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Malnutrition in Cambodia and the Practical Solution of Entomophagy

Cambodia, a country in Southeast Asia, has a central position that opens up to the Gulf of Thailand in the south. The country's borders contain a variety of different land features including mountainous regions to the west, the vital Mekong river which stretches the entire country in the east, and various sections of low alluvial land that spans most of the state. The composition of Cambodia's geography support the country's main industry; agriculture. Nutrient rich low lands paired with the Mekong river valley provide perfect conditions for rice cultivation (Overton, L., & Chandler, D. 2014). Even though Cambodia is recognized by the world as a developing country, the past few decades have brought much industrial and population growth to the state. Cambodia has been experiencing an exponential population increase since the fall of the Khmer Rouge in the late 1970s. The Cambodian government has forged relations with China and this connection has begun to develop the industrial landscape. While Cambodia still has close ties with their agrarian background there has been a noticeable shift to industrial occupations which provide a higher income. This migration has triggered a drastic growth in wealth within urban and metropolitan areas, while isolated highland villages have not seen much progression in the past decades. Cambodia is still recovering from over 20 years of civil unrest and conflict. Most of the infrastructure remains outdated and there are sections of dense jungle that are laced with bombs dating back to the Khmer Rouge (Food and Agriculture Organization of the United Nations 2010). Cambodia has been progressing towards a sustainable future, but there are many obstacles that must be overcome.

The average family size in Cambodia is 4.7 persons, which is relatively similar to other southeast Asian countries. Family size in Cambodia has begun to decline, dropping from 4.8 to 4.7 persons within a decade as the country begins to shift towards a more industrial outlook. An average female's fertility rate is reasonably low in urban areas reaching around 2.6 children per woman. In rural areas however, that number jumps to nearly 4.6 children per woman (Central Intelligence Agency 2019). The difference between fertility rates within the city and rural areas depends greatly on the lack of female education and healthcare present in isolated communities. It is still common for females to stay home and tend to the household and cultivate farms while the men either travel to developed areas for work or remain as the head of the family. Gender roles are prevalent in Cambodia where most of the population possesses traditional views of a woman's role in society. Only about 70% of females living in Cambodia are literate and most girls only complete 10 years of education, one year less than their male counterparts (Central Intelligence Agency 2019). The lack of education that women receive is linked to high fertility rates and a poor quality of life. There is also an unnaturally high rate of infant deaths within the first year of life. UNICEF estimates that nearly 141 infants won't make it past their first birthday due to poor living conditions and care (UNICEF 2003). This is mostly impart to poor prenatal care, lack of sufficient nutrition during and after birth as well as poor living conditions. Most children are exposed to unsanitary practices at a very young age, making it easier for them to contract life threatening diseases that either end in premature death or developmental obstacles. Unfortunately, it is still culturally stigmatized to some extent for women to breastfeed young children which deprives infants from an important developmental stage that will affect physical and cognitive abilities in the future. It is recommended that women breastfeed exclusively during the first 6 months of life, but most infants are given supplementary food after the first month. These circumstances paired present a very high likelihood that the child will experience chronic malnourishment within the first few years of life with lasting effects that continue into adulthood (UNICEF 2010).

Citizens within city limits benefit from improved water and sanitation systems while the quality of these systems decline drastically the farther one travels from urban areas. A study done by the Water and Sanitation Program reports that 71% of the population has access to improved water supplies

while only 37%. This still leaves 4.3 million people without access to piped safe water sources and 9.4 million are without sufficient sanitation systems (Cambodian Ministry of Rural Development 2015). The fact that only one fifth of the population lives within urban areas means that most of the population is unable to have reliable access to improved water and sanitation systems. Unimproved water systems allow bacteria and other infectious diseases to spread quickly throughout a village and region; mainly attacking the young and the old populations. Many of the diseases that commonly end in death in Cambodia are easily treatable and preventable in developed countries. The high death rate is partially impart to isolated regions that are unable to receive adequate health care, but also to the fact that the Cambodian healthcare system has many flaws. In 2015 there was only 0.8 available hospital beds per 1,000 people, leaving the majority of the population unable to receive adequate care (Central Intelligence Agency 2019).

Nearly 79% of the Cambodian population dwells in rural communities, which isolates them from urban and wages and amenities while confining them to agricultural occupations. Over 13% of Cambodians live below the poverty line while the average income in Cambodia around 1,230 US dollars per year (World Bank Group 2018). Low wages and varying conditions leaves 14% of the population vulnerable to experiencing poverty. The World Food Programme estimates that a 30 cent drop in wages could more than double the current poverty rate. This is not due to lack of jobs available, in fact official reports declare severe underemployment with the unemployment rate in 2017 at 0.8% (Central Intelligence Agency 2019). Throughout the most recent decade there has been sharp economic growth within the country, but it still remains one of the poorest East Asian countries. Many service and industrial companies have taken a foothold within Cambodia and have begun to create an industrial landscape within the country. However, the economic growth is only felt within urban limits, the sharp decrease in development is exemplified most upon leaving the city and entering rural villages. The quality of life decrease as the average wage begins to drop under one US dollar, which is not uncommon in rural Cambodia. It is estimated that 21% of Cambodians are unable to afford and provide a nutritious diet, putting themselves and their children at risk for physical and cognitive health complications later on (World Food Programme 2018).

Rice, the main crop within Cambodia, is a staple food for many households. In 2012 the FAO estimated that over 67% of Cambodians are engaged in sustenance agriculture and rely heavily on the seasonal harvest of sticky rice. Rice farming is common within the Mekong river basin where the land is accustomed to rice paddies. Seasonal floods and droughts leave farmers with failed crops, but technology for improving the biological traits of rice is beginning to become the center of technical research in this area. There have been attempts by the government within the past few decades to implement irrigation systems to aid farmers who experience dry spells. The developing government was able to improve some systems to the point where two to even three rice crops were possible a year. However, most of these systems fell apart in a matter of years leaving the farmers who once benefited from the irrigation vulnerable to unpredictable weather patterns (Overton, L., & Chandler, D. 2014). Most farmers are able to farm one to two crops of rice a year, but the rate of failure has begun to increase as unusually dry weather patterns have entered the region. The dependence on rice crops contributes to the strong prevalence of underweight, stunted and wasted children. A national report estimates that 52% of adolescents are underweight, 56% experience stunted growth and 13% of children were wasted (Food and Agriculture Organization of the United Nations 2010). The nation contributes these high percentages to the lack of diverse nutrients available to rural dwellings. Most rural households own hogs, chickens and occasionally different crops, but livestock numbers in Cambodia are scarce. Meat only composes 8% of a Cambodian's daily protein intake; rice takes up over half (Consultative Group on International Agricultural Research 2012). The protein value of glutinous rice is low, reaching only about 3.5 grams per cup. Health professional Aviva Patz claims that the average adult should consume approximately 56 grams of protein a day to maintain a healthy weight (Patz, A. 2016). It is reasonable to conclude that most of the Cambodian population does not fall within the healthy boundaries of protein intake, which contributes to the stunting and wasting epidemic. There are also high rates of anemia prevalence found in women and children reaching 43% and 53% respectively (Wieringa T., Dahl M., Chamnan C., et al 2016). It is necessary to stress the importance of having a diet that consists of viable protein and iron sources. Experts blame the typical

static diet of sticky rice and an occasional meat source to what is contributing to high levels of nutrient deficiencies and developmental issues.

It is important to once again note that most of Cambodia is food sufficient as most of the country is engaged in sustenance agriculture. The areas that experience chronic hunger are limited; the issue impacting the majority of the population is the lack of essential macromolecules. Villages have limited access to markets to diversify what they are consuming on a daily basis. Sticky rice provides them with nearly all of their required daily caloric intake. Supplemental food includes chicken, additional fruits, plant life forged from the forest floor, and if the family is wealthy enough, a few pigs. However, there are circumstances where families consistently rely on rice for their daily intake of essential nutrients. Especially paired with the declining amounts of nutrients found in rice there has been an increase of terminal health cases that pertain to lack of nutrition. Over the past few decades the percentage of adolescents who are considered stunted and underweight have dropped, but it still remains alarmingly high. The World Food Programme (World Food Programme 2018) estimates that 35 of 1,000 children will die before their fifth birthday due to complications surrounding malnourishment alone. From birth to approximately 20 years is when some of the most crucial development for the body and brain take place. Unfortunately most Cambodian's diets lack the essential nutrients that aid in physical and cognitive growth. A static diet of glutinous rice is detrimental to the health of developing humans and this trend is seen across the nation.

Malnourishment is a major epidemic that has been plaguing Cambodia for decades. Only recently has it been the center of local and foreign aid. In order to present a practical solution to Cambodia, it is appropriate to examine the efforts that other countries in the Southeast Asian region have made to approach the situation. Malnourishment is not unique to Cambodia, most of the developing world falls victim to stunting, below natural weight and wasting. Bordering countries, Laos and Thailand, have begun efforts in implementing entomophagy and small scale insect farms within regions where malnutrition levels are high. Insects are high in protein, iron and various minerals, all of which is lacking in Cambodia. Insect farms are inexpensive and are manageable for families to keep. There is more protein and essential nutrients within crickets and sago palm weevils per gram than beef or other red meats (Van Itterbeeck, J. 2013). They have been used to fight the strong anemia prevalence in developing countries and are used as nutrient supplements. Cricket farming has taken a foothold in Laos, government backed projects have introduced cricket farms to a couple dozen villages and the effects have been remarkable. Within the short time of these farms being implemented cases of anemia have dropped and there have been indications that the added protein intake is beginning to decrease the number of wasting cases within the region (Hanboonsong, Y., Jamjanya, T., & Durst, P. 2013). Entomophagy could be a solution to the crisis that has been plaguing Cambodia for decades.

Insects are already consumed as a delicacy in Cambodia. *Lethocerus Indicus*, or the giant water bug, is a common ingredient found at most markets. These insects have been eaten for generations and any stigma around eating insects is virtually non-existent (Hanboonsong, Y., Jamjanya, T., & Durst, P. 2013). It is difficult to successfully cultivate the giant water bug because of the habitat it requires. However, another popular insect choice for dishes is the Sago Palm Weevil. This insect is simple to cultivate and would be virtually free for villages to implement. Their habitat, the sago palm or Ian Phru tree are native to Cambodia and are distributed bountifully across the country. Acquiring the weevils is not complicated. Weevil infested trees are easy to spot or adult mating pairs can be purchased from suppliers (Hoddle, M. 2013). Sago Palm Weevil cultivation labor and supplies costs are incredibly low to near non-existent which makes it practical for a family in any financial situation to execute. The natural living space of sago palm weevils allows for them to be cultivated vertically. The ability to farm in this fashion allows for even Cambodians without much land to produce their own insects. Cultivating sago palm weevils would be a cheap and easy way to add dimension to the diets of populations experiencing malnutrition.

A successful palm weevil farm requires one palm trunk to be cut into 50 centimeter stumps with multiple 10 centimeter holes drilled into it. Two fully mature weevils must be placed into each hole and the top covered by palm bark to protect the weevils from the elements. It takes about 40 days

before the insect larvae are ready to be harvested, and each stump produces about 4.5 pounds of sago palm weevil larva; enough to add nutritional support for a single person for six months (Hanboonsong, Y., Jamjanya, T., & Durst, P. 2013). Relatively few Sago Palm larvae are required to provide a hearty meal so one stump could support the average Cambodian family for weeks. The act of rearing sago palm weevils is simple and manageable enough that one family could own many stumps that would produce enough food to support the family for years. Sago Palm Weevil larvae is the most practical insect to be cultivated on a domestic scale. They are very nutritional and beneficial for the consumer. The protein value of the Sago Palm weevil is comparable to an egg yolk with nearly 67% of the insect being protein (Okpala B. 2016). They are effective in combating anemia and provide various minerals that most rural Cambodians wouldn't have access to otherwise (Menghun, K., & Geary, D. 2013). Sago palm weevils share many of the nutritional properties as crickets do, which is another common insect cultivated for human consumption. However, the sago palm weevil is less complex and more docile than the cricket is to farm in containers, making it a better choice for Cambodian farmers. The Sago Palm Weevil spends the majority of its life inside a palm and only leaves when the palm has been thoroughly consumed, meaning some generations stay in the same palm their entire life cycle. Crickets are not adapted to live in containers with large populations. Conditions like this allow disease to spread quickly among them, wiping out a whole generation (Hoddle, M 2013). Farmers who begin to cultivate Sago Palm weevils alongside their annual rice crop will also be presented with more options financially. Large enough weevil farms can produce a surplus and can be sold to neighboring families, villages or even abroad. Sago Palm weevils are valuable and are in high demand locally and internationally. There has been instances of where farmers have profited more off of their weevil farms than their rubber or rice crops (Hanboonsong, Y., Jamjanya, T., & Durst, P. 2013). The market for Sago Palm weevils has grown throughout the past decade, fueled by the health craze that struck the developed world at the beginning of the millenia. A single kilogram of sago palm weevils can be sold via market or internationally for around seven US dollars (Hoddle, M. 2013). The money earned from selling surplus sago weevil larvae is enough to afford other necessities that these communities are lacking. Not only could the cultivation of Sago Palm weevils would add dimension to diets of countless people but it would also provide extra income that is desperately needed.

Encouraging farmers to rear insects alongside their crops is a practical solution to the lack of nutrition communities face in Cambodia. Educating rural areas on the importance of a varied diet as well as introducing insect farming is a promising solution to nutrition deficiencies in all regions of Cambodia. Insect farming opens a new perspective on tackling malnutrition that is effective, economically stimulating, and culturally accepted. The simplicity and affordability of rearing sago palm weevils can provide countless meals for families who would not otherwise have access to, as well as providing an alternative income if the family so chooses. The cultivation of insects could begin to bring communities out of the grasp of poverty and could potentially create a market within the country. Breakthrough advancements like this are what will be able to change the nutritional landscape of the world, and someday potentially extinguish chronic malnourishment in all regions.

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