Chapter 7 | Food[7]

Ms. HOY Sokkea

Consumer Narrative: Ms. Sopheak Jing is so occupied at work that she forgets it is time for lunch. Thankfully, her smart watch alerts her to the time and suggests a few options based on her eating history. Having found a particularly well rated Kampot Pepper Crab stew, Sopheak taps to order and awaits delivery. Unlike times of old, her meal is prepared in the newly established KitchenLab where robotic chefs create dishes from a vast pantry of raw ingredients. Once cooked, meals are transported to the destination by a fleet of driverless tuk-tuks. Packaging is complete with a QR code that contains information on the origin of produce alongside nutritional information. She picks up her phone to scan the QR code and finds out that the farmers were from Kampot (crab), Kampong Cham (pepper) and Battambang (rice). Should she wish to explore further, she can see how long the pepper and rice took to grow and understands which types of fertilizers and seeds that were used.

Producer Narrative: Mr. Visal Hak owns a 50-hectare farm. He grows various crops including rice, pepper, corn and a cassava. Orders for his produce are

[7] **A note from the author:** This chapter will explore the concept of Future Food in Cambodia through the consumer and producer lenses. On the consumer side it will explore a generational shift in food preferences and delivery; considering the dominating role that technology is envisioned to play. From the producer side we will then consider how this consumer demand can be met in the Cambodian context. From this vantage point we are interested in the growing cultural relevance of food in the kingdom, beyond the standard discussion of agricultural processes and logistics, and instead towards the Khmer heart of the matter.

made through a platform on his smartphone developed in a public-private partnership to address food scarcity, access, and farmer equity. The application will match him to suppliers, consumers, and support personnel when needed. Hak divides his farm into different plots based on the level of land, the type of soil, the nutrient content of the soil itself, and the proximity to other farms. Information on these matters is continually collected through a range of ground sensors and drone mapping processes. In addition, Hak has employed a smart irrigation system that works alongside AI robotic instruments that are able to take remedial action in the case of a substandard change in the environment.

I. Future Food: The Ideal Scenario

The above scenarios discuss how Cambodian consumers and producers will interact with the food process in 2040. In order for these narratives to bare out anticipated realities, there must be actions across the supply (producer) and demand (consumer) sides. Accordingly, this chapter will explore the supply and demand side constraints, realities, and opportunities.

Demand Side

The demand for food is driven by a set of common factors, such as population dynamics, disposable income, prices, and consumer preferences (FAO, 2014). The world's population is projected to be at nine billion by 2040 (UNDESA 2015). In light of continued income growth, the consumption of meat and other foodstuffs per capita globally is projected to increase (OECD-FAO, 2019). Technology has allowed for more efficient and cheaper food production, which in turn has resulted in increased demand. The key factors concerning food in 2040 fall into three categories: health, social, and functional.

Higher income earners are better placed to take health into account when making decisions on their food purchases, with the demand for quality food increasing accordingly (Wharton, 2015). Safety will become a key element, with all food providers complying with the kingdom's health standards. To this end, a national food standards agency has been established to deliver consistent and quality oversight around the production, transport, and consumption of food products. Better educated, more health-aware consumers will make decisions on food

purchases based on factors such as technology allowing for easier calculation of nutritional needs and insurance companies incentivized to ensure people stay healthy. Food, aside from being a basic need, is also an individual and social experience. It has been predicted that "eating" as we currently understand it will no longer be necessary in the future, with the taking of tablets enough to meet nutritional requirements (Farrimond, 2019). Cheaper supplements will become a more widespread solution to nutrient deficiency in Cambodia.

However, culturally, Cambodians cook and enjoy food in each other's company: With humans being social creatures, it would not be as pleasurable to get together to merely ingest pills. Bonding through food has long been a rich part of Cambodian culture, and this can be seen in traditional festivities such as Pchum Ben, Khmer New Year, and Water Festival, in which strangers gather to celebrate and eat together. This will continue in the years to come, and with a greater variety of food available to enjoy based on taste and values; such as a vegan lifestyle being better catered to.

The kingdom will also have enough information on market demand to be able to supply the market with what is needed, when, where, and by whom. The orders of raw materials that currently need to be placed a few months or more ahead of delivery will only take hours given the upgraded infrastructure vastly improving delivery times. Food standards will also have improved, with consumers demanding products with quality assurance stamps and QR codes allowing easy traceability.

Supply Side

To meet the aforementioned demands, key factors including farming practices, food science, and financing will have determined the ability to supply market demand.

To feed the population and/or export to other markets, Cambodia will have learnt how to utilize less labor yet produce greater outputs by employing new methods of cultivation. The employment of technology will offset a lack of labor in the food industry, with food waste/loss minimal. Future farmers will be digitized and able to manage their farms with higher productivity and greater

efficiency. Plant-based and "laboratory-grown" meat and insect-derived protein bars are just some examples of developments to meet a growing need for food and offset predicted future limitations. Cambodia will have in place an effective committee comprised of public and private sector entities and research institutions to carry out studies into new forms of food to meet the needs of the population in both taste and quality. The underprivileged will have access to affordable food supplements to make up for a lack of nutrients. To do this effectively, heavy investment and incentivization should be put in place.

To have moved up the food industry's value chain, the purchasing of local Cambodian produce for processing into the finished product will be less expensive. The kingdom will also need to have met other challenges, such as high electricity and logistics costs[8]. Energy costs will be lower to allow for profitable production. There will be an increase in renewable energy sources, with the aforementioned traceability able to ascertain whether a product is environmentally friendly. With future consumers taking into account the sustainability of what they buy, being able to produce food that takes into account climate change impacts will allow for increased Cambodian sales. The kingdom's more efficient sourcing of energy and competitive production will drive down prices as technology allows for reduced energy consumption, resulting in higher quality food at lower prices.

One of the main difficulties Cambodian rice millers face, for example, is a lack of financial resources. Securing financial support for investments in high-risk sectors such as food and agriculture is a crucial part of providing food security for the general populace, especially to prevent people from falling back into poverty. Aware of the importance of this, by 2040 the Agricultural Bank, currently known as the Rural Development Bank (RDB), will be lending to eligible agro-processors for investment in processing local food with low to zero interest rates. Processors would then be able to make profits and gain further expertise in operating efficient facilities to produce food affordable for the local poor to purchase, helping reduce poverty in the country. The ability to produce at low

[8] These issues are discussed in greater deal in Cambodia 2040 Volume 1. Economic Development.

prices will also enable Cambodia to compete in international markets. This will incentivize Cambodian farmers to become more innovative.

Cambodia will have developed its transportation system to allow for the improved movement of products around the country. Rapid routes for trucks equipped with the cold chain system will accommodate the needs of both local and international customers. Greater volume at airports and deep seaports will also be largely available, not just for passengers, but for the shipping of products in and out of the country, with advanced technology tracking specific shipments for security and tax revenue reasons. With well-connected routes and the use of future means of transportation, such as driverless trucks, Cambodia will be able to deliver its food faster and more cheaply. Cambodia will comply with food safety standards by making products traceable back to the farm. The kingdom will have in place a warehouse system able to trace every aspect of what is considered food. To allow for this quality assurance, technological advancements in genetic testing, pesticide residue measurement, and bacteria prevention, to name just three, will be in place. Digitizing every document on different products to determine in which category and in which province, and for which price and for which customers will be a common practice.

Cambodia will have fully implemented smart city schemes in three main urban areas, Phnom Penh, Siem Reap, and Battambang; with the aim of increasing connectivity, digitalization, and incubate progressive start-ups. These projects will bring important results on improving connectivity between rural and urban Cambodia. Such connectivity will lead to improved smart irrigation management, optimal GPS use, and data collection, as well as improved logistics, thereby leading to further ideal food transactions and business practices. Cambodia will also be connected with other ASEAN cities on food trade that will allow supply and demand equilibrium that will address one of the future urban issues faced by the city poor.

The future is predicted to bring revolutions in biotechnology and information technology (Harari 2018). This could make the world more prosperous or result in many people in many countries becoming redundant if they fail to adapt. The Cambodian food industry should therefore make use of the technologies

available to introduce healthy, nutritional new tastes to the world. As today, the population in 2040 will be predominantly young, with around 50% of people under 30 (WorldPopulationReivew, 2019). This human capital will play a crucial role in developing new technologies that can help grow the Cambodian food industry to where it can meet the needs of its people as well as export abroad.

II. Scenario Space and Key Factors for Food

Agriculture and food have not only been the main drivers of the kingdom's economy, but they are also a way of life for Cambodians and will likely continue to shape and affect them. These sectors have helped promote economic growth, reduce poverty, and ensure national food security (WorldBank, 2019). They have been prioritized in many important government policies, including the Rectangular Strategy-Phase IV, the National Strategic Development Plan 2019-2023, and the Industrial Development Policy, to name but three. As Cambodia has continued its economic expansion and development, the share of agriculture in both GDP and labor has gradually decreased (WorldBank, 2019).

The kingdom was one of the few countries not impacted by the 2008 global food price spike, and it took that opportunity to leverage agricultural growth (World bank, 2015). Likewise, with production and consumption that takes into account the main factors driving the food industry, the livelihoods of Cambodian people can be improved.

Demand Factors

Food, of course, also serves the functional purpose of providing the body with the necessary energy and nutrients, something the underprivileged can find difficult meeting. Cambodia has achieved seven percent economic growth over the past decade, with poverty reduced to 13.5% in 2014 from 47.8% in 2007 (World bank, 2019). However, around 4.5 million people remain near-poor and vulnerable to falling back into poverty if exposed to economic or other external shocks (World bank, 2019). Economic growth may be a necessary ingredient for sustained poverty reduction, but it does not necessarily benefit society's poorest. Illuminating the question of how the benefits of economic growth can and do reach the poorest enables policy-makers to more effectively promote pro-poor

growth, and to implement policies to protect the poor from the potentially adverse consequences of growth (Hoy and Samson, 2011).

It is estimated that no fewer than eight out of ten of those living in the lower Mekong basin are dependent on the river for the fish catch taken from the river or for its role in agriculture and horticulture. And up to 80% of the Cambodian population's animal protein intake comes from the fish caught in the Mekong River system (Osborne, 2019). In 2019, a sustained drought in southern China and mainland Southeast Asia brought water in the Mekong River to its lowest levels in 30 years. This disturbing development has focused attention on the major changes to the river's character stemming from constructions of hydroelectric dams. The dams can reduce the amount of sediment reaching the Mekong Delta by up to 97% that can obstruct the flow of nutrients that support agriculture and reduce fishery biomass by up to 80% in 2040 (Pawar, 2019).

Food accounts for almost half the total consumption of Cambodian households; from 2009 to 2017, monthly food consumption in Cambodian households increased 75% (CSES 2017). The ability to predict demand can help eliminate food waste in the system and increase reliability in sourcing supply (de Moraeos et al., 2020). Without the knowledge needed to be able to respond to the market, Cambodian suppliers would have to wait for orders and be unable to guarantee meeting demand. Cambodia would also be a heavy consumer of imported food products, which would be expensive for lower income earners, who would then need measures from the government to address their nutritional shortages.

Supply Factors

Farming practices. Labor and skills will be key elements defining the success of all businesses in the country, not only those in the food sector. Heavy investment will be needed today in developing human capital to address the rise of automation that will remove many unskilled jobs from tomorrow's labor market. Without such investment, Cambodia will find it increasingly hard to climb the economic ladder. Smaller-scale farmers leaving agriculture for employment in other sectors will result in the expansion of the remaining farms, allowing for the more efficient deployment of technology. Labor in agriculture has decreased from 48.7% in 2013 to 37% in 2017 (MoP 2017), with this decline

predicted to continue as more and more people move away from the fields in search of jobs in the cities and neighboring countries. Agriculture's share in GDP has also decreased from 30.7% in 2014 to 23.5% in 2018 given rising sectors such as construction and services. The tables below show recent trends in agriculture.

Table 1: Agriculture as a Share of GDP

	2013	**2017**
Total labor force	7,951,000	10,416,000
Agriculture (%)	48.7	37
Industry (%)	19.9	26.2
Service (%)	31.5	36.8
Others		0.1

Source: Ministry of Planning, Cambodia Socio-Economic Survey 2017, dated November 2018

The development of food science will be a key factor in determining the availability of food options for the differing income brackets of the population. With Cambodia currently using traditional farming techniques, it will be crucial that the necessary human resources and facilities are put in place to allow the food industry to flourish. However, data from 2014 shows that fewer than six percent of Cambodian university students were enrolled on a science major, such as biology, while 46% studied accounting, finance or management (World bank, 2014).

Profitable agro-industry and financing will be able to relieve the burden of high food prices via cheaper processing costs. The food industry in Cambodia is a complicated system in which machines are not optimally used due to seasonal produce availability (Song, 2019). Guaranteed sales and prices are needed before farmers will run machinery to full capacity. Economies of scale are lacking, which makes investing in the food industry less attractive than other sectors

(Song, 2019). This market failure can be addressed with government interventions such as cheap financing and infrastructure availability such as the cold chain systems.

Infrastructure consisting of different stages, from transportation to logistics, to energy sources, will play an even more crucial role in food development. Were less to be invested in improving infrastructure, Cambodia would still have adequate roads due to their importance in driving the economy. However, the kingdom's roads would not be equipped for convenient food logistics, with this hampering the efficient operation of the sector. In addition, the efficiency of farm operations would then be limited without access to necessary equipment such as smart greenhouses that allow for the optimal time of harvest, proper input applications, and appropriate water usage. Cambodia could still increase its quality control systems despite a lack of focus on improving infrastructure by adopting those of neighboring countries. However, this would be made less efficient, with malfunctions slow to fix, the confused traceability of products, and even simple issues becoming costly. Lower energy prices are a major factor in driving down the cost of food.

Energy. Renewable energy policies should play a significant role in enabling competition in the market to bring down the cost of electricity. Electricite du Cambodge (EdC), the kingdom's main energy supplier, should be challenged in the market by other entities. Without policy that brings about increased private sector investment, Cambodia will continue to pay more for energy than its neighbors in the region. Greater renewable energy will be available given the impacts of climate change and that Cambodia has to meet the international renewable energy standards. However, the kingdom may only be able to do this to a certain extent. To mitigate the impacts of climate change, Cambodia will need to utilize smart irrigation that will not only save water but allow food to be grown more efficiently. It is important to note that drought-resistant crops are being developed to cope with a changing climate, with the supply of water becoming more expensive in Cambodia as it becomes scarcer.

III. Policy Initiatives to Achieve the Ideal Scenario

A comprehensive road map is required for Cambodia to achieve the best food sector scenarios as described, with the steps needed to be taken now so the kingdom is not to be left behind in 20 years' time outlined below. Detailed steps in key factors—market consumption demand and production that utilizes improved farming practices, a workforce with upgraded skills, the employment of food science, and improvements in agro-industry that would be ideal with the presence of good infrastructure and sufficient energy—will be needed alongside strategies to protect intellectual property rights and measures to cope with climate change.

Demand Side Policies

Employment of technology. Smart watches with tracking technology will play a critical role in informing people when and what to eat based on information on their health. Even a smart watch today can tell heart rate and blood pressure, as well as act as a fitness tracker, but they are predicted to soon be able to be sensitive to human emotions, understand nutritional needs, and alert the wearer to health problems. The employment of artificial intelligence (AI) will enhance lifestyles, with people willing to risk their privacy for the resultant health benefits (Harari, 2018). This area should be driven by the private sector, which is incentivized to better understand demand and so best able to supply products and services; however, the government should ensure the information collected is not used for purposes not agreed to by those using them. The key steps to take are:

- As an initial step, the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Health (MoH), the Ministry of Interior (MoI), and the Ministry of Posts and Telecommunications (MPTC) should develop detailed consumer protection laws to address this, especially with regard to technology platforms, with heavy punishments for companies that manipulate data.
- A working group of information technology and biotechnology experts should be formed to ensure the effective implementation of such laws.

- Health insurance companies should be encouraged and subsidized to utilize health tracking information via food consumption data as they are incentivized to keep their customers fit and healthy.

Food safety. To satisfy the local and international markets, Cambodia has to meet food safety standards. Food safety has long been a major public health concern in Cambodia. The *Khmer Times* reported that in 2016 alone, there were around 1,000 cases of food poisoning in the kingdom, with studies on the impact of unsafe food in Cambodia having never been carried out.

The excessive and inappropriate use of pesticides in Cambodia's farming practices negatively impact public health, presenting dangers to consumers in Cambodia who have few other options. Cold chain systems that play a crucial role in maintaining food quality are not widely available, with wet markets considered to sell fresh produce often not meeting food safety standards. It is clearly visible in wet markets in Cambodia that there is no segregation of meat and other fresh/dry foods. The Asia Development Bank conducted research in 2008 where wet markets were commonplace for cross contamination risks. The report continued on to point out that although large animals were not slaughtered at the market, poultry and fish were slaughtered with no separation between retail and slaughtering (dirty and clean) and water for the slaughter process spilt into the very narrow and uneven walkways leading to difficulties in cleaning (ADB, 2008).

More than a decade later today, the experience in Cambodia's wet markets, a common food place for locals, has not changed much. Inter-ministerial Prakas 868 on Food Safety in Cambodia is still loosely implemented, with a lack of quality checks at food production facilities, while the Law on Food Safety, which aims to cover a wide range of food safety aspects, is yet to be approved and implemented. A lack of food data presents a challenge to the implementation of Prakas 868 and the Law on Food Safety. Outlined are some key steps for achieving food safety standards for both the local and international market.

- The Law on the Management of Pesticides and Fertilizers must be strictly enforced, with serious checks made on the import of hazardous pesticides that do carry labels in Khmer. MAFF officials should punish breaches of the law with the provision of fines.

- Good Agricultural Practices (GAP) - as defined by FAO, are a "collection of principles to apply for on-farm production and postproduction processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability." - should be implemented countrywide, and quality control must be made available, with products labelled as such.
- The implementation of food safety standards should be enforced by market authorities closely connected to traders. Daily random checks on stalls are feasible if implemented by local market personnel.
- The MAFF and the Ministry of Commerce (MoC) should train vendors to recognize unsafe ingredients in food, as well as give them trusted advice. Random checks can be made by higher authorities at the MAFF level to regulate common practices.
- Slaughterhouses are the sources of viruses that lead to pandemics such as Severe Acute Respiratory Syndrome (SARS) or Novel CoronaVirus or COVID-19 and should be closely monitored.
- Food science researchers, MAFF, and the private sector should invest in available technology that allows data collection on the contents of food products, the location of suppliers, and safe preparation methods.
- The education of the public via public food safety forums would also play a crucial role in raising awareness of the issue.
- The creation of a top-quality wet markets that compartmentalize different food sections and is equipped with reliable cold storage will also need to be put in place to maintain food quality and freshness. The MoC should attract investment in the food hub/market by subsidizing rental fees and land use, but in turn require investors to install refrigeration for retailers.

Food for poverty reduction. Some key steps in using food measures to reduce poverty are outlined below:

- A reduction in food prices will serve as a social protection mechanism preventing the near-poor from falling back into poverty. Making healthy food affordable is also a policy measure that would tackle preventable health problems that result in avoidable government expenditure.

Therefore, branches of government such as the Ministry of Economy and Finance (MEF) and MAFF should work with emerging companies such as Agribuddy, Farmforce, and BlocRice, to name just three, and invest in their growth as they have the means of reducing the price of food while increasing quality via their wide network of farmers and consumers.

- Food supplements that help meet nutritional needs should be developed and made available at low costs for the less affluent. Food may be a social and leisure experience for the better-off, but for those on lower incomes, it is a basic need to ensure sustenance and physical development; therefore, certain food products should be developed and made available for this group. The debate will center on how to make sure it is only the underprivileged that benefit from these products. The answer will lie in a process that discourages the more affluent from wishing to take supplements instead of enjoying traditional meals. Further measures to reduce food prices will be illustrated in the section on profitable agro-processing.

Supply Side Policies

Enhancement of farming and agri-business techniques. The ability to efficiently make the best use of inputs to create maximum outputs will be the main factor determining success in producing food. Some key steps to take are:

Farm level:

- Setting clear policy as to the distinctions between public and private extension services that are incentivized differently to minimize inefficiency and incorrect practices. The government can provide training to inform suppliers on applications that have been researched and developed by independent agencies, for example. The suppliers can then spread information to farmers with whom they interact with every day. However, this could allow for unethical conduct, with unscrupulous suppliers pushing the sale of inappropriate products by telling farmers they were needed to increase yields.

- Incorporate the applications created by tech companies that manage farming practices, such as calculating the correct usage of pesticides and fertilizers and clearly indicating the amount, time and on which crops, specifically for the Cambodian soil and climate. MoC and MAFF should encourage this type of investment by providing free field testing, staffing, the data available on the current practices, and expertise on best practices. Lead farmers can then be trained on how to properly use the technology and thereafter pass the information on to their peers.
- Mainstreaming information and knowledge dissemination through various extension services from both the private and public sectors. An extension service should be formed at each village, either at the input retailer or local government. These groups should be equipped with applications that allow the management of the aforementioned farming practices.

Market level: Blockchain technology that independently records information and transactions between different players in the food market can act as a platform to optimize market demand and supply. Oxfam Novib in Cambodia has facilitated BlocRice technology, which allows organic rice farmers in Preah Vihear province to produce and supply to the international market. Each step of the transaction from farm to supermarket to consumers is fully captured. The size and number of orders made via the system, importantly, allows producers to make an informed decision on what to grow, when to harvest, and to whom to sell. However, this practice is still at a very early stage of utilization of technology that reduces the dead weight loss in the rice sector and challenges are still pervasive. The key steps are as follows:

- The lessons learned from BlocRice – such as challenges faced during the application process including violation of contracts by farmers, low skills of farming and the lack of data on drought/flood - should be remedied and expanded to other crops and agricultural products in Cambodia. Agribuddy, another example of a home-grown technology company that targets food production in Cambodia, has implemented an application whereby farmers, input suppliers, bankers, and consumers are gathered in one place to make transactions. The government should encourage

such businesses and incentivize their continued growth by providing financial support and allowing them to operate without being taxed.

- Improve data collection via new investment in available technology; form a team led by the Ministry of Agriculture, Forestry and Fisheries and the Ministry of Commerce to collect data from all producers in the country.

Advanced development of food science. To support the aforementioned new and innovative farming techniques, it is crucial that food science and agronomy are expanded on and developed, with studies and research carried out at universities. Here are the key steps:

- MAFF must increase funding for projects carried out by researchers at the Royal University of Agriculture and other universities. The collection of data specifically on Cambodian soil conditions alongside with the employment of available technology developed by more advanced countries would allow an informed decision on both current and future farming practices. This would also make the most of the human resources available to support the future of the Cambodian food industry.
- The Department of Drugs and Food at MoH should further accommodate food technology, with more research and development conducted on specific active substances in the food grown in Cambodia. Food biotechnology and biosecurity are critical subjects, and their study must be encouraged.
- With ethical behavior playing a critical role in developing food, investment in technology alone will not suffice if learning does not come with an understanding of ethics. Ethics in food development takes into account environmental impacts, animal rights, and social development. Such issues will become increasingly important and will require Cambodian food production to comply.
- Universities and companies teaching computer engineering should add ethics to their curriculums. It may take a long time for this to take off, but it would be an investment made today for a better tomorrow. In a decade's time, Cambodia will have reaped the benefits and there will be better practices.

Agro industry and financing. To achieve the goal of cheaper food, costs need to be reduced. Policies to correct market failure in this sector need strong measures and penalties to avoid regulatory capture and rent seeking. In order to reduce costs, public investment needs to be made via different streams. First, the government should not tax the agro food processing industry, which is forever at a stage of infancy, merely for reasons of targeted economic growth. In early 2019, the government introduced a suspension of profit tax prepayment for the agro-processing industry in Cambodia. The government should measure the success of this measure and draw lessons learnt accordingly. Below are some further key steps to take for the industry to flourish:

- The agricultural bank and the SME bank should, for example, provide loans to food processing players needing to employ the latest technology to drive down costs on post-harvest losses. Approximately one-third of food produced for human consumption is lost or wasted globally, around 1.3 billion tons per year (FAO, 2011). According to the same source, more than 40% of food losses occur post-harvest and during processing in developing countries. Purchasing raw materials from local producers also needs to be made cheaper to drive down costs. The Rural Development Bank, established by the Royal Government of Cambodia—which will have been converted into a commercial agricultural bank to assist government policies on agriculture—gets funding every year from MEF, such as for emergency loans. However, these should not be labeled "emergency", rather annual budgeted spending that targets improvements in food processing.
- In addition to making these loans available at competitive rates, the government should ensure that they are provided to processors with a genuine competitive edge to optimize their operations. To do this, clearly defined steps to screen eligible processors must be put in place, with the competition law fully implemented.
- To carry out this policy, restructuring the bank by recruiting experienced and competent experts who are properly incentivized is key. As well as using government funding to drive down the costs of production, investing should also be made convenient for private investors both inside and

outside Cambodia. Food investment hubs can play an important role in negotiating financial investments from different sources into the food industry. While the Cambodian stock market is still in its infancy, these have been in play around the world for centuries. With financial technology (fintech) a complicated emerging industry that not many people fully understand, artificial intelligence will therefore be a better fit. Here are some key steps:

- Cambodia must catch up quickly, and the government, MEF, and the National Bank of Cambodia (NBC) should form a blockchain association or encourage the creation of one. This will serve the specific purpose of enhancing expertise in the sector. This would not only bring more suitable investments into the food industry but also in other sectors. In addition, regulations will again be important role encouraging and protecting private investment. Algorithms that calculate the ability to invest, borrow, and save will be needed by both the public and private sectors. If Cambodia wants to encourage greater investment in the food sector and other industries, it will need to maximize learning in this area.

Food infrastructure. Investment in skills is crucial in ensuring a bright future for the country, and not only in the food industry. However, the necessary infrastructure will need to be in place to gain the most from these skills. Here are some key steps to develop infrastructure for the future food industry in Cambodia:

- Cambodia should set up food laboratories available for testing in various food categories and shift focus away from what is already in the fields today to facilitate this more efficiently. The growing of rice, vegetables, and industrial crops, and the raising of animals on farms will be less relevant in the future, when land will be scarce.
- Energy plays an important role in the food industry. Current energy sources are divided into hydropower, biomass, and coal. Hydropower, which is currently the source of around half of total energy (EAC, 2018), is a somewhat risky given its dependence on the Mekong, a river system that is likely to be heavily impacted by climate change and geopolitical issues (which are not going to be discussed here). Evidence for this can

be taken from the shortages of electricity throughout Cambodia in March 2019 when there was not enough water to generate power. The kingdom should continue to raise the bar in clean energy production, with the right policies put in place to encourage investment.

- EdC should create new sources of sustainable energy. This will not only play an important role in the food industry but all other sectors if Cambodia wants to become self-sufficient.
- EdC and the Ministry of Mines and Energy (MIME) have made a commitment for electricity to reach every household in Cambodia by 2030, with the share of solar energy-generated electricity coming into the grid to increase to 20% before 2022 from less than five percent in 2019 (Keo, 2019). These are positive steps; however, the government should encourage further investment from players other than EdC to encourage faster innovation.

Cross-cutting Policy Requirements

Intellectual Property Rights. It will be difficult to develop the best possible innovations for future food production in Cambodia if the kingdom allows inventions to be copied without proper recognition. Without the protection of intellectual property (IP), innovation will be constrained in all sectors, but the food industry will be particularly affected.

It is easy to ignore the protection of IP in DVDs, in books, or in clothing design, but if IP in the food industry is disregarded, real human development and lifestyle enhancement will be jeopardized. Cambodia will not be able to attract investment in food technology from either inside or outside the country if IP protection is not properly implemented. However, while IP protection in food supplement development, for example, is important to implement, it is also very difficult to ensure. When the lower income segments of the population will depend on food supplements to fill their nutrient needs as mentioned throughout the chapter, IP violations regarding illegal copy of samples of these products may take place. However, to go deeper into flavors, ingredients, designs, color combinations, and the packaging of food products that are mixed with many other micro-elements make protecting food IP rights complicated.

Set out below are some of what Cambodia can put into practice to ensure the safe future of the food industry in Cambodia:

- AI will act as a patent screener, inspector, and analyst. For all the micro ingredients that go into each innovation, food will be scrutinized and investigated before the rights are given to anyone. The program will analyze and look through the massive amounts of data that will have been collected, not only in Cambodia but worldwide. The kingdom will not only trade food within the country but will do so with other parts of the world; therefore, abiding by IP rights protection will become more and more important. The employment of AI will enable the traceability of the invention, with better accuracy in pinpointing the sources and thereby providing better accountability.
- Whole new varieties of devices will likely aid IP protection, and maximizing such technology will depend on the investments Cambodia makes today in collecting the available data on the combinations of food ingredients and genes, and creating a learning space that will prepare for the future.
- Besides the tools needed to protect IP rights in the food industry, putting in place laws and regulations that work alongside these will be crucial. IP rights protection in Cambodia is currently on an upward trajectory, although it remains constrained by many factors. The expansion of IP rights protection into further areas, particularly food, must be accelerated if Cambodia is to catch up and then be on the front line of innovation.
- This will have to start with the understanding that IP rights in food will be a must in the future, and that Cambodia needs to start taking steps to ensure their protection now.
- Measures the government and other bodies can take are to put greater financial and human resources into the sector to enhance the current management system into one that will be able to use technology to efficiently tackle IP issues in a complicated food sector.
- The employment of technologies as tools to both develop and protect IP, backed up by the strict enforcement of IP rights violation laws, will

only be fully effective when people are educated as to why the issue is important. Changing mindsets will necessitate convincing the general populace. Steps, including regularly conducted discussions and utilizing educational spaces, should therefore be taken to embed the importance of IP.

- IP rights protection is an alien concept at the moment because most people do not see the harm in flouting it. However, the harm will be realized when the rest of the world rejects Cambodian food products—and by then it will be too late, with competitors already ahead and the opportunity missed. Reaching the ideal future scenario should be the goal of every country that wants to develop to its full potential.

Climate change. While climate change will be a huge challenge that everyone will have to adapt to, its impacts will likely push today's poorer farmers out of the system. The farmers of the future will be those who own extensive land and are equipped with the knowledge and skills needed to excel in the food industry of the 21st century. The children of poorer farmers, unlike today, will no longer be able to work abroad and send remittances home, unless they possess needed skills, as automation replaces unskilled labor. The world will be taking serious climate change measures that every country in the food trade will have to abide by. Cambodia will need to prepare for such tremendous changes. It is therefore crucial to invest in clean energy and green food production now, learning from mistakes to be operating fully efficiently in the future. Smart irrigation systems, land intensification, drought-resistant crops, and food wastage reduction mechanisms are just a few examples of the measures to be taken as part of climate change adaptation efforts. In addition, the current lack of fish supply and the blockage of sediment necessary for agriculture is anticipated to become worse in the future as a result of the continued construction of hydropower dams along the Mekong. The measures needed to be taken to mitigate these issues are, however, too broad a subject to be explored in detail in this chapter.

IV. Food Under the Baseline Scenario: Business as Usual in 2040.

Demand Side

Cambodian consumers take health factors into consideration when choosing food, ahead of price or whether it is organic. However, the availability of healthy food in the market is limited. Small- and medium-sized enterprises (SMEs) are urged to adopt food safety standards such as the Good Manufacturing Practice (GMP), HACCP (Hazard Analysis Critical Control Point) and ISO 22000. However, it was estimated in 2008 that of 530,000 SMEs operating in Cambodia, only 30 met such standards (Cheng and Spengler, 2016). In 2016 there were around 1,000 reported cases of food poisoning throughout the country.

Cambodia will have the Law on Food Safety in place by 2040 but lack detailed action plans if information regarding the food chain, infrastructure, and technology is limited. Future technology will mean people are better informed, with them more health conscious and demanding of quality food. Many Cambodians may therefore still trust imported food over their own and consume more of it accordingly.

Food security will be another key factor resulting from a lack of food safety as previously mentioned. If demand is high for better quality imported products, Cambodian food businesses will face fierce competition just to remain in the market, let alone produce cheaper food for the less affluent. Food supplements to offset a lack of nutrients and cheaper food to meet the needs of poorer households would then become expensive for the government to supply.

Socially, Cambodians will still flock together in various traditional events where food will be a main content and options may be limited based on the different classes of people.

Supply Side

Farming practices - Labor and skills. Agricultural labor is currently decreasing given the opportunities for younger members of rural communities to work abroad for higher incomes than farming at home in a volatile market. Smaller farms will likely join together to form larger concerns run by richer industrial farmers. These farmers will like today use technology spillover from neighboring countries such as Vietnam and Thailand but on a larger economy of scale.

It is estimated that there were around 1.5 million Cambodians working abroad in 2017 (ILO 2017), mainly in Thailand, the Republic of Korea, and Malaysia, sending home remittances to help their families. This trend will continue for some time until their labor is replaced by automation. Without needed skills in a future of anticipated automation, these workers will have to return home or look for work elsewhere. If they choose to come home, the Cambodian garment industry of today will no longer be able to employ them because factories in California, for example, will be using automation that will not only be more efficient, but will not be able to threaten industrial action. During the industrial revolution, workers were needed and often exploited; however; in the era of robots, they will no longer be at risk of exploitation, but will simply become irrelevant.

What is certain is that technological advances will gather momentum over the next two decades and Cambodia will face huge challenges. It will be difficult for the kingdom to deal with the technological revolution in food if it has not prepared well enough for what is to happen.

The Cambodian 2040 food industry vision does not touch much on technological disruption. Much of it focuses on organic living, promoting SMEs, contract farming, and the one village, one product movement, to name but a few, which may have become irrelevant by 2040. Advancements in food technology, such as automated farming techniques, "laboratory-grown" cell-based meat, and drone delivery systems, may well constrict the Cambodian food sector. The kingdom will import more food to meet local demand, which would not necessarily be problematic should it enjoy higher incomes.

However, it remains questionable whether Cambodia will achieve its goals of reaching upper middle-income status by 2030 and becoming a high-income country by 2050 when there are many challenges to be overcome. What will become of Cambodia's agriculture sector, which currently employs more than one-third of the population, if it is unable to compete in an increasingly specialized arena?

Without the necessary investment in the food science subject, facilities relating to the development of the sector such as labs will be even more irrelevant. The transportation may generally be developed, although not specifically for the

food purposes. Fast tracks that shall be assigned for fresh produce to reach consumers may not be there, but Cambodian food sector will be able to take advantage of the general improvement of more quality roads. Difficulties in tracing food from farm to table will be a challenge in 2040, especially when consumers demand more information about the food they consume, such as the quality status and the accountability that comes with the production of food. Energy costs may be cheaper than today's given its emphasis on cost reduction in other sectors in the economy. However, the price will still be more expensive than the neighboring countries that are more advanced. Therefore, competition in prices of food with, for example, Vietnam and Thailand, will still be an issue.

The agro-industry is currently struggling to be profitable, limiting its size. Most, if not all, agro food processing companies in the kingdom are small and medium-sized businesses that lack the investment necessary to expand. Without intervention, Cambodia's agro-processing sector will be under financial pressure as it faces greater competition from abroad. Financing food processing could take the sector to the level described in the ideal scenario at the beginning of this chapter. Without investment, Cambodians could instead be supporting the food industries of other countries in 2040. Private and public investments that drive this sector will be crucial in allowing food start-ups to continue to develop quality and safe food for subsequent generations.

Infrastructure in 2040 will be improved with faster routes for the general operations of businesses. However, without a specific focus on food systems, the agribusiness competitiveness in Cambodia will still be a challenge.

Energy will be more sufficient as there will be more renewable sources resulting from knowledge and the availability of more advanced technology spillover from the neighboring countries. Energy consumption in the food sector will still be higher than the competitive neighboring countries which will exacerbate the exports of Cambodia's main agricultural products.

Climate change. Climate change will make the food market in 2040 ever more challenging. Production will require a many different techniques to yield the same result. This will require a whole new technology to address. The population that used to make a living off of farming today will not be the same population

that will make food in the future. Countries like Cambodia where land is abundant will not be the same. Land prices will rise to the extent where less educated farmers find it difficult to afford. Therefore, those that will be in the farming sector in the future will be the ones who will not only be able to afford land and/or will have to be very innovative in the sector. If Cambodia does not inject into its human capital the ability to adapt to climate change today, it is hard to imagine Cambodia being able to be outside the consumer zone of food. The dependence on water, land, and the condition of the weather will not be the variables determining the result of food as much as they are today. Biometric data, geographical data, calories consumption, to name just three, will play more roles in the food sector. Countries that are ahead of the curve in food technology will be able to lead the market and be profitable from it. Others that are lagging behind will have to depend on these suppliers to survive.

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