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**The Role of the Private Sector in Food
System Resilience**

Lessons from Cambodia

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ABSTRACT

A food system approach to attaining Sustainable Development Goals related to poverty eradication, hunger elimination, and health and nutrition is gaining momentum as a development paradigm. However, operationalizing a food system approach at the national policy and programming level remains largely unexplored. The sustainability and the resilience of food systems are driven by many factors that result from the increasing complexity and uncertainty in global matters such as climate change, rapid urbanization, population aging, unexpected shocks such as natural disasters and financial and political crises, and finally, unexpected responses of food systems themselves to these events. The role of the private sector in achieving resilience for the food system has been recognized for some time. Better functioning food, agriculture, and input markets can reduce price uncertainty and the vulnerability of farmers and consumers alike. Yet little is known about the specific interventions, both public and private, that can help build a resilient food system through increasing the private sector's role. This paper assesses the role of the private sector by using the case study of Cambodia to learn specific lessons for increasing the resilience of food systems in the developing world. In order to develop a sustainable and lasting impact, it is imperative that both market actors and private actors be involved in addressing the new challenges facing vulnerable food systems.

Keywords: food system resilience, private sector, Cambodia, information systems, risk financing, contract farming, waste to energy, smallholder farmers

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1. INTRODUCTION

According to the World Bank, over the next 15 years, the demand for food is projected to rise by at least 20 percent, with the largest increases anticipated in Africa south of the Sahara, South Asia, and East Asia (World Bank, 2018). The expanding challenges to global food security also include food price volatility, changing dietary preferences, urbanization, high food waste and loss, inefficient supply chains, and reduced biodiversity, among others. The challenge we face today is not only to meet increasing demands for food and agricultural products but to do so in a way that also strengthens the food system and builds its resilience. The private sector is increasingly recognized as an important actor that has the potential to contribute toward building a sustainable and resilient food system, as illustrated in the United Nations 2030 Agenda for Sustainable Development and the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation (Dubbeling et al., 2016 & Sharma et al., 2014).

The role of the private sector in achieving the resilience of the food system has been recognized for some time. Better functioning food, agriculture, and input markets can reduce price uncertainty and reduce the vulnerability of farmers and consumers alike. Yet little is known about the specific interventions, both public and private, that can help build a resilient food system through increasing the private sector's role. This paper assesses the role of the private sector by using a case study of Cambodia to learn specific lessons for increasing the resilience of food systems in the developing world. In order to develop a sustainable and lasting impact, it is imperative that both market actors and private actors be involved in addressing the new challenges of vulnerable food systems (Sharma et al., 2014).

This paper is organized as follows: The next section develops a conceptual framework to describe the role of the private sector in a national food system. Section three presents a case study of Cambodia. It analyzes the involvement of the private sector in Cambodia in the areas of access to information, risk financing for climate hazards, contract farming—a way to strengthen the business environment—and the use of agricultural waste to produce energy. Section four presents a set of lessons for developing countries, highlighting some barriers to private-sector investment in Cambodia's food system. The

removal of such barriers, it argues, would create a more investment-friendly business environment.

Section four also points out huge new business opportunities for the private sector to invest in both the agriculture sector and the extended food system of Cambodia to make them more resilient to unforeseen internal and external disturbances. The last section provides concluding remarks.

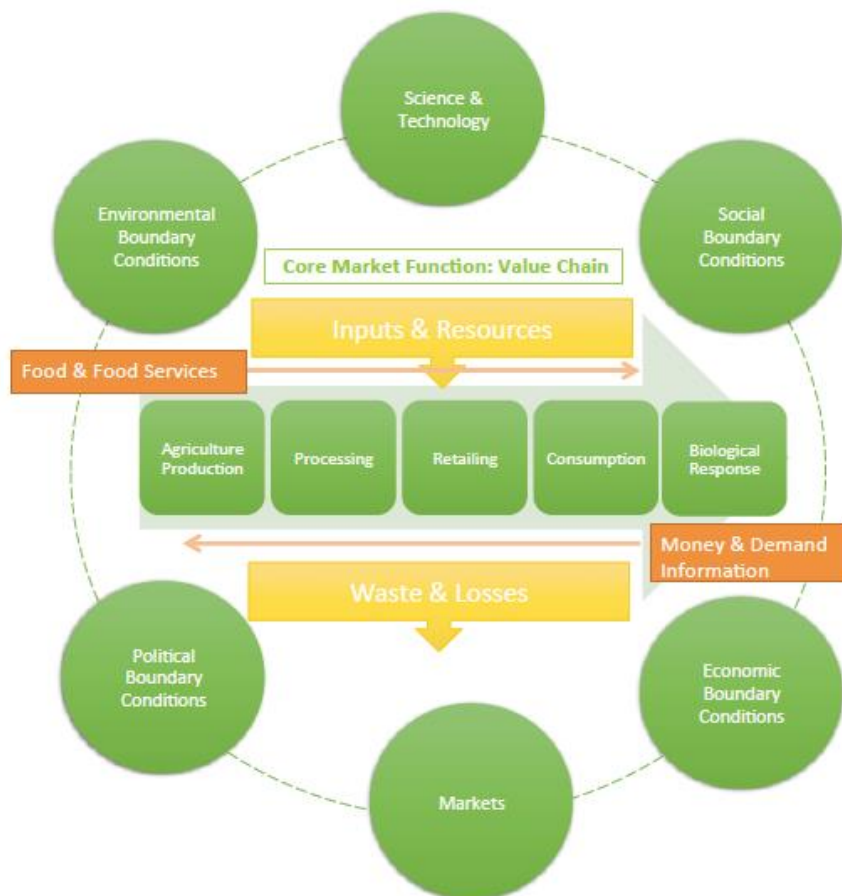
2. CONCEPTUAL FRAMEWORK

There is a growing pressure on already fragile food systems as a result of growing global population. According to the World Bank, over the next 15 years, the demand for food is projected to rise by at least 20 percent, with the biggest effects anticipated in Africa south of the Sahara, South Asia, and East Asia (World Bank, 2018). Worldwide, nearly 795 million people are undernourished (more than 1 in 9 people in the world) (FAO et al., 2015), including 165 million children (Population Connection, 2018). By 2050 the world population is projected to increase to 9.7 billion, and to 11.2 billion by 2100 (UN-DESA, 2015), which means that under the present scenario, it is estimated that we will have to increase food production by at least 50 percent over the coming decades (Teng et al., 2017 & World Bank, 2017b). This comes at a time when the world is facing ongoing political and civil instability and conflict, large-scale displacement, climate change, and degradation of natural resources—which continue to deepen food insecurity for millions of people (World Bank, 2017b). The expanding challenges to global food security also include food price volatility, changing dietary preferences, urbanization, high food waste and loss, inefficient supply chains, and reduced biodiversity, among others.

Global organizations also acknowledge that food security is a problem and have set global targets to eradicate hunger and food insecurity. The year 2015 marked the end of the monitoring period for the targets of the Millennium Development Goals. There were achievements in line with these targets, resulting from rapid economic growth and increased agricultural productivity. However, in many countries, extreme hunger and malnutrition remain a prominent barrier to development. Sustainable Development Goal (SDG) 2 aims to end all forms of hunger and malnutrition by 2030. In order to achieve this SDG, it is imperative that all people—especially children—have access to sufficient and nutritious food all year round. Hence, this involves not only promoting sustainable agricultural practices—such as supporting small-scale farmers and allowing equal inputs and resources such as access to land, technology, and markets—but also requires us to ensure investment in infrastructure and technology to improve agricultural productivity. The availability and accessibility of diverse, nutritious foods is also

influenced by food systems. Although there are indirect ties from the food system to nutritional outcomes, food systems ultimately influence the ability of consumers to make healthy diet choices (Nugent et al., 2016).

Figure 2.1 Food System Diagram adapted from M. Grant, World Food System Centre, ETH Zürich (cited in Six, 2014), and United Nations System Standing Committee on Nutrition (Nugent et al., 2016).



The term *food system*, as used in this paper, comprises all the activities and stages of food production and consumption, from “farm to flush” (Nugent et al., 2016). These stages involve converting resources and effort into food—that is, producing, harvesting, processing, packaging, distribution/transportation, marketing, trading, consumption, and in the end, disposal of waste. Figure 1 displays various boundaries and factors that affect the core value chain of an agricultural product. The

food industry is constantly reaching out to the private sector to work within these boundaries in order to be resilient and self-sufficient (Setrakian, 2018).

Likewise, the security of food supplies is disturbed by many factors that result from the increasing complexity and uncertainty around global matters such as climate change, rapid urbanization, population aging, unexpected shocks such as natural disasters and financial and political crises, and finally, unexpected responses of food systems themselves to these events (Tendall et al., 2015). Food systems are exposed to many internal and external drivers of change, from unexpected shocks to long-term disturbances, that in turn make them more susceptible to shocks (Wisner et al., 2003). The global food system is facing high pressure from all of these factors.

The challenge we face today is not only to meet increasing demands for food and agricultural products but to do so in a way that also strengthens the food system and builds its resilience. Resilience in a food system refers to its ability to self-organize in such a way that it can withstand a shock, absorb the effects of the shock, and recover from the shock to its original state or an even better state (Babu et al., 2017 & Tendall et al., 2015) in terms of producing enough healthy food to which everyone has access, avoid environmental damage, and contribute to livelihood generation (Six, 2014). A resilient food system is also characterized by the degree to which it has the ability to build capacity for learning and adaptation (Ingram et al., 2010). A resilient food system is intended to make affordable, nutritious, and fairly traded foods from local and regional producers more easily available to all consumers (Ligot et al., 2016).

The private sector is recognized increasingly as an important actor that has the potential to contribute to building a sustainable and resilient food system, as illustrated in the United Nations 2030 Agenda for Sustainable Development and the Malabo Declaration on Accelerated Agricultural Growth and Transformation (Dubbeling et al., 2016 & Sharma et al., 2014). Typically a wide range of private-sector actors are actively involved in different aspects of the food system, including input supply, production, processing, retail, and consumption. Working in the formal and informal sectors, these private-sector organizations comprise small, medium, and large agricultural farms; food value chain enterprises; individual entrepreneurs; family-run businesses; cooperatives; social enterprises; and even

large corporations (Ligot et al., 2016). However, recent times have seen an increase in the involvement of nontraditional-sector actors, such as water and energy companies, technological companies, private funds, and insurance companies.

For instance, the Thai economy has witnessed sustainable growth and economic diversification predominantly led by the private sector, which is driven by inexpensive labor, high capital investment, and effective economic institutions (Abonyi, 2013). The country's economy grew faster than economists had predicted during the last quarter of 2017. Gross domestic product (GDP) increased to 4.3 percent, more than the median estimate of 3.9 percent from Bloomberg economists (Yuvejwattana, 2017). In a government mandate to support private-sector involvement in agriculture, many schemes have been implemented in the least developed areas of the country to help subsistence farmers. In the late 1980s, in order to boost agricultural growth, the Thai government introduced a Four-Sector Cooperation Plan that was applicable to private agricultural industries, farmers, financial institutions (especially agricultural banks), and various ministries (Schwartz, 1994). Due to the advancement in the Thai economy, Thai firms have displayed great success in diversifying products and production processes, not only within sectors such as agriculture and manufacturing but also across sectors, for instance by transitioning from lower-productivity agriculture to higher-productivity manufacturing (Abonyi, 2013).

The following section offers examples that were chosen specifically to illustrate private-sector involvement in various factors that affect the food system (environmental, technological, social, economic, market, and political factors) in an attempt to build a stronger and more resilient food system in Cambodia.

3. CASE STUDY OF THE ROLE OF THE PRIVATE SECTOR IN BUILDING A RESILIENT FOOD SYSTEM IN CAMBODIA

Cambodia Private-Sector Context

According to the World Economic Forum, along with Laos and Myanmar, Cambodia's economy is one of the fastest growing in the world (Grey, 2017). Cambodia's economy has seen a growth of 6.9 percent on average over the last five years (World Bank, 2017a, b). This can be attributed to growth in the private sector, which contributes mostly to the agriculture, garment, tourism, and services sectors (Ligot et al., 2016). The country has also been an attractive destination for foreign direct investment after its economic integration into the Association of Southeast Asian Nations (ASEAN) in 1999 (RGC, 2013a). The majority of businesses in Cambodia are small and medium enterprises that provide approximately two-thirds of the country's employment (Ligot et al., 2016). The informal sector, made up of unofficial business activities that are not registered and therefore not formally covered by official labor or institutional regulations, encompasses a high share of the private sector. See Table 1 for summary statistics on Cambodia's economy.

Food System Context

The food system in Cambodia has the potential to be an important driving force for economic growth and food security. Nearly 80 percent of the population live in rural areas, and approximately 65 percent depend on agriculture, fisheries, and forestry for their livelihood (MAFF, 2014). However, in 2016, only 26.7 percent of total GDP came from the agriculture sector (CIA, 2017), with the garment, tourism, and construction industries contributing more to GDP than agriculture. According to the World Bank, agriculture-sector growth was 5.3 percent between 2004 and 2012, one of the highest rates globally. As a result, farm wages have also doubled over the last decade, aligning with the salaries of other sectors in the country, lifting four million people out of poverty, and dropping the poverty headcount from 50 percent in 2007 to 18 percent in 2012 (World Bank, 2015).

Table 3.1 Cambodia Statistics

Cambodia Statistics	
Population (2017)*	16.2 million
Human Development Index (2014)*	143
Gross domestic product per capita (2016)*	US\$3,700
Urban population (2017)*	21.2%
Population growth (2017)*	1.52%
Population living below poverty line**	14%

*Source CIA, 2017. ** Source ADB, 2014.

Although poverty has declined in Cambodia, farmers' vulnerability has grown because the majority of these people remain poor. A small loss of only US\$0.70 per day would result in many farm households' moving back into poverty, doubling the country's poverty rate to 40 percent. This high rate of vulnerability reflects the fact that the majority of farmers in Cambodia are subsistence farmers who own land of less than a hectare and are incapable of responding to any economic or weather shocks with increased agricultural productivity. Cambodia is a food-insecure country where one-fifth of the population is food deprived, meaning that they ingest fewer than the minimum daily required calories (USAID, 2017).

Three-quarters of Cambodia's farming system is rainfed, mainly focused on paddy rice production, with minimal crop diversification (ACIAR, 2018). Rice is the staple and overwhelmingly predominant crop, accounting for more than 90 percent of agricultural land. The success and size of the rice harvest depends on rainfall distribution (De Silva et al., 2013). Because the government understands that crop diversification and regional specialization could increase farmers' income and alleviate poverty, there have been some trends in the government's effort toward the promotion of growing other crops besides just rice so that farmers can take advantage of agroecological systems and market opportunities. These crops include vegetables, cassava, and maize. However, these attempts are not significant because the majority of agricultural lands are dependent on rainfall due to poor infrastructure and because

agricultural production is damaged by uncertainty, restricted to growing one crop per year, and nondiversified (De Silva et al., 2013).

The willingness of the government to support Cambodia's food system is visible in the way it prioritizes agriculture in its "rectangular" growth strategy and its national development agenda. The strategic objective of the growth strategy is to intensify agricultural productivity and diversification on existing land by focusing on cross-cutting interventions such as promoting the adoption of appropriate agriculture inputs, research and development, extension services, construction and maintenance of rural infrastructure, provision of rural microfinance, and improved market access for agricultural communities (RGC, 2013b). Like its neighbor, Thailand, Cambodia recognizes the value of an efficient and developed agricultural sector for poverty reduction, food security, job creation, increasing household incomes, and overall economic growth (MAFF, 2014). The national Rectangular Strategy Phase III (RGC, 2013b) aims to modernize the agriculture sector and remove its dependency on land expansion and traditional agriculture. It also emphasizes diversification in high-value crops and noncrop agricultural products, including livestock farming and aquaculture, as well as the commercialization of agriculture and the development of agro-industry to encourage value addition in agriculture. In addition to the Rectangular Strategy and the National Strategic Development Plan 2014–2018, the Agricultural Sector Strategic Development Plan 2014–2018 also outlines priority actions for the Ministry of Agriculture, Forestry and Fisheries (MAFF, 2014).

Despite much progress in agriculture in Cambodia, the country still must address its production and postharvest infrastructure, market failures, coordination issues, business enabling environment, and insecurity in land tenure—all of which constrain investment in productive activities—and increase its capacity for financial services to reach rural farmers and entrepreneurs (ADB, 2012). A long-term vision for Cambodia's agriculture sector is to be a sustainable, competitive, and value-added sector in order to ensure that it generates employment and incomes and is sustained despite various shocks like rising input costs, price volatility, and weather perils (World Bank, 2015). The ministry also encourages the

involvement of the private sector in sustainable agriculture practices. Below are some examples of areas in which the private sector in Cambodia has been active in building a strong and resilient food system.

Access to new technologies such as information systems, improved financial arrangements for farmers, crop and climate insurance, contract farming, and biomass gasification will not only allow the private sector to invest for its profit-maximization motive but also assist smallholder farmers by supplying information, financing, and negotiation power in order to make them more resilient when faced with internal and external disturbances.

Access to information systems to improve productivity

Farmers in Cambodia are risk averse, have limited adaptive capacity, and very often require initial intensive technical and financial support to demonstrate success from upgraded practices (Keatts, 2015 & Rollet, 2014). This is a major factor in the vulnerability of Cambodia's agriculture sector. Hence, access to information on weather patterns and various agricultural technologies, such as seeding at the optimal time and using modern cultivation and harvesting techniques, would benefit the productivity of the sector. Focusing on pro-poor growth and sector transformation through its agricultural extension policy, the Cambodian government aims to adopt pluralistic and demand-driven approaches to modernize its agricultural extension and advisory services (Oeurn Ke et al., 2018).

Presently, it is mainly the donor community in Cambodia that pushes sustainable farming techniques that help reduce risks due to climate impacts and build a resilient food system, because the current farming system does not provide a mature investment climate and the current public extension system requires additional support. However, according to the general secretariat of the National Council for Sustainable Development in Cambodia, the number of private-sector actors that are interested in decreasing the risk profile of farmers is increasing. For example, United Cambodia Agri (UCA), a private agriculture consultancy company, has partnered with a USAID (United States Agency for International Development) program, Helping Address Rural Vulnerabilities and Ecosystem Stability (Cambodia-HARVEST), to disseminate climate-smart agriculture practices to farmers. The company has also

purchased a weather station to collect reliable weather information for better disaster forecasting (Ligot et al., 2016). Similarly, another nongovernmental partner of UCA, known as iDE, has worked with various private and public partners such as Nestlé and donors such as the International Fund for Agricultural Development and the Australian Agency for International Development to develop a farm business advisor (FBA) network that focuses on building the capacity of farmers in crop productivity, business entrepreneurship, and climate information in order to reduce their risk aversion (iDE, 2018). Although donors have funded the FBA model, its cost has been balanced through private income from sales and farmer training. Despite such donor-led efforts, Cambodia still has not optimally utilized its extension system, not only to provide sustainable agricultural techniques but also to lead its nutrition education program, as have countries such as Vietnam and Brazil (IFPRI, 2016).

Hence, there is room for the private sector to invest in developing an information system to assist farmers and in turn increase their productivity. Raising productivity in agriculture is central to the country's development prospects because a majority of households depend on agriculture and its subsector of livestock, fisheries, and forest exploitation for their livelihood. By entering this new market of information and communication to disseminate agriculture information to farmers and farm communities, the private sector can improve farmers' productivity and their economic, social, and environmental sustainability (Zhang et al., 2016).

Risk financing for climate hazards

Effective private-sector engagement in climate hazard adaptation will catalyze greater investment in vulnerability reduction and result in more climate-related technologies and services (Biagini et al., 2013). The Asian Development Bank defines *climate risk financial strategies* as “the application of financing strategies and instruments as part of a systemic approach to manage the financial consequences of climate variability and extremes” and classifies them into three complementary mechanisms—risk retention, risk sharing, and risk transfer (ADB, 2017c, Pg. 4). Risk retention includes working on high-frequency, low-impact events such as localized flooding by using one's own resources such as saving and borrowing,

along with reserves from lending institutions. Risk sharing involves working on medium-frequency, medium-impact events such as a moderate flood with the pooled resources of individuals and households within the same community or across communities. Last, risk transfer involves dealing with extreme events by transferring the burden of big financial losses to another party at a cost. A combination of appropriate risk financing options can provide very effective risk protection for farmers.

Rural agrarian communities in Cambodia are particularly affected by climate-related disasters and shocks. Floods and droughts have very serious economic implications on the lives of these subsistence households, pushing them into extreme poverty. Rice crops (paddy rice and upland rice), which are very important livelihood assets as well as a major source of food security, are at risk (Van Wensveen et al., 2015). According to the Asian Development Bank, for paddy crops, a drought in Cambodia causes an estimated 70 percent loss in economic income due to reduced production (ADB, 2017c). Cash crops are also very vulnerable to weather hazards, with economic losses from a drought estimated at 30 percent (ADB, 2017c). To make matters worse, it is predicted that due to global climate change, these weather hazards will grow in intensity and frequency. This will also negatively affect later stages of agricultural production and the value chain, including transportation, storage, processing, and market access (Ligot et al., 2016).

In Cambodia, along with other countries in the region such as Thailand (Oxford Business Group, 2016), the government is exploring many index insurance schemes for rice, with the involvement of the insurance sector, agricultural banks, and the donor community. The government is looking to develop public-private partnership models of risk financing for climate risk management. In Cambodia, some farming households adopt financial measures to cope with climate risk—mainly the risk-retention measures of saving and borrowing (ADB, 2017c). Borrowing from informal financial institutions such as savings groups is common in the country. However, despite these risk-reduction and coping mechanisms, most rural communities are not fully protected from the financial consequences of climate shocks.

Although a number of development partners are working with the Ministry of Agriculture, Forestry and Fisheries and other line ministries to counteract the effect of climate change by empowering

farmers and raising awareness of climate-smart farming technologies, private investors in sustainable farming remain scarce because they operate in a risky investment context, where regulations on investment are not clear. However, addressing climate risk is an emerging phenomenon in Cambodia (Ligot et al., 2016). For instance, in early 2015, the Cambodian Agriculture Cooperative Insurance Company, funded by the private Achmea Foundation (based in the Netherlands), along with an initiative of the Cambodia Center for Study and Development in Agriculture (CEDAC), established an agriculture microinsurance service to insure rice farmers against climate change (Muyhong, 2015). Because the service is provided by private investors, farmers have to pay an insurance fee of US\$10 per hectare every season. They receive consultation on farming techniques and climate change resilience methods, and when their crop is damaged by either flood or drought, they get an insurance payout. By mid-2015, approximately 60 farmers were registered, accounting for more than 60 hectares of rice (Ligot et al., 2016).

When another insurance company, Forte, introduced a new crop insurance product in 2015, its fast registration of farmers was a sign that such a financial product is in high demand (Kunmakara, 2015). To scale up following the product's initial success in offsetting damages due to drought in 2015, the company will need a guarantee system that sufficiently equips farmers with climate adaption measures, making them less likely to default. At present, due to a lack of professional farmers' associations with a good information system in place, Cambodian farmers are not protected, resulting in a vulnerable agriculture system and a weak food system. In this regard, a public-private partnership funded by the Swiss Agency for Development and Cooperation, called Remote Sensing–Based Information and Insurance for Crops in Emerging Economies (RIICE), is working to achieve two objectives: (1) increase the available information on rice growth areas using remote-sensing technology, and (2) provide access to insurance solutions for governments, agriculture intermediaries (such as rural banks and cooperatives), and rural farmers.

Blue Orchard, an impact investment company in Cambodia, manages an exciting model called the Climate Insurance Fund. The overall objective is to improve access to and the use of insurance in

developing countries by providing financing to qualified insurance and reinsurance companies. In addition to financing, this fund also provides technical assistance for product design to reduce the premium payment for end clients.

In spite of the programs mentioned, there is a big opportunity to expand on the supply of green finance. There is a scope for the private sector to develop a financial product for small and medium-size energy-efficient businesses. At the same time, the government should provide a framework for scaling up climate risk insurance by engaging with insurance companies.

Contract farming: A way to strengthen the business environment

Contract farming effectively links and coordinates agribusiness with small producers in an agreement with terms that are beneficial for both parties. When contract farming is efficiently managed, it reduces risk and uncertainty for both parties, in comparison with buying and selling produce in an open market (Eaton et al., 2001). The major advantage of a contractual agreement for farmers is that all of their produce, within specified quality and quantity specifications, will be purchased by the sponsor. Along with guaranteed purchase of their products, the farmers also get access to managerial, technical, and extension services that would be unavailable otherwise.

Research conducted by the Cambodia Development Resource Institute using a snowball-sampling methodology to identify different contract farming models found that community-level contract farming practices do exist but government support for them is not clear, even though a sub decree has been signed (Sreymom et al., 2015 & Cai et al., 2008). Unless the sub decree is accompanied by policy, strategy, and action plans, the promotion of contract farming to improve agricultural productivity and rural incomes will not be effective.

Despite the unfavorable environment, Angkor Kasekam Roongroeng Co., Ltd., a private Cambodian firm, has been the largest contract rice farming operation in Cambodia since 2001. The company reportedly has contracts with more than 50,000 smallholder farmers to support its main business of exporting a noncertified, aromatic, organic Cambodian rice variety to the international market

(Sokhorng, 2016). A French development agency, Agence Française de Développement, has also been working with private companies on contract farming over the last 10 years. Organizations such as CEDAC and the Cambodian Farmers Association Federation of Agricultural Producers have encouraged the development of a growing number of farmers' associations in Cambodia with the aim of empowering farmers and improving their negotiating power. This approach also helps farmers cope with the high price volatility in the food market. On the other hand, food processors such as the Cambodia Rice Federation (CRF), composed of rice millers and exporters, are enthusiastic about working with their suppliers to strengthen the supply chain and transfer sustainable farming techniques such as repairing damaged soils, rotating crops to improve soil fertility, maximizing storage facilities, using the most energy-efficient means of transportation, and so on. However, according to CRF, this approach may have a slow rollout due to various viewpoints among its members.

Similarly, building its model on contract farming, a for-profit social enterprise called Project Alba partners with more than 500 smallholder farmers in a project that will allow them to instantly increase their income while they generate profits. This enterprise links farmers to the local market where their produce, such as fresh vegetables, is in high demand. As in standard contract farming, the farmers benefit because Project Alba guarantees in advance to buy the produce from them and also provides necessary tools, inputs, and advice with no up-front cost. Project Alba then resells the collected produce to regional wholesalers. Since the project began in 2010, farmers have delivered **178 metric tons of high-quality vegetables** to markets in Cambodia. The innovation of Project Alba lies in three key elements: (1) it introduces new crops, (2) it offers farmers personalized progress, and (3) it disseminates best-value technology for small-scale farmers (Project Alba, 2018).

Waste to energy: Biomass gasification and biogas

Waste from biomass offers a good solution to the high cost of energy that food manufacturers face. At the same time, this waste from biomass or manure is readily available in close proximity to factories, addressing the limited grid access of many food manufacturers in Cambodia. The biomass is usually

burned to produce heat or steam, which starts a generator for electricity, or simply left to decompose to produce biogas.

Rice millers, such as Angkor Kasekam, and some pig farms, such as Mong Reththy Group (MRT), use rice husk gasification or biogas from animal waste to produce a lot of energy. In 2012, Angkor Kasekam set up a rice husk gasification system of 2 Mw and sold surplus electricity back to rural electrification entrepreneurs (Angkor Rice, 2018). MRT uses animal waste from its pig farm to produce biogas for its factory (1.5 Mw) and bio-slurry to partly cover the fertilizer needs of the plantations. At the same time, the factory uses palm oil waste for gasification, producing 3 Mw of steam for palm oil processing. Additionally, it provides energy for 15 neighboring villages and offices around the plantation. However, some companies have raised concerns about the adaptability of foreign equipment and health issues related to the residue of husk gasification. Also, due to lack of information on the expansion of the electricity grid, private-sector investors have apprehension about going any further (Mong Reththy Group, 2018).

4. LESSONS LEARNED

A country once known for conflict and poverty, Cambodia is now one of the fastest-growing economies in Asia, with a projected growth of 7.1 percent for 2017 and 2018 (ADB, 2017a & Grey, 2017).

Cambodia, like many countries in Asia (for instance, Thailand and Vietnam) is on its way toward becoming a more industrialized country that does not just rely on its agriculture sector (ADB, 2017a & 2016). However, in order to strengthen the agriculture sector, which is one of the biggest employers and GDP contributors, the country should pay attention to some existing barriers. The removal of these barriers would create a more investment-friendly business environment and accelerate the journey of the country toward making its food system more resilient. These barriers include the following:

- 1 Limited information and guidance: As mentioned earlier, limited access to information and guidance on appropriate technologies, combined with resistance to change, is a huge barrier to private-sector involvement in the agriculture sector. It is very difficult to break traditional habits, for instance monoculture farming, because the Cambodian people are very attached to them. This resistance increases the private sector's cost of introducing new products because companies also need to invest in behavior change activities. An unfavorable investment environment is the reason that the donor community is very active in providing information to farmers and working to change their behavior. Adoption of smart technologies, such as smartphones and Internet activities, to accelerate access to information could be a game changer in boosting agricultural productivity and resilience in a sustainable way.
- 2 Finance: Farmers are using their own savings, remittances, and loans from savings groups to finance investments in agro-technologies, especially mechanical technologies. However, at present, due to the large size of the informal sector and the lack of appropriate financing products from formal banks and microfinance institutions, some climate risk solutions do not get access to financing in Cambodia. Hence, even in the risk financing arena, most of the time the only source of financing available is donors or development partners. Adoption of the much-touted

blockchain technology could be a solution to expand rural finance. This technology could make financial transactions more accessible and less expensive, allowing farmers and others throughout the value chain to manage their supply chains more efficiently (Ehui, 2018).

3 Limited availability of technical solutions: The country needs technologies that reduce the cost of farming and the cost of energy for farmers and private-sector food manufacturers alike. The available technologies, such as rice husk gasification, are difficult for the majority of the Cambodians to adopt because they mainly involve imported machinery that is very expensive to procure and install; maintenance and spare parts are also not cheap. Hence, the Cambodian government should prioritize and encourage adoption and innovation of appropriate agricultural technologies, as the governments of Brazil and Vietnam have done (IFPRI, 2016). At present there are few educational and training facilities that train people on human-centric design thinking.

4 Government will: From the standpoint of supporting the environment, the most imperative factor is the support of the government in terms of strategy and policy. The Royal Government of Cambodia has shown great interest in developing its agriculture sector, with a vision of making the country more food secure. This is apparent in the Rectangular Strategy Phase III (RGC, 2013b), in which the government has included agriculture as one of four priority areas, alongside infrastructure, private-sector development, and human resource capacity building. The Rectangular Strategy is accompanied by other national development plans. However, the government should focus more on implementing these strategies and creating an improved business environment for the private sector to invest in the agriculture sector.

5. CONCLUDING REMARKS

Unless the structural and institutional constraints on agricultural and rural development are addressed, Cambodia will witness a slowing of economic growth and poverty reduction. The constraints mentioned earlier—such as poor infrastructure, insecurity in land tenure, low productivity, market failures, a poor enabling environment for business, and lack of access to finance—hinder private investment and, in turn, hinder access to new markets, as mentioned earlier (ADB, 2012). Strong agricultural productivity growth; increased private-sector investment; and enhanced partnerships between government, the private sector, and civil-sector stakeholders are common factors in food system transformations. This discussion paper aims to demonstrate the significant role the private sector plays in building the resilience and adaptive capacity of food systems to face various internal and external shocks, such as climate hazards, difficult access to finance, and so on, taking Cambodia as an example.

Providing access to better technology, markets, credit, and perhaps most important, knowledge can make farmers more likely to work on their land than to migrate to neighboring countries such as Vietnam and Thailand. With the support of the government, as the private sector invests in these new markets, Cambodian farmers, who have some of the lowest paddy yields per hectare in Asia, could have access to better agricultural resources to boost yields (ADB, 2017b). Interest and investment in various aspects of food systems, such as production and agribusiness, are growing in Cambodia, as confirmed by a variety of new initiatives in these areas. Various traditional and nontraditional food-system actors, such as multinationals, civil society groups, and governmental and intergovernmental organizations, are shaping the future of food systems in Cambodia and working toward defining their vision of sustainable growth and healthy food systems in the country by 2025.

There are huge new business opportunities for the private sector to invest in the agriculture sector and the extended food system of Cambodia to make it more resilient toward unforeseen internal and external disturbances. The private sector, for instance, can invest in developing and strengthening the provision of information and communication technology services to boost high-quality, climate-resistant

agricultural inputs (resilient seeds, organic fertilizers), risk-coverage services (crop insurance, microcredit), and dissemination of sustainable farming technologies (seeders, weeders, irrigation systems) along the value chain (IFPRI, 2016). Private-sector intervention in food system strengthening can also be significant if the government provides a mature business environment like that of neighboring countries Thailand and Vietnam, which have strong private sector-led economies (Abonyi, 2013 & IFPRI, 2016). Cambodia should also grab the opportunity to utilize its extension services, with the involvement of the private sector, to promote nutrition education programs to improve the nutritional status of its citizens, as Brazil and Viet Nam have done (IFPRI, 2016.)

Combining the agriculture and energy sectors could also result in a significant, profitable opportunity for sustainable agriculture. As agricultural waste, such as rice husks and corncobs, is processed in gasifier systems, the resulting energy can be used in the industry itself and its excess sold on the national grid. This strategy would not only reduce the cost of production but also make Cambodian agriculture products more competitive on the global market.

Overall, Cambodia presents a favorable environment for private-sector investments. Given Cambodia's unpleasant history of civil war, the government has put a lot of effort into developing the country, such as prioritizing diversification and industrialization as key development priorities when Cambodia integrated into the ASEAN Economic Community in 1991 (RGC, 2013a). This new single market in Southeast Asia will allow Cambodia to benefit from the free-flowing economy in the region.

Cambodia, along with other developing nations, has very high stakes in achieving food security and sustainable agriculture. Cambodia's food system transformation process will accelerate through a combination of strong food system policies and reforms that support smallholder agriculture; increased investment in agricultural research and development, specifically for technology-driven agribusiness; and access to finance, all of which, in turn, will also support nutritional diversity.

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