

ENTREPRENEURIAL DRIVERS OF AGTECH IN THE PHILIPPINES

JURISE OLIVEROS



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ABSTRACT

Modern agriculture has evolved from farmers operating simple mechanized tractors to using high-tech drone imagery of fields or digital farm information systems navigated by a mobile app.

Drones and agriculture-smart mobile apps are just some of the AgTech innovations with the potential to disrupt and restructure the global agri-food industry and increase productivity and sustainability across the sector's value chain. This study explores interconnections among different types of enterprise groups and sub-groups that constitute the Philippine AgTech sector. Although the global growth trajectory of AgTech has been impressive, developing economies like the Philippines lag behind the rest.

This paper examines various factors that would enable AgTech SMEs and young enterprises in the Philippines to gain leverage from this emerging economic sector by focusing on the external and internal drivers that impact performance.

INTRODUCTION

There are a myriad challenges facing the agri-food industry. On the demand side, population growth and changing food preferences hinder the industry's ability to feed everyone. On the supply side, the depletion of natural resources and mounting environmental stressors threaten the long-term viability and sustainability of food production systems.¹ Employing innovative technologies and smarter resource use is key to ensuring food security, environmental sustainability and a better economic outlook for developing economies.

The pace of technological innovation in the agri-food industry has been glacial compared with other major industries. However, a recent wave of technological innovations and startup activities as well as an investment movement in agricultural technology (AgTech) has shaken the status quo.

Emerging niche digital technologies have the potential to boost the value chain and significantly impact the agri-food industry. Prior to 2013, investment in global AgTech was stagnant (at around \$500M) and most was publicly sourced. But then came a dramatic expansion, during which AgTech investment surpassed the \$2B mark in 2014 (Agfunder) and peaked to \$4.6B in 2015. The momentum has shown no signs of slowing in succeeding years.²

Although growth projections in AgTech have been impressive at the global aggregate level, cross-country and even intra-regional variations persist. Based on the AgFunder report, top investment gains are mostly in developed economies. Within Southeast Asia, there is a disparity in the influx of capital: only a few member countries such as Singapore and Indonesia receive notable support.³ Philippines in particular, lags behind its Asian counterparts in terms of investment expansion. There are major constraints and challenges faced by the AgTech sector in the country. Left unexamined and unaddressed, these roadblocks will hinder the sector's growth and development. An exploration of AgTech enterprises can help us understand the underlying factors and constraints.

REVIEW OF RELATED LITERATURE

AgTech refers to the array of technologies that provide the agri-food industry with tools, information, equipment and knowledge that enhance productivity and sustainability of the agricultural value chain.⁴ These technologies are adapted on-farm, deployed across the supply chain, operated by retailers and accessed by consumers. Compared to past technological contributions, modern AgTech is characterized by its fast-paced access into global markets and ability to disrupt the world's agri-food industry.⁵ AgTech spans a growing catalogue of diverse technological innovations across the value chain (refer to AgFunder report for more detailed discussion of AgTech categories).

Because AgTech is so new, there are few empirical studies to help explain the sector's underlying issues and challenges. To date, the publication of Dutia⁶ is the only paper that provides an extensive discussion and empirical analysis of AgTech challenges and opportunities. Empirical evidence, however, was limited to the US and the research did not explore cross-country growth disparity or offer nuanced insight on region-specific issues affecting AgTech enterprises. The existing literature has been mostly focused on general entrepreneurship issues or studies relating to linkages between country-based and sector-specific innovation in small and medium size enterprises (SMEs). The paper Gueco⁷ for instance tackled agriculture innovation systems in the Philippines.

Based on previous studies, SMEs in general face a variety of obstacles to efficiency, productivity and overall development. These obstacles include varying economic and political, as well as physical factors such as poor infrastructure. In particular, the agriculture-focused SMEs in developing SEA countries face major barriers to financial and market access.⁸ In the AgTech business niche, some analyses have found the lack of well-funded ventures, and comparatively slow regional expansion AgTech is due to high-level investor risk and uncertainty as well as lack of exposure at the global level.³ This prevents smaller enterprises and young ventures from exploiting the creative culture and innovation-driven growth of the sector.

Research into SMEs and startups is crucial since the sector is considered a key engine of economic growth and development and major source of livelihood in the Philippines.⁹ The growing AgTech market presents a viable opportunity for inclusive and sustainable development for smaller enterprises and startups. Opportunities depend on tapping the entrepreneurial potential of the AgTech SMEs. However, the nature and process of entrepreneurship in these markets is not yet well understood. The goal of this paper is to expand the discussion of

AgTech and highlight major issues confronting SMEs and young enterprises in the Philippines.

Entrepreneurship: Antecedents and Consequents

Entrepreneurship refers to the dynamic process of value creation and resource utilization to exploit an opportunity, to achieve performance goals and growth realization.¹⁰ In an entrepreneurial sense, performance serves as the paramount yardstick or criterion in determining whether a business venture has succeeded. Positive performance outcomes depend on whether the enterprise can leverage opportunity and successfully grow to its full potential. The study of Lumpkin and Dess¹¹ stressed the importance of utilizing a multidimensional view of enterprise success.

The “Triple Bottom Line” construct, coined by John Elkington, offers one such multidimensional approach to gauge enterprise performance. The bottom lines correspond to the resulting financial (profit), social (people) and environmental (planet) performance of an enterprise.^{12, 13} The model places value in the society and environment as well as a firm’s growth. Traditional accounting measures were concerned solely with profitability and growth offers, but that offers too narrow and fractional an outlook of firm performance. There has been growing collective demand for corporations to better align enterprise goals, commitment and actions with social responsibility (‘people’ bottom line) and environmental protection.

The existing literature recognizes the integral link between entrepreneurship and socio-economic development.¹⁴ Entrepreneurship is seen as a springboard to innovation that enhances firm success and in turn stimulates job and wealth creation. While there is consensus on entrepreneurs’ consequents, there are fragmented and disjointed stances on its antecedents. Two main strands of research emerge in relation to entrepreneurial antecedents. Internal conditions focus on the entrepreneurs or the innovators themselves as well as factors innate to the enterprise or organization. Research relating to external conditions emphasizes peripheral or tangential factors over which the enterprise has no control.

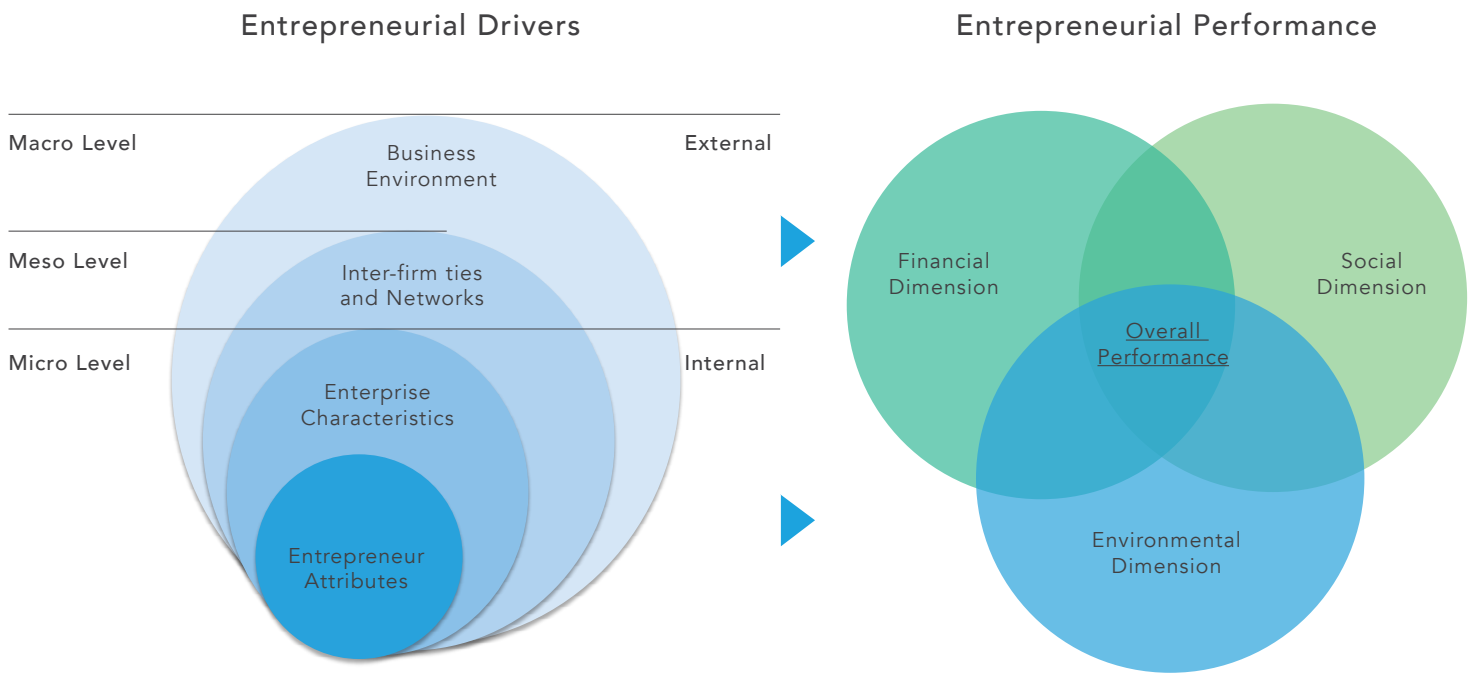
A range of empirical research points to the internal qualities and traits of the entrepreneur as a significant contributing factor to entrepreneurial performance.¹⁵ The Schumpeterian view deems development as a consequent of innovative creation by entrepreneurs. The entrepreneur revolutionizes the growth path by upsetting and disrupting the established order to trigger dynamic change.¹⁶ Kirzner’s view, on the other hand, highlights ‘alertness’ defined as the ability of an entrepreneur to perceive and recognize undervalued resources as an economic opportunity.¹⁷ However, enterprises also need adequate

funding to ensure viability and further innovation. Most empirical research into entrepreneurship study how resources are acquired. The study by Wright, Clarysse & Mosey¹⁸ explained how resource accumulation and orchestration serve as vital conditions for entrepreneurship development. Equally significant are research studies focused on resource providers, their characteristics, purpose and function in assisting and nurturing of entrepreneurship development.^{4, 18} Prominent examples of resource providers are incubators, angel investors and resource accelerators.

Another stream of literature offers insight into the influence of external factors. Policies comprise an entire system of principles and goals that set direction for decisions to be implemented to achieve beneficial outcomes for key stakeholder such as enterprises. Empirical studies on specific domestic policies show how a policy environment more favorable towards innovation leads to favorable entrepreneurship performance.¹⁹ State and regional institutions serve pivotal roles in developing and implementing policies.²⁰ Using country cases, the study of Kalinowska-Beszczynska²¹ points to the interdependencies of institutions and organization networks with the entrepreneurial process. Other studies are more focused on governance issues such as political stability²² and bureaucratic processes²² and their role in boosting entrepreneurship. The policy environment facilitates and fosters entrepreneurship by enforcing legislation and contracts, administering resources and implementing rules and regulations across industries.

Other related studies have conceptualized the determinants of entrepreneurial outcome by superimposing layers.^{23, 24} The varying entrepreneur attributes and enterprise characteristics comprise a firm's internal layers and drives entrepreneurial development. The third layer points to relationships, interaction and social ties of the enterprise with other networks as growth motivators. The outer macro layer relates to the overall business environment and its impact on enterprise development.²³ These layers represent factors external to the firm. Rather than individually affecting the enterprises, this model assumes a combined impact that widens in scope, schematically resembling an 'onion' pattern. The conceptual framework below integrates two separate models that are essentially bound in the entrepreneurial development process. The chief aim of this paper is to deconstruct the varying layers and determine which specific antecedent factors impact entrepreneurial triple-bottom line performance.

Figure 1. Integrative Framework for Entrepreneurial Antecedent Factors and Performance



Source: 'Onion Model' adapted from Morris, Kuratko & Schindehutte, 2001

RESEARCH QUESTIONS

1. What is the composition of the AgTech sector in the Philippines? How does each group connect with other enterprises and stakeholders across the agri-food chain?
2. How do AgTech enterprises differ in terms of their overall performance across financial, social and environmental dimensions?
3. What are critical success factors for enterprise performance? What are the major constraining factors that hinder entrepreneurial growth?

RESEARCH DESIGN

To determine the antecedent factors influencing enterprise performance (outcome), the empirical approach consists mainly of data collection through in-depth interviews with entrepreneurs in selected cases. For the initial stage, the study relied on the secondary database (e.g. Global Entrepreneurship Monitor (GEM), World Bank Enterprise Survey and Global Innovation Index) as well as data from the Philippine Statistics Agency to give an overview of the AgTech landscape in the Philippines. Based on initial quantitative findings, it is clear there are few statistics or databases classifying AgTech enterprises in the country. Furthermore, firm-level information from the government census of small and medium establishments is not publicly available. Since this study aims to gain a deeper, richer understanding of the unexplored AgTech subsector, a parallel sub-group sampling design was used for the qualitative case study component. This sampling strategy allowed us to examine and compare two or more different subgroups extracted from the enterprise population study.

To obtain the population pool or the domain from which the qualitative cases were selected, the study consulted company registries from various online databases (refer to Appendix A). The study focused on small and new enterprises that fall under the general classification of AgTech, taken from broader categories established by AgFunder. Additionally, the study also utilized convenience method in searching for samples online by using specific keywords and tracking

back links that would yield list/details on the company. A further review was done of the company's description, products and services and from there it was slotted into an AgTech category.

From the aggregated list of small and new AgTech enterprises, the study identified major groups currently operating in the Philippines based on enterprise innovation activity and linkages across the value chain (refer to Appendix A). For the in-depth interviews, two or three cases were selected from each of the major AgTech categories, guided by the case selection protocol to insure diversity and variation (refer to Appendix A). To control for other factors that could affect the outcome variable, the study selected cases roughly similar in size (small and medium-sized enterprises) and development (nascent/young – adolescent business ventures).

A total of 18 cases were selected for further examination. The interview instrument included semi-structured, self-reported questions as well as prompts for additional information designed to assess the entrepreneurs' experiences and perception relating to their own businesses and entrepreneurship in broader terms. To analyze the main outcome variable, the study relied on the triple bottom line model to measure enterprise performance. The findings were evaluated based on general themes and sub-themes that indicate individual performances (refer to the table below).

The ratings guidelines below were used to evaluate the level of growth, development and relative impact of the reported actions, plans and commitments of each case in accordance with general themes.²⁵ For instance, if the case informant reported significant revenue growth plus significant increases in other areas, the enterprise was considered to have high gains and was assigned a score of (2). Conversely, if that same case revealed unsatisfactory regulatory compliance, the businesses environmental performance would be rated low and assigned a score of (0). Raw scores in each area were combined to arrive at a total performance score for each case. The individual indicators were also tested for reliability and internal consistency and the resulting reliability test (Cronbach Alpha = 0.65) falls under the acceptable measure of reliability.

Table 1. List of General Themes and Sample Indicators for Triple Bottom Line Evaluation

Economic Dimension	Environmental Dimension	Social Dimension
Revenue & Profitability	General	General
Increased Profits	Corporate Commitment	Corporate Commitment
Return on Investments	Awards & Recognition	Awards & Recognition
Increased Sales	R&D/Future Plans & Agenda	Management
Client Base/Market Share	Consumption & Materials	Employees
Market Expansion	Energy Usage	Employee Benefits
Client Base Expansion	Water Usage	Salary & Compensation
Corporate Investments	Materials/Supplies	Training & Development
Facility Expansion	Pollution & Waste Management	Community
R&D Investments	Pollution/Emission	Community Initiative
Earning & Sales Forecast	Waste Management	Local Business Engagement
Projected Growth	Recycling/Reusing	Customer/Client
Production Inputs/Supplies	Environmental Regulation	Customer/Client Satisfaction
Volume of Production	Compliance	Consumer Policy/Protection

Table 2. Rating Guidelines for Evaluating Performance Outcome

Triple Bottom Line Evaluation Guidelines

Criterion/Level (Rating Scale)	Financial Performance	Environmental Performance	Social Performance
<i>Higher Gains; Higher Impact (2)</i>	With significant improvement/increase in revenue	Active programs for sustainability; Large-scale impact;	Offers competitive package for employees, benefits; Community initiatives
<i>Moderate Gains; Moderate Impact (1)</i>	Minimal/Unsteady improvement/increase; encounter problems	Sustainability-based plans but not actively practiced, Small-scale impact;	Offers some benefits; No plans for expansion or other development initiatives
<i>Lower/No Gains; Lower/No Impact (0)</i>	No significant improvement/increase	No active/current sustainability initiative;	Does not offer competitive salary or benefits to employees

Based on the conceptual framework, the study designated enterprise performance as the main outcome variable and the antecedent conditions as key explanatory variables. To unravel meanings and patterns behind the narratives and data, the antecedent factors identified and reported by survey respondents were initially clustered in terms of specific layers (internal or external). Each internal and external factor was further compared in terms of its relative contribution or impact — whether it serves to strengthen (+) or weaken (-) enterprise performance. The resulting list was then ranked in terms of the most to least frequent response.

To further determine which antecedent factors significantly impact the outcome variable, this study employed a qualitative comparative analysis (QCA) to examine the data. The QCA is an analytical technique based on Boolean method of logical inference. The analytical method is designed to determine how complex set of factors are linked to the outcome of interest through a logical minimization process. The process works by minimization or removal of less relevant factors to generate a simpler and more parsimonious combination of factors that are necessary conditions leading to the outcome. This is particularly applicable since this study aims to analyze a range of antecedent factors and its relation to the entrepreneurial performance (outcome of interest).

The fs/QCA software (www.fsqca.com) was mainly used to conduct the QCA test and perform the minimization algorithm. The test also yields the calculation of coverage and consistency, indicators that can be used to analyze the relative strength of the inferences.

The method generally requires dichotomous variables for testing and is widely recommended for exploring causal variables with small-N data. The initial step is to transform the total score for the outcome into a categorical scale.²⁶ This is done by calculating the percentile rank of the distribution and then re-scaling the raw performance scores into (1) “high” and (0) “low” threshold. Scores within and above the median percentile (50th) are grouped as high and scores falling below the median rank as low. This re-scaled composite variable represents performance level across the three main dimensions. The measures for the antecedent conditions, on the other hand, already present a natural dichotomy with factors differentiated as (1) identified/reported and (0) not identified/not reported.

It should be noted the assessment conducted in this study does not in any way reflect the performance of the firm in absolute terms but rather relative to the performance of other AgTech cases. For privacy and confidentiality purposes, case names are omitted in this part of the analysis. This enables a more objective evaluation of the general patterns of enterprise performance outcome and corresponding determinants.

RESULTS AND DISCUSSION

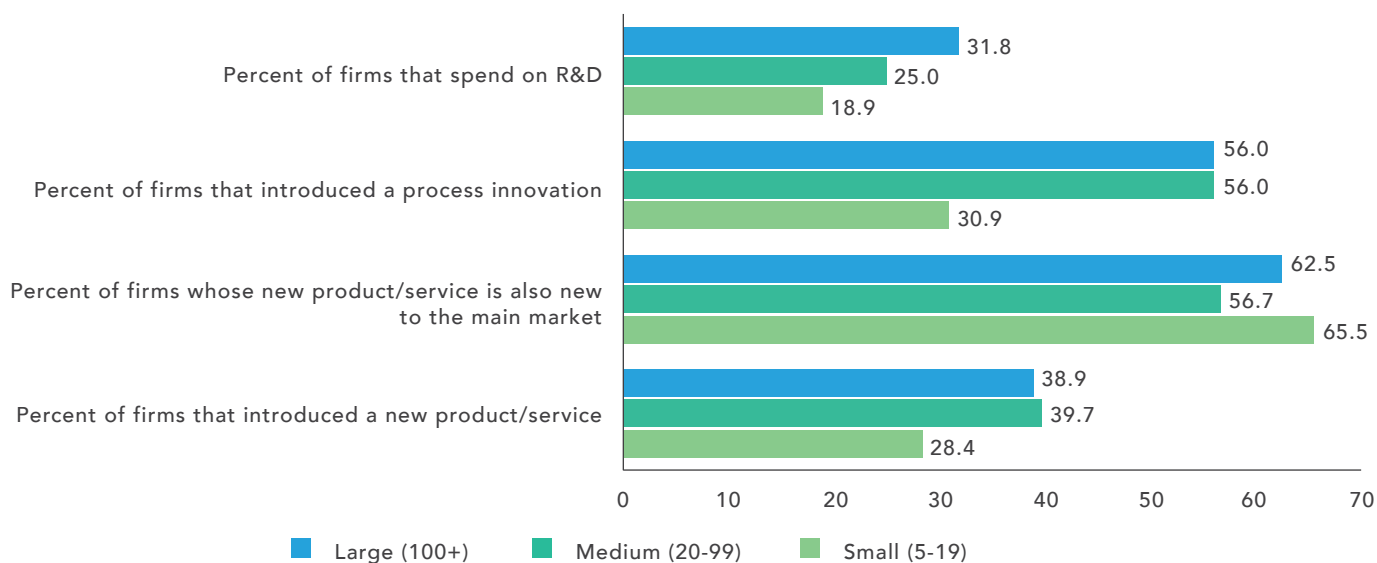
The results and discussion portion of the paper is divided into four main sections. The first defines the AgTech landscape in the Philippines and maps major groups and their connection in the agri-food value chain. The second introduces innovations across AgTech groups. The main analysis of the study, which evaluates performance outcome of AgTech enterprises vis-à-vis the triple bottom line as well as varying entrepreneurial drivers impacting performance are examined in the third and fourth sections.

I. Defining the AgTech Landscape in the Philippines

In the Philippines, MSMEs are defined by two operational indicators: the size of workforce and enterprise assets. As with all developing economies, the MSME sector is the bedrock of the economy, comprising 99 per cent of all registered businesses. Previous studies have underlined obstacles hampering the efficiency, productivity and overall development of the sector. In particular, the agriculture-focused SMEs in developing Asian countries face major barriers to financial and market access.⁸ The presence of innovative technologies has been significantly linked to long-term success and deemed as key contributor that could help address noted obstacles. To improve firm's competitive edge and provide them with better leverage in permeating markets, firms are constantly seeking for new ways to produce goods and serve customers.

The MSME sector in the Philippines is succeeding in the area of innovation and technological performance and has potential to grow. The percentage of medium-sized firms that introduced new product and process innovation is notably larger or at par with large corporations. The share of firms introducing new products or services to the market is much greater among small-sized enterprises than large firms. Yet, SMEs spent less on research than large firms. This trend highlights the disproportionality of resources invested in the sector. Such inefficiencies should be addressed through economic policies to help leverage the growth and innovation potential of MSMEs.

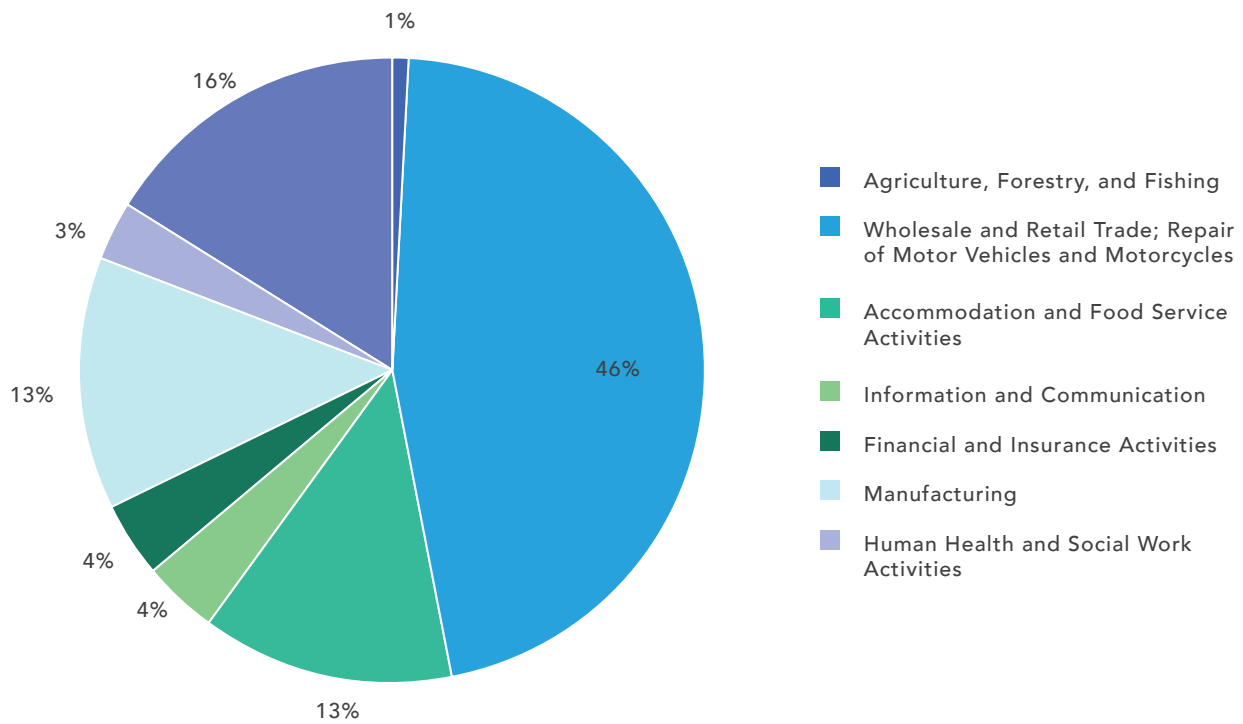
Figure 2. Innovation Potential of Philippine Firms



Source: World Bank Enterprise Survey

The rapidly emerging AgTech sector has the potential to boost sustainable growth and act as a catalyst for economic development in the country through product and process innovations. However, there is little specific information available for AgTech industries. MSME in the Philippines are dominated by the wholesale and retail trade (46 per cent). The manufacturing sector as well as accommodation and food services activities comprise about 13 percent of MSME establishments. It is apparent that the available quantitative data does not adequately represent the AgTech niche. Relying on these databases will be insufficient since, by definition, the AgTech enterprises encompasses varying industry sector such as financial, manufacturing and services and does not necessarily fall under the current sectorial delineation of the agri-food industry.

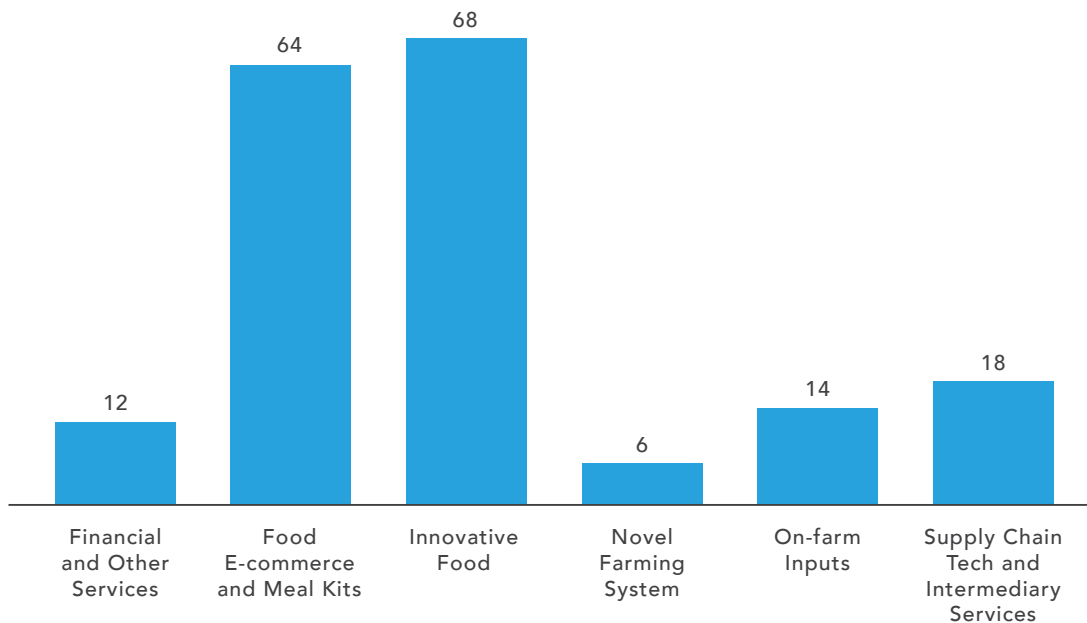
Figure 3. Percentage Distribution of MSME by Industry, 2017



Source: Philippine Statistics Agency, 2017

The data deficiency problem was addressed by developing an AgTech enterprise list based on broader AgTech categories. The list was then re-classified according to enterprise innovation activity and the relative position in the agri-food chain or the distance to farm/consumer to more accurately reflect enterprises currently operating in the country. The reclassification resulted in six major categories and each major group can be further divided into specific sub-groups. Compared to other agri-food tech groups, both the innovative foods and beverages category and food e-commerce and meal kits groups appear to have the most ventures. Other groups such as on-farm inputs, supply chain tech and intermediary services, financial services and novel farming systems have a notably weaker presence.

Figure 4. Distribution of Major AgTech Groups in the Philippines



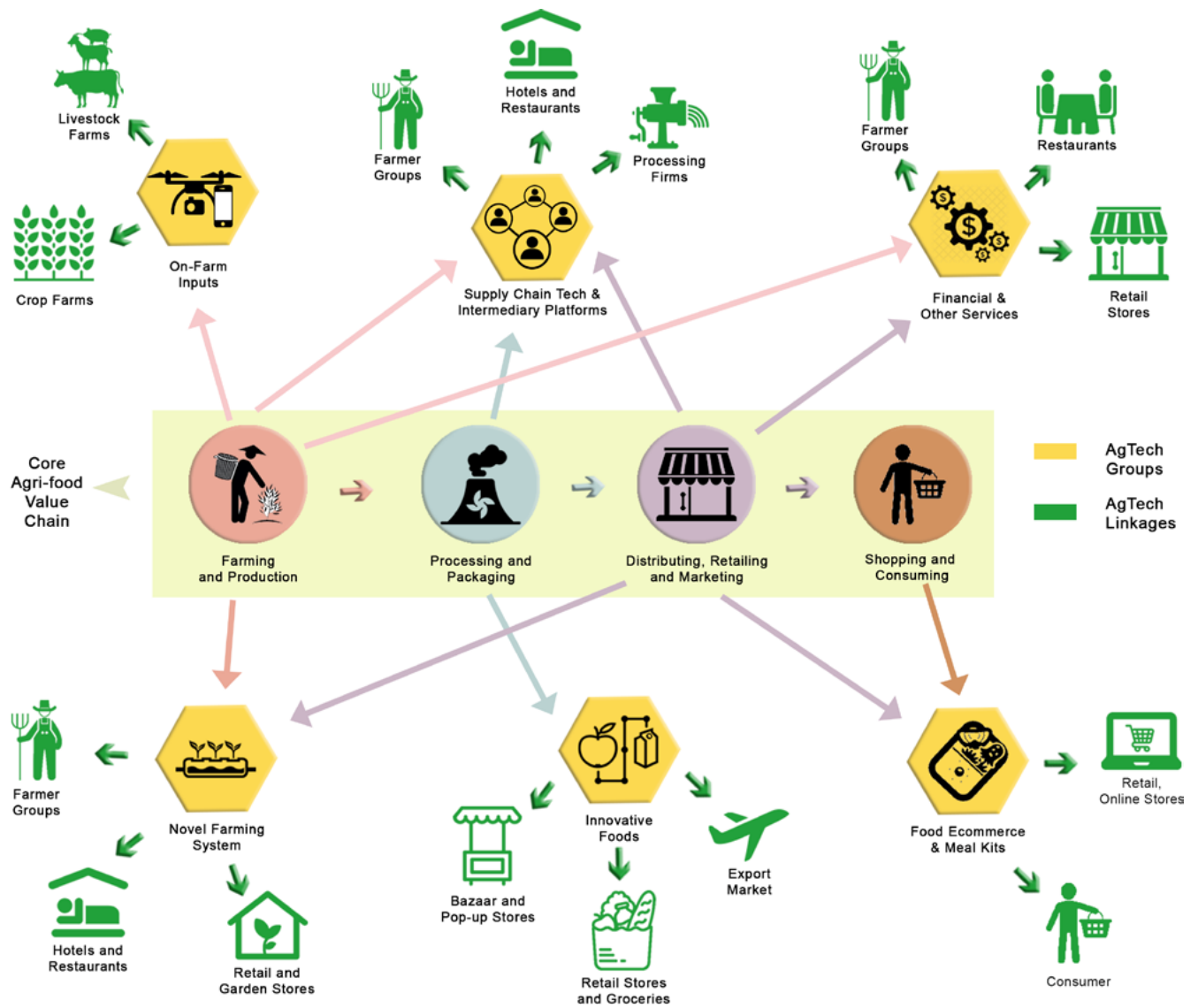
Note: The base for the figure is 182 (enterprises) sampled from various online databases

Source: AgTech List Compiled by Author

Looking at the relational structure of the country's AgTech sector, the figure below illustrates how the agri-food chain is linked with various stakeholders and agribusiness players. At the core is the general chain of activities that connects food production from the farm gate towards the delivery and consumption of food at the consumer end. Many entrepreneurs have tapped opportunities by advancing innovative ideas across each juncture of the value chain. As the illustration show, the traditional delineation of the agri-food value chain has grown increasingly seamless, as innovations from specific AgTech groups permeate different markets and forge linkages with other value chain stakeholders.

As noted from the data, some activities and network linkages of the AgTech group can be subsumed under specific agri-food chain groups. For instance, on-farm inputs is directly linked to farmer groups, including crops and livestock, and lies in the pre-harvest and production stage of the agri-food chain. Innovative food enterprises on the other hand are involved mostly in processing and packaging activities of the chain. They relay their products through distributors as well as supermarkets while others sell directly through pop-up stores and bazaars, the usual channels for small and startup firms. Some of the products are particularly geared towards the export market.

Figure 5. AgTech Linkages across the Value Chain



Source: Author Compilation

Other groups cater to different stakeholders and agribusinesses across the value chain. Some financial service enterprises target specific groups like farmers while others offer services for the broader MSME market. While some enterprises under the novel farming system engage with traditional farmers, others also cater to a variety of downstream agribusiness such as restaurants and resorts.

Novel farming startups also bring innovative method and tools through which consumers are able to take over the control and experience of growing and producing food. From a traditionally farm group dominated activity, such novel system of growing food has expanded the opportunities to access and tap broader markets such as retail and supermarkets.

II. Innovations across Major AgTech Enterprise Groups

The following sub-sections delve deeper into the major AgTech groups and sub-groups and introduce innovative products and services offered by emergent AgTech enterprise groups in the Philippines (refer to the summary table below).

Table 3. Summary of AgTech Groups/Sub-groups and Cases

Major Groups	Sub-groups	Category Description	Case Studies
On-farm Inputs	Ag Biotechnology	This agrifood tech category includes most agricultural inputs including seed, fertilizer, and pesticides.	<i>Sustansya BioAgriTech</i>
	Farm Management Software, Sensing, & IOT	This category encompasses sensors and satellite imagery, online enterprise resource planning tools, decision support software, data analytics algorithms, machine learning, and Internet-of-Things (IoT) connectivity technology used across agricultural production systems.	<i>FarmWatch</i>
Innovative Foods and Beverages	Innovative Foods and Beverages	This category mainly rely on finding new ingredient or flavour and/or science and technology intervention to manipulate ingredients to produce better tasting and healthier food/beverage alternatives.	<i>Muy Bien Ventures Chili Asylum Nipa Brew Pika Pikel</i>
Supply Chain Tech & Intermediary Platforms	Supply Chain Tech & Intermediary Platforms	This category advances innovative models that aim to create more efficient and inclusive supply chain, logistics and distribution system. It includes models that provide a platform to connect and scale-up agri-food stakeholders.	<i>Coco Asenso Food For Thought Agrabah</i>

Major Groups	Sub-groups	Category Description	Case Studies
Food E-commerce and Meal Kits	eGrocery and Food E-commerce	These are online tech platforms delivering food from a wide range of vendors in the shortest amount of time possible. Includes On-demand grocery delivery, including farm-to-consumer marketplaces and specialty providers.	<i>Plan Eat</i>
	Online Restaurants and Meal Kits	This category includes prepared meal delivery, often based on specialty diets, or pre-portioned ingredient kits to cook at home.	<i>Down to Earth</i>
Novel Farming System	Novel Farming System and Farm Equipments	This category includes new ways to produce food such as growing produce in high-tech greenhouses and automated vertical farms and also encompasses all equipment innovations for production such as grow kits and equipment.	<i>MNL Growkits</i> <i>Qubo PH</i> <i>NXTLVL Farms</i>
Financial and Other Services	Financial Services for Agribusiness	This category includes innovative tech services that specifically caters for agribusinesses such as crowdfunding platforms for farmers.	<i>Cropital</i>
	Other financial platform	This category includes other innovative financial tech services that links to other enterprise activities in the agri-food value chain such as lending, invoice discounting etc.	<i>Leverage.ph</i> <i>Acudeen</i>

a. On-Farm Inputs

With reference to the agri-food value chain, the On-farm Inputs category encompasses the sub-categories of Ag Biotechnology as well as the Farm Management Software, Sensing and IoT groups. The Ag Biotechnology sub-group generally refers to technologies involving advancements in biological and chemical processes to improve crop yields and reduce pesticide use. An example of this is BioAgritech, an enterprise that develops a soil conditioner to help restore and resuscitate soil nutrients. The main product—Compostar—enhances soil health by correcting pH and increasing moisture holding capacity to make soils more balanced and nutrient rich. This innovative product helps improve farm produce quality. Sustansiya is another start-up agribusiness focused on organic fertilizer manufacturing. Its main product is a biofertilizer made

from chicken manure. The enterprise adds value by creating byproducts from industrial waste. Sustansiya custom blends fertilizer to suit varying customer and crop requirements.

The second sub-category under on-farm inputs is Farm Management Software, Sensing and IoT group, comprised primarily of informational inputs in the pre-harvest stage of the chain. These different types of software and big data technologies help manage farm operations more effectively (e.g. Internet-of-Things (IoT), sensors, and data analytics among others). The technologies enable farmers to automatically collect predictive information and data analytics about their production inputs such as soil, water and crops. FarmWatch is one example of a Philippine-based enterprise under this sub-category. The enterprise provides farm management and monitoring solutions – primarily for poultry farms – with remote monitoring systems, emergency SMS warnings and critical status reports and data representation and analysis tools, among others. FarmWatch sensors monitor critical aspects of poultry farming including environmental (e.g. temperature, humidity, CO2 levels, ammonia levels), health and consumption (e.g. weight, feeds and water) as well as compliance (e.g. fly count and hydrogen sulfide levels).

On-farm inputs enterprises directly engage with crop and animal farm groups in the pre-harvest and production stage of the agri-food chain. Compared to other AgTech groups, on-farm inputs has a weaker presence. Big data and IoT based innovation is a relatively young field, which partially explains why its share in the market is comparatively low. In the case of the Ag Biotech sub-group, despite being quick to pick up on biotechnology research, the Philippines has been slow to adopt the technologies. Industries cited weak political will and a failure to provide resources as the reason Ag Biotech has failed to advance.²⁷ The advancement of on-farm inputs offers a renewed vitality and a much-needed commercial base for Ag Tech to take off in the country.

b. Innovative Foods and Beverages

Dietary patterns and food consumption are rapidly changing. Based on the data from FAO, there has been a noticeable increase in the consumption of rice, wheat and other cereals as well as meat.²⁸ Increased demand has led to a surge in production, which places even bigger stress on the environment. A notable percentage of greenhouse gas emissions (15 per cent) can be tracked back to the meat industry, leading innovators to seek alternatives to keep up with consumer demands.²⁹ As a response to growing consumer demand for healthier food with greater nutritional value, innovators and entrepreneurs are producing novel products and ingredients.

Innovative foods rely on new ingredients as well as science and technology to manipulate ingredients during the production or process stage to create better

tasting and healthier food and beverage alternatives. An example of this is Muy Bien Ventures, which offers turmeric calamansi juice and turmeric teas infused with ginger and lemongrass. Their products have been recognized for being healthy and innovative, particularly the new formulation for calamansi juice. Nipa Brew, on the other hand, is focused on the science of brewing to introduce a quality and good-tasting craft beer. The company is also looking at fermenting locally sourced honey to make an alcoholic sparkling drink. This product would not only advance new formulation for beverages but also promote greater inclusion across the supply chain.

Other innovative food products offer notable improvements in shelf life. An example is the product offering of Chilli Asylum, which uses all-natural, vinegar-based preservatives. Their bestsellers — the chilli chutney and chimichurri — offer dairy-free, vegan and vegetarian options for customers. They are also introducing all-natural ketchup products made from locally sourced fruits and vegetables (e.g. pineapple, strawberry among others.) Pika Pikel, on the other hand, saw a market opportunity in producing and processing pickled mango, and is now expanding into pickled fruits and vegetables. They employ a specialized pickling process to ensure their products remain crunchier and last longer.

Compared with other agri-food tech groups in the Philippines, entrepreneurial opportunities are the most prevalent in the innovative food category. This is not surprising considering food is a lynchpin of Filipino culture. The expansive market as well as broad prospects for innovation in food and flavor, provide huge opportunities for new and smaller entrepreneurs. In terms of their chain connections, product innovations are relayed mostly through distributors as well as supermarket, grocery and retail stores. Others sell directly through pop-up stores and bazaars, which are typical channels for small and startup firms. Some of the products are particularly geared towards the export market. Pika Pikel's product packaging, for instance, is specifically designed to be more lightweight and less prone to breakage for more efficient transport.

c. Supply Chain Tech and Intermediary Platforms

The agri-food value chain is typically composed of interwoven links at the farm where food is cultivated and before food is delivered to consumers. Given the many intermediate linkages and activities that are agri-food based, there has been rising demand for transparency, traceability and inclusivity along the chain. Agrifood tech startups in this category spawn product innovations such as logistic tracking and shelf-life enhancement to improve efficient movement of products across the chain. This category also includes supply chain innovations that connect and scale-up various agri-food stakeholders. Such platforms lead to greater efficiency and inclusivity for different stakeholders in the agri-food

supply chain.

One example is CocoAsenso, an enterprise that aims to improve livelihoods and efficiency in the coconut sector by lessening the distance between production and processing activities in the supply chain. It established a network of coconut processing factories in remote areas where coconuts can be directly purchased from local farmers and processed into desiccated coconut, which is then transported to coconut oil production factories. This system not only increases the farmer takeaways but also reduces the logistic and transport costs. Meanwhile, Food For Thought's main product offering is processed mushroom chips. They differ from other processors with a socially innovative model for their enterprise specifically designed to support earnings and inclusivity among families in the countryside. A portion of the product's purchase price is allocated to different social enterprises, such as the company's foundation and other corporate and social investments (e.g. farming) and training and education activities.

A third example is Agrabah Marketplace, a business-to-business online marketplace that connects hotels and restaurants to seafood suppliers. The online system manages information and supply data from customers, which is automatically transmitted to vendors and suppliers, thereby helping supply chain clients to reduce seafood costs, address supplier related issues, aid in strategy selection, and provide accurate data.

Enterprises in this category have the most diverse linkages across the agri-food value chain. CocoAsenso mainly engages with coconut farmers, processing centers and production companies. Food For Thought directly links with produce suppliers as well as foundations, training institutes and rural families. Agrabah Marketplace connects with produce suppliers, hotels and restaurants. They have all created value with the use of platforms that help scale-up other businesses, farmer groups and the larger community as a whole.

d. Food E-commerce and Meal Kits

The agri-food value chain is a complex web of linkages that unite stakeholders to provide food for consumption. Modern consumer demands have a large impact on the entrepreneurial activity and innovative prospects along the chain. For entrepreneurs in this category, the main concerns are delivery efficiency and offering consumers a wide variety and range of food choices. The advancement in digital information technology efficiently narrows the distance through which food is delivered to consumers. Innovations in online tech and e-grocery platforms allow consumers access to food products and meal take-outs from restaurants and retail stores.

Take for example, Down-to-Earth, a producer and processing firm which focuses

on specialty vegetables and grass-fed beef. The company's innovative e-commerce website allows consumers to buy locally sourced, sustainably produced and conflict-free food products with home delivery for a minimum purchase. The service started in 2003 but didn't take off until the past few years when e-commerce became a more common way to buy food.

Aside from speedy access, modern consumers prefer greater control and broader, healthier variety of meal choices. Customized menus that lean towards specialized diets (e.g. vegan, keto... etc) provide huge business prospects for entrepreneurs. This demand has led to the emergence of meal plans or meal-kit enterprises that offer cooked meals or pre-portioned ingredients for consumers to prepare at home. Plan:Eats is among the enterprises providing this product and service innovation. It mainly offers packaged meal plans with calorie counts and delivers directly to consumers. The meal plans include different selections that can be chosen by consumers based on what is best suited to their targeted body weight, lifestyle as well as daily caloric intake.

Food e-commerce and meal kits are comparatively more common ventures in the Philippines, and tend to be concentrated in cities within the national capital region. Businesses in these groups are highly dependent on infrastructure to deliver and transport food to consumers. Considering that this particular group is highly dependent on infrastructure to efficiently deliver and transport food to consumers, the lack of services provided outside the city and across other more remote and rural location is indicative of the weaknesses in the both physical and digital infrastructure of the country.

e. Novel Farming System

The agri-food industry is under scrutiny for adverse environmental consequences resulting from the extensive use of finite natural resources such as water and arable land. Conventional farming methods, which rely on the intensive use of chemicals and fertilizers heavily contribute to soil degradation. The industry is now being challenged to seek alternative, sustainable methods to grow crops and manage agricultural resources. Farming system innovations are alleviating pressure on agricultural resources through novel or enhanced food production methods that lessen the burden on land and soil.

One of the local enterprises, NXLVL Farm, introduced an innovative farmbox to the market. Driven by highly volatile weather in the Philippines, which damages crops and disrupts food availability, the startup initiated an indoor farming system. The enterprise's main product is a farmbox consisting of a repurposed container outfitted with hydroponic growing equipment and hardware. The farmbox provides a controlled, insulated growing environment, safe from external weather. It also allows cultivation during countercyclical periods, which makes for a more consistent and quality harvest. Other enterprises in this

category produce smaller-scale growing kits more suited for retail sales. Qubo PH offers DIY garden kit while MNLGrow Kits offer different types of organic plant kits (e.g. herb, vegetable, seedling, tree and garden). These kits generally include a biodegradable coconut husk pot, potting mix, choice of seed packet and organic fertilizer.

Farm system innovations have changed the value chain by narrowing the distance between food production and consumers. While NXTLVL Farms sells to traditional farmers, their farmboxes also cater to entrepreneurs, restaurants, and resorts. Startups found in the novel farming system category are changing the way consumers control and experience growing food. Both MNLGrow Kits and Qubo PH are retail products that consumers can easily purchase and use. Their products are targeted towards a younger, urban demographic and the packaging is artfully designed and customized for smaller spaces.

f. Financial Tech and Other services

Given that the agri-food sector spans huge interconnected agribusiness nodes, its survival relies on the support of key related sectors. Many small farmers, particularly in a country where agriculture remains a major source of livelihood and employment, require specialized financial services. Agricultural activities are volatile and farmers are often exposed to risk, which creates challenges for financial service providers. Innovations in this category are classified under the emerging sector of FinTech. These technologies are revolutionizing financing for many stakeholders including many small and new enterprises.

Some of the innovative financial services specialize on particular groups such as farmers. An example is Cropital, which offers a crowdfunding platform that links farmers to financiers. With this platform investors have the option to invest short or long-term and choose a farm to fund. Farmers use this financing and once they sell their products, investors receive a return on their investment. Other FinTech services cater to wide variety of businesses. An example is Leverage.PH, which offers bridge financing to 'unbankable' small and medium-sized enterprises and startups, including agri-food based businesses. Their financial product provides lending options for a market largely underserved by larger financial institutions. Acudeen's technology, on the other hand, supports a two-sided marketplace that links small businesses to networks of investors both local and international through invoice discounting. Their online platform offers an efficient and seamless means of transaction both for sellers in need of cash flow and investors looking for alternative investments. From data collated from payment behaviors of businesses, they also have a credit-scoring algorithm that can help assess and compare businesses.

Although the related FinTech sector is expanding at a rapid rate only a fraction engages or overlaps with the agri-food sector and an even lower number of

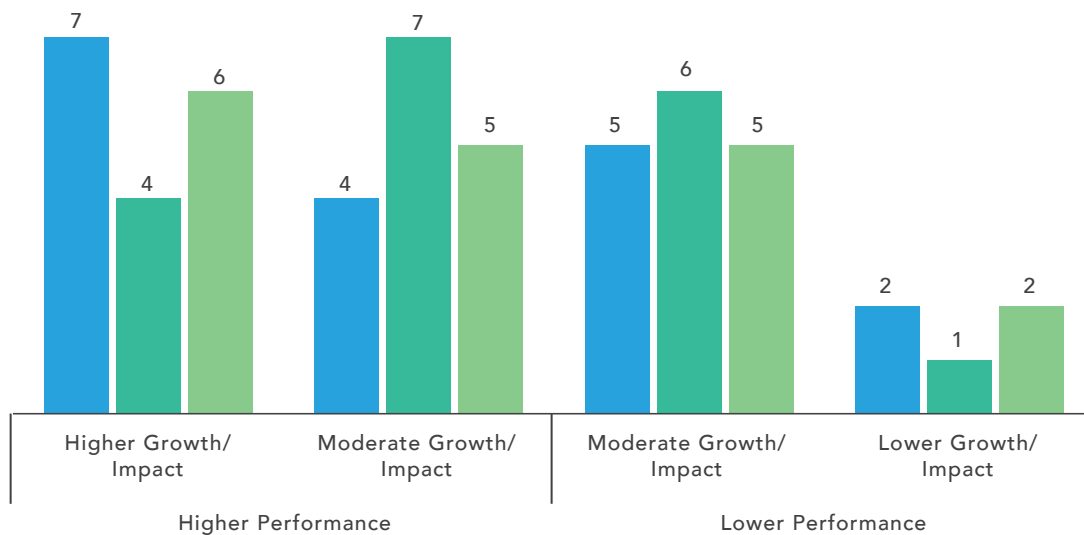
enterprises that provide service specific for the agribusiness market. Part of the problem, is the dependence on informal lending options and limited financial literacy among many agri-food players across the supply chain. The requirement for business plans and proof of financial stability for loans, pushes many micro enterprises and farmers into informal lending schemes such as 5-6 lending option.³⁰ This option persists because it requires little or non-traditional collateral, but demands higher rates to account for the increased risk. However such schemes place small businesses in an even more vulnerable state if they are unable to make payments. The presence of platforms that offer innovative financial products/services could expand the financial inclusion of smaller agribusiness players.

In sum, the qualitative exploration of various AgTech groups affirms the secondary quantitative data findings in terms of the promising innovation potential of MSME. However, the progress of AgTech MSME appears uneven with greater entrepreneurial uptake on specific groups such as Innovative Foods and Food E-commerce while other groups lag behind. A deeper understanding of the value chain connection of each emergent group provides greater understanding of the rapidly evolving AgTech landscape in the Philippines and insight as to how the industry could gain better traction in relatively untapped areas. The following sections shed light on the performance of AgTech enterprises and the various factors that determined their success.

III. Performance Outcome of AgTech Enterprises in the Philippines

The Triple Bottom Line model was used to assess entrepreneurial performance for this study. By rescaling the composite indicator for performance into a dichotomous variable, the study is able to discern nuances between higher and lower performance outcomes. Based on the data, AgTech enterprises collectively were trending positively. Eleven of 18 cases performed better than or at par with the median percentile of sampled cases. The figure below illustrates the frequency distribution of performance ratings for each outcome group and across the three dimensions. From the data, it appears that higher performance outcome of AgTech cases were essentially boosted by entrepreneurial successes with respect to their social and financial bottom lines. This is not surprising as some studies provide empirical support relating to the positive link between firm's financial resources and their corporate social performance. The rationale is that financially able firms have the capability to allocate resources and investments to pursue social goals.³¹ In terms of environmental indicators, however, most of the AgTech cases displayed comparatively moderate efforts/impact.

Figure 6. Frequency Distribution on Overall Performance Composite Score



Note: The study sample (N=18) was grouped based on percentile rank

Source: Author Compilation/Calculation

Financial Performance: Profitability and revenue growth are the two main indicators for the financial bottom line. Enterprises with relatively higher performance reported notable increases in sales and production, improved profitability and greater investor returns. Strong performers also experienced expanded customer bases, services and facilities. Although they believed their businesses had expanded their product offerings or service, they also stated there is much room for improvement. Enterprises that performed comparatively lower, although they achieved some gains, grappled with financial issues such as highly volatile or flat growth as well as low returns for some products/services. Some also encountered difficulty penetrating the market. Nearly all respondents stated the initial period was a struggle particularly on the financial front.

Environmental Performance: Although all representative cases recognized the importance of environment safeguards and stewardship, the majority exhibited only moderate performance in their environmental bottom line. Despite that many enterprises had set goals and future plans, few had large-scale initiatives underway. The most common indicators of environmental performance are waste management practices, including reuse and recycling and environmental impact reduction through the use of sustainable materials. Another common indicator is management and regulatory compliance practices. Those with relatively stronger performance invested in sustainable/clean technologies and machinery. Some strong performers even surpassed regulatory compliance by collaborating with other institutions to advance green initiatives. Enterprises exhibiting poor impact had weaker regulatory

compliance, used unsustainable supplies or materials, and had a greater emission/ carbon footprint as well as inadequate environmental planning.

Social Performance: Employees are a large part of any firm's operation and general employee welfare and satisfaction is indicative of the overall organizational climate. Most enterprises had plans to expand their workforces, however a notable number placed even higher value on providing for the wellbeing and personal development of existing staff. Some focused on providing sufficient benefits and incentives while others offered skills training. Other enterprises with stronger overall performance advanced initiatives or maintained inclusive practices that positively impact the community by engaging other local businesses or supporting specific groups (e.g. farmer groups).

Social impact is also measured by customer satisfaction and most enterprises made gains in this area. However, few had systematic ways to solicit customer feedback through digital feedback or online systems. Most still rely on more informal and unstructured ways of evaluating customer satisfaction such as asking staff to randomly inquire about the product or note the number of regular customers. Such informal systems are less costly, but also result in rather biased evaluations of their products, which could inadvertently impact their goals to improve their product/ services.

Compared to the financial and social bottom lines, there remains a slim gap in terms of the enterprises' environmental performance. Most firms acknowledge they have room to improve their environmental protection initiatives. Some had plans to improve and were researching renewable sources of energy. There were also plans to upcycle, which means transforming by-products or waste into product of better value. Implementing these ideas would definitely narrow the performance gap and up overall entrepreneurial performance. This tracks back to the question of what conditions are driving the higher or lower entrepreneurial performance.

IV. Entrepreneurial Drivers of AgTech Enterprise Performance

The variety of antecedent conditions identified by the case informants were initially clustered corresponding to the overarching layers (internal or external) and relative influence on performance outcome. That list of factors was then rank-ordered according to frequency of reference or report. In order to establish the link between the antecedent and the outcome, the antecedent conditions were further grouped by enterprise outcome (higher/lower performance). This varying tier of categorization and clustering enabled the researcher to observe patterns and themes across the cases. As explained in the literature, including every possible antecedent condition poses problems, as it produces complex and less meaningful results.³² The cross-case categorical comparison below also helped trim the antecedent variables for further testing in order to generate more focused and stronger results. The following discussion and analysis will focus specifically on the more commonly reported antecedent conditions by enterprise groups.

a. Comparative Internal Strengthening Factors of Higher/Lower Performance Outcome

Looking at ranking relative to the internal layer, the most prominent factor that contributes positively to enterprise growth and development is resource accumulation. Funding is funneled to the enterprise through varying sources but across all cases, self-financing remains the most common. Self-financing is particularly utilized at the beginning stages of the enterprise birth. Most enterprises within the high group acquired resources formally while financing for most firms from the low group was informally sourced. Formally acquired resources, as the name suggests, include those generated through a more structured process of negotiation and acquisition or via an official application process or competition. Formal funding was granted or awarded by external providers such as private or corporate investors, institutional grants, as well as government agencies.

Table 4. Ranking of Internal Antecedent Drivers for Higher/Lower Performance Outcome

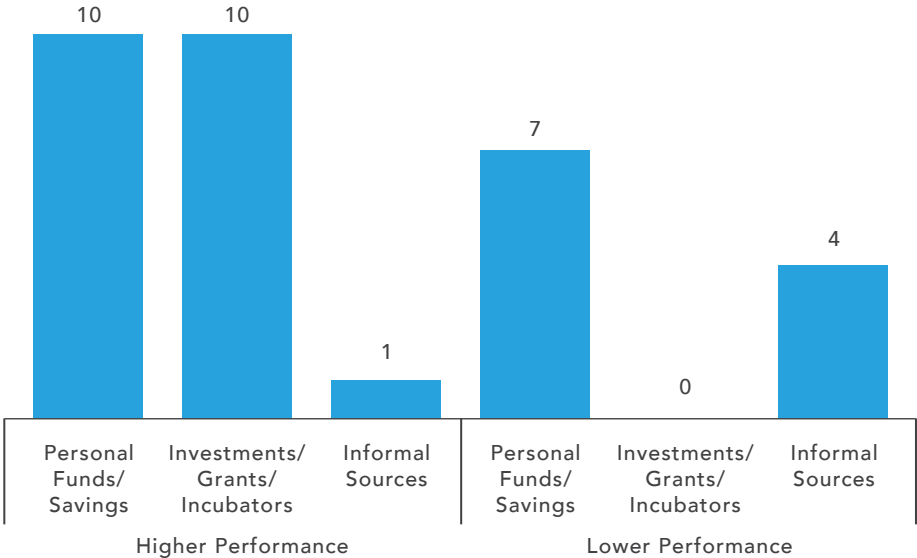
Internal Antecedent Factors for Higher and Lower Performance Outcome					
Higher Performance	Effect	Count	Lower Performance	Effect	Count
Financing from Formal/External Source	(+)	10	Financing from Personal Funds/Savings	(+)	7
Financing from Personal Funds/Savings	(+)	10	Educational Background & Work Experience	(+)	6
Educational Background & Work Experience	(+)	9	Financing from Informal Source	(+)	4
Organizational Structure & Management	(+)	8	Persistent Attitude	(+)	3
Vision/Goals & Product Innovation	(+)	7	Diligence/Hard-work	(+)	3
Persistent Attitude	(+)	7	Vision/Goals & Product Innovation	(+)	3
Adequate Physical & Labor Resource	(+)	6	Passionate Attitude	(+)	2
Passionate Attitude	(+)	4			
Empathy with Customers	(+)	3			
Financing from Informal Source	(+)	1			
Supplementary Skills and Training	(-)	7	Inadequate Physical/Labor Resource	(-)	7
Convincing/Pitching to Investors	(-)	4	Deficient Capital/Financial Funding	(-)	6
Limited/Deficient Capital or Financial Funding	(-)	3	Supplementary Skills and Training	(-)	2
Supply Chain, Logistics & Operational Issues	(-)	3	Supply Chain, Logistics & Operational Issues	(-)	2

Note: The study sample (N=18) was grouped based on percentile rank

Source: Author Compilation/Calculation

It should be noted however, that external funding presents certain drawbacks as well as benefits; while it often offers greater funding than internally sourced alternatives, the requirements and conditions attached to it are likewise more stringent. This is indicative of a proactive and more varied approach to resource accumulation. As one of the respondents mentioned, the effort and knowledge to seek grants and obtain funds from different sources factored significantly in their development. For some enterprises, securing investments translates into more advanced facilities that benefit their production process. The lower group, on the other hand, relies heavily on personal financing. Some used personal savings and others acquired funds by selling properties and other assets. Once personal funds run dry, they turned to other informal means such as loans from family connections or friends.

Figure 7. Comparison of Resource Accumulation Strategies by Performance Outcome



Source: Author Compilation

Knowledge resource (i.e. from education and work experience) is another key factor frequently identified by both groups. The founders’ education might not be directly related to their area of specialization, but the majority has earned degrees that are either business-related or agri-food based, which they regard as a major advantage. For some entrepreneurs, previous work directly or indirectly related to their business equipped them with knowledge and increased their business acumen. In some cases, professional experience was deemed largely beneficial to enhance specific skills (e.g. skills in sales, customer services).

Besides knowledge and capital, an entrepreneur's attitude, particularly being persistent, passionate, and hard working appears to be essential for enterprise performance.

Other firm-specific conditions such as corporate vision, concept innovation, and organizational management structure were also among the top antecedent factors identified by the respondents, particularly within the higher group. Many firms believe success is largely reliant on how able they are to turn their vision into innovative products and service. Most AgTech enterprise founders emphasized that their innovative product or service provided solutions to key issues or gaps in the agri-food sector. This conviction resonated prominently across the AgTech sector.

How firms are managed and organized is another important determining factor of favorable performance outcome, particularly within the high performance group. Some enterprises explained staying small scale benefited their growth because it made them more adaptable to change, which fosters the introduction of new ideas and concepts. The organization and management of small enterprises is less structured and formal, making employee relationships more tight-knit and familiar. Team-oriented dynamics make for an easier learning and more nurturing environment. This differs significantly from the highly formalized structure in large corporations, which are less adaptable to innovation and change.

b. Comparative Internal Weakening Factors of Higher/Lower Performance Outcome

For high performing firms, the most constraining factors were attributed to supplementary skills and training as well pitching innovation ideas to potential investors. Supplementary skills are specific skills in areas that enhance or raise competencies. For instance, although having a business-related degree provides necessary knowledge for an entrepreneur, skills and training in food preservation elevates his or her abilities to operate a food manufacturing or processing business. Besides actual product-specific knowledge, the lack of administrative or managerial know-how is also a big hurdle for most enterprises. Such lack of training, compounded by an insufficient workforce is a major roadblock for entrepreneurs in some enterprises. Small enterprises and startups have limited finances and therefore struggle to hire specialized employees, so the partners sometimes have to learn skills like accounting themselves. For most enterprises, a lack of knowledge and skills in these supplementary areas creates operational and efficiency problems.

Although having formally-sourced investments and grants are more prevalent among high-performing group, securing these resources initially presented huge difficulty for most of the enterprises, particularly during the birth phase

of the entrepreneurial process. As one of the respondents mentioned, pitching a conceptual innovation is no easy feat, especially when most investors are only loosely connected to agriculture. Other respondents reported they often encountered difficulty convincing investors how their innovation would provide a solution and more importantly turn a profit from their investment. Even those enterprises that were able to acquire funds via more formal means, through a private company or bank, found it challenging to obtain trade credit or financing. Bank loans require collateral and most enterprise founders had insufficient assets to secure loans. In one case, an investor reneged on a deal, forcing one of the founders to take a day job to compensate for lost capital.

Maintaining sufficient funding is also a notable constraint to entrepreneurial development. This is more frequently a problem for low performing enterprises since their funding is restricted to their internal networks. As one founder explained, good ideas go nowhere without money to bring them to fruition. Labour resources are another problem for enterprises exhibiting relatively low overall performance. Companies with smaller workforces are less efficient because there are fewer employees to do the work. Some enterprises were unable to keep up with the production demands and fell behind with deliveries. Funding deficiencies also make it difficult for enterprises to upgrade physical resource such as equipment and machinery. Some mentioned they need newer replacements to avoid compromising their product.

c. Comparative External Strengthening Factors for High/Low Enterprise Group

Most enterprises mentioned they are acquainted with the majority of players in the tight-knit agri-food industry field, especially those they regularly conduct business with such as product and raw material suppliers. This underscores how the agri-food industry has become increasingly interlinked into a larger web of supply chain stakeholders. Engaging with different networks and forming relationships is crucial for business development, even more so in an industry linked in backward and forward chains. Maintaining connections benefits enterprises in the longer term and respondents in both groups reported they value the importance of good working relationships with other firms across the agri-food value chain.

Table 5. Ranking of External Antecedent Drivers for Higher/Lower Performance Outcome

External Antecedent Factors for Higher and Lower Performance Outcome					
Higher Performance	Effect	Count	Lower Performance	Effect	Count
Linkages with Supply Chain Stakeholders	(+)	11	Linkages with Supply Chain Stakeholders	(+)	6
Partnership/Affiliation with Organization Networks	(+)	9	Personal/Familial Ties	(+)	7
Access/Exposure to Resource Assistance/Grants	(+)	8	Partnership/Affiliation with Organization Networks	(+)	5
Personal/Familial Ties	(+)	8	Government Facilitated Program Initiative	(+)	2
Enabling Business Policies/Legal Frameworks	(+)	5	Enabling Business Policies/Legal Framework	(+)	2
Government-Facilitated Programs/Initiatives	(+)	4	Monitoring of Programs/Initiatives	(+)	1
Monitoring of Programs/Initiatives	(+)	2			
Inefficient Regulatory Standard & Procedures	(-)	8	Lack of Exposure to Resource Assistance/Grants	(-)	6
Weak Communication of Programs/Initiatives	(-)	5	Inefficient Regulatory Standard & Procedures	(-)	6
Poor Policy Implementation/Enforcement	(-)	5	Weak Communication of Programs/Initiatives	(-)	4
Constraining Policies/Legal Framework	(-)	3	Constraining Policies/Framework	(-)	4

Note: The study sample (N=18) was grouped based on percentile rank

Source: Author Compilation/Calculation

Besides forward and backward linkages within the industry, enterprises also maintain partnerships with professional networks, stakeholders and organizations (local and international) that provide consulting and expert advice in the agri-food sector. These groups help enterprises develop products and identify areas for expansion. For some enterprises these professional connections directly translate into sales, as they became eventual clients. These linkages also help enterprises develop prototypes and market new products. Partnerships with global institutions and non-government organizations are also instrumental in realizing broader company goals. Few enterprises mentioned collaboration with global/local institutions (e.g. World Wildlife Fund) to advance environmental protection initiatives.

Outside professional networks, personal and family ties were also found to favorably influence enterprise growth and development. This was most evident

among low group enterprises, which lack financial, physical and workforce resources, resulting in lower productive capacity. Personal ties can be important in filling a firm's structural and resource gaps. Most entrepreneurs mentioned they often called on family and friends to assist during special events or work when manpower was lacking. They can also rely on their family to help out in marketing channels and they informally seek out familial networks to do casual/commissioned work for lower cost (e.g. designing layout). The dependence on family is rooted in the predominantly family-oriented Philippine culture and meshing personal ties with business matters is quite common.

Compared to the low enterprise group, a greater number of small enterprises from the high group received financial funding from a wide range of sources, including government agencies, private/international corporations, and non-government organizations. Some enterprises received financial grants from government agency programs. Few enterprises obtained financial grants from international organizations (e.g. USAID) or agri-based competitions. Grants bolster entrepreneurial development and enable enterprises to finance their operations, purchase appropriate equipment and supplies and essentially sustain the business. They also contribute valuable knowledge, physical and relational resources. Some enterprises received assistance in skills and training as well as support building networks from incubator and accelerator groups. Government agencies also facilitate training seminars and specific events like trade fairs and bazaars, which help nurture relationships with other supply chain players.

d. Comparative External Weakening Factors for High/Low Enterprise Groups

Based on the qualitative data, regulatory standards are the top external constraint. Enterprises report trouble acquiring legal business documents such as permits, licenses, patents, certification and accreditation has significantly hampered their development. This problem cost some enterprises export opportunities because they lack certification and accreditation. According to them processing of documents takes a long time, involves tedious procedures, and requires a lot resources. They mentioned many requirements appear arbitrarily vague and unclear. One of the respondents said there were some documents that were required but not included on the checklist, which meant the application had to be redone, costing time and money. Some enterprises simply couldn't afford the process. Others were not clear which regulatory body governed their product and unsure which guidelines to follow particularly in terms of the formulation of their product.

For the low group in particular, the lack of government support is seen as a main constraint. Even within the agri-food industry there is a perceived incongruity in terms of government support.

For instance, the general perception across the group is that tech start-up firms receive greater financial support and less strict policy provision. Furthermore, there appears to be very familiarity with MSME-specific resource assistance programs. During the interviews, only a few respondents could name programs in their field. Among the programs mentioned were the DOST training program, DTI-organized fairs, DOST-PCIEERD I2Tech, and DOST Set-up program. One enterprise mentioned that they did not know of any specific program for agri-food businesses. This is indicative of the weaknesses in the promotion and communication of programs given that a considerable number of enterprises have very little familiarity and awareness of what programs they can participate in and are applicable to them.

Among AgTech groups interviewed, the perception of overall business environment policies was mixed. Some policies and programs were seen as helpful and others in need of improvement. This aligns with the APEC Business Advisory Council (ABAC) research that explored all existing policies for MSME and concluded the country is in no shortage of policies geared towards development of MSME in general. Of the different policies reviewed, most of them were enacted just in the past few years, an indication of the aggressive push by the recent administration to aid growth of smaller scale enterprises. They have observed the government's focus on developing MSME.³³ Among the policies and programs highlighted by the interviewees were supportive tax rates for small businesses as well as the DTI's the Go Negosyo [business] Centers. Some even mentioned there is no shortage of policies, but there are problems with implementation and policy enforcement.

e. Analysis of Key Entrepreneurial Drivers of AgTech Enterprise Performance

The preceding section provided the encompassing comparative discussion of frequently reported factors relating to the outcome of interest. The ensuing discussion will test the relative importance of these antecedent conditions using qualitative comparative analysis (QCA) which is based on Boolean method of inference. From the complex set of antecedent conditions identified by the respondents (refer to the table below), the QCA test is used to pinpoint the combination of factors that serve as necessary conditions leading to higher performance, which is the designated outcome of interest in this study. The test applies algorithms to minimize or remove less relevant factors in order to generate simpler and more parsimonious combination of factors linked to outcome.

QCA's main advantage is that it supports multiple causal paths or solutions. For instance, the outcome of interest (Higher Performance) compared with the potential antecedent conditions under the Entrepreneur Attributes Category

yielded the solution term of $[Outcome = IA*IF + \sim IE*IF + \sim IA*\sim IB*IE*\sim IF]$. The solution term means that there are three paths that significantly relates to higher entrepreneurial performance: either the (1) combined entrepreneur persistence and supplementary skills/training ($IA*IF$) OR (2) the combined absence of education and work experience and presence of supplementary skills and training ($\sim IE*IF$) OR (3) combined education & work experience and the absence of persistence, passion and lack of supplementary skills/training ($\sim IA*\sim IB*IE*\sim IF$).

Table 6. List of Antecedent Conditions by Entrepreneurial Layers

Internal Antecedental Factors	External Antecedental Factors
Entrepreneurial Qualities	Inter-Firm Ties and Network Links
IA. Persistent Attitude	EA. Personal/Familial Ties
IB. Passionate Attitude	EB. Linkages with Supply Chain Stakeholders
IC. Empathy with Customer	EC. Partnership/Affiliation with Organization/Networks
ID. Diligence/Hardwork	
IE. Education and Work Experience	
IF. Supplementary Skills/Training	
IK. Convincing/Pitching to Investors	
Enterprise Characteristics	Business Environment
IG. Financing from Personal Funds/Savings	ED. Inefficient Regulatory Standards & Procedures
IH. Financing from Formal/External Source	EE. Enabling Business Policies/Legal Framework
II. Financing from Informal Resource	EF. Constraining Policies/Legal Framework
IJ. Vision/Goals & Concept Innovation	EG. Poor Policy Implementation
IL. Deficient Capital/Financial Funding	EH. Access/Exposure to Resource Support/Assistance
IM. Adequate Physical/Labor Resource	EI. Lack of Access to Resource Support /Assistance
IN. Inadequate Physical/Labor Resource	EJ. Government Facilitated Events/Programs
IO. Organizational Structure and Management	EK. Weak Communication of Programs/Initiatives
IP. Supply Chain, Logistics & Operational Issues	EL. Monitoring of Policies and Initiatives

Each solution set includes the calculated “consistency” and “coverage,” indicators that can be used to better interpret and make sense of the solution set. Consistency refers to the degree of which the values of causal combination are consistent with the outcome. The consistency result, which is conceptually analogous to the notion of statistical significance, helps decide, based on a set threshold, the combinations should be included in the final solution term.

For this study, we've already defined the threshold as 1; any less would be excluded in the output. Coverage, on the other hand, corresponds to the representation of the causal combination to set of cases. This means that the higher the coverage, the greater the empirical relevance or the number/count of cases that exhibit the causal condition.^{34,35} Moreover, the test done corresponds to factors across the different internal and external layers since the conceptual basis of the study assumes that the layers pose a complementary impact on the outcome. The summary of the QCA results is detailed below.

Table 7. Summary of QCA Test Comparing Antecedent Factors to Performance Outcome

Internal Layer Antecedent Factors				
Category	Solution	Coverage	Consistency	Count
Model:	<i>Outcome (Higher Performance) = f(IA, IB, IE, IF, IG)</i>			
Entrepreneur Attributes/Qualities	IA*IF	0.5455	1	6
	~IE*IF	0.1818	1	2
	~IA*~IB*IE*~IF	0.1818	1	2
Model:	<i>Outcome (Higher Performance) = f(IH, II, IJ, IK, IL, IM, IN, IO, IP)</i>			
Enterprise Characteristics	II	0.9091	1	10
	IO	0.7273	1	8
	~IL*~IN	0.7273	1	8
	~IJ*~IN	0.9091	1	10
	IK*~IN	0.6364	1	7
External Layer Antecedent Factors				
Category	Solution	Coverage	Consistency	Count
Model:	<i>Outcome (Higher Performance) = f(EA, EB, EC)</i>			
Inter-firm Ties and Networks	~EA*EB*EC	0.2727	1	3
Model:	<i>Outcome (Higher Performance) = f(ED, EE, EF, EG, EH, EI, EJ, EK, EL)</i>			
Business Environment	EH	0.7273	1	8
	~EF*EI	0.7273	1	8
	~EI*~EJ	0.6364	1	7
	EE*~EI	0.4545	1	5
	~EF*EJ	0.2727	1	3
	EE*EJ	0.2727	1	3

*See to List of Antecedent Factors for the solution combination reference
The character (~) denotes a negated set, which means the absence of or not the variable
Solution combinations are based on parsimonious solutions*

At the entrepreneur level, the causal configuration that is substantially linked to outcome is represented by “IA*IF” in the summary table. Given the higher degree of coverage, the result indicates that persistence and competency in supplementary skills and training are empirically important factors linked to higher entrepreneurial performance. At the micro level, founders of new ventures often encounter setbacks, particularly in terms of necessary business or technical skills, but having the right attitude and adequate set of skills are the mitigating factor and helps them cope. The remaining combinations provide less compelling explanation of outcome relative to their minimal coverage estimate. The frequency data on education and past work experience offers some insight into why the education variable results was empirically trivial. Based on the frequency table, relevant education is deemed a crucial and common factor shared by most respondents and this is probably why the variable did not necessarily distinguish between higher or lower performance outcomes. They emphasized the importance of being able to draw crucial knowledge and information from courses and apply it in their businesses.

With respect to the enterprise layer, the generated solution was [Outcome = II + IO + ~IL*~IN ~IJ*~IN + IK*~IN]. The first two configurations underscored financing accumulation via formal sources as well as organizational structure and management as significant conditions for higher performance. As the results suggest, employing a varied and proactive strategy in resource accumulation or striving for good organizational/team dynamics appears most conducive to higher enterprise performance. In the last three configurations, the causal combination of deficient financial and other resources or the absence of informally acquired resources and deficiencies in physical and labor resources or the presence of both company vision/concept innovation and absence of deficiencies in physical and labor resource likewise showed high estimates in coverage and consistency. What is common among the sets is not having resource deficiencies appears substantively instrumental in attaining higher performance. In the case of the AgTech sector, physical and labor capital are the most important considerations since most agri-food based SMEs are equipment and machine heavy and involve labour intensive activities. There is no doubt resource deficiencies would affect their performance.

There is also an interesting relationship between the presence of vision/goals and concepts with enterprise outcomes. Based on the data, firms more inclined to set sustainable and/or inclusive company goals, had higher individual environmental and/or social bottom lines. This indicates that having the vision/goal appears to be the key determinant that reinforces the environmental and social performance of AgTech enterprises. Overall this solution term under the enterprise layer category provides a very compelling and offers strong explanatory capability relating to the outcome variable, taking into consideration the high consistency and coverage results.

Under the network linkages category, the test yielded the solution [Outcome = $\sim EA*EB*EC$]. The configuration denotes the combined influence of having no personal ties and supply chain linkages and professional affiliations/partnerships. Although the solution is highly consistent with the outcome, the coverage or the degree to which the solution represents cases returned a very low estimate. This made the overall solution less compelling and inferences drawn from it comparatively weak. Although the solution offers some interesting nuances regarding the negative implications of personal ties in business, some of the respondents pointed out personal ties in business can have a beneficial effect. As one case informant explained, managing families can be difficult especially when they don't reach targets. Owners are torn between admonishing a relative and cultural norms dictating they should be deferential to family.

At the macro layer, the resulting set of configurations comparing business environment variables is [Outcome = $EH + \sim EI*\sim EJ + \sim EF*\sim EI + EE*\sim EI + \sim EF*EJ + EE*EJ$]. The first four configurations generated relatively greater empirical relevance as evidenced by the higher coverage estimate. What's noticeable in these expressions is the relative importance of having adequate access/exposure to resource support both on a local and international scale (e.g grants, government assistance, private grants, incubator/accelerator support) as well as enabling business policies. Based on empirical data, having opportunities to expand resources generally results in higher performance outcomes. This result meshes with the quantitative data findings regarding innovation potential of SMEs in the Philippines. The data found that despite higher growth in innovative products and processes there are comparatively fewer resources (expenditures on knowledge training) invested in the sector. Having greater access to broader range of resource support/assistance gives firms the means to bring ideas to fruition and enhance productive capacity.

Understanding the key entrepreneurial drivers from all potential antecedent conditions helps determine the optimum conditions for AgTech enterprises to succeed. Based on empirical evidence, optimum performance is driven largely by a firm's varied financing accumulation strategy, a more dynamic and team-oriented organization structure as well as adequate physical and labor resources. With respect to the external business environment, having sufficient access/exposure to resource support/assistance helps foster conditions that increase performance. It also helps frame policies and structure specific regulatory measures that could enable firms to maximize strengths and minimize weaknesses. Separating the principal drivers from the proximate factors enables a more targeted approach for critical resource provision and supplementary skills assistance. Identifying these areas allows firms to focus on specific areas to maximize growth potential.

RECOMMENDATIONS

The entrepreneurial development of any business venture is an intricate mesh of conditions internal to the firm and entrepreneur as well as varying external conditions. It is crucial that policies tackle the challenges and constraints that hinder enterprises from reaching their growth potential. This section underscores specific measures that can be taken to fill the emergent gaps and issues discussed in the study.

Develop Targeted Skills Training — Policies relating to skills training are an important measure particularly for nascent and startup enterprises. As Autio, Kronlund & Kovalainen²⁴ explained, the entrepreneurial decision to set up a business often relies on the confluence of opportunity, motivation of the entrepreneur and skills. Based on the result, having the right attitude as well as competency in skills and training are key internal conditions for entrepreneur. This is particularly crucial in the startup period when efficiency is negatively impacted by lack of formal knowledge or training in activities directly related to their production/service (e.g. food processing or food preservation) as well as other ancillary functions (e.g. business management, administration and accounting). Facilitating skills training that are targeted in these supplementary areas would provide the integral support for AgTech startups. Skills training should also address the vulnerabilities of SMEs in terms of acquiring permits, licenses and certification. As reported by a number of respondents, acquiring these business documents involves difficult and costly procedures. A better harmonization of the process as well as provision of incentives could encourage SMEs to pursue the process.

Key institutions and international organizations already provide skills training such as e-Extension program of the Philippine's Department of Agriculture through its implementing agency Agricultural Training Institute (ATI). Considering the rapidly evolving nature of the AgTech sector, the presence of these digital knowledge assistance platforms could be instrumental particularly for struggling startups. The available courses could be better streamlined and broadened since most offered today focus on particular activities in the value chain. Adding courses that could assist specific AgTech groups would be helpful in strengthening entrepreneurial competence. Consulting directly with emerging AgTech groups regarding their knowledge and training needs would also help enhance the curriculum of agricultural education schemes.

Explore New Lending Tech — Low financial inclusion remains a major problem plaguing SMEs in developing countries. Although MSMEs have enormous innovation potential and contribute to employment, the sector’s growth has remained stunted as MSMEs often face challenges generating capital (e.g. equipment, machineries and R&D for tech innovation). Given the huge number of SMEs in the country as well as the growth potential of AgTech SMES, it is crucial that the government increases the allocated budget for SMEs and develop more relaxed lending policies for SMEs. Government financing programs should focus on new lending models and approaches as well as alternative financial instruments.³⁶

The study of Aldaba³⁷ discussed new lending technology that banks on the business viability of SMEs and places collateral as a secondary requirement for loans. By recognizing high growth potential, financial institutions would be more likely to lend which would increase the viability of innovative AgTech ventures. Moving forward, blockchain-based applications will be instrumental in enhancing existing financial instruments by providing more efficient, transparent and secure management of financial information and data.³⁸ This could have positive implications in the Philippines as it could mitigate the country’s institutional weaknesses and rampant corruption problems.

Develop Information Hub — One key measure would be to develop an information hub designed to aggregate information related to AgTech SMEs. The platform can link local AgTech enterprises with resource providers both domestically and globally. This would help raise the exposure of AgTech firms to a wider network of investors and providers and help usher in more resource opportunities. At the present, extensive data on AgTech remains scarce at the regional level. Focusing on the key competencies of developing countries like Philippines as well as other neighboring countries would help develop the region’s agri-food sector. The Asia Pacific Foundation of Canada's online toolkit for MSMEs in Vietnam took a big step in this direction¹. Developing knowledge resources specifically designed for the agri-food sector would provide the much-needed tools for aspiring entrepreneurs. These platforms will also raise awareness of the country’s innovative AgTech products and services and help draw in much-needed investment and entrepreneurial resource support.

An important initial step in developing a harmonized and wide-ranging information hub is the development of consistent definition and proper delineation of the country’s AgTech groups. As this study found, the current awareness level of AgTech as an emerging sector appears quite weak and fragmented. Some enterprises interviewed were unclear about which sub-group their AgTech product fell under. It is necessary to establish clearly

¹ *The MSME Toolkit (<https://apfcanada-msme.ca/toolkits>) delivers practical ideas, addresses key challenges, and introduces relevant best practices on MSME business development to entrepreneurs in APEC developing economies through on-the-ground training with Canadian and local experts.*

defined groupings across all AgTech enterprises in order to identify needs and better align policy recommendations. Although this study provides a baseline understanding of different AgTech groups, a larger quantitative survey of enterprises would help supplement our understanding of the AgTech population.

Encourage Collaboration and Dialogue — Although entrepreneur motivation and attitude are factors that cannot be directly influenced by policies, creating measures aimed at stimulating and kindling innovative ideas would ensure a broader reach by including wider array of agri-food based enterprise groups. This would increase the probability of concept generation among nascent and startup ventures. Another key measure is for government and relevant institutions to amplify initiatives aimed at providing dialogue platforms. This would require key government groups in collaboration with pertinent organizations to proactively alert target groups of current upcoming opportunities in the AgTech sector.

Encourage socially inclusive and sustainable platforms — Interestingly, all of the enterprises have taken environmental protection initiatives or have clear plans to do so. The initiatives lean toward proper waste management through recycling and ‘upcycling’. Policies and programs should also encourage enterprises to advance sustainability measures and clean tech in their business operations. One way to operationalize this is to develop an environmental performance measurement system with a structure suitable for sustainability reporting. Providing incentives for enterprises that practice environmental protection and inclusive employment in their businesses would also encourage sustainable development.

CONCLUSION

AgTech businesses in the Philippines are thriving and expanding through an intricate web of linkages among various stakeholders and agribusiness players. As the results suggest, many startups and small ventures have leveraged opportunities across the agri-food chain and the study has identified six major AgTech groups that offer diverse product and service innovations. Generally, most prominent advances were found in innovative food and food e-commerce/meal kits. Yet other emerging AgTech groups offer promise and opportunity for adventurous entrepreneurs.

This study also shed light on key entrepreneurial drivers that substantially boost entrepreneurial success. Internally, enterprise performance could be enhanced with more diverse resource accumulation strategies as combined deficiencies in financial, physical and labor resources significantly hampers growth and development. With respect to the external layer, having sufficient access/exposure to resource support/assistance as well as enabling business environments can boost entrepreneurial performance. Lastly, from a research perspective, while this study offers baseline insights into the AgTech sector in the Philippines, future studies could also explore quantitative approaches to map the country's broader AgTech population.

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APPENDIX A.

Table 1. List of Online Data Sources for the Enterprise List Development

Name	Website	Country Coverage	Industry Coverage	Data Coverage
AngelList	https://angel.co/	Global	Can be specific to Agri-food, includes other industries	Companies, People, Investor List
Crunchbase	https://www.crunchbase.com	Global	Can be specific to Agri-food, includes other industries	Organizations, People, Events, Products, Marketplaces, People, Investors, Funding Rounds, Acquisitions, Schools
Tech Shake	http://www.techshake.asia/	Philippines, Bulgaria, Cambodia, Germany, Hong Kong, Malaysia, Singapore, UK	Not Specific to Agri-food; includes other industries	Startups, Investors and Community List
Thrive AgTech	http://thriveagtech.com/thrive-program-summary/	Global	Specific to Agriculture	Corporates, Startups, Growers Events, News
Business List	https://www.businesslist.ph/category/agriculture	Global (127 countries), can be specific to Philippines	Can be specific to Agri-food, includes other industries	Companies
Company List	https://companylist.org/Philippines/Agriculture/	Global	Can be specific to Agri-food, includes other industries	Companies
e27.co	https://e27.co/startup?	Global, but mostly Asia	Can be specific to Agri-food, includes other industries	News, Jobs, Events, Startups, Investor, Marketplace
Jobstreet	https://www.jobstreet.com.ph/	Asia	Can be specific to Agri-food, includes other industries	Jobs
f6s.com	https://www.f6s.com/	Global	Can be specific to Agri-food, includes other industries	Events, Jobs, Startups
LinkedIn	https://www.linkedin.com/feed/	Global	Not specific to Agri-food; includes other industries	People, Jobs, Companies

Table 2. Guidelines in Selecting and Categorizing Major AgTech Groups

AgTech Groups Categorization Guidelines	
Product or Service Innovation	generally refers to firms that introduce new or significantly improved goods or services in the market.
Process Innovation	refer to new and significant methods in production or new model of system of operation
Value Chain Position	Relative position in the agri-food value chain or distance to farm/consumer end of the agri-food value chain.

Table 3. Qualitative Case Selection Protocol

Case Selection Protocol:
Case should be a registered small enterprise or a young venture (startup) that conforms with the MSME classification in the Philippines;
Case should have at least one (1) product or service that can be considered as innovative and has the potential to impact the profitability, productivity, efficiency and sustainability of the agri-food sector and the rest of agri-food value chain (e.g. on-farm inputs, processing, packaging, transportation, finance, marketing, retail services);
Select a minimum of 2-3 cases from each major groups identifies in the collected AgTech population pool;
Select cases using intensity sampling. This entails choosing information-rich cases that manifest the phenomenon of interest intensely for each sub-group.

APPENDIX B.

Table 3. List of General Themes and Sample Indicators for Triple Bottom Line Evaluation

Economic Dimension	Environmental Dimension	Social Dimension
Revenue & Profitability	General	General
Increased Profits	Corporate Commitment	Corporate Commitment
Return on Investments	Awards & Recognition	Awards & Recognition
Increased Sales	R&D/Future Plans & Agenda	Management
Client Base/Market Share	Consumption & Materials	Employees
Market Expansion	Energy Usage	Employee Benefits
Client Base Expansion	Water Usage	Salary & Compensation
Corporate Investments	Materials/Supplies	Training & Development
Facility Expansion	Pollution & Waste Management	Community
R&D Investments	Pollution/Emission	Community Initiative
Earning & Sales Forecast	Waste Management	Local Business Engagement
Projected Growth	Recycling/Reusing	Customer/Client
Production Inputs/Supplies	Environmental Regulation	Customer/Client Satisfaction
Volume of Production	Compliance	Consumer Policy/Protection

Table 4. Summary of Enterprise Performance Evaluation Guidelines

Triple Bottom Line Evaluation Guidelines

Criterion/Level (Rating Scale)	Financial Performance	Environmental Performance	Social Performance
<i>Higher Gains; Higher Impact (2)</i>	With significant improvement/increase in revenue	Active programs for sustainability; Large-scale impact;	Offers competitive package for employees, benefits; Community initiatives
<i>Moderate Gains; Moderate Impact (1)</i>	Minimal/Unsteady improvement/increase; encounter problems	Sustainability-based plans but not actively practiced, Small-scale impact;	Offers some benefits; No plans for expansion or other development initiatives
<i>Lower/No Gains; Lower/No Impact (0)</i>	No significant improvement/increase	No active/current sustainability initiative;	Does not offer competitive salary or benefits to employees

Table 5. Data Processing/Categorizing Guidelines for Across-Case Comparison

Entrepreneurial Layers	
Internal Layer	corresponds to forces that are inherent to the enterprise, which include entrepreneur qualities and enterprise characteristics categories.
External Layer	refers to forces that are outside the firm boundaries, which spans influence of other organizations, networks, institutions, policies, political system and the overall business environment.

Relative Contribution/Influence to Enterprise Performance	
Strengthens (+)	pertains to factors that positively influence and contribute in enhancing or boosting enterprise performance.
Weakenings (-)	relates to factors that negatively influence and contribute in constraining or hindering enterprise performance.

APPENDIX C.

Table 6. List of All Potential Antecedent Factors

Internal Antecedental Factors	External Antecedental Factors
Entrepreneurial Qualities	Inter-Firm Ties and Network Links
IA. Persistent Attitude	EA. Personal/Familial Ties
IB. Passionate Attitude	EB. Linkages with Supply Chain Stakeholders
IC. Empathy with Customer	EC. Partnership/Affiliation with Organization/Networks
ID. Diligence/Hardwork	
IE. Education and Work Experience	
IF. Supplementary Skills/Training	
IK. Convincing/Pitching to Investors	
Enterprise Characteristics	Business Environment
IG. Financing from Personal Funds/Savings	ED. Inefficient Regulatory Standards & Procedures
IH. Financing from Formal/External Source	EE. Enabling Business Policies/Legal Framework
II. Financing from Informal Resource	EF. Constraining Policies/Legal Framework
IJ. Vision/Goals & Concept Innovation	EG. Poor Policy Implementation
IL. Deficient Capital/Financial Funding	EH. Access/Exposure to Resource Support/Assistance
IM. Adequate Physical/Labor Resource	EI. Lack of Access to Resource Support /Assistance
IN. Inadequate Physical/Labor Resource	EJ. Government Facilitated Events/Programs
IO. Organizational Structure and Management	EK. Weak Communication of Programs/Initiatives
IP. Supply Chain, Logistics & Operational Issues	EL. Monitoring of Policies and Initiatives

Table 7. Full Result of Qualitative Comparative Analysis Test

Internal Layer Antecedent Factors

Entrepreneur Attributes/Qualities

Model: Outcome (Higher Performance) = f(IA, IB, IE, IF, IG)

Solution	Coverage	Unique Coverage	Consistency	Count
IA*IF	0.545455	0.454545	1	6
~IE*IF	0.181818	0.0909091	1	2
~IA*~IB*IE*~IF	0.181818	0.181818	1	2

solution coverage: 0.818182

solution consistency: 1

Enterprise Characteristics

Model: Outcome (Higher Performance) = f(IH, II, IJ, IK, IL, IM, IN, IO, IP)

Solution	Coverage	Unique Coverage	Consistency	Count
II	0.909091	0	1	10
IO	0.727273	0	1	8
~IL*~IN	0.727273	0	1	8
~IJ*~IN	0.909091	0	1	10
IK*~IN	0.636364	0	1	7

solution coverage: 1

solution consistency: 1

External Layer Antecedent Factors

Entrepreneur Attributes/Qualities

Model: Outcome (Higher Performance) = f(EA, EB, EC)

Solution	Coverage	Unique Coverage	Consistency	Count
~EA*EB*EC	0.272727	0.272727	1	3

solution coverage: 0.272727

solution consistency: 1

External Business Environment

Model: Outcome (Higher Performance) = f(ED, EE, EF, EG, EH, EI, EJ, EK, EL)

Solution	Coverage	Unique Coverage	Consistency	Count
EH	0.727273	0.0909091	1	8
~EI*~EJ	0.636364	0.181818	1	7
~EF*~EI	0.727273	0	1	8
EE*~EI	0.454545	0	1	5
~EF*EJ	0.272727	0	1	3
EE*EJ	0.272727	0	1	3

solution coverage: 1

solution consistency: 1

