EARLY STAGE AGRICULTURAL ENTREPRENEURS AND INNOVATION

Eduardo Millet, University of Texas Rio Grande Valley
Joo Jung, University of Texas Rio Grande Valley
Steve Lovett, University of Texas Rio Grande Valley

ABSTRACT

We are in the midst of an age of agricultural innovation, but these innovations will produce benefits only if they are embraced by the world's agricultural entrepreneurs. In this research we sought to determine how well suited the agricultural entrepreneurs of the world are to take advantage of the rapid innovation occurring in agriculture. We investigated differences between agricultural and non-agricultural entrepreneurs' attitudes and aspirations using data from the 2018 Adult Population Survey of the Global Entrepreneurship Monitor (GEM) project. We restricted our sample to early stage entrepreneurs, or those with businesses less than three and a half years old. We expected the agricultural entrepreneurs to be more conservative than the non-agricultural entrepreneurs, or more predisposed to maintain existing conditions.

Our results indicate that agricultural entrepreneurs are poorly prepared to deal with an era of rapid agricultural innovation. They tend to be older, less educated and poorer than non-agricultural entrepreneurs. More importantly, they tend to be less interested in product and process innovation, and this is especially true in low income countries. Product innovation could simply mean the farmer experiments with crops other than those he or she had grown in the past. For example, a farmer might shift away from staple food production to vegetables and fruits for export, spices, or nonfood products such as cut flowers. Process innovation might require the application of new technology, or it might simply be new patterns in the application of existing technology.

An innovation systems approach is therefore needed to bring modern technology to the agricultural entrepreneurs of the world. Systems approaches emphasize the interactions of all the actors involved. Technical expertise must be complemented with expertise in markets, finance and especially education. In the traditional approach, farmers could be either adopters of technology or laggards, but in a systems approach they become sources of information, experimenters and even innovative entrepreneurs. The goal of the traditional approach is simply that farmers adopt some particular technology, while the goal of a systems approach is that farmers develop capacities to innovate, to learn, and to change their practices and even their environment.

INTRODUCTION

We are in the midst of an age of agricultural innovation. Over 90% of the corn, soybeans and cotton grown in the US are now genetically modified (USDA, 2018), salmon can be engineered to grow to market size in eighteen months rather than three years (Scientific American, 2017a), and agricultural drones can improve efficiency in applications of herbicides or pesticides (Scientific American, 2017b). These innovations could potentially produce widespread benefits because agriculture is by far the most important employer in the world – it provides jobs for about 1.3 billion people, or 19% of the world's population, and in underdeveloped regions such as south Asia and sub-Saharan Africa it provides jobs for over half the population (CropLife International, 2019). Furthermore, in a statistical analysis of forty-eight countries using primarily World Bank data, Thirtle, Lin and Piesse (2003) concluded that agricultural productivity growth had a substantial impact on poverty reduction, while productivity growth in industry and services did not.

But these innovations can produce such benefits only if they are embraced by a generation of agricultural entrepreneurs, and the agricultural entrepreneurs of the world may be poorly suited to deal with this new world of innovation. The vast majority of agricultural entrepreneurs are family farmers (Graeub et al., 2016), and several authors have suggested that farmers do not have a strong sense of the market environment and enter the agricultural sector without a strong entrepreneurial inclination (Lourenço et al., 2014; McElwee, 2006; Stenholm and Hytti, 2014; Vesala and Pyysiäinen, 2008). Vaillant and Lafuente (2007) explain how cultural barriers such as limited entrepreneurial role models in the rural landscape diminish the entrepreneurial inclinations of individuals venturing into the agricultural sector. Also, agricultural entrepreneurs have limited access to the formal institutions that support entrepreneurship in the urban environment (Dickes and Robinson, 2014). Finally, a lack of incentives, qualified labor and resources affects entrepreneurial decisions and venture creation in agriculture (Liang and Dunn, 2014).

In this research we defined agricultural entrepreneurs as those belonging to the division "Agriculture and Farming" within the International Standard Industrial Classification (ISIC) scheme. Our goal was to determine how well suited the early-stage agricultural entrepreneurs of the world are to take advantage of the rapid innovation occurring in agriculture. This topic has been neglected by researchers. Naudé (2011), for example, called for a greater emphasis on entrepreneurship in development economics, and Pato and Teixeira (2016) lamented the paucity of research on rural entrepreneurship in developing economies. The objective of the current work is to study the propensity of individuals to create an agricultural business. This work combine demographic and economic factors with perceptual variables, such as attitudes, perceptions and personal attributes to the analysis of the early-stage agricultural entrepreneur. This approach is coherent with the one adopted by Arenius and Minniti (2005). We therefore compared agricultural and non-agricultural entrepreneurs' attitudes and aspirations, with particular emphasis on innovation.

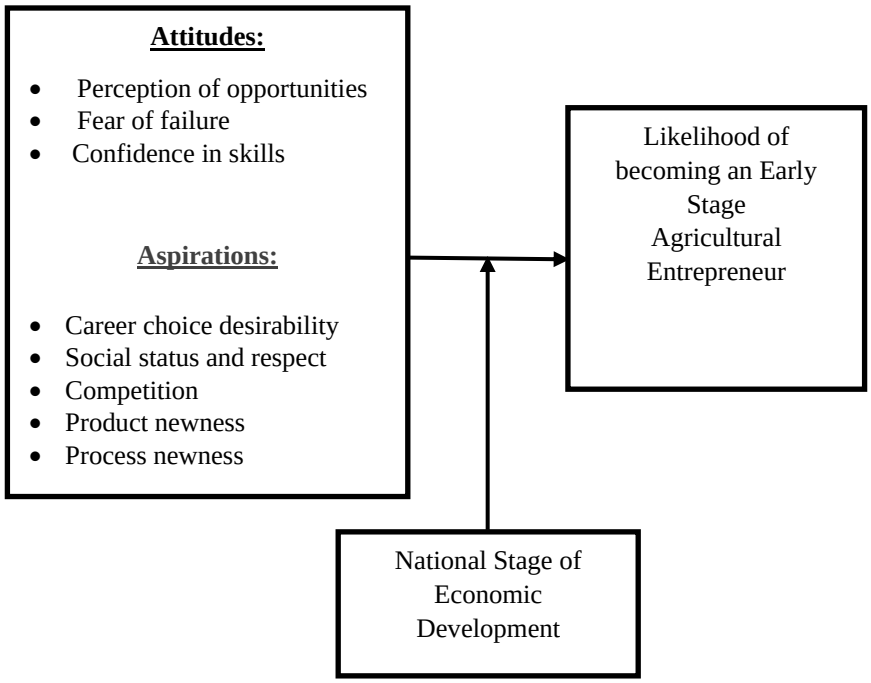
Our expectations in regard to the differences are based primarily on two assumptions. First, that agricultural entrepreneurs will generally be more conservative than non-agricultural entrepreneurs. To be conservative means to be disposed to maintaining existing or traditional conditions. Agricultural entrepreneurs are predominately rural entrepreneurs, and we believe people living in rural areas tend to be more conservative than people living in urban areas in part because of a selection effect. Over the past two hundred years the world has experienced a great migration from the country to the cities. Census data shows in 1790 only 5.1% of the U.S. population lived in urban areas, but this figure increased quite steadily to 75.2% in 1990 (US Census, 2018). The same migration has also occurred most of the rest of the world, although it has been concentrated in the past one hundred years in many developing nations. Therefore, people living in rural areas are those who have *not* moved to the cities, and nor did their parents or grandparents. This indicates a disposition to maintain existing conditions. Of course, some people living in rural areas may wish to move to cities but be constrained from doing so by lack of resources or skills. Still, given the size of the migration it is reasonable to assume that the disposition to maintain existing conditions plays a role in differentiating between rural and urban populations.

Also, to be progressive (the opposite of conservative) requires sensemaking. Sensemaking means to develop images that explain the world and our role in it, and it becomes especially important when the perceived or desired state of the world is different from the expected state of the world (Weick et al., 2005). Most importantly, sensemaking is a social process, requiring peer feedback (Hoyte et al., 2019; Wood and McKinley, 2010). Agricultural entrepreneurship occurs mainly in rural environments with low population densities which reduces opportunities for social sensemaking (Leon, 2005), resulting in a greater disposition to maintain existing conditions.

Our second assumption is that agricultural entrepreneurs will tend to be poorer than non-agricultural entrepreneurs. Rural areas worldwide tend to be poorer than urban areas. The *Oxford Poverty and Human Development Initiative* (2014), along with the *United Nations Development Programme,* developed a Multidimensional Poverty Index (MPI), and found that 85% of the people across 105 countries who are MPI poor live in rural areas, and that the intensity of poverty is consistently higher in rural areas for all regions of the world. Similarly, Olinto, Beegle, Sobrado and Uematsu (2013) reported that a rural household is more likely to be poor than an urban one, and that about 63% of the world's poor are working in agriculture, mostly in smallholder farming. But we also recognize that entrepreneurs' attitudes and aspirations may vary by national stage of economic development and will return to this theme later. A graphical representation of our research model is presented in Figure 1 below. We investigated this model using data from the 2018 Global Entrepreneurship Monitor (GEM) dataset (Arafat, Saleem, Dwivedi and Khan, 2020; Bosma, 2013).

Section two below presents the theoretical framework. Section three describes the methodological aspects of the research: the characteristics of the sample, the variables, and the statistical model used. Section four reports and discusses the results. Section five is an additional analysis in which we group countries using the Country Income Group. The last section is a discussion.

FIGURE 1: Research Model



ENTREPRENEURAL ATTITUDES AND ASPIRATIONS

Entrepreneurial Attitudes

Attitude is a predisposition to respond in a positive or negative way to the object of the attitude. Shariff and Saud (2009) explained that any attitude has an object such as a person, place, thing, event, activity, etc. Attitude explains how the person "feels" about the object. We will consider attitudes regarding perception of opportunities, fear of failure and confidence in skills.

Opportunity recognition is a critical step that occurs early in the process of venture creation, when an entrepreneur can recognize a way to generate economic value or profit that is not currently exploited by others (Baron, 2006; Corbett, 2005). Some opportunities are Schumpeterian (Schumpeter, 1934). These are disequilibrating, require new knowledge, and occur rarely. A historical example is Eli Whitney's 1793 invention and marketing of the cotton gin. But many more opportunities are Kirznerian (Kirzner, 1973). These are equilibrating and require only effective application of existing knowledge. An example might be an eighteenth-century farmer who switched from tobacco to cotton after acquiring a cotton gin. Because they are so much more common, Kirznerian entrepreneurs will be the focus of this paper.

Some of the most important factors that have been identified in the creation of new ventures are the capacity to search for and recognize opportunities, and knowledge of the market,

customers, and industry (Baron, 2006). Entrepreneurs pursue opportunities when they spot suboptimal deployments of resources within markets (Ardichvili, Cardozo and Ray, 2003), but opportunities may require different ***personal characteristics and competencies, affecting the reaction of the entrepreneur*** (Bryant, 1989). Additionally, e***xternal stimuli such as macro-economic factors, the political environment, and societal structure affect how the entrepreneur reacts to opportunities*** (Barbieri and Mahoney, 2009).

GEM makes a distinction between need driven and opportunity driven entrepreneurship, as do Hessels, van Gelderen and Thurik (2008). Yessoufou, Blok and Omta (2018) emphasized that entrepreneurship is often a response to challenging situations such as a lack of wage employment, especially in rural areas. Because they tend to be more conservative and poorer, we believe that agricultural entrepreneurs will be more need driven and less opportunity driven than non-agricultural entrepreneurs, and so we expect that opportunities will be less important to them.

Fear of failure occurs when an entrepreneur evaluates starting a business against other options. If he or she sees the opportunity as risky, he or she may be reluctant to start the new venture (Weber and Milliman, 1997). Of course, entrepreneurs do not know ex-ante how good they need to be in order to survive in the market, but Koellinger et al. (2007) maintained that individuals who believe themselves to have the ability to start a new business are more likely to take an optimistic view of their prospects. The self-perception of the entrepreneur will therefore influence the likelihood of opening a new business (Bayon, Vaillant and Lafuente, 2015). Since we expect agricultural entrepreneurs to be more need driven than non-agricultural entrepreneurs, we expect fear of failure to be less important for them.

Confidence in skills matters because it is important that prospective entrepreneurs believe they have the skills required to start a business. It is necessary to separate the actual skills an individual may have from the perception of having skills – the emphasis is not on the accumulated knowledge and experience of the entrepreneur, but rather in the self-confidence of the entrepreneur (Arenius and Minniti, 2005; Tominc and Rebernik, 2007).

There are three factors that influence the learning process of entrepreneurs. First are internal factors such as personality and previous knowledge. Second are external factors such as the general environment and culture, educational opportunities, and available services. Third are relationship and networking opportunities (Vesala and Pyysiäinen, 2008). Since we expect agricultural entrepreneurs to be more conservative, we expect confidence in skills will be less important than simple diligence and hard work.

Entrepreneurial Aspirations

An aspiration is a desire to achieve something positive. Entrepreneurial aspirations are critical factors that determine the results of the new venture creation efforts (Hessels, van Gelderen and Thurik, 2008), and entrepreneurs certainly vary in their aspirations – one may aspire to develop and market a revolutionary new product like the transistor or the personal computer and change peoples' lives world-wide, while another may aspire to open a new restaurant and profit by offering food or service that is slightly different from competing

restaurants. We will consider aspirations regarding career choice desirability, social status and respect, competition, new products, and new processes.

Career choice desirability is important because a positive perception of a behavior will encourage the behavior (Ajzen, 1991). This is explained by the theory of planned behavior that proposes that individuals will be influenced by how society perceives a behavior. We expect that social perceptions will impact the entrepreneur's aspirations to create an agricultural business. In constructing an identity as an agriculture entrepreneur, the individual responds to their understanding of how society sees the agricultural entrepreneur (Stenholm and Hytti, 2014). If the individual perceives that people regard being an entrepreneur as an attractive profession the propensity to start a new venture will be higher. Because we expect agricultural entrepreneurs to be more conservative or more disposed to maintain existing conditions, and because career choice desirability is based on fulfilling societal expectations, we expect career choice desirability will be more important to them.

Social status and respect is important because if the entrepreneurial environment assigns positive social status and respect to the role of entrepreneurs, individuals will have a higher propensity to start a new business. This is based on the idea that entrepreneurs reflect their understanding of the expected behavior of them (Stenholm and Hytti, 2014). Etzioni (1987) emphasized the importance of the degree of 'legitimation' or 'moral approval' of entrepreneurship within a culture. This view claims that a higher overall level of legitimation of entrepreneurship implies wide ranging manifestations, including more attention to entrepreneurship within the educational system and a higher social status of entrepreneurs (Freytag and Thurik, 2007). The prospective entrepreneur may perceive that people regard being an entrepreneur as an attractive profession with high social status and prestige, so to view oneself as an entrepreneur is connected to fulfilling societal expectations. Because we expect agricultural entrepreneurs to be more conservative than non-agricultural entrepreneurs, we expect social status and respect will be more important for them.

Entrepreneurs may have limited competition when they serve or even create new markets. Competition is generally most intense in older and more established markets, and especially in commodity markets (Porter, 1985). Because we expect agricultural entrepreneurs to be more conservative than non-agricultural entrepreneurs, we expect them to offer less innovative products and services, and so to perceive more competition.

Entrepreneurs aspiring to produce new products may have a higher level of aspirations and contribute more to economic growth (Hessels, van Gelderen and Thurik, 2008). Product innovation could simply mean the farmer experiments with crops other than those he or she had grown in the past. Lambrecht, Kuhne and Gellynck (2014) provide the example of a tomato farmer who began growing kiwi berries during a downturn in the market for tomatoes, and Perks and Medway (2012) that of a dairy farmer who found it profitable to grow sunflowers for local florists. The World Bank (2007) noted that farmers in many developing countries are shifting away from staple food production to vegetables and fruits for export, as well as spices, aquaculture products and nonfood products such as cut flowers. Ogutu and Qain (2019) found the commercialization of small farms, which occurs when a farmer shifts from subsistence to more market-oriented farming, was associated with the reduction of poverty levels.

Gars and Ward's (2019) study of the patterns of adoption of hybrid rice in India illustrated the risks involved in product innovation. Even if an experienced rice farmer were certain that the hybrid rice could potentially produce a better crop, he or she might still be concerned that the hybrid rice would require different care than the older variety, so that he or she might be worse off with the new variety until after learning to care for it. The authors also emphasized that there is considerable heterogeneity among individuals regarding adopting any new technology (also see Barham et al., 2015), including new rice varieties, with late adopters taking the opportunity to learn by observing the potentially costly experimentation of their neighbors. Agricultural entrepreneurs work in less densely populated rural environments, and so have less opportunity for such social learning than do their non-agricultural counterparts. Therefore, we expect agricultural entrepreneurs to be less interested in new products than non-agricultural entrepreneurs.

Another type of agricultural innovation is the adoption of a new process. Some new processes involve the application of modern technology. For example, drip irrigation systems, which involve the frequent application of small amounts of water directly to a crop's root zone, were developed in the 1960s but now represent about 5 percent of the total worldwide irrigated area (Venot, Kuper and Zwarteveen, 2017). More recently, in the dairy industry genomic testing of newborn female calves to predict their future productivity has become common in developed nations, as has the use of sexed semen so that the cows produce mostly female calves (Newton, Hayes and Pryce, 2018).

Other new processes simply require new patterns or procedures. Partey et al. (2018) described how climate change and desertification in West Africa encouraged the increasing use of "planting pits," in which grain is grown in small, shallow pits which accumulate water. A more complex example is Community Supported Agriculture (CSA) where consumers purchase "shares" on the farm before planting begins and receive a portion of the crop that the farmer can harvest later. This movement creates a partnership between local farmers and community members to create a sustainable local food system and gives the farmer access to capital before the production starts (Brehm and Eisenhauer, 2008; Brown and Miller, 2008; van En, 1995).

If entrepreneurs perceive they can use new processes they may have a higher propensity to create new businesses. However, because we expect agricultural entrepreneurs to be more conservative than non-agricultural entrepreneurs, we expect them to be less interested in new processes than non-agricultural entrepreneurs.

METHODS

Data and Procedures

We used data from the 2018 Global Entrepreneurship Monitor (GEM). Although a more recent GEM dataset is available, we used 2018 dataset as it includes all variables that we use in our study. The dataset has observations from about 60 countries. We used only those observations in which the respondents identified themselves as early-stage entrepreneurs (Reynolds et al., 2005). There were just over 17,000 of these. These are individuals with

businesses less than three- and one-half years old. GEM refers to total early-stage entrepreneurial activity (TEA) as its "primary measure" of entrepreneurship. The percentage tends to be higher in poorer countries where individuals are driven by necessity to become entrepreneurs, and lower in wealthier countries where established firms play a more important role in the economy. Because they are so common in poorer countries, it's reasonable to assume that most of these entrepreneurs are Kirznerian, or those who apply existing knowledge, rather than Schumpeterian, or those who create new knowledge.

We categorized business types as agricultural or non-agricultural using the International Standard Industrial Classification (ISIC) scheme. We assigned the value 1 when respondents were early-stage entrepreneurs and belonged to division 01, "Agriculture and Farming", and 0 otherwise. These made up about 4.5% of all early-stage entrepreneurs. We then applied the chi-square test to check whether any significant differences existed between the agricultural or non-agricultural early-stage entrepreneurs.

MEASURES

We measured attitudes and aspirations using dichotomous variables with a value 1 for an answer of "yes" and 0 for "no." We used three variables to measure attitudes. The first was *Perception of Opportunities*, taken from the question "In the next six months, will there be good opportunities for starting a business in the area where you live?" Nominally, this question is about the respondents' perceptions of the world around them. However, since we are comparing the perceptions of individuals who have selected themselves into either the agricultural entrepreneur group or the nonagricultural entrepreneur group, we can interpret the results as showing the relative importance of opportunities to the two groups. *Fear of Failure* represents the question "Would fear of failure would prevent you from starting a business?" C*onfidence in Skills* represents the question "Do you have the knowledge, skill and experience required to start a new business?"

We used five variables to measure entrepreneurial aspirations. *Career Choice Desirability* represents the question "In your country, most people believe that starting up a business is an attractive profession." *Social Status and Respect* represents the question "In your country, a person who successfully starts up a new business gains high social status and prestige." *Competition* represents the question "Right now, are there many, few, or no other businesses offering the same products or services to your potential customers?" *Product Newness* represents the question "Will all, some, or none of your potential customers consider this product or service new and unfamiliar?" *Process Newness* represents the question "How long have the technologies or procedures required for this product or service been available?" We assigned this a value of 1 if the technologies were new and 0 otherwise. Table 1 further clarifies variables adopted from the 2018 GEMS dataset in either description or survey questions format.

TABLE 1	
Variables adopted from the GEMS dataset	
Variables	**Notes**
Total early-stage Entrepreneurial Activity (TEA) Rate:	Percentage of 18-64 population who are either an entrepreneur involved in setting up a business (nascent entrepreneur) or the owner-manager of a new firm less than 3.5 years old (owner-manager) *
Agricultural versus Non-Agricultural	Recoded from the variable TEAISIC4_1 of the GEM dataset. Responses are classified agricultural or non-agricultural using the International Standard Industrial Classification (ISIC) scheme.
Age range	Age range for all respondents recoded from AGE and AGE7c from the GEM dataset
Education	Harmonized based on education variable provided by country (UN Categories, GEM variable: GEMEDUC)
Work status	Harmonized work status (GEM variable: GEMWORK)
Income	GEM income recoded into thirds (GEM Variable: GEMHHINC)
Perception of Opportunities	Question: In the next six months, will there be good opportunities for starting a business in the area where you live?
Fear of Failure	Question: Would fear of failure would prevent you from starting a business?
Confidence in Skills	Question: Do you have the knowledge, skill and experience required to start a new business?
Career Choice Desirability	Question: In your country, most people believe that starting up a business is an attractive profession?
Social Status and Respect	Question: In your country, a person who successfully starts up a new business gains high social status and prestige?
Product Newness	Question: Right now, are there many, few, or no other businesses offering the same products or services to your potential customers?
Competition	Question: Will all, some, or none of your potential customers consider this product or service new and unfamiliar?
Process Newness	Question: How long have the technologies or procedures required for this product or service been available?

RESULTS

Demographics and Characteristics of Participants

Table 2 shows the early-stage agricultural entrepreneurs tend to be older, less educated and poorer than the non-agricultural entrepreneurs. Among the agricultural entrepreneurs, 43.96% were age 45 or older, while only 28.97% of the non-agricultural entrepreneurs were in

this age group. The agricultural entrepreneurs are also less educated. Within this group, 35.21% had either no education or only some secondary, while only 19.53% of the non-agricultural entrepreneurs had so little education. Being older and less educated might tend to make the agricultural entrepreneurs more conservative. In terms of work status, the agricultural and non-agricultural entrepreneurs are similar with over 80% of both groups working full time. But in terms of income, the agricultural entrepreneurs are poorer. Within this group 36.63% were in the lower third of income, while only 27.26% of the non-agricultural entrepreneurs were in this category. Being poorer might tend to make the agricultural entrepreneurs more need-driven and less opportunity-driven. Please note these four demographic variables are included here to provide an overview of our sample but are not used in the main analysis to follow.

TABLE 2

Demographics of Early Stage Entrepreneurs

Variable	% of Early Stage Non-Agricultural Entrepreneur	% of Early Stage Agricultural Entrepreneur
Age range		
0-17	0.00%	0.00%
18-24	15.93%	12.35%
25-44	29.83%	24.84%
35-44	25.28%	18.86%
45-54	17.80%	22.50%
55-64	9.72%	18.34%
65-120	1.45%	3.12%
Number of Entrepreneurs	*17,153*	*769*
Education attaiment		
None	6.79%	18.00%
Some Secondary	12.74%	17.21%
Secondary degree	32.87%	27.99%
Post secondary	38.87%	32.06%
Graduate experience	8.73%	4.73%
Number of Entrepreneurs	*17,003*	*761*
Work status		
Full time	85.90%	89.42%
Part time	5.98%	3.57%
Retired, disabled	0.81%	0.79%
Homemaker	1.65%	1.06%
Student	1.19%	1.46%
Not working	4.47%	3.70%
Number of Entrepreneurs	*16,881*	*756*
Income		
Lowest 33% percentile	27.26%	36.63%
Middle 33% percentile	30.93%	33.69%
Upper 33% percentile	41.81%	29.68%
Number of Entrepreneurs	*14,761*	*647*

CORRELATIONS

Table 3 presents the descriptive statistics and the correlation matrix of the variables of the model. The highest correlation is that between *Product Newness* and P*rocess Newness* with a correlation of .1844. This indicates that at least some early-stage entrepreneurs relate the idea of creating a new product with the need for generating a new process. The correlation between

Career Choice Desirability and *Social Status and Respect* is roughly the same at .1843. The third highest is between *Fear of Failure* and *Confidence in Skills* with a negative correlation of -.1786.

TABLE 3

Descriptive Statistics and Correlation Matrix

	Variable	Obs.	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9
1	Likelihood of becoming an Early-Stage Agricultural Entrepreneur	17,922	0.043	0.203	1.000								
2	Perception of opportunities	16,153	0.652	0.476	-0.044*	1.000							
3	Fear of failure	17,442	0.295	0.456	0.024*	-0.080*	1.000						
4	Confidence in skills	17,483	0.822	0.382	-0.016*	0.166*	-0.178*	1.000					
5	Career choice desirability	16,312	0.688	0.463	0.018*	0.112*	0.029*	0.018*	1.000				
6	Social status and respect	16,308	0.709	0.454	0.005	0.129*	0.048*	0.013	0.184*	1.000			
7	Product newness	11,969	0.588	0.492	-0.034*	0.045*	0.005	0.006	0.023*	-0.035*	1.000		
8	Competition	12,158	0.899	0.301	0.014	-0.014	0.047*	-0.030*	0.014	0.016	-0.097*	1.000	
9	Process newness	11,423	0.470	0.499	-0.017	0.025*	0.020*	0.028*	0.038*	0.000*	0.184*	-0.077*	1.000

*Correlation significant at the .05 level (2-tailed)

Comparison of Non-Agricultural versus Agricultural Entrepreneurs

A comparison of the agricultural and non-agricultural entrepreneurs is shown in Table 4. Differences among the three attitudinal variables, *Perception of Opportunities, Fear of Failure,* or *Confidence in Skills*, were all significant. The agricultural entrepreneurs were more pessimistic, more concerned about failure, and less confident than the non-agricultural entrepreneurs. Among the aspirational variables neither *Social Status and Respect* nor C*ompetition* showed significant differences. *Career Choice Desirability* showed a small but significant higher proportion among the agricultural entrepreneurs, as we had expected.

TABLE 4

Comparison of Non-agricultural versus Agricultural Attitudes and Aspirations of Early Stage Entrepreneurs

Variable		% of Early Stage Non-Agricultural Entrepreneur	% of Early Stage Agricultural Entrepreneur	Statistical test (Chi-square)
Entrepreneurial Attitudes				
Perception of opportunities	No	34.35%	44.84%	
	Yes	65.65%	55.16%	
Number of Entrepreneurs		15,475	678	p<.000
Fear of failure	No	70.77%	65.29%	
	Yes	29.23%	34.71%	
Number of Entrepreneurs		16,693	749	p<.001
Confidence in skills	No	17.62%	20.74%	
	Yes	82.38%	79.26%	
Number of Entrepreneurs		16,726	757	p<.028
Entrepreneurial Aspirations				
Career choice desirability	No	31.36%	27.24%	
	Yes	68.64%	72.76%	
Number of Entrepreneurs		15,585	727	p<.019
Social status and respect	No	29.17%	28.13%	
	Yes	70.83%	71.87%	
Number of Entrepreneurs		15,590	718	NS
Product newness	No	40.82%	49.20%	
	Yes	59.18%	50.80%	
Number of Entrepreneurs		11,471	498	p<.000
Competition	No	10.14%	8.10%	
	Yes	89.86%	91.90%	
Number of Entrepreneurs		11,652	506	NS
Process newness	No	52.87%	57.08%	
	Yes	47.13%	42.92%	
Number of Entrepreneurs		10,964	459	p<.077

But the greatest difference between agricultural and non-agricultural entrepreneurs was regarding *Product Newness*. As we had expected, *Product Newness* showed a significant difference, with much fewer agricultural entrepreneurs aspiring to start a business by introducing a new product to the customer. None of the other aspirational variables showed such a large difference between the agricultural and non-agricultural entrepreneurs. *Process Newness* also showed a significant difference, with agricultural entrepreneurs being less likely to use new processes.

Additional Analysis – Country Income Group

We were also interested in how agricultural entrepreneurs vary by Country Income Group and expected them to be more suited to innovation in higher income countries. Acs, Desai and Hessels (2008) described how economies go through various stages of development. Low-income countries have mostly low-skill labor and use natural resources as their main factor of production. Businesses offer basic products and compete on price. We might refer to low-income economies as factor-driven. In middle-income countries productivity and wages increase while the country develops other competitive advantages. Competitiveness increases because of better education and training, and more efficient financial and labor markets. We might refer to middle-income economies as efficiency-driven. High-income economies are driven by innovation. Wages are high and businesses compete by producing new and different products. We might refer to high-income economies as innovation-driven.

Recent changes in transport infrastructure, communication, and information technologies in high income countries have changed the rural environment, reducing the gap between the urban and rural realities (Vaillant and Lafuente, 2007). Furthermore, farmers in high-income countries tend to benefit from rich communication networks with other farmers, food manufacturers and third parties such as government agencies and research institutions (Gailhard, Bavorová and Pirscher, 2015; Kuhne, Gellynck and Weaver, 2015). We therefore anticipated that county income level will affect the relationship between entrepreneur type and interest in innovation such that, while agricultural entrepreneurs in low-income countries will be less interested in product and process newness, agricultural entrepreneurs in high income countries will be more like non-agricultural entrepreneurs.

Tables 5a, 5b, and 5c present the results of comparing agricultural versus non-agricultural early-stage entrepreneurs by the country income group. We expected that the relative disinterest in product newness among agricultural entrepreneurs would be concentrated in the low-income countries, with those in high-income countries being roughly as interested in innovation as non-agricultural entrepreneurs. And in fact, *Product Newness* showed a significant difference for low-income countries, with fewer agricultural entrepreneurs indicating that their products would be perceived as new. However, *Product Newness* did not show a significant difference for middle- and high-income countries. Likewise, *Process Newness* showed a significant difference for low-income countries, but not for middle- or high-income countries. In fact, in high-income countries the percentage of entrepreneurs expecting to start businesses with new processes was slightly higher for agricultural entrepreneurs than for non-agricultural entrepreneurs. These results indicate that it is specifically the low-income country early-stage agricultural entrepreneurs who are relatively disinterested in new products and processes, and so are poorly prepared to deal with a world of innovation.

TABLE 5a

Comparison of Non-agricultural versus Agricultural Attitudes and Aspirations of Early Stage Entrepreneurs, by Country Income Group: Low

Variable		Low Country Income Group** % of Early Stage Non-Agricultural Entrepreneur	% of Early Stage Agricultural Entrepreneur	Statistical test (Chi-square)
Entrepreneurial Attitudes				
Perception of opportunities	No	27.23%	33.15%	
	Yes	72.77%	66.85%	
Number of Entrepreneurs		*2,751*	*184*	NS
Fear of failure	No	64.77%	58.38%	
	Yes	35.23%	41.62%	
Number of Entrepreneurs		*2,946*	*197*	NS
Confidence in skills	No	17.74%	22.93%	
	Yes	82.26%	77.07%	
Number of Entrepreneurs		*2,959*	*205*	NS
Entrepreneurial Aspirations				
Career choice desirability	No	22.03%	13.00%	
	Yes	77.91%	87.00%	
Number of Entrepreneurs		*2,879*	*200*	p<0.002
Social status and respect	No	19.64%	16.16%	
	Yes	80.36%	83.84%	
Number of Entrepreneurs		*2,861*	*198*	NS
Product newness	No	45.71%	63.87%	
	Yes	54.29%	36.13%	
Number of Entrepreneurs		2,076	155	p<0.000
Competition	No	9.33%	3.85%	
	Yes	90.67%	96.15%	
Number of Entrepreneurs		*2,112*	*156*	p<0.021
Process newness	No	36.46%	58.20%	
	Yes	63.54%	41.80%	
Number of Entrepreneurs		*1,769*	*122*	p<0.000

** Based on the Country Income Group by the World Bank

TABLE 5b

Comparison of Non-agricultural versus Agricultural Attitudes and Aspirations of Early Stage Entrepreneurs, by Country Income Group: Middle

Variable		Middle Country Income Group** % of Early Stage Non-Agricultural Entrepreneur	% of Early Stage Agricultural Entrepreneur	Statistical test (Chi-square)
Entrepreneurial Attitudes				
Perception of opportunities	No	38.84%	39.68%	
	Yes	61.16%	60.32%	
Number of Entrepreneurs		*3,754*	*189*	NS
Fear of failure	No	71.52%	64.43%	
	Yes	28.48%	35.57%	
Number of Entrepreneurs		*3,933*	*194*	p<0.033
Confidence in skills	No	17.87%	19.19%	
	Yes	82.13%	80.81%	
Number of Entrepreneurs		*3,990*	*198*	NS
Entrepreneurial Aspirations				
Career choice desirability	No	23.72%	20.43%	
	Yes	76.28%	79.57%	
Number of Entrepreneurs		*3,103*	*186*	NS
Social status and respect	No	24.75%	17.13%	
	Yes	75.25%	82.87%	
Number of Entrepreneurs		*3,099*	*181*	p<0.020
Product newness	No	37.66%	42.22%	
	Yes	62.34%	57.78%	
Number of Entrepreneurs		2,568	135	NS
Competition	No	9.33%	8.89%	
	Yes	90.67%	91.11%	
Number of Entrepreneurs		*2,638*	*135*	NS
Process newness	No	53.99%	59.38%	
	Yes	46.01%	40.63%	
Number of Entrepreneurs		*2,482*	*128*	NS

** Based on the Country Income Group by the World Bank

TABLE 5c

Comparison of Non-agricultural versus Agricultural Attitudes and Aspirations of Early Stage Entrepreneurs, by Country Income Group: High

Variable		High Country Income Group** % of Early Stage Non-Agricultural Entrepreneur	High Country Income Group** % of Early Stage Agricultural Entrepreneur	Statistical test (Chi-square)
Entrepreneurial Attitudes				
Perception of opportunities	No	34.66%	55.08%	
	Yes	65.34%	44.92%	
Number of Entrepreneurs		*8,970*	*305*	p<0.000
Fear of failure	No	72.26%	69.55%	
	Yes	27.74%	30.45%	
Number of Entrepreneurs		*9,814*	*358*	NS
Confidence in skills	No	17.48%	20.34%	
	Yes	82.52%	79.66%	
Number of Entrepreneurs		*9,777*	*354*	NS
Entrepreneurial Aspirations				
Career choice desirability	No	36.60%	39.30%	
	Yes	63.40%	60.70%	
Number of Entrepreneurs		*9,603*	*341*	NS
Social status and respect	No	33.42%	41.00%	
	Yes	66.58%	59.00%	
Number of Entrepreneurs		*9,630*	*339*	p<0.004
Product newness	No	40.53%	42.79%	
	Yes	59.47%	57.21%	
Number of Entrepreneurs		6,827	208	NS
Competition	No	10.71%	10.70%	
	Yes	89.29%	89.30%	
Number of Entrepreneurs		*6,902*	*215*	NS
Process newness	No	56.79%	55.02%	
	Yes	43.21%	44.98%	
Number of Entrepreneurs		*6,713*	*209*	NS

** Based on the Country Income Group by the World Bank

Table 6 illustrates three Country Income Groups (Low, Middle, and High) and corresponding countries adopted from the 2027-2018 Global Competitiveness Report (World Economic Forum). It also contrasts non-agricultural entrepreneurs to agricultural entrepreneurs of GEMS dataset by 'Country Income Group' classification.

TABLE 6
Composition of Entrepreneurs by Country Income Group

Country Income Group *	Country	Non-Agricultural Entrepreneurs		Agricultural Entrepreneurs		Total	Global Competitiveness Index **	
		No.	Pct.	No.	Pct.		Rank	Score
Low	Indonesia	442	96.93%	14	3.07%	456	36	4.68
	India	541	99.08%	5	0.92%	546	40	4.59
	Morocco	222	96.10%	9	3.90%	231	71	4.24
	Egypt	234	91.05%	23	8.95%	257	100	3.90
	Madagascar	375	78.95%	100	21.05%	475	121	3.40
	Sudan	400	89.29%	48	10.71%	448	N/A	N/A
	Angola	794	99.13%	7	0.87%	801	N/A	N/A
	Total	**3,008**	**93.59%**	**206**	**6.41%**	**3,214**		
Middle	China	348	98.31%	6	1.69%	354	27	5.00
	Thailand	352	85.44%	60	14.56%	412	32	4.72
	Russia	100	90.91%	10	9.09%	110	38	4.64
	Bulgaria	106	88.33%	14	11.67%	120	49	4.46
	Turkey	325	92.86%	25	7.14%	350	53	4.42
	Colombia	426	95.52%	20	4.48%	446	66	4.29
	Iran	288	92.90%	22	7.10%	310	69	4.27
	Peru	446	98.02%	9	1.98%	455	72	4.22
	Brazil	376	99.47%	2	0.53%	378	80	4.14
	Guatemala	793	97.18%	23	2.82%	816	84	4.09
	Lebanon	473	98.13%	9	1.87%	482	105	3.84
	Total	**4,033**	**95.28%**	**200**	**4.72%**	**4,233**		
High	Switzerland	138	99.28%	1	0.72%	139	1	5.86
	United States	424	97.47%	11	2.53%	435	2	5.85
	Netherlands	233	97.08%	7	2.92%	240	4	5.66
	Germany	226	95.76%	10	4.24%	236	5	5.65
	Sweden	263	92.28%	22	7.72%	285	7	5.52
	United Kingdom	526	97.77%	12	2.23%	538	8	5.51
	Japan	103	94.50%	6	5.50%	109	9	5.49
	Canada	344	97.18%	10	2.82%	354	14	5.35
	Taiwan	200	96.15%	8	3.85%	208	14	5.33
	United Arab Emirates	207	100.00%	0	0.00%	207	17	5.30
	Austria	476	97.74%	11	2.26%	487	18	5.25
	Qatar	215	99.08%	2	0.92%	217	18	5.11
	Luxembourg	197	99.49%	1	0.51%	198	19	5.23
	France	87	95.60%	4	4.40%	91	22	5.18
	Ireland	189	98.44%	3	1.56%	192	23	5.16
	Israel	217	99.09%	2	0.91%	219	24	5.31
	South Korea	291	99.66%	1	0.34%	292	26	5.07
	Saudi Arabia	482	100.00%	0	0.00%	482	29	4.83
	Chile	1,976	95.27%	98	4.73%	2,074	33	4.71
	Spain	1,168	93.89%	76	6.11%	1,244	34	4.70
	Poland	415	99.05%	4	0.95%	419	36	4.59
	Panama	272	98.19%	5	1.81%	277	42	4.44
	Italy	71	88.75%	9	11.25%	80	43	4.54
	Slovenia	114	91.94%	10	8.06%	124	56	4.48
	Slovakia	244	97.60%	6	2.40%	250	65	4.33
	Croatia	180	92.31%	15	7.69%	195	74	4.19
	Uruguay	252	97.67%	6	2.33%	258	76	4.15
	Cyprus	77	100.00%	0	0.00%	77	83	4.30
	Greece	117	92.13%	10	7.87%	127	87	4.02
	Argentina	177	97.25%	5	2.75%	182	92	3.95
	Puerto Rico	231	96.65%	8	3.35%	239	N/A	N/A
	Total	**10,112**	**96.53%**	**363**	**3.47%**	**10,475**		

* Classification: World Bank
** Classification: World Economic Forum; Rank (out of 137); Score (1-7)
N/A: Data not available

DISCUSSION

Entrepreneurship research continues to grow as a discipline. This study contributes in an area that has been for the most part neglected within the discipline: agricultural entrepreneurship. We linked entrepreneurial attitudes and aspirations to the propensity to start a business in the agricultural sector, using data from the 2018 Adult Population Survey for the GEM project, and compared agricultural versus non-agricultural Early Stage Entrepreneurial Activity.

Our most striking findings indicate that agricultural entrepreneurs are poorly prepared to deal with the rapid innovation of the agricultural sector. They tend to be older, less educated and poorer than non-agricultural entrepreneurs. More importantly, they tend to be relatively disinterested in new products and processes, and this is especially true in low-income countries.

What, then, can be done to encourage the agricultural entrepreneurs of the world to adopt new products? Thirtle, Lin and Piesse (2003) noted that in many poor countries a lack of technology is not the problem, but rather diffusion of the technology. Rogers (1962, 1995) identified several factors influencing the diffusion of innovations. Innovation itself is only the first of these, and other important factors heighten the concern for the agricultural entrepreneur. One of these is communication. Mass media channels are effective means of communicating many innovations such as the newest cell phone or the latest video game, but are less effective in communicating innovations that require a greater commitment by the user, such as when an agricultural entrepreneurs adopts a new product or process. Interpersonal channels, or face-to-face exchanges are more likely to be effective in these situations. A difficulty, though, is that interpersonal channels are most likely to be effective when the individuals involved are similar to each other, while government or university agricultural extension agents and the farmers they are seeking to communicate with are likely to be quite different from each other.

Another factor in the diffusion of innovations is time, and individuals are quite heterogeneous in terms of how much time they need to adopt an innovation. Since our focus is on entrepreneurship, we are primarily interested in the earlier adopters. Rogers (1962, 1995) described several general characteristics of these, and here the demographic variables shown in Table 1 give us further cause for concern. Rogers found earlier adopters generally had more education and were more literate than later adopters, while we found agricultural entrepreneurs tended to be less educated than non-agricultural entrepreneurs. Likewise, Rogers stated that earlier adopters were generally wealthier than later adopters, while we found that agricultural entrepreneurs tended to be poorer than non-agricultural entrepreneurs.

The World Bank (2007) suggested an innovation systems approach to bring technology to the farmers of the world. Systems approaches emphasize the interactions of all the actors involved. Technical expertise must be complemented with expertise in markets, finance and especially education. Klerkx, van Mierlo and Leeuwis (2012) described how the systems approach differs from traditional approaches to agricultural innovation. In the traditional approach, farmers could be either adopters of technology or laggards, but in a systems approach they become experimentors and sources of information. The goal of the traditional approach is simply that farmers adopt technology, while the goal of a systems approach is that farmers develop capacities to innovate, to learn, and to change their practices. Several authors have described successful applications of systems approaches. In an innovation-driven country setting, Nettle, Brightling and Hope (2013) described how a programme team approach is proving effective in the Australian dairy industry. On these teams a leader and representatives from relevant organizations set goals and establish approaches to deliver benefits within the industry. Similarly, McElwee, Smith and Somerville (2018) described how community development workers have inspired rural entrereneurs in the British isles. In a factor-driven country setting,

Shikuku (2019) discussed the use of "disseminating farmers," who are selected and trained to encourage their neighbors to adopt new technologies.

An example of an effective systems approach can be found in urban agriculture. The U. S. Department of Agriculture offers support to urban farmers and will even offer a National Urban Agricultural Conference in the summer of 2024. Urban agriculture has advantages such as increasing food security, taking advantage of otherwise used land, reducing encroachment on wildlife, and reducing transportation costs and carbon emissions as food grown in cities travels shorter distances than food grown in the countryside (Oliva, Rontanini and Rosenblatt, 2019). However, another major advantage is that urban farmers are more likely than rural farmers to seek help from government agencies such as the USDA, and more likely to communicate with each other, and often better prepared and educated (USDA, 2024). Furthermore, it is important to note that urban agriculture is not restricted to the U.S. but is rather a world-wide phenomenon. Examples of effective systems approaches to urban agriculture can be found in Italy (Amato and Simonetti, 2021), Iran (Ghahremani, Noori, Deihimfard and Veisi, 2024) and Dubai (Simon, Rickards and Rutherford, 2024).

CONCLUSION

How, then, can policymakers best contribute to agricultural entrepreneurship and innovation? An answer can be found at the intersection of two scholarly fields: entrepreneurship and developmental economics (Hessels and Naudé, 2018). Entrepreneurship scholars often emphasize the "knowledge spillover" theory of entrepreneurship, in which entrepreneurs use knowledge generated by universities, existing private firms or other entrepreneurs to start businesses (Ács, Braunjerhjelm, Audretsch, and Carlsson, 2009). Likewise, development economists have long emphasized "externalities," or unintended benefits accruing to parties other than the entrepreneur (Hausemann and Rodrick, 2003). The conclusion to be drawn from both fields is that policymakers should concentrate rather than spread their efforts. They should focus on developing local clusters of connected entrepreneurs who can learn from and provide examples to each other, and these clusters may even be in urban areas. This may be difficult for policymakers who often feel the need to provide equal attention to all parts of their jurisdictions. None-the-less, if policymakers can help to create such clusters, they may find them to be self-sustaining (Isenberg, 2010), which of course is the most important goal.

In any case, while we are in the midst of an age of agricultural innovation, these innovations can produce widespread benefits only if they are embraced by a generation of agricultural entrepreneurs. The apparent disinterest in innovation among the agricultural entrepreneurs of the world discovered in this research is therefore of great concern, and a challenge for researchers and policymakers around the world.

REFERENCES

Acs, A.J., S. Desai, and J. Hessels. (2008). Entrepreneurship, economic development and institutions. *Small Business Economics*, 31, 219-234.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes,* 50(2), 179-211.

Ács, Z., P. Braunjerhjelm, D. Audretsch, and B. Carlsson (2009). The knowledge spillover theory of entrepreneurship. *Small Business Economics,* 32, 15-30.

Amato, F., and Simonetti, L. (2021). Can urban agriculture be used to improve green infrastructure and social well-being? The urban garden in Ponticelli neighbourhood of Naples. *Journal of Urban Regeneration & Renewal*, 15(1), 129-140.

Arafat, M.Y., I. Saleem, A.K., A.K. Dwivedi, and A. Khan. (2020). Determinants of agricultural entrepreneurship: A GEM data based study. *International Entrepreneurship and Management Journal,* 16, 345-370.

Ardichvili, A., R. Cardozo, and S. Ray. (2003). A theory of entrepreneurial opportunity identification and development. *Journal of Business Venturing,* 18(1), 105-123.

Arenius, P. and M. Minnit. (2005). Perceptual variables and nascent entrepreneurship. *Small Business Economics*, 24(3), 233-247.

Barham, B.L., J-P Chavas, D. Fitz, V. Ríos-Salas, and L. Schechter. (2015). Risk, learning, and technology adoption. *Agricultural Economics,* 46, 11-24.

Barbieri, C. and E. Mahoney. (2009). Why is diversification an attractive farm adjustment strategy?: Insights from Texas farmers and ranchers. *Journal of Rural Studies,* 25(1), 58-66.

Baron, R.A. (2006). Opportunity recognition as pattern recognition: How entrepreneurs "connect the dots" to identify new business opportunities. *Academy of Management Perspectives,* 20(1), 104-119.

Bayon, M.C.,Y. Vaillant, and E. Lafuente. (2015). Initiating nascent entrepreneurial activities. *International Journal of Entrepreneurial Behavior and Research*, 21(1), 27-49.

Bosma, N. (2013). The Global Entrepreneurship Monitor (GEM) and its impact on entrepreneurship research. *Foundations and Trends® in Entrepreneurship,* 9(2), 143-248.

Brehm, J.M. and B.W. Eisenhauer. (2008). Motivations for participating In community-supported agriculture and their relationship with community attachment and social capital. *Southern Rural Sociology*, 23(1), 94-115.

Brown, C. and S. Miller. (2008). The impacts of local markets: A review of research on farmers' markets and community supported agriculture (CSA). *American Journal of Agricultural Economics*, 90(5), 1296-1302.

Bryant, C.R. (1989). Entrepreneurs in the rural environment. *Journal of Rural Studies*, 5(4), 337-348.

Corbett, A.C. (2005). Experiential learning within the process of opportunity identification and exploitation. *Entrepreneurship: Theory and Practice*, 29(4), 473-491.

CropLife International. (2019). Agriculture: A $2.4 trillion industry worth protecting. https://croplife.org/news/agriculture-a-2-4-trillion-industry-worth-protecting/

Dickes, L. and K. Robinson. (2014). An institutional perspective of rural entrepreneurship. *American Journal of Entrepreneurship,* 7(2), 44-57.

Etzioni, A. (1987). Entrepreneurship, adaptation and legitimation: A macro-behavioral perspective. *Journal of Economics Behavior and Organization*, 8, 175-189.

Freytag, A., and R. Thurik. (2007). Entrepreneurship and its determinants in a cross-country setting. *Journal of Evolutionary Economics*, 17 (2), 117-131.

Gailhard I.U., M. Bavorová, and F. Pirscher. (2015). Adoption of agri-environmental measures by organic farmers: The role of interpersonal communication. *Agricultural Education and Extension,* 21(2), 127-148.

Gars, J., and P.S. Ward. (2019). Can differences in individual learning explain patterns of technology adoption? Evidence on heterogeneous learning patterns and hybrid rice adoption in Bihar, India. *World Development*, 115, 178-189.

GEM. (2018). Global Entrepreneurship Monitor 2018 Global Report.

Ghahremani, V., Noori, O., Deihimfard, R. and Veisi, Hadi. (2024). The effect of three urban agriculture, government and freelance job on psychological resilience. *Journal of Studies in Entrepreneurship & Sustainable Agricultural Development,* 11(1), 1-18.

Graeub, B.E., M.J. Chappell, H. Wittman, S. Ledermann, R. Bezner Kerr, and B. Gemmill-Herren. (2016). The state of family farms in the world. *World Development*, 87, 1-15.

Hausemann, R., and D. Rodrick (2003). Economic development as self-discovery. *Journal of Development Economics*, 72, 603-633.

Hessels, J, and W. Naudé (2019). The intersection of the fields of entrepreneurship and developmental economics: A review toward a new view. *Journal of Economic Surveys*, 33(2), 389-403.

Hessels, J., M. van Gelderen and R. Thurik. (2008). Entrepreneurial aspirations, motivations, and their drivers. *Small Business Economics*, 31(3), 323-339.

Hoyte, C., H. Noke, S. Mosey, and S. Marlow. (2019). From venture idea to venture formation: The role of sensemaking, sensegiving and sense receiving. *International Small Business Journal*, 37(3), 268-288.

Isenberg, D. (2010). The big idea: How to start an entrepreneurial revolution. *Harvard Business Review*, 1-11.

Kirzner, I. (1973). *Competition and Entrepreneurship*. Chicago: University of Chicago Press.

Klerkx, L., B. van Mierlo, and C. Leeuwis. (2012). Evolution of systems approaches to agricultural innovations: Concepts, analysis and interventions. In Darnhofer, I., Gibbon, D., and Dedieu, B. (Eds.), *Farming Systems Research into the 21st Century: The New Dynamic.* Springer, Dordrecht, 457-483.

Koellinger, P., M. Minniti, and C. Schade. (2007). "I think I can, I think I can". Overconfidence and entrepreneurial behavior. *Journal of Economic Psychology*, 28 (4), 502-527.

Kuhne, B., X. Gellynck and R.D. Weaver. (2015). Enhancing innovation capacity through vertical, horizontal, and third-party networks for traditional foods. *Agribusiness*, 31(3), 294-313.

Lambrecht, E., B. Kuhne, and X. Gellynck. (2014). How do innovation partners differ with respect to innovation type and stage in the innovation journey of farmers? *Entrepreneurship and Innovation*, 15, 191-203.

Leon, Y. (2005). Rural development in Europe: A research frontier for agricultural economists. *European Review of Agricultural Economics*, 32(3), 301-317.

Liang, C., and P. Dunn. (2014). Entrepreneurial profile, characteristics, expectations, and outcomes: An empirical study to compare rural entrepreneurs with urban entrepreneurs. *American Journal of Entrepreneurship*, VII(2), 58-75.

Lourenço, F., N. Sappleton, A. Dardaine-Edwards, G. McElwee, R. Cheng, D.W. Taylor, and A.G. Taylor. (2014). Experience of entrepreneurial training for female farmers to stimulate entrepreneurship in Uganda. *Gender in Management: An International Journal*, 29(7), 382-401.

McElwee, G. (2006). Farmers as entrepreneurs: Developing competitive skills. *Journal of Developmental Entrepreneurship*, 11(03), 187-206.

McElwee, G., R. Smith and P. Somerville. (2018). Conceptualising animation in rural communities: The village SOS case. *Entrepreneurship and Regional Development*, 30 (1-2), 173-198.

Naudé, W. (2011). Entrepreneurship is not a binding constraint on growth and development in the poorest countries. *World Development*, 39(1), 33-44.

Nettle, R., P. Brightling and A. Hope. (2013). How programme teams progress agricultural innovation in the Australian dairy industry. *Journal of Agricultural Education and Extension*, 19, 271-290.

Newton, J.E., B.J. Hayes and J.E. Pryce. (2018). The cost-benefit of genomic testing of heifers and using sexed semen in pasture-based dairy herds. *Journal of Dairy Science*, 101, 6159-6173.

Ogutu, S.O., and M. Qaim. (2019). Commercialization of the small farm sector and multidimensional poverty. *World Development*, 114, 281-293.

Olinto, P., K. Beegle, C. Sobrado, and H. Uematsu. (2013). The state of the poor: Where are the poor, where is extreme poverty harder to end, and what is the current profile of the world's poor? *The World Bank Economic Premise.* file:///C:/Users/nhm524/Documents/Publishing%20with%20Joo/Olinto.%202013%20The%20State%20of%20the%20Poor.pdf

Oliva, B., Rontanini, C., and Rosenblatt, M. (2019). Vertical Farms and the New Green City, *Proceedings of the Northeast Business & Economics Association,* 178-182.

Oxford Poverty and Human Development Initiative. (2014). *Poverty in Rural and Urban Areas.* https://www.ophi.org.uk/wp-content/uploads/Poverty-in-Rural-and-Urban-Areas-Direct-Comparisons-using-the-Global-MPI-2014.pdf

Partey, S.T., R.B. Zougmoré, M. Ouédraogo, and B.M. Campbell. (2018). Developing climate-smart agriculture to face climate variability in West Africa: Challenges and lessons learnt. *Journal of Cleaner Production*, 187, 285-295.

Pato, M.L., and A.A.C. Teixeira. (2016). Twenty years of rural entrepreneurship: A bibliometric survey. *Sociologia Ruralis*, 56(1), 3-28.

Perks, H. and D. Medway. (2012). Examining the nature of resource-based processes in new venutre development through a business-duality lens: A farming sector taxonomy. *International Small Business Journal*, 30(2), 161-188.

Porter, M.E. (1985). *Competitive Advantage,* New York: Free Press.

Reynolds, P., N. Bosma, E. Autio, S. Hunt, N. De Bono, I. Servais, and N. Chin. (2005). Global entrepreneurship monitor: Data collection design and implementation 1998–2003. *Small Business Economics*, 24(3), 205-231.

Rogers, E.M. (1962). *Diffusion of Innovations*, New York: Free Press.
Rogers, E.M. (1995). *Diffusion of Innovations*, 4th edition, New York: Free Press.
Schumpeter, J. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital Credit, Interest and the Business Cycle*, Cambridge, MA: Harvard Iniversity Press.
Scientific American. (2017a). First genetically engineered salmon sold in Canada. By Emily Waltz, Nature, August 7, https://www.scientificamerican.com/article/first-genetically-engineered-salmon-sold-in-canada/
Scientific American. (2017b). Precision farming increases crop yields. By Geoffery Ling and Blake Bextine, Engineering, June 26. https://www.scientificamerican.com/article/precision-farming/
Schwab, K. (2018). *The Global Competitiveness Report 2018*. World Economic Forum. http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf
Shariff, M.N.M. and M.B. Saud. (2009). An attitude approach to the prediction of entrepreneurship on students at institutions of higher learning in Malaysia. *International Journal of Business and Management*, 4(4), 129-135.
Shikuku, K.M. (2019). Information exchange links, knowledge exposure, and adoption of agricultural technologies in northern Uganda. *World Development*, 115, 94-106.
Simon, M., Rickards, L. and Rutherford, J. (2024). The urbanization of controlled environmental agriculture: Why does it matter for urban studies? *Urban Studies*, 61(80), 1430-1450.
Stenholm, P. and U. Hytti. (2014). In search of legitimacy under institutional pressures: A case study of producer and entrepreneur farmer identities. *Journal of Rural Studies*, 35, 133-142.
Thirtle, C., L. Lin, and J. Piesse. (2003). The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America. *World Development*, 31, 1959-1975.
Tominc, P., and M. Rebernik. (2007). Growth aspirations and cultural support for entrepreneurship: A comparison of post-socialist countries. *Small Business Economics*, 28(2-3), 239-255.
US Census. (2018). https://www.census.gov/population/censusdata/table-4.pdf
USDA. (2018). Adoption of genetically engineered crops in the U.S.. *United States Department of Agriculture Economic Research Service.* https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx
USDA Climate Hubs. (2024). Urban agriculture. U.S. Department of Agriculture, https://www.climatehubs.usda.gov/hubs/international/topic/urban-agriculture.
United Nations. Statistical Division. (2008). International Standard industrial classification of all economic activities (ISIC). New York :United Nations.
Vaillant, Y., and E. Lafuente. (2007). Do different institutional frameworks condition the influence of local fear of failure and entrepreneurial examples over entrepreneurial activity? *Entrepreneurship and Regional Development*, 19(4), 313-337.
van En, R. (1995). Eating for your community: Towards agriculture supported community, *Context*, 42(Fall), 29-31.
Venot, J.P., M. Kuper, and M. Zwarteveen (Eds.) (2017). *Drip Irrigation for Agriculture: Untold Stories of Efficiency, Innovation and Development*, Routledge: Abingdon, UK and New York, USA.
Vesala, K.M., and J. Pyysia¨inen (Eds.) (2008) Understanding entrepreneurial skills in the farm context. *Research Institute of Organic Agriculture (FiBL)*, Frick, Switzerland available on www.esofarmers.org.
Weber, E.U., and R.A. Milliman. (1997). Perceived risk attitudes: Relating risk perception to risky choice. *Management Science*, 43(2), 123-144.
Weick, K.E., K.M. Sutcliffe, and D. Obstfeld. (2005). Organizing and the process of sensemaking. *Organizational Science*, 16(4), 409-421.
Wood, M.S., and W. McKinley. (2010). The production of entrepreneurial opportunity: A constructivist perspective. *Strategic Entrepreneurship Journal*, 4(1), 66-84.
World Bank. (2007). *Enhancing agricultural innovation: How to go beyond the strengthening of research systems*, World Bank Publications, Washington DC.
Yessoufou, A.W., V. Blok, and S.W.F. Omta. (2018). The process of entrereneuerial action at the base of the pyramid in developing countries: A case of vegetable farmers in Benin. *Entrepreneurship and Regional Development*, 30 (1-2), 1-28.