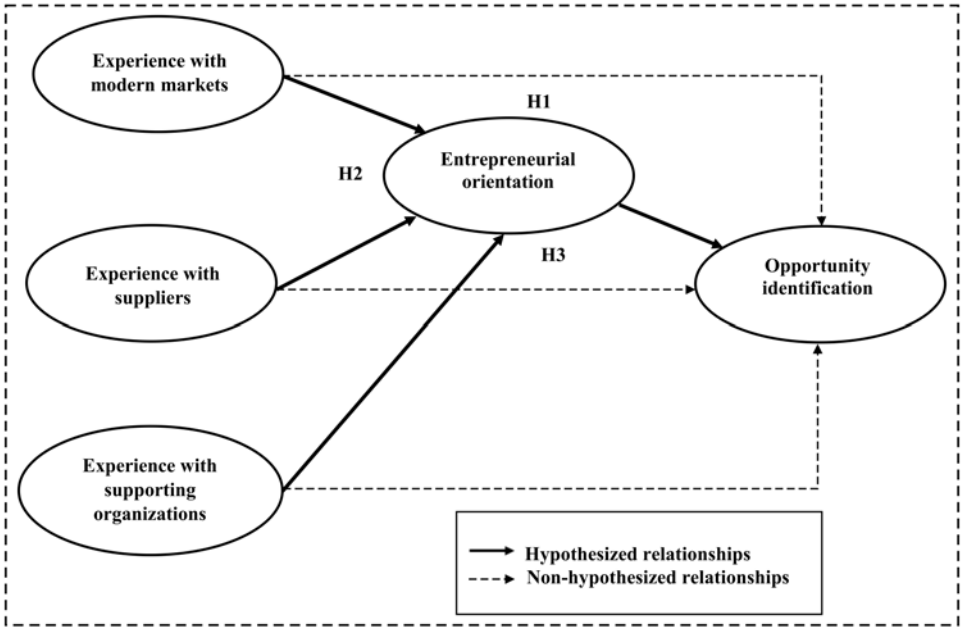

Figure 4.1. Research model

4.3 Methods

4.3.1 Data

To test the hypotheses, we used samples representing the farmers' population (as owner-managers of farms) producing vegetables as sources of family income (BAPPENAS, 2014). The data were gathered using a survey administered to 320 respondents in four regions of West Java, Indonesia (i.e., Pangalengan Bandung, Cisarua Bandung, Garut, and Pacet Cianjur). These areas were chosen based on the variation of technologies (e.g., farms using greenhouses, open fields, or plastic shades) and market access variation. Farmers located in Pangalengan Bandung, Cisarua Bandung, and Pacet Cianjur, could easily access modern and traditional

markets. In contrast, farmers in Garut (primarily operated in remote areas) were mostly depended on traditional markets and had limited access to modern markets.

We used the list provided by the agriculture officials to build a database for our study population and validated it through local authorities. We used this validated list as the sampling frame. The respondents were chosen using random sampling. Eighteen cases in total were excluded for the following reasons: (1) the farmers did not produce vegetables in 2015 as the basis for data analyses, (2) small farm size (less than 0.05 hectares) might indicate that producing vegetables were not their primary job, (3) considerable farm size that was far above the average farm size (> 20 times higher than the average farm size), and (4) extreme values on net revenues because production costs per hectare and revenues per hectare were far above the average values of other farmers who grew the same vegetables in the same area. The final sample size was 302 farmers to elaborate in further analyses. This final sample size is more than ten times the parameters used in this chapter's research model ($n_{\text{parameter}} = 20$), sufficient for the data analysis using PLS-SEM (Hair et al., 2019).

We used a questionnaire to collect the data. The questionnaire was prepared in English and then carefully translated into Bahasa Indonesia language. We discussed the questionnaire's content with an agricultural economist, followed by pre-testing the questionnaire to 30 farmers located in Pangalengan Bandung to get more insights and corrections. Afterward, the final version of the questionnaire was used in the survey with face-to-face interviews, which were administered between May and September 2016.

This chapter assumes that farmers are the farm leaders, so farmers may represent their farms, having similar characteristics to firms with a simple organizational structure (Miller, 1983). Since the entrepreneurial orientation concept requires firms as the unit of analysis (Covin and Wales, 2019), this chapter used farmers representing their farms as the unit of analysis.

4.3.2 Measurements of the independent and mediating variables

Experience

The experience was measured by the amount of farmers' experience in linking to modern markets, suppliers, and supporting organizations (measured in years). Farmers might be involved in specific activities with modern markets, suppliers, or supporting organizations regarding experiments, training, or contractual agreements. This chapter considers modern markets consisting of supermarkets, exporters, and food processors; suppliers consist of seed companies, fertilizer companies, and pesticide companies; and supporting organizations consist of universities, research institutes, and NGOs.

Entrepreneurial orientation

This chapter measured entrepreneurial orientation using the well-established reflective construct developed by Covin and Slevin (1989). This construct incorporates the proactiveness and risk-taking dimensions, measured with a seven-point Likert scale. This chapter operationalized proactiveness as farmers' tendency to be the first-mover in the markets by anticipating future market demands. We operationalized risk-taking as farmers' willingness to take more risks to be involved in new business activities. The general rule suggests testing the relationship of entrepreneurial orientation by building up the research model with mutually exclusive constructs (Covin and Wales, 2019). Therefore, this chapter excluded innovativeness from the entrepreneurial orientation construct to avoid redundancy with the opportunity identification construct. We incorporated innovativeness into the opportunity identification measure.

4.3.3 Measurement of the dependent variable

Opportunity identification

This chapter operationalized opportunity identification as number of opportunities and opportunity innovativeness, adapted from DeTienne and Chandler (2004). We used the score of opportunity innovativeness to weight the number of opportunities. Opportunity identification was calculated as follows:

Opportunity identification = number of opportunities × opportunity innovativeness.

Number of opportunities

In this chapter, opportunities refer to the idea of potential business activities that have potential economic benefits and are possibly realized in the future (Casson, 1982). Opportunities were calculated by counting the number of opportunities mentioned by the respondents, referring to new business activities beyond their current farm businesses, which may be related to the existing farm businesses or not.

Opportunity innovativeness

Considering the variation of opportunity quality (Shane and Venkataraman, 2000), we used opportunity innovativeness to proxy the quality of opportunities identified by farmers. The degree of opportunity innovativeness was rated based on the study conducted by DeTienne and Chandler (2004), using a three-point scale based on the following categories: (1) *less innovative*: if the business activity is similar to the products/services/businesses in the farmer's area/current markets; (2) *reasonably innovative*: if the business activity is a modification of the current products/services/businesses; (3) *highly innovative*: if the business activity is

relatively new, unique, and exceptional to the farmer's area/current markets, which reflects 'new-to-the-industry innovations.'

4.3.4 Measurement of the control variables

Small firms, including smallholder farmers, may face enormous challenges in identifying opportunities when confronted with changing business environments (Khedhaouria et al., 2015; Wiklund and Shepherd, 2003; Yessoufou et al., 2018). Therefore, this chapter controlled the following variables that may affect entrepreneurial orientation and opportunity identification. First, farmer age (in years) represents a proxy of human capital. Second, farm size (in hectares) represents a proxy of physical assets (Khedhaouria et al., 2015). Third, commercial zone (i.e., Pangalengan, Cisarua, and Pacet; 1 = commercial zone; 0 = otherwise), representing the geographic areas close to modern or traditional markets (Hernández et al., 2015). Farmer age indicating farms' human capital tends to decrease (or younger) over time (Pindado and Sánchez, 2019), while the increasing farm size may allow farmers to formulate their entrepreneurial strategies (Dias et al., 2019b). Farmers located in the commercial zone are possibly more entrepreneurial oriented and may identify more opportunities than those located in the non-commercial zone/remote areas.

One may argue that farmer age determines farmers' experience. However, previous studies conducted among smallholder vegetable farmers in Indonesia indicated that younger farmers tend to link to more business partners (e.g., modern markets and supporting organizations) than older ones (Hernández et al., 2015; Sahara et al., 2015; Suprehatin, 2019). Therefore, the causality of farmer age and farmers' experience may not hold in our context. This chapter assumes that older farmers do not necessarily have more experience in linking to modern markets, suppliers, and supporting organizations. We put farmer age as one of the control variables that may affect entrepreneurial orientation and opportunity identification.

4.3.5 Data analysis

To test the research model, we used partial least squares-structural equation modeling (PLS-SEM) analysis with SmartPLS (version 3.2.8, SmartPLS GmbH, Germany) (Ringle et al., 2015), taking the steps suggested by Garson (2016) and Hair et al. (2017). The statistical power of PLS-SEM can explain relationships among latent variables (constructs) in the model, aimed to represent the actual situation in the population. PLS-SEM also estimates complex models that involve formative constructs when the covariance-based approach cannot adequately predict a construct (Hair et al., 2012). Therefore, PLS-SEM is suitable to test a structural model containing both reflective and formative constructs (Ringle et al., 2012).

Hence, PLS-SEM fits with our research model that incorporates both types of constructs.

PLS-SEM approach is also suitable to examine complex relationships, including mediating effects (Hair et al., 2017). Although the mediating effects can be tested using regression analysis, PLS-SEM analysis has advantages over regression analysis (Ramli et al., 2018). First, PLS-SEM better identifies mediation effects for structural models by offering less contradictory results. Second, PLS-SEM analysis can reduce multicollinearity problems better than regression analysis. Third, in contrast to regression analysis, PLS-SEM includes measurement errors to test the hypothesis of mediating effects for models involving latent variables (measured by several items). This chapter tested the mediating effect of entrepreneurial orientation using the bootstrapping approach (Hayes, 2009). In reporting and interpreting the results, we used the recommendations of Hair et al. (2019).

4.4 Results

4.4.1 Testing the measurement model of the reflective construct

We assume that proactiveness is closely related to risk-taking. Therefore, we treated entrepreneurial orientation as a unidimensional construct (Wiklund and Shepherd, 2005). To prove this assumption, we conducted a principal component analysis (PCA) to test the number of factors extracted from the items of proactiveness (three items) and risk-taking (three items). This test shows that all the six items were loaded on one factor, with an explained variance of 56.16 percent and an eigenvalue of 3.37. Thus, the results support the assumption that entrepreneurial orientation as a unidimensional construct.

We tested the convergent validity and reliability of entrepreneurial orientation as the reflective construct of our research model. A reflective construct's convergent validity is met if the factor loadings of the items on the construct exceed 0.60, and if the average variance extracted (AVE), indicating the amount of variance explained by the construct, exceeds 0.50 (Hair et al., 2017). The factor loadings of the entrepreneurial orientation items range from 0.70 to 0.83, and the AVE score is 0.56 (Table 4.1). Furthermore, cross-loadings of entrepreneurial orientation items are higher on the construct of entrepreneurial orientation than other constructs. We conclude that this construct meets convergent validity. Next, the reliability of a reflective construct is fulfilled if the value of Cronbach's alpha (CA), indicating internal construct consistency, is higher than 0.70 (Nunnally, 1978) and the value of composite reliability (CR) is more than 0.60 (Hair et al., 2019). The CA value of

entrepreneurial orientation is 0.84, and the CR value of this construct is 0.88 (Table 4.1), both of which exceed the suggested threshold, demonstrating satisfactory reliability for the entrepreneurial orientation construct.

Table 4.1. Measurement results for the reflective construct

Construct	Items	Factor loadings	Cronbach's alpha	Composite reliability	AVE
Entrepreneurial orientation			0.84	0.88	0.56
	Proactive on initiating changes	0.75			
	Proactive on being a pioneer	0.83			
	Proactive over competitors	0.73			
	Risk-taking on new projects	0.74			
	Risk-taking on achieving goals	0.70			
	Risk-taking on becoming a first-mover	0.73			

n = 302

4.4.2 Testing the measurement model of the formative constructs

The research model of this chapter includes the constructs of experience as the formative constructs, namely: (1) experience in linking to modern markets, (2) experience in linking to suppliers, and (3) experience in linking to supporting organizations. The formative construct's reliability is indicated by the multicollinear level (Diamantopoulos et al., 2008). The following indicators were used to check the presence of collinearity between items: (1) variation inflation factor (VIF) of items of the construct that should be lower than 3.30 (Diamantopoulos and Siguaw, 2006) and the average VIF should not be broadly higher than 1 (Field, 2009), (2) tolerance statistics (1/VIF) that should be greater than 0.20 (Field, 2009), and (3) correlation coefficients between items that should be less than 0.70 (Field, 2009). The results demonstrate that the individual VIF values of the items of the three constructs range from 1.02 to 1.90, and the average VIF value of each construct was not considerably higher than 1 (i.e., 1,03; 1.68; and 1.41, respectively) (Table 4.2). The values of the tolerance statistics of all items were higher than 0.20 (Table 4.2). The individual correlations between the items were below 0.70, ranging between 0.00 and 0.59 ($p < 0.01$; the correlation coefficient between experience with universities and experience with research institutes) (Table 4.3). Thus, the results indicate no severe multicollinearity.

Table 4.2. Measurement results for the formative constructs

Construct	Items	VIF	Tolerance
Experience in linking to modern markets	Supermarkets	1.02	0.98
	Exporters	1.03	0.97
	Food processors	1.03	0.97
Experience in linking to suppliers	Seed companies	1.58	0.63
	Fertilizer companies	1.90	0.53
	Pesticide companies	1.55	0.65
Experience in linking to supporting organizations	NGOs	1.08	0.92
	Universities	1.60	0.62
	Research institutes	1.54	0.65

n = 302

Table 4.3. Correlations matrix of the items of the formative constructs

Experience in linking to:	1.	2.	3.	4.	5.	6.	7.	8.
1. Supermarkets								
2. Exporters	0.11							
3. Food processors	0.08	0.16**						
4. Seed companies	-0.01	0.14*	0.07					
5. Fertilizer companies	-0.01	0.23**	0.07	0.59**				
6. Pesticide companies	0.00	0.20**	0.33**	0.45**	0.58**			
7. NGOs	0.05	0.04	0.04	0.12*	0.28**	0.14*		
8. Universities	0.11	0.10	0.02	0.07	0.30**	0.07	0.27**	
9. Research institutes	0.05	0.24**	0.09	0.12*	0.36**	0.19**	0.20**	0.59**

n = 302

The data of this chapter were collected from one source (i.e., one respondent for every observation) at one point in time (i.e., cross-section approach), at the risk that the common method bias may increase the estimates of the structural parameters (Gefen et al., 2011). To evaluate the potential problem of common method bias, we conducted Harman's one-factor test (Harman, 1976; Podsakoff and Organ, 1986) by performing a single unrotated principal component analysis. The variance of the extracted factor containing the items measured with the same method is suggested to be lower than 50 percent (Harman, 1976). The results posit that distinguished factors were extracted. The factor with the most considerable variance accounted for 23.27 percent (i.e., all the six items of the entrepreneurial orientation construct measured in a seven-point Likert scale). These results indicate little threat of common method bias and support the validity of the research model's measures.

The descriptive statistics of farmers' demographics, entrepreneurial orientation, and experience are reported in Table 4.4. These results indicate that less than half of farmers (approximately 30 percent) who participated in our survey had experiences in linking to downstream or upstream partners (i.e., modern markets or suppliers, respectively) or had access to supporting organizations.

Table 4.4. Descriptive statistics of farmers' demographics, entrepreneurial orientation, and experience

	Mean	SD	Percentage
Farmer age (year)	47.61	10.82	
Farm size (hectare)	1.53	2.08	
Farmers in the commercial zone			68.54
Entrepreneurial orientation			
Proactive on initiating changes	3.74	1.75	
Proactive on being a pioneer	3.86	1.93	
Proactive over competitors	4.07	2.30	
Risk-taking on new projects	4.33	2.22	
Risk-taking on achieving goals	4.46	1.96	
Risk-taking on becoming a first-mover	4.41	2.55	
Experience in linking to modern markets (years)			
Supermarkets	0.63	2.26	
Exporters	0.49	2.06	
Food processors	1.85	4.30	
Experience in linking to suppliers (years)			
Seed companies	0.55	2.92	
Fertilizer companies	0.36	2.15	
Pesticide companies	0.66	2.70	
Experience in linking to supporting organizations (years)			
NGOs	0.46	2.67	
Universities	0.26	1.92	
Research institutes	0.49	2.15	

n = 302

Table 4.5 presents the opportunity identification of farmers. More than half of farmers could identify opportunities (65.56 percent), ranging from one to three opportunities ($n_{\text{opportunities}}$ = 254). Although more than half of the identified opportunities were similar to business activities already present in the farmers' areas (67.71), there was a tendency that farmers could also identify a higher degree of opportunity innovativeness. A quarter of opportunities were a modification of current business activities in the farmers' areas (25.20 percent) or even unique business activities (7.09 percent).

Table 4.5. Opportunity identification of farmers

	N	Percent	Mean	SD	Min	Max
Number of farmers identifying opportunities	198	65.56				
Number of opportunities	254		1.27	0.54	1.00	3.00
Opportunity innovativeness:						
Highly innovative	18	7.09				
Reasonably innovative	64	25.20				
Less innovative	172	67.71				

We also tested the extent to which opportunity innovativeness is correlated to farmers' actual innovations. We used plot size for experiments (m^2; mean = 106.8; SD = 315.43), number of new products (mean = 0.33; SD = 0.99), and number of new varieties (mean = 0.44; SD = 1.51) to measure farmers' innovations. The results show that opportunity innovativeness is weakly correlated with the number of new products ($r = 0.19$; $p < 0.05$) and is not correlated with plot size for experiments and the number of new varieties. It seems that opportunity innovativeness cannot describe current farmers' innovations, but it is potentially realized in the future.

4.4.3 Testing the structural model

Figure 4.2 presents path coefficients of direct effects between independent variables, a mediator, control variables, and the dependent variable opportunity identification.

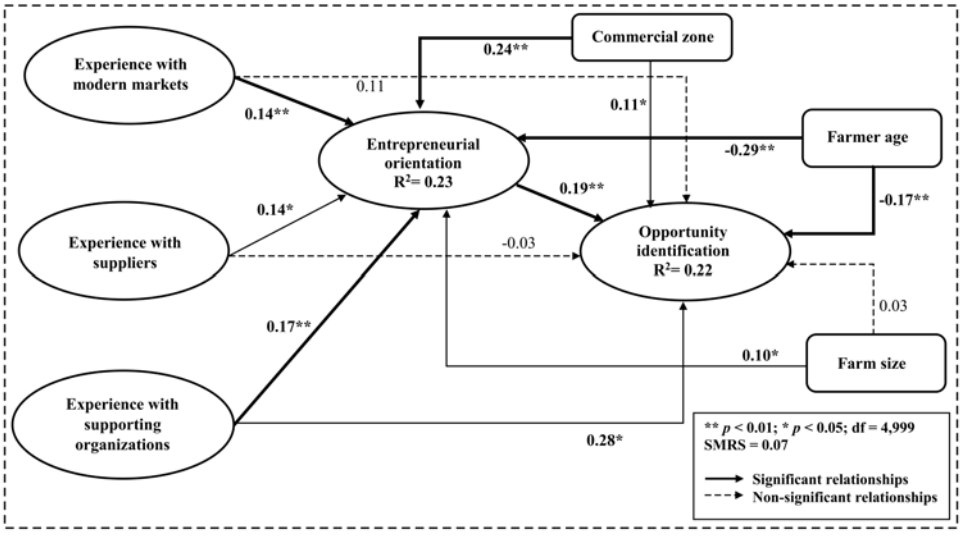

Figure 4.2. Results for the research model

We then tested for the mediating effect of entrepreneurial orientation. A mediating effect is present if the third variable or construct intervenes in the relationship between two other constructs (i.e., independent and dependent variables) (Baron and Kenny, 1986). To test for a mediating effect, we took the PLS-SEM model procedures to examine if the entrepreneurial orientation construct is a mediator, using the bootstrapping approach with 5,000 resamples (Hair et al., 2017; Hayes, 2009). This approach involves the non-parametric approximations of the sampling distribution of indirect effects, which has power in retaining type I error within the robustness interval (MacKinnon et al., 2004). We investigated with a 95 percent confidence interval. If the value of zero does not exist within the lower and upper limits of the confidence interval, the indirect effect is regarded to be significantly different from zero (Preacher and Hayes, 2008). The significance of path coefficients of the indirect effect will prove whether entrepreneurial orientation is a mediating variable.

Hypothesis 1 claimed that entrepreneurial orientation mediates the relationship between farmers' experience in linking to modern markets and opportunity identification. The results demonstrate that the direct effect of experience in linking to modern markets to opportunity identification is weak and statistically not significant (β = 0.11, p > 0.05) (Figure 4.2, Table 4.6). The bootstrap results for the indirect effects show that entrepreneurial orientation fully mediates the relationship between experience in linking to modern markets and opportunity identification (β = 0.03, p < 0.05, lying between 0.01 and 0.06, indicating no zero presents between the upper bound and lower bound) (Table 4.6). Consequently, H1 is confirmed.

Next, hypothesis 2 claimed the mediating effect of entrepreneurial orientation on the relationship between farmers' experience in linking to suppliers and opportunity identification (hypothesis 2). The results reveal that the direct effect from farmers' experience in linking to suppliers to influence opportunity identification; is weak and statistically not significant (β = -0.03, p > 0.05) (Figure 4.2, Table 4.6). The tests for the indirect effects demonstrate that entrepreneurial orientation does not mediate the relationship between experience in linking to suppliers and opportunity identification (β = 0.03, p > 0.05, lying between 0.00 and 0.05) (Table 4.6). As a result, H2 is not supported.

Finally, hypothesis 3 claimed that entrepreneurial orientation mediates the relationship between farmers' experience in linking to supporting organizations and opportunity identification. The results demonstrate that farmers' experience in linking to supporting organizations weakly directly influences opportunity identification (β = 0.28, p < 0.05) (Figure 4.2, Table 4.6). The bootstrap results for the indirect effects show that entrepreneurial orientation partly mediates the relationship between experience in linking to supporting organizations and

opportunity identification (β = 0.03, p < 0.05, lying between 0.01 and 0.06) (Table 4.6). Therefore, H3 is validated.

Overall, our findings provide empirical support that entrepreneurial orientation represents a *full mediator* (Baron and Kenny, 1986) or *indirect-only mediator* (Hair et al., 2017) of the relationships between experience in linking to modern markets and opportunity identification. The findings also demonstrate that entrepreneurial orientation represents a partial mediator (Baron and Kenny, 1986) or *complementary mediator* (Hair et al., 2017) of the relationship between experience in linking to supporting organizations and opportunity identification. Moreover, the model fit measure shows that the value of standardized root mean square residual (SRMR) is 0.07, below the suggested threshold of 0.08, indicating the structural model achieves a good fit (Hair et al., 2017).

Table 4.6. Mediating effect of entrepreneurial orientation on the relationship between farmers' experience and opportunity identification: significance analysis of the direct and indirect effects

Direct effect				Indirect effect			
Relationship	Path coefficient	95% confidence interval	t-value	Relationship	Path coefficient	95% confidence interval	t-value
Experience in linking to modern markets (X) on Opportunity identification (Y)	0.11	[0.00, 0.22]	1.94	Experience in linking to modern markets (X) via Entrepreneurial orientation (M) on Opportunity identification (Y)	0.03*	[0.01, 0.06]	2.06
Experience in linking to suppliers (X) on Opportunity identification (Y)	-0.03	[-0.144, 0.138]	0.42	Experience in linking to suppliers (X) via Entrepreneurial orientation (M) on Opportunity identification (Y)	0.03	[0.00, 0.05]	1.92
Experience in linking to supporting organizations (X) on Opportunity identification (Y)	0.28*	[0.022, 0.490]	2.27	Experience in linking to supporting organizations (X) via Entrepreneurial orientation (M) on Opportunity identification (Y)	0.03*	[0.01, 0.06]	2.38

n = 302
X = independent variable; M = mediating variable; Y = dependent variable
** p < 0.01; * p < 0.05.

4.5 Discussion

This chapter investigates the mediating effect of entrepreneurial orientation on the relationships between experience and opportunity identification of vegetable farmers in West Java, Indonesia. The results show essential findings, which are discussed as follows. We found that farmers' experience in linking to modern markets does not directly increase opportunity identification, but opportunity identification can be realized through entrepreneurial orientation. As hypothesized, entrepreneurial orientation fully mediates the relationship between farmers' experience in linking to modern markets and opportunity identification (hypothesis1). This finding suggests that entrepreneurial orientation enables farmers who are knowledgeable about markets and customer needs accumulating in their experience to detect the presence of opportunities (Grande et al., 2011; Verhees et al., 2012). Entrepreneurial orientated farmers use this type of experience to identify new markets, enhance product efficiency, and overcome resource shortages (Grande, 2011).

The results also show that entrepreneurial orientation partly mediates the relationship between farmers' experience in linking to supporting organizations and opportunity identification (hypothesis 3). This finding implies that, to some extent, entrepreneurial orientation facilitates farmers' knowledge about markets and resources obtained from linking to supporting organizations to identify opportunities that are relevant for further innovation development (Cofré-Bravo et al., 2019). Capabilities of being alert to opportunities are essential to involve in innovation development (Grande, 2011). However, entrepreneurial orientation does not mediate the relationship between farmers' experience in linking to suppliers and opportunity identification (hypothesis 2). Linking to suppliers might not provide sufficient knowledge for farmers to understand the industry better. Therefore, entrepreneurial orientation cannot facilitate knowledge from suppliers to make farmers aware of opportunities.

Tacit knowledge integrated into specific farmers' experience is substantial for farmers to identify opportunities (Alsos and Carter, 2006; Grande, 2011). Although smallholder farmers may have limited physical resources, entrepreneurial orientation helps them focus on opportunities emerging from environmental changes by searching for the relevant resources needed to identify and exploit the opportunities. Entrepreneurial orientation enables farmers to use necessary farm resources efficiently or overcome resource constraints by being adaptive and flexible in dealing with environmental changes (Grande et al., 2011). Experience with substantial knowledge provides farmers distinctive resources, while entrepreneurial orientation facilitates farmers to use their resources efficiently. The synergy of experience and entrepreneurial orientation allows farmers to identify opportunities.

Entrepreneurial-oriented farmers use their experience to assimilate prior knowledge with new knowledge and, in turn, combine this knowledge assimilation with available resources. These processes also help farmers identify opportunities (Grande, 2011). For instance, in anticipating the increasing demands for high-value crops, entrepreneurial-oriented farmers are likely to enhance the product marketability. They search for opportunities, such as alternative outlets, based on their knowledge from experience linking to various markets (Kuivanen et al., 2016). In general, our findings suggest that entrepreneurial orientation helps smallholder farmers be alert and adaptive to environmental changes by assimilating and turning the knowledge acquired from experience into valuable resources, enabling them to identify opportunities.

Regarding control variables, we found that the younger the farmers, the more entrepreneurial oriented they are and identify more opportunities. Similar findings are found among novice farmers (indicating younger farmers) in Europe. Novice farmers tend to be more proactive, alert on opportunities, and more courageous over risks in facing competitive markets than those more established (Pindado and Sánchez, 2017). Furthermore, we found that farm size affects entrepreneurial orientation but does not affect opportunity identification. This finding implies that physical assets do not limit farmers to be alert to opportunities. This chapter also found that farmers located in the commercial zone tend to be entrepreneurial oriented and identify more opportunities than those located in the non-commercial zone (i.e., remote areas). This finding indicates that proximity or access to markets makes farmers aware of opportunities and anticipates market changes.

Generally, this chapter proves that entrepreneurial orientation facilitates smallholder farmers to identify opportunities. We suggest that entrepreneurial orientation is required for farmers to utilize their experience in linking to modern markets or supporting organizations to identify opportunities. Our findings are in line with the prior studies demonstrating entrepreneurial orientation is vital for farmers in developing countries to identify opportunities by improving their abilities to innovate, recognize and access new markets (Barzola Iza and Dentoni, 2020; Khedhaouria et al., 2015; Sher et al., 2019). Thus, entrepreneurial orientation makes smallholder farmers possible to benefit from environmental changes by utilizing their experience in identifying more opportunities.

4.6 Conclusions

Our findings confirm that entrepreneurial orientation is crucial in bridging the relationship between farmers' experience in linking to modern markets or supporting organizations and opportunity identification. Proactiveness over future needs and courage in taking risks enable farmers to benefit from environmental

changes by conveying knowledge accumulation in farmers' experience to identify opportunities.

This chapter's findings enrich the agricultural entrepreneurship literature by addressing the entrepreneurship process for smallholder farmers in identifying opportunities in the developing country's context. This chapter addresses the underlying mechanisms of how experience and entrepreneurial orientation give smallholder farmers a means to benefit from environmental changes. Entrepreneurial orientation makes farmers recognize that the changes are sources of opportunities. Entrepreneurial orientation further embraces the knowledge integrated with their experience in linking to modern markets and supporting organizations to identify opportunities. We extend the theories of opportunity identification and provide insights into the critical role of entrepreneurial orientation for entrepreneurs (i.e., entrepreneurial smallholder farmers) operating in changing environments in a developing country.

This chapter has some limitations. We used the list provided by the agricultural officials and then updated by the local authorities for the sampling frame. This situation might cause interest bias from those who suggested the list (Etriya et al., 2019). Furthermore, during the fieldwork, we could not find all targeted respondents chosen through random sampling due to difficulties accessing some of their addresses, particularly those who lived in remote areas. This situation might also cause availability bias (Etriya et al., 2019). The data updates were difficult to be accessed in some developing countries, including Indonesia (Gunawan et al., 2016); therefore, we suggest future studies to improve the methods for data collection that can reduce both types of bias.

This chapter suggests that policymakers help farmers access more modern markets and supporting organizations, making farmers possible to have more experience and knowledge. In facing environmental changes, we also suggest that farmers keep improving their entrepreneurial orientation in terms of being more proactive (e.g., updating the market trends continuously and predicting future market demands) and risk-taking to utilize their experiences in linking to the business partners (e.g., markets and supporting organizations). These processes may help farmers identify more opportunities and stay competitive.

Chapter 5

Discussion and Conclusions

5.1 Introduction

Most smallholder farmers discern business environmental changes as threats and find it difficult to adapt to them (Hazell et al., 2010; Wiggins et al., 2010), while some entrepreneurial ones perceive the changes as opportunities (Barzola Iza and Dentoni, 2020; McElwee and Bosworth, 2010; Yessoufou et al., 2018). Recent studies on agricultural entrepreneurship suggest that entrepreneurship is vital for farmers to sustain and grow their farm businesses (Barzola Iza and Dentoni, 2020; Dias et al., 2019a; Dias et al., 2019b; Fitz-Koch et al., 2018; Pindado and Sánchez, 2019; Pindado et al., 2018; Yessoufou et al., 2018). However, these studies pay little attention to how smallholder farmers, which are in general short of sufficient resources, may have benefitted from these environmental changes (e.g., the growth of modern markets), and what makes them alert to the presence of opportunities stemming from these changes. It remains unclear whether innovation adoption or innovation generation has a more significant impact on entrepreneurial smallholder farmers to introduce product innovations, how network content facilitates them to access essential resources to innovate, and what factors allow smallholder farmers to identify opportunities emerging from the environmental changes.

This thesis investigates what mechanisms allow smallholder farmers in West Java to adapt to and benefit from the environmental changes. The main objective of this thesis is addressed by three research questions formulated in Chapter 2-4. Hence, the research questions of this thesis concern 1) how innovation adoption and innovation generation enable entrepreneurial-oriented farmers to introduce innovations, and in turn, enhance farm performance; 2) what types of networks facilitate farmers to be more entrepreneurial and to improve farm performance, and; 3) how entrepreneurial orientation conveys farmers' experience to identify opportunities.

The next section discusses the main findings of Chapter 2-4 and provides conclusions. Based on these findings, this chapter presents theoretical contributions and recommends managerial and policy implications. We close this chapter by presenting the limitations of this thesis and suggesting directions for further studies.

5.2 Answers to the research questions

Research question 1 (Chapter 2)

Previous studies on entrepreneurship mainly emphasize the impact of entrepreneurial orientation on firm performance (Rauch et al., 2009; Wiklund and Shepherd, 2003, 2005). However, still few studies explore the contribution of

entrepreneurial orientation in cooperation with both process innovation and product innovation that may enable smallholder farmers to face environmental changes. Chapter 2 of this thesis investigates the extent to which entrepreneurial orientation enhances innovation adoption and generation, whether both innovations enhance product innovation and whether product innovation enhances farm revenues when smallholder farmers face a dynamic agrifood market as part of environmental changes. We formulate the following research question:

Research question 1 (RQ1): In what way do entrepreneurially oriented farmers deploy innovation adoption and innovation generation to introduce product innovations, and does this enhance farm performance?

We examine entrepreneurial orientation as farmers' tendency to be proactive and bear more risks, innovation adoption as the extent to which farmers outsource innovations, innovation generation as the extent to which farmers develop their innovations, product innovation as new and improved products, and farm performance as farm revenues. The PLS-SEM analysis demonstrates that entrepreneurial orientation is more significantly linked to innovation generation than innovation adoption, indicating that entrepreneurial-oriented farmers tend to find new solutions themselves. Further relationships show that innovation adoption is more substantial linked to product innovation than innovation generation linked to product innovation. These results indicate that, in the end, it is more efficient for entrepreneurial smallholder farmers in West Java to apply ready-to-use innovations than to generate innovations themselves.

Although entrepreneurial smallholder farmers engage in innovation generation, this thesis's findings indicate that innovation adoption is crucial for them to understand and meet the market demands by introducing new or improved products. Innovation adoption allows farmers to adapt to environmental changes by obtaining existing knowledge from external sources (e.g., input providers, extension agents, or peers). Afterward, they assimilate this knowledge at their farms (Damanpour and Wischnevsky, 2006; Norton and Alwang, 2020; Pannell and Zilberman, 2020). The innovation adoption process consists of being aware of the innovation, assessing it, conducting experiments, adopting it, evaluating the results, and, finally, deciding to use the innovation or not (Weersink and Fulton, 2020). This process is relatively faster than the process of innovation generation by creating innovations using new knowledge (Damanpour and Wischnevsky, 2006; Pérez-Luño et al., 2011). Therefore, to quickly meet the market demands, innovation adoption may bring product innovations faster to the market than innovation generation. This situation may explain why innovation adoption has a more positive relationship with product innovation than innovation generation.

The overall findings of Chapter 2 confirm that the subsequent relationships among entrepreneurial orientation, innovation adoption, innovation generation, and

product innovation are essential for smallholder farmers to enhance farm revenues. We emphasize the contribution of innovation adoption on product innovations that meet the market demands and herewith confirm the positive impact of entrepreneurial orientation on farm performance. Thus, in the dynamic agrifood markets of West Java, innovation enables entrepreneurial oriented farmers to adapt to environmental changes, better understand the markets, and, eventually, meet the market demands.

Research question 2 (Chapter 3)

Previous studies focus on the role of network structure on farmers' livelihood. However, these studies pay less attention to network content and entrepreneurial degrees that help smallholder farmers face and benefit from environmental changes. Chapter 3 of this thesis aims to identify the entrepreneurial degree of smallholder farmers, compare their network content (i.e., business ties, technology ties, and network heterogeneity), and investigate the impact of the entrepreneurial degree and network content on farm performance. The research question is as follows:

Research question 2 (RQ2): What types of networks (i.e., network content in terms of business and technology ties and network heterogeneity) are linked to more entrepreneurial farmers, and what types of networks improve farm performance?

This chapter uses cluster analysis to categorize smallholder farmers based on the entrepreneurial orientation degrees in terms of more entrepreneurial farmers and less entrepreneurial ones. We then compare the network content of these two groups of farmers using the Mann-Whitney test. The results show that more entrepreneurial farmers have a larger number of business ties and technology ties and have more heterogeneous networks than those who are less entrepreneurial. Afterward, we performed regression analyses to test the impact of entrepreneurial degree and network content on farm performance (i.e., innovative performance and financial performance). The results show that more entrepreneurial farmers with more business ties have enhanced innovative performance and financial performance. A higher level of network heterogeneity only enhances innovative performance while having a higher number of technology ties is not related to either innovative or financial performance.

The findings of Chapter 3 show that being more entrepreneurial oriented and having more business ties are vital for smallholder farmers in West Java to successfully adapt to environmental changes, which is reflected in enhanced innovative and financial performance. Furthermore, network heterogeneity is particularly crucial for these smallholder farmers to enhance their innovative performance. Business ties provide more entrepreneurial farmers access to essential resources, such as knowledge, business advice, and information about potential markets, market trends, and consumer preference (Arregle et al., 2015; Lechner et al., 2006; Spielman

et al., 2011). Business ties may also enable more entrepreneurial farmers to understand the market better; afterward, help them meet the market demands by conducting innovations (Fafchamps and Minten, 1999). Also, network heterogeneity provides farmers with non-redundant information from heterogeneous contacts, such as information about market opportunities and new technologies (Claro et al., 2006; Kiptot and Franzel, 2014; Pratiwi and Suzuki, 2017). This information may make them aware of the need to innovate to satisfy the markets (Polman and Slangen, 2008; Spielman et al., 2011). In general, Chapter 3 reveals that more entrepreneurial farmers in West Java with networks that are rich in business ties and heterogeneous contacts show a better farm performance.

Research question 4 (Chapter 4)

After investigating factors enabling smallholder farmers to enhance farm performance, Chapter 4 of this thesis further explores the mechanisms that smallholder farmers use to identify opportunities beyond their current farm businesses to respond to environmental changes. Although previous studies have examined the contribution of farmers' knowledge to opportunity identification (Pindado et al., 2018; Sher et al., 2019; Yessoufou, 2017), the findings remain inconclusive in explaining how entrepreneurial oriented farmers utilize knowledge embedded in their experience to be alert to opportunities. Chapter 4 of this thesis investigates the mediating effect of entrepreneurial orientation on the relationship between farmers' experience and opportunity identification. The research question is the following:

Research question 3 (RQ3): what is the impact of entrepreneurial orientation on the relationships between smallholder farmers' experience and opportunity identification?

Chapter 4 examines farmers' experience in linking to modern markets, suppliers, and supporting organizations. Opportunity identification is examined in terms of a number of opportunities and opportunity innovativeness, the level of innovativeness of the opportunity. Using the PLS-SEM analysis, Chapter 4 proves that entrepreneurial orientation fully mediates the effect of farmers' experience in linking to modern markets on opportunity identification. Furthermore, entrepreneurial orientation partially mediates farmers' experience in linking to supporting organizations on opportunity identification. However, entrepreneurial orientation does not mediate the relationship between farmers' experience in linking to suppliers and opportunity identification. These findings confirm that being proactive and risk-taking helps farmers use their experience to identify opportunities coming from environmental changes.

The entrepreneurship literature acknowledges that to identify opportunities is critical for smallholder farmers to face environmental changes (Lans et al., 2017;

Seuneke et al., 2013), which involve experience containing the accumulated knowledge as part of a farmers' human capital (Esparcia, 2014; Pindado et al., 2018). Knowledge and experience are essential for farmers to assess and make sense of new information (Baggen et al., 2015; Carter, 1998; Shane, 2000). By continuously monitoring the markets, knowledge and experience help farmers better understand market demands and customer preferences, allowing them to identify opportunities emerging from environmental changes (Baron, 2006; Pindado et al., 2018). Entrepreneurial opportunities may consist of process innovations (improvement of business processes, logistics, and marketing) and product innovations (development of new products) (Hulsink, 2005; Khedhaouria et al., 2015; Pindado and Sánchez, 2017; Vik and McElwee, 2011).

In conclusion, we can say that entrepreneurial orientation enables smallholder farmers to identify opportunities by improving their capacity to recognize potential new markets, access these new markets, build market connectivity, and pursue these markets' requirements. Entrepreneurial oriented farmers posit the tendency to be persistent in pursuing their goals, flexible to make decisions, adaptive to environmental changes, and be alert to detect new trends in the markets (Grande et al., 2011; Sher et al., 2019; Warren, 2004). Furthermore, they are likely to apply new methods and increase the current products' value (Barzola Iza et al., 2019). Therefore, entrepreneurial orientation helps farmers recognize environmental changes as sources of opportunities. Afterward, they use the accumulated knowledge from their experience in linking to modern markets and supporting organizations to identify opportunities beyond their existing farm businesses (Kaish and Gilad, 1991; Shane, 2000; Sher et al., 2019).

5.3 Contributions to theory

Our study uses a quantitative approach applying PLS-SEM analysis. The results are robust and contribute to the literature on entrepreneurship in the context of the agricultural sector in developing countries by investigating the mechanisms that allow smallholder farmers to be successful in adapting to and benefiting from environmental changes, as reflected in enhanced farm performance. This thesis also confirms that agricultural entrepreneurship is relevant to describe "everyday entrepreneurship" focusing on small business owners who usually got less attention in mainstream entrepreneurship studies (Welter et al., 2016).

We analyzed the importance of innovation adoption, innovation generation, and product innovation for entrepreneurial-oriented farmers to pursue enhanced farm performance (especially in Chapter 2). We investigated the tendency of entrepreneurial-oriented farmers to adopt or generate innovations and the extent to which innovation adoption and innovation generation impacted product

innovation. Previous studies conducted in high-technology industries found that innovation generation significantly contributes to product innovation than innovation adoption (Avlonitis and Salavou, 2007). In contrast, our study shows that innovation adoption is more critical for smallholder farmers than innovation generation to meet the market demands by introducing product innovations. Innovation generation may be more appropriate for smallholder farmers when they need to solve problems in adapting to complex technologies. Innovation generation may then help them create comprehensible solutions to make these complex technologies suitable for their needs using local resources (Hoffmann et al., 2007). Therefore, for smallholder farmers, innovation adoption tends to be market-oriented, and innovation generation tends to be problem-solving oriented. Thus, this thesis contributes to the current debate on the relative importance of innovation adoption or innovation generation facilitating smallholder farmers to successfully adapt to environmental changes, measured in this thesis as enhanced farm performance.

We also contributed to the entrepreneurship literature by integrating the concepts of network content and network heterogeneity to analyze the factors that enable smallholder farmers to take advantage of environmental changes (especially in Chapter 3). Business networks in which market information is shared help smallholder farmers develop market-oriented innovations and enhance farm performance more than technology networks that share information related to new technologies. Our study indicates that information related to demand-driven innovations are more crucial for smallholder farmers than information related to supply-driven innovations. Furthermore, networks that provide access to businesses information from diverse, more heterogeneous contacts help farmers identify opportunities (Pindado et al., 2018). Therefore, networks rich in business information are substantial for entrepreneurial smallholder farmers in West Java to innovate and pursue enhanced farm performance. Hence, this thesis contributes to the literature by analyzing the types of network (content and heterogeneity) that enable entrepreneurial smallholder farmers to face environmental changes.

We also contributed to the opportunity identification literature by expanding the relevance of this theory to smallholder farmers facing environmental changes (especially in Chapter 4). We used the entrepreneurial orientation theory to analyze how the knowledge integrated with farmers' experience affects smallholder farmers in identifying opportunities. The literature acknowledges that opportunity identification and knowledge play a critical role in agricultural entrepreneurship (Lans et al., 2017; Pindado et al., 2018; Seuneke et al., 2013). This thesis proves that entrepreneurial oriented farmers are alert to opportunities coming from environmental changes and are helped by their experiences in linking to modern markets and, although to a lesser extent, linking to supporting organizations. Thus, this thesis enriches the literature about agricultural entrepreneurship by

addressing smallholder farmers' mechanisms to identify opportunities beyond their existing farm businesses.

5.4 Recommendations

This study has implications for farmers as well as for policymakers. Based on the findings of Chapter 2, this study encourages farmers to seek entrepreneurial opportunities by using innovation adoption and generation when aiming to introduce product innovations and pursue enhanced farm performance. Entrepreneurial farmers try to adapt to the environmental changes by taking risks, being proactive and innovative to sustain their businesses. However, farmers should be critical when deciding how to pursue market opportunities, either through short term innovation adoption or through longer-term innovation generation, by considering the characteristics of both innovation processes (Pérez-Luño et al., 2011). Our findings show that innovation adoption is better for entrepreneurial farmers if they want to quickly meet market demands. Innovation generation is better if they want to transform complex technologies to fit their circumstances. We recommend that farmers consider adopting innovations to produce new or improved products quickly. Afterward, if needed, they can decide to fit the technologies to their needs by innovation generation. Hence, innovation generation may complement innovation adoption over time. We also suggest that policymakers encourage farmers to share their knowledge to make innovation adoption easier.

This thesis found that linking to networks containing business information from diverse contacts is essential for smallholder farmers to understand modern market needs better. Therefore, we suggest that policymakers encourage and facilitate farmers to have access to diverse contacts who have different roles, such as potential buyers (e.g., supermarkets, exporters, or food processors), researchers, and credit providers. Policymakers may initiate a multi-stakeholder platform to facilitate these actors, including smallholder farmers, to share the latest information and learn from each other. This platform may stimulate smallholder farmers to keep innovating to meet market demands.

5.5 Study limitations and suggestions for future research

This thesis acknowledges some limitations. With the six selected areas in West Java, the farmer population used was based on lists provided by local authorities or extension agents. However, during fieldwork, it was discovered that many farmers, especially young farmers, were not included in these lists. Therefore, the sample

might be biased towards an over-representation of farmers with government support. This study population might also suffer from interest bias from the agricultural officials or cooperative managers who shared the farmer list. Sample selection bias also happened because farmers' addresses were missing. It was challenging for us to find and contact all the farmers on the list. We suggest local authorities and extension agencies improve their farmers' lists to assure better spreading of extension information and smallholder support. This approach would also improve future data-collection and sampling by reducing the problems of incomplete data availability.

Our studies use cross-sectional data that might raise causality problems, e.g., possible reverse effects can never be ruled out. Costs limited the possibilities for conducting a longitudinal study that would provide more certainty about endogeneity and the direction of the relationships. Our data were also based on data recalled by the respondents (i.e., smallholder farmers) who often did not make formal records of their production cycles, farm inputs, expenses, and revenues. This approach limited us in the precision of the calculation of farm performance and farm innovations. A similar situation was found in a study among smallholder vegetable farmers in Columbia (Gil et al., 2019). Therefore, surveys addressing smallholder farmers in developing countries, which rely only on recall data, might suffer from inaccuracy. A longitudinal data collection method, with detailed follow-ups on production cycles conducted in a certain period, could reduce these limitations.

Our survey areas were mostly in commercial zones of West Java and closed to big cities, such as Jakarta and Bandung (Hernández et al., 2015). This situation makes the farmers have better access to education, information, technologies, and logistic infrastructure than those who live in more remote areas of West Java. However, this situation might restrict the generalization of our findings. Therefore, we recommend that future studies consider conducting surveys covering broader areas and other countries.

Summary

Farmers in developing countries are mostly smallholder farmers operating farms less than two hectares (Hazell et al., 2010). They face the pressure of business environmental changes emerging from globalization and agrifood market transformation, i.e., the growth of modern food retail and fresh-food exporters (Pindado and Sánchez, 2017; Poole, 2017; Reardon et al., 2009; Reardon et al., 2014).

The rural studies focus on the effect of environmental changes (e.g., the growing food demands of supermarkets) on smallholder farmers' livelihood (Hazell et al., 2010; Hernández et al., 2015; Sahara et al., 2015; Wiggins et al., 2010). However, current research has not adequately addressed what mechanisms make smallholder farmers benefit from these environmental changes. Furthermore, it remains unclear how smallholder farmers discover and identify opportunities that emerge from these situations. Consequently, there is a need to investigate what factors allow smallholder farmers to adapt to and benefit from these environmental changes. Successful or failed adaptation will be reflected in their farm performance. Hence, the main research question of this thesis is formulated as follows:

The main research question (RQ): What factors enable smallholder farmers to enhance farm performance and, ultimately, identify opportunities in changing environments?

Past research on innovation in the agricultural sector mainly focuses on innovation adoption, such as experimenting with new seeds or new farming technologies introduced by suppliers or research institutes (Pannell and Zilberman, 2020). To some extent, farmers may also involve in the process of innovation generation, such as formulating substitutions for chemical farm inputs using local resources or experimenting with local adaptations for new farming technologies (Hoffmann et al., 2007; Leitgeb et al., 2011; Leitgeb et al., 2012). Although farmers may involve in one or both of these types of process innovation, it remains unclear the extent to which entrepreneurial oriented farmers (i.e., proactive and risk-taking farmers) tend to use ready-to-use innovations (i.e., innovation adoption) or develop innovations to find solutions themselves (i.e., innovation generation) (Damanpour and Wischnevsky, 2006). In turn, it is also not clear whether innovation adoption or innovation generation has a more significant impact on the introduction of product innovations (i.e., new or improved products) (Damanpour and Aravind, 2006). Therefore, this thesis investigates the subsequent relationships between entrepreneurial orientation, innovation adoption, innovation generation, and product innovation. Eventually, successful process innovation and product

innovation may be reflected in enhanced farm performance. Accordingly, the research question is as follows:

Research question 1 (RQ1): *In what way do entrepreneurially oriented farmers deploy innovation adoption and innovation generation to introduce product innovations, and does this enhance farm performance?*

The PLS-SEM analysis results demonstrate that entrepreneurial orientation is more significantly linked to innovation generation than to innovation adoption. This finding indicates that entrepreneurial oriented farmers tend to try to find new solutions themselves. Further relationships show that innovation adoption is more substantial linked to product innovation than innovation generation. These results indicate that, in the end, it is more efficient for entrepreneurial smallholder farmers in West Java to apply ready-to-use innovations than to generate innovations themselves.

Smallholder farmers fundamentally have limited resources (e.g., farmland or capital) to operate their farms (Hazell et al., 2010; Wiggins et al., 2010). However, it remains unclear what enables smallholder farmers to adapt to environmental changes and develop innovations when they lack resources. The literature indicates that linking to specific types of networks potentially enlarges farmers' access to essential resources and information (McElwee and Bosworth, 2010; Pratiwi and Suzuki, 2017). Numerous studies have investigated the importance of networks on farmers' livelihood (Hoang et al., 2006; Spielman et al., 2011; Warriner and Moul, 1992; Wu and Zhang, 2013); however, these studies pay little attention to the contribution of network content (i.e., information discussed between actors in the networks (Burt, 1997b)) to farm businesses. This thesis explores network content in terms of business ties (i.e., relationships between actors in the networks that exchange information related to markets and opportunities (Lechner et al., 2006)), technology ties (i.e., relationships between actors in the networks that exchange information related to technologies and problem solving (Ahuja, 2000a)), and network heterogeneity (i.e., the diversity of actors' roles in the networks (Renzulli et al., 2000)). The research question is formulated as follows:

Research question 2 (RQ2): *What types of networks (i.e., network content in terms of business and technology ties and network heterogeneity) are linked to more entrepreneurial farmers, and what types of networks improve farm performance?*

The results show that more entrepreneurial farmers with more business ties have enhanced innovative performance and financial performance. A higher level of network heterogeneity only enhances innovative performance while having a higher number of technology ties is not related to either innovative or financial performance.

Smallholder farmers are encouraged to focus on enhancing farm performance and identifying opportunities beyond their existing farm activities to benefit from these environmental changes (McElwee and Bosworth, 2010; Pindado et al., 2018). The literature suggests that experience plays a vital role in allowing entrepreneurs to identify opportunities (Hsieh et al., 2007). The experience contains rich knowledge that enables entrepreneurs to understand the environmental changes better and translate them into opportunities (Baron, 2006; Venkataraman, 1997). Smallholder farmers in developing countries may find it difficult to access resources; however, experience linking to business partners (i.e., modern markets, suppliers, and supporting organizations) might help farmers understand the market better. Moreover, environmental changes may also stimulate farmers to be more entrepreneurial oriented by being proactive and bear more risks (Gellynck et al., 2015; Pindado et al., 2018). The research question is formulated as follows:

Research question 3 (RQ3): *what is the impact of entrepreneurial orientation on the relationships between smallholder farmers' experience and opportunity identification?*

Using the PLS-SEM analysis, Chapter 4 proves that entrepreneurial orientation fully mediates the effect of farmers' experience in linking to modern markets on opportunity identification. Furthermore, entrepreneurial orientation partially mediates the effect of farmers' experience in linking to supporting organizations on opportunity identification. However, entrepreneurial orientation does not mediate the relationship between farmers' experience in linking to suppliers and opportunity identification. These findings confirm that being proactive and risk-taking helps farmers use their experience to identify opportunities coming from environmental changes.

We recommend that farmers consider adopting innovations to produce new or improved products quickly based on our findings. Afterward, if needed, they can decide to fit the technologies to their needs by innovation generation. Hence, innovation generation may complement innovation adoption over time. We suggest that policymakers encourage farmers to share their knowledge to make innovation adoption easier. Furthermore, we also suggest policymakers may initiate a multi-stakeholder platform to facilitate various actors in the vegetable sector, including smallholder farmers, to share the latest information and learn from each other. This platform may stimulate smallholder farmers to keep innovating to meet market demands.

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Appendix

Appendix 1. Questionnaire

Entrepreneurial orientation

Proactiveness (adapted from Covin and Slevin, 1989)

	Scale	
Proactive on initiating changes		
Concerning competitors,		
my farm usually responds to competitors' actions.	1 2 3 4 5 6 7	my farm usually initiates changes that are responded by competitors.
Proactive on being a pioneer		
my farm is rarely being a pioneer in introducing new products or technologies.	1 2 3 4 5 6 7	my farm is frequently a pioneer in introducing new products or technologies.
Proactive over competitors		
my farm usually keeps away from competitors by waiting for their actions.	1 2 3 4 5 6 7	my farm usually encounters competitors by doing better than them.

Risk-taking (adapted from Covin and Slevin, 1989)

Risk-taking on new projects	Scale	
My farm tends to involve in low-risk projects with possibilities to earn normal returns.	1 2 3 4 5 6 7	My farm tends to involve in high-risk projects with possibilities to earn high returns.
Risk-taking on achieving goals		
On achieving goals, my farm takes careful action in exploring the business environment.	1 2 3 4 5 6 7	On achieving goals, my farm takes courageous actions in exploring the business environment.
Risk-taking on being a first-mover		
My farm usually takes careful action to seize new opportunities and be a first-mover in the market.	1 2 3 4 5 6 7	My farm usually takes courageous action to seize new opportunities and be a first-mover in the market.

Innovation

Innovation adoption (adapted from Diederen et al., 2003)

Survey 2012	To what extent you adopt these kinds of innovation	Not at all						To a great extent
	Seeds	1	2	3	4	5	6	7
	Farming techniques	1	2	3	4	5	6	7
	Farm inputs	1	2	3	4	5	6	7

Innovation generation (adapted from Hoffmann et al., 2007 and Van der Veen, 2010)

Survey 2012	To what extent you generate these kinds of innovation	Not at all						To a great extent
	New fertilizer formula (e.g., bio-fertilizers from local-based ingredients)	1	2	3	4	5	6	7
	New pesticide formula (e.g., bio-pesticides from local-based ingredients)	1	2	3	4	5	6	7
	New farming techniques	1	2	3	4	5	6	7

Product innovation

New products

How many new products (e.g., new types of vegetables) you introduced to the markets in the last three years? (adapted from Covin and Slevin, 1989).

Improved products

New varieties (adapted from Avlonitis and Salavou, 2007; Covin and Slevin, 1989)

How many new varieties of vegetables did you introduce to the markets in the last three years?

Product changes (adapted from Covin and Slevin, 1989)		
There have been small changes in my existing products.	1 2 3 4 5 6 7	There have been significant changes in my existing products.

Plot size for experiments

Plot size
How large the plot size you used to conduct experiments or trials in the last year? (in m^2)

Farm revenues (adapted from Nuthall, 2011)

	Please specify all vegetables you produced and sold in the last year (for 12 months).				
a	b	c	d	e	f
Vegetable	Sold quantity (kg)	Price per kg	Production costs	Gross revenues	Net revenues
1.				b × c	e - d
2.					
3.					
4.					
5.					
…					
…					
…					

About the author

Etriya was born in 1978 in Bandung, Indonesia. In 2002, she received her Bachelor's degree in Agricultural Socio-Economics at the IPB University. She took a Master in Agribusiness Management at the same university, completed in 2004. Since 2005, she has started her academic career in the Department of Agribusiness, the IPB University, as a lecturer for entrepreneurship courses. In 2010, she had an opportunity to pursue a Ph.D. study in the Management Studies and later became the Business Management & Organization Group at the Wageningen University, funded by Netherlands Fellowship Program (NFP)-Nuffic. She can be contacted via the following email address: etriya@apps.ipb.ac.id.

Completed Training and Supervision Plan

Etriya
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Writing research proposal	WUR	2010	6
Qualitative Data Analysis, Atlas.ti : Procedures and Strategies (YRM60806)	WUR	2010	6
Quantitative Research Methodology and Statistics (MAT 22306)	WUR	2011	6
Advanced Econometrics (AEP 60306)	WUR	2013	6
Quantitative Data analysis: Multivariate Techniques (YRM 60306)	WUR	2013	6
Cooperatives and Producer Organizations (BEC 53306)	WUR	2013	6
Entrepreneurship Boot Camp	MST-DAFNE	2010	1.5
Structural Equation Modeling & Spatial Econometrics	IPB University & University of Groningen	2012	1.2
Introductory Social Network Analysis	University of Southern Denmark	2013	5
B) General research related competences			
Information Literacy, including Endnote Introduction	WGS	2010	0.6
Academic Writing	WGS	2010	0.8
Techniques for Writing and Presenting a Scientific Paper	WGS	2011	1.2
Optimising the Performance of Producers' Organisations	CDI-WUR	2011	2.5
Scientific Writing	WGS	2014	1.8
Scientific Publishing	WGS	2013	0.3

Name of the learning activity	Department/Institute	Year	ECTS*
Scientific Integrity	WGS	2013	0.2
English Scientific Writing	IPB University	2015	1.2
Entrepreneurial University Transformation in South-East Asia	Maastricht School of Management	2016	2.5
Econometrics for Panel and Spatial Data Models	IPB University	2017	1.2
'Entrepreneurship of farmers working on different types : case studies of vegetable farmers in West Java, Indonesia'	International Conference on Small-Scale Producer Agency in the Globalized Markets, Padjadjaran University, Bandung, Indonesia	2012	1
'Exploring factors related to entrepreneurial orientation and innovation capacity of farm-firms: a lesson from vegetable farmers in West Java, Indonesia'	International workshop on Agribusiness, IPB University, Bogor, Indonesia	2012	1
'The impact of entrepreneurial orientation on innovation adoption and innovation generation, and ultimately performance of vegetable farmers in West Java, Indonesia'	The 3rd AGRIMBA-AVA CONGRESS, Mediterranean University, Budva, Montenegro	2013	1
'Networks, innovation adoption, and farm productivity of small-scale and large-scale farmers in West Java, Indonesia'	The 3rd GARCOMBS Conference, Padjadjaran University, Bali, Indonesia	2015	1
C) Career related competences/personal development			
PhD Competence Assessment	WGS	2010	0.3
Seminar: 'Seeds for Business and Business for Seeds'	CDI-WUR	2017	0.5
Total			**60.8**

*One credit according to ECTS is on average equivalent to 28 hours of study load

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The book cover presents different types of local chilies. These chilies used to be marketed only in wet markets. Currently, the good quality ones are also available in many supermarkets in Indonesia. These chilies represent farmers' product innovation (i.e., improved product), one of the topics discussed in this book.

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