FLOODING, DROUGHT AND MIGRATION: THE ENVIRONMENTAL AND

SOCIO-ECONOMIC NEXUS IN CAMBODIA

by

Lisa Renee Ness, B.F.A.

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Committee Members:

Sarah Blue, Chair

Frederick A. Day

Denise Blanchard

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DEDICATION

To the people of Cambodia and their quest for a brighter future:

Education, Health, and Prosperity.

the statistical analysis--- I now have a greater appreciation for the role of statistics in academic research.

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CHAPTER I

INTRODUCTION

1.1 Background

A high risk to floods and droughts, as well as having few resources to rebound

from them, has led Cambodia to be ranked as one of the most vulnerable countries in the

world to natural disasters (Verisk Maplecroft 2015). The Intergovernmental Panel on

Climate Change (IPCC) reports that temperatures across Southeast Asia have increased at

a rate of 0.14° C to 0.20° C per decade since the 1960s, with the number of cool days and

evenings having decreased overall (Barros et al. 2014). The average annual wet day

rainfall, despite climate variability and differing trends across the region, has increased

by 22mm per decade, while rainfall from extreme rain days has increased by 10 mm per

decade (Barros et al. 2014). Given this, a greater frequency of floods and droughts are

expected, which will likely reduce crop yields and cause much damage to infrastructure.

There may also be forest degradation, loss of wet and dry forest eco-systems, pest

infestations, and more volatile ground and surface water supplies. In addition, the IPCC

predicts that the timing and onset of the monsoon will be affected, where the rainy season

is expected to be shorter and wetter, and the dry season, drier and longer. These changes

will cause severe disruptions in rice production, fisheries, and other agricultural

processes. Because climate change and its impact on migration are difficult to pinpoint,

my research will focus on the repeated and slow-onset of environmental conditions over

time that, when added to other migration drivers, triggers migration. Migration, indeed,

is complex and often involves multiple drivers that work together to trigger the decision to migrate.

In this study I analyzed quantitative data from the Cambodia Inter-Censal Population Survey (CIPS 2013), the second population survey to be conducted between the census of 2008 and the next scheduled census of 2018. The survey provides information on population size and distribution including sex, age, and marital status; fertility and mortality; migration status; disabled population; literacy and educational level; employment and unemployment; housing and household amenities; and other population and household information (Ministry of Planning 2013). The reasons for migration provided in the survey are: (1) Transfer of work place, (2) In search of employment, (3) Education, (4) Marriage, (5) Family moved, (6) Lost land/lost home, (7) Natural calamities, (8) Insecurity, (9) Repatriation or return after displacement, (10) Orphaned, (11) Visiting, and (12) Other (Ministry of Planning 2013). Although the definitions provided in the enumerator's manual did not specify natural disasters as a reason for migration, I selected the following migration reasons to analyze because they not only describe impacts that result from environmental degradation, but also, collectively, they help explain the complexity of migration decisions in Cambodia: (1) Transfer of work place, (2) In search of employment, (3) Lost land/lost home, (4) Natural calamities, and (5) Insecurity. I combined these five migration reasons to create another migration category called "Natural Disaster Migration." Regression analysis was then used to weigh the significance of the independent variables, such as, age, gender, level of education, occupation, and specific household information, all of which contribute to migration decisions.

In addition, The *Analysis Report 1996-2013: Cambodia Disaster Loss and Damage Information System* (CamDi), was used to identify provinces and their respective districts that were most affected by natural disasters between1996 and 2013 (NCDM 2014). The purpose of the report was to collect and analyze disaster loss and damage data in order to understand risks and vulnerabilities in Cambodia. The results are important to my study because they provide district level data on the damages and losses caused by floods and droughts, such as deaths, houses destroyed, hospitals affected, schools affected, paddy fields destroyed (Ha), rural roads destroyed (m), and farm crops destroyed (Ha). The report also lists the types of disasters that typically occur in each province, their impacts, and frequency of disaster events.

1.2 Cambodia and Water: The Setting of this Study

Cambodia, so vulnerable to flooding and drought, has a majority of people who are rural, poor, and agriculturally dependent. Nearly eighty percent of all Cambodians live in rural areas and eighty-five percent of the rural population depends on subsistence farming for their daily caloric needs and livelihood (Gunjal et al. 2012). Since 1996, increased incidence of floods and droughts have had negative impacts throughout Cambodia, particularly in the Tonlé Sap Lake and Mekong Plains regions, where fishing and rice cultivation are primary sources of peoples' livelihoods and the economy. These include the loss of crops and income, threats to livestock, destruction to infrastructure and housing, and water and food insecurity. The consequences have been far-reaching, with displacement being among the range of pressures on people and their communities likely to arise from the environmental and socioeconomic impacts of floods and droughts.

1.2.1 The Importance of Seasonal Flooding in Cambodia

Cambodia has a unique and profound relationship with its water resources. The Mekong River Basin and the Tonlé Sap, or Great Lake, nourishes Cambodian culture and the country's socioeconomic well-being. Called the 'Mother of All the Waters' and the 12th longest river in the world, the Mekong originates from melting snows in the Tibetan Himalayas and travels through the countries of China, Myanmar, Thailand, Laos, Cambodia, and Vietnam. It is one of the most diverse fisheries in the world and plays an important role in industry, agricultural development, and transportation. The Tonlé Sap, centrally located in the northwest section of the country, is the largest freshwater lake in Southeast Asia and is an important resource for fishing and wet-season rice cultivation, as well as restocking the Mekong River Basin fisheries by providing nursery habitat for migratory river fish species.

Both the Tonlé Sap and the Mekong River are affected by the monsoon, a wind system driven by cyclic air changes over Central Asia that brings two distinct seasons to Cambodia each year. The dry Southeast monsoon brings cooler temperatures and drier air during the months of November through May, and the wetter Southwest monsoon brings sustained and heavy rainfall during the months of June through October. At the end of the rainy season, high water levels in the Mekong empties into the Mekong Delta with such volume that the river of the Tonlé Sap reverses direction and flows upstream and empties into the Great Lake. This phenomenon causes the lake to increase over three times its original size, from an area of 2,500 km^2–3,000 km^2 during the dry season, to 10,000 km^2–16,000 km^2 during the rainy season (Matsui et al. 2006) (Figure 1).
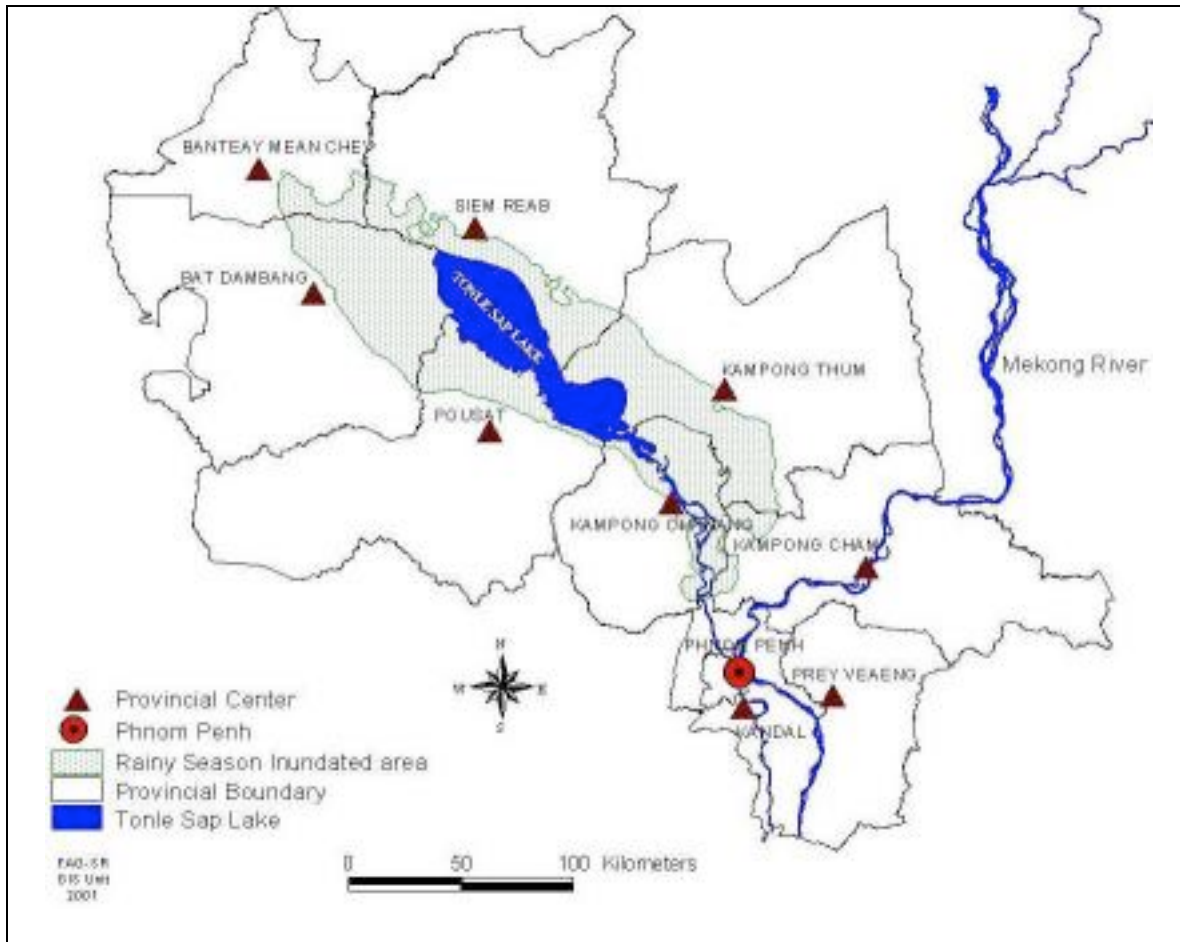
Figure 1: Wet Season Flooding of the Tonlé Sap.
Source: The Gecko Environment Center 2009

Flooding of the surrounding plains produces rich deposits of silt and fertilized fields as well as an abundant harvest of fish. With fish being the primary source of animal protein in the Cambodian diet, the lake is vital in providing over half the fish consumed in Cambodia, or about 41,740 tons per year (Matsui et al. 2006). However, these natural wetlands are currently under threat by more severe flooding that is occurring more frequently, which is affecting biodiversity, food security, and peoples' livelihoods.

1.2.2 Negative Impacts of Floods in Cambodia

The impacts of severe floods in Cambodia include damages to land/harvest and infrastructure, loss of income, food security, and access to medical care and medical expenses. The National Committee for Disaster Management (NCDM) reports that flooding was responsible for 21,418 damaged or destroyed housing and 1,091 deaths between 1996-2013 (NCDM 2014) (Figure 2). The provinces most affected by floods are located near the Mekong River and Basac River (Prey Veng, Kampong Cham, Kandal, and Kratie) or surround the Tonlé Sap Lake (Siem Reap, Kampong Thom, Banteay Meanchey, Battambang, Kampong Chhnang, and Pursat) (NCDM 2014). Each of these provinces is vulnerable to floods and other natural disasters due to having a majority population that is poor and agriculturally dependent. Poor families that suffer a loss of income and assets may be unable to rebound from a natural disaster readily enough to fully recover. Some families have no choice but to sell livestock or take out high interest loans in order to make up for loss of crops or rebuild their homes. In other cases, families are temporarily displaced until flood waters recedes.
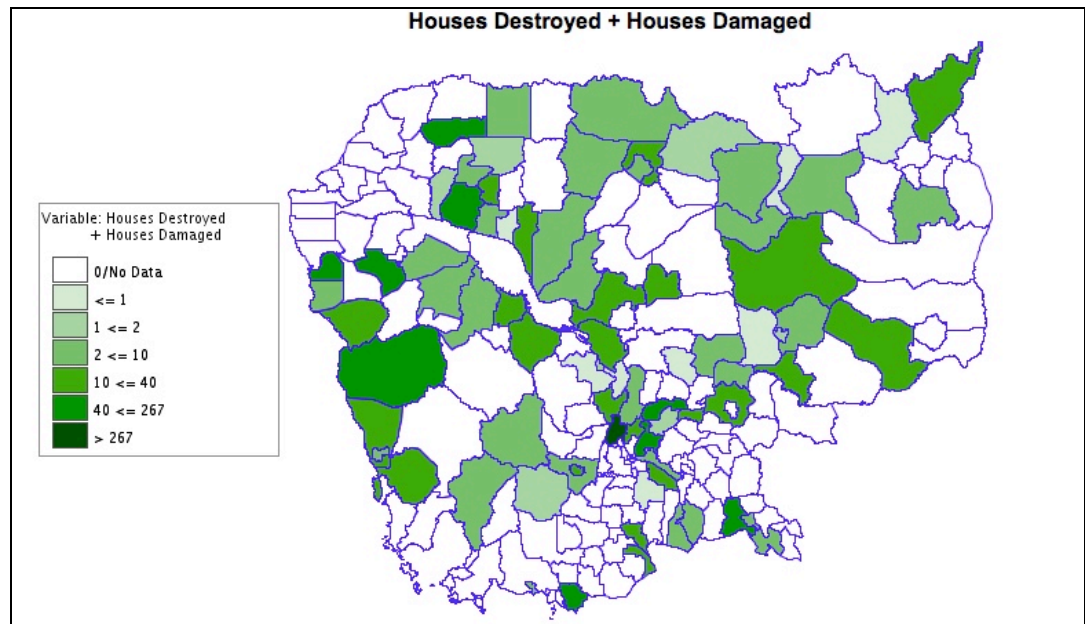
Figure 2: Damaged and Destroyed Housing Caused by Floods (1996-2013).
Source: NCDM 2014

The *2012 Cambodia Post-Flood Relief and Recovery Survey* found that families

suffered extensive damages to their assets as a result of the 2011 floods (NCDM 2012).

Caused by heavy rains and overflow of the Mekong River, the floods affected 18

provinces out of 24 in Cambodia, destroying crops and communal infrastructure. In

addition, 1.2 million people were affected and 247 deaths were reported. Some of the

reported losses were fishing nets (33%), boats (21%), rice mills (19%), bicycles (19%),

and water pumps (14%) (NCDM 2012, 19). More than a quarter of households reported

they could not afford to replace their lost assets. In many cases, families had to go into

debt and take out loans as a coping strategy to rebound from the 2011 floods, not only for

the poorest households, but also the middle class.

The economic impact of the 2011 floods on families was significant and

widespread (See Table 1). These losses directly affected a household's ability to buy

food and other necessities.

Table 1: Reported Income Change After the 2011 Floods.
Source: NCDM 2012

Percent distribution of households by reported income change since the floods, according to background characteristics (weighted). Cambodia Post-flood Relief and Recovery Survey, January 2012.

	Decreased	No change	Increased	Number
Ecological Zone				
Plains	62.3	33.8	3.9	1,524
Tonle Sap	66.5	31.3	2.1	873
Affect index				
Unaffected	58.9	37.6	3.5	1,565
Mildly	71.5	27.0	1.5	380
Moderately	73.7	22.4	3.9	349
Severely	77.8	18.6	3.6	103
Wealth quintile				
Poorest	74.3	24.0	1.7	520
Second	70.9	27.1	2.0	494
Middle	66.3	31.0	2.7	471
Fourth	60.4	36.4	3.3	458
Richest	45.3	47.9	6.8	454
Compare income earners				
Less than before	74.8	21.5	3.6	97
Same as before	63.8	33.2	3.1	2,178
More than before	57.7	36.1	6.2	109
Income source previous month				
Self-employed	59.8	36.7	3.5	900
Agricultural wage labour	73.2	25.6	1.2	391
Non-ag casual labour	67.3	28.9	3.8	341
Income from fishery	69.9	26.2	3.9	292
Construction	64.1	33.2	2.7	284
Sale of paddy	66.7	30.7	2.6	264
Sale of other agri.	60.7	32.6	6.7	245
Total	63.9	32.9	3.2	2,397

1.2.3 The Southwest Indian Monsoon and Drought in Cambodia

Drought is often misunderstood, especially in Cambodia where the monsoon is central to the country's agriculture and ways of life. Despite substantial rainfall brought by the wet season monsoon, drought can also result from abnormal timing of wet season rains. For example, in the Mekong region, nearly all of the precipitation is confined to a single period of six months, between May and October; the rest of the year sees very little rainfall. Moisture deficits can occur when there is even the slightest variability during the wet season (Adamson and Bird 2010). This type of variability can be defined by timing of the 'onset' and 'end' of the Southwest Indian Monsoon, which, historically, has been highly predictable with very low variance from year to year. Any significant deviation from these dates can have substantial agricultural and economic consequences.

The severity of a drought, however, is determined not only by the levels of deficit it reaches, but also the timing of crucial moisture shortfalls. For example, if a rainfall deficit occurs during the grain-filling or flowering stage of crop development, then "the severity of the event from an agricultural point of view is maximized" (Adamson and Bird 2010, 3). A moisture deficit resulting from rainfall variability during the wet season can also have consequences during the dry season. For example, deficient flows of the tributary system in the Lower Mekong Basin during the dry season months permit more extensive saline intrusion in the Vietnam delta, which reduces water availability for irrigation. This leads to lower yields, reduced planted area, and significant economic loss for rice producers (Adamson and Bird 2010, 3). In addition, "below normal flows during the flood season affect the timing, depth, and duration of wetland inundation and the inflows to the Tonlé Sap Lake system, with negative consequences on fisheries and,

therefore, the economy of Cambodia" (Adamson and Bird 2010, 3).

1.2.4 Negative Impacts of Drought in Cambodia

The IPCC predicts that low rainfall and higher temperatures will intensify drought in the Mekong Region substantially (Barros et al. 2014). Although floods are most talked about when discussing Cambodia and climate change, drought must also be recognized as a serious problem. Unlike floods, the impacts of drought are generally slow-onset, non-structural, and are widespread geographically. The severity of a drought and its impact is dependent not only on its "duration, intensity and spatial extent, but also on the specific environment and the economic activities carried out within it, as well as the capacity of the prevailing institutional and social systems to cope with it" (Adamson and Bird 2010, 2).

According to the *Climate Change Vulnerability in Cambodia Assessment Report*, many agricultural communities in Cambodia have noticed changes in all aspects of the weather for the past 40 years (CBAP 2012). Changes in the frequency of droughts, duration of droughts, changes in rainfall patterns, and incidence of crop disease and insect infestations, have been observed by local communities throughout Cambodia. Interestingly, farmers are more worried about droughts and their impact rather than floods because of threats to crops and livestock. With increasing temperatures, crop pest attacks have been on the rise and farmers are seeing a strong link between droughts and insect populations (CBAP 2012). They noted that good rains promote water flow in rice fields and these conditions inhibit insect population explosions by flushing away ground pests. In drought conditions, however, water is either stagnant or the fields are dry, causing insects to stay and breed in the rice fields.

Droughts impact rice farmers who depend extensively on rainfall and annual precipitation and are a determinant of rice productivity and rural food security (NCDM 2012; WFP 2003). The National Committee for Disaster Management (NCDM) reports that, in 2004, drought affected 12,000 hectares of transplant rice fields and 790,000 hectares of paddy rice fields and damaged 490,000 hectares of farming crops (NCDM 2012) (Figure 3). In addition, a 20 percent loss in rice production was experienced due to droughts between 1998-2002 with the drought of 2002 affecting eight provinces and over two million people (NCDM 2012).

Agricultural losses from drought are also connected to a lack of irrigation. Currently, only 3,536 km^2 of cultivated land in Cambodia is irrigated (Central Intelligence Agency 2014). For example, the province of Prey Veng has only 40,000 out of its 310,000 hectares of cultivated land irrigated; therefore, the province is highly dependent on seasonal rainfall (World Food Programme 2008). In some cases, droughts force farmers to plant crops that require less water and refrain from planting a second rice crop. In other cases, droughts force farmers to seek non-farm jobs to supplement their income. Areas that are prone to drought are also susceptible to food shortages. In addition, droughts and high temperatures are a concern for Cambodian farmers because they cause disease and heat stress among livestock. For the average Cambodian farmer, it may take up to three years to save enough money to buy one farm animal (CBAP 2012). Livestock is not only valuable for a family's food security, but it also serves as a financial safety net when a harvest results in crop loss. For example, like a bank account, an animal can be sold to buy food or other necessities when needed; loss of livestock could result in driving a farmer and his family into deep poverty, thus lowering their

adaptive capacity when faced with future shocks.

Figure 3: Victims of Drought in Cambodia (1996-2013).
Source: NCDM 2012

1.3 Resilience and Vulnerability of Rural Populations in Cambodia

Cambodia is ranked 136 out of 185 countries in the UNDP 2014 Human

Development Index with 53 percent of working poor living below $2 a day (UNDP

2014). Although the economy has improved since 2009 and the national poverty rate in

Cambodia has decreased from 53.2 percent in 2004 to 20.5 percent in 2011, it is

important to note that many Cambodians have moved only slightly above the national

poverty line and are still at risk from natural disasters (Asian Development Bank 2014).

Specifically, frequent floods and droughts could have a damaging impact on poor

populations who rely on fishing and agriculture for their livelihood (ADB 2014) and it is

the rural population that is most at risk of falling deeper into poverty at the slightest

income shock. For example, the impact of losing US$0.30 a day in income would double

the poverty rate to 40 percent (ADB 2014). This is critical because poverty is directly

related to the adaptive capacity of a community to rebound from a natural disaster.

Because floods and droughts are occurring more frequently, peoples' vulnerability has

also increased and it is likely that poverty will become worse than the current situation

(CBAP 2012).

Poverty is a key indicator relative to vulnerability and resilience of an affected

population. Depending on the average wealth of households in a particular area, the

resilience to withstand a natural disaster differs. For example, the average wealth is

greater in the Plains region, as compared to the Tonlé Sap region (Keskinen 2003). This

may be a result of higher education rates among the Plains population, as well as

diversity of livelihoods. In addition, considerably more households in the Tonlé Sap

(64 percent) identified damage to land/harvest as a main difficulty compared to the Plains

(41 percent) (NCDM 2012). One in four households in the Tonlé Sap (25 percent) also identified the loss of animals as a main difficulty compared to 15 percent of households in the Plains (NCDM 2012).

1.3.1 Responses to Vulnerability in Cambodia

Depending on their level of vulnerability, people respond to threats differently. In particular, when faced with a natural disaster, such as a flood or drought, the most likely response is to either: (1) adapt to the threat in situ, or (2) move. My research will investigate the "move" response. Migration induced by environmental degradation occurs as either temporary displacement or permanent displacement. In Cambodia, temporary or circular migration has been the typical response throughout its history, as the population had to adjust to new environmental, socioeconomic and political situations.

It is also common in Cambodia for a family member to migrate to an urban area, or other rural area, in order to find work and send remittances back home. Although people in different parts of the country migrate as a means of finding alternative livelihoods, some view their having to migrate as a negative consequence of climate change (Table 2). Farmers are concerned that a future consequence of climate change will be more forced migration in order to find alternative livelihoods to support their families (CBAP 2012) (Figures 4 and 5).

Table 2: Migration After the 2011 Floods.
Source: NCDM 2012

Percent distribution of households with a usual member migrating since the flood, and among those with migration, the main reasons for migration, by background characteristics (weighted). Cambodia Post-flood Relief and Recovery Survey, January 2012.

Background	Any member migrate	Number	Among HH with a member that migrated since the flood, main reason:				
			Seasonal	Due to flood	Education	Health	Number
Ecological Zone							
Plains	6.7	1,524	28.7	55.2	4.0	1.3	103
Tonle Sap	7.9	873	30.0	60.2	2.9	0.0	69
Wealth quintile							
Poorest	9.4	520	18.9	68.8	3.8	0.0	49
Second	9.5	494	(31.8)	(59.1)	(0.0)	(0.0)	47
Middle	8.9	471	(35.9)	(54.4)	(1.6)	(3.3)	42
Fourth	3.5	457	*	*	*	*	16
Richest	3.9	454	*	*	*	*	18
Total	7.2	2,396	29.2	57.2	3.5	0.8	172

Note: Figures in parentheses are based on 25-49 unweighted cases; an asterisk indicates that a figure has been supressed because there were fewer than 25 unweighted cases.
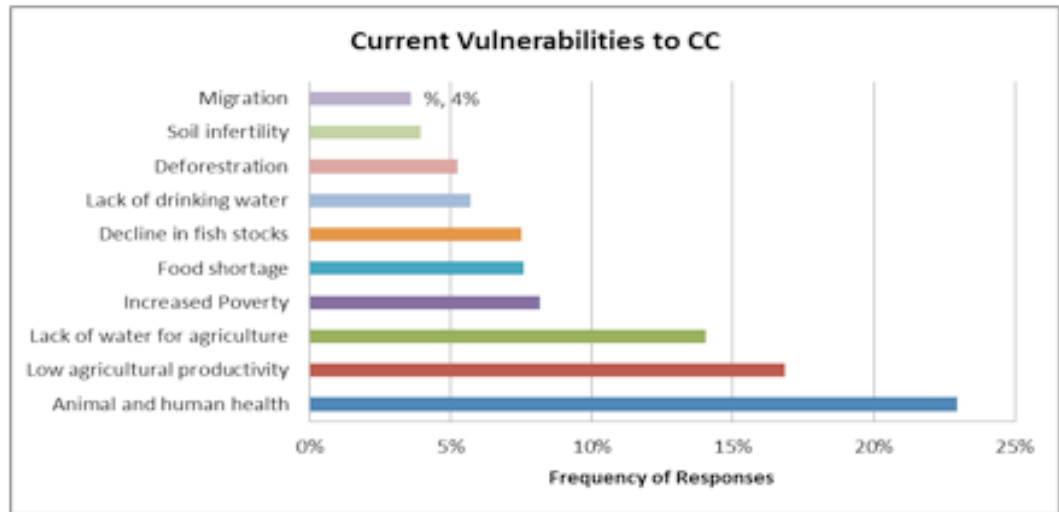
Figure 4: Current Vulnerabilities to Climate Change.
Source: CBAP 2012
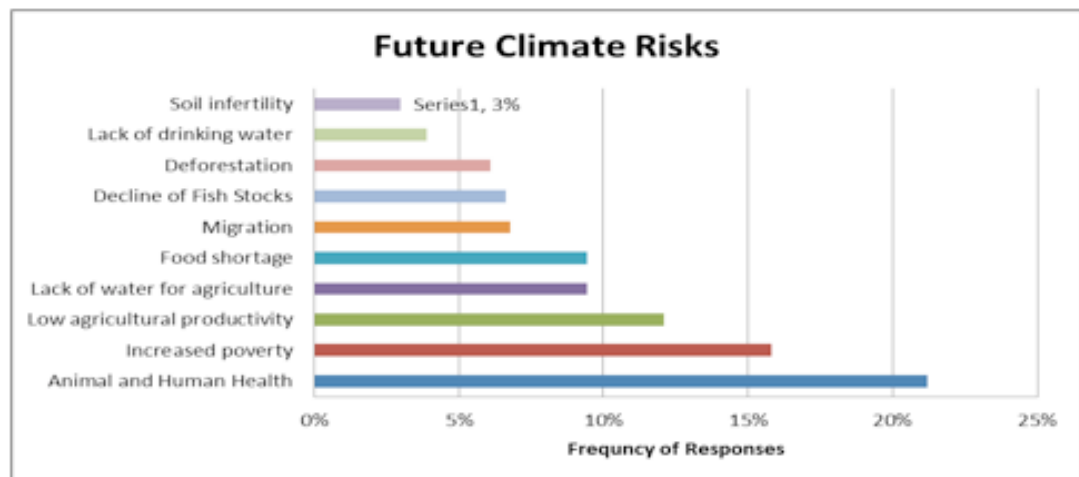
Figure 5: Future Climate Risks.
Source: CBAP 2012

Migration and displacement can be a measure of the severity of a natural disaster in a certain location. In the Plains and Tonlé Sap ecological zones, the 2011 floods displaced nearly 1 in 10 households (9 percent) from their dwelling for at least one night as a direct result of the floods (NCDM 2012). This accounts for nearly 64,000 households having been forced to spend at least one night away from home (NCDM 2012). Slightly more households in the Tonlé Sap zone appear to have been displaced as a result of the floods. Again, this indicates that the poorest households were most likely to have been displaced (20 percent) and only 1 percent of the richest households were displaced due to the floods. People who decided to migrate outside of their community or to another province accounted for only 2.7 percent of those surveyed, however, 7.3 percent of the result was from those considered poorest (NCDM 2012). Therefore, it can be suggested that poverty impacts migration decisions when a natural disaster occurs.

1.4 Rationale of Thesis

There is little academic research on the relationship between the slow-onset of environmental conditions promulgating socioeconomic vulnerability and potential population displacement and climate change-induced migration. Although there are recent reports from a variety of international organizations and government entities on poverty, climate change and agriculture, more in-depth study still needs to be done on migration flows in Cambodia, specifically pertaining to environmental and socioeconomic conditions at the district level. The current research will contribute to the important geographic inquiries of climate change, migration, and displacement of vulnerable populations.

1.5 Purpose of Study

The purpose of my research is to better understand migration decisions in Cambodia and determine if floods and droughts impact these decisions. In order to endure future floods and droughts it is important to have the local and national disaster contingency plans relative to the most vulnerable households. In the case of Cambodia, it is important to understand which provinces are most vulnerable to floods and droughts and the levels of displacement and migration that can be expected when such disasters occur.

CHAPTER II

LITERATURE REVIEW

2.1 Overview of Migration Theory

Migration can be defined as the voluntary or involuntary moving away from a place of origin, either on a permanent or temporary basis (Hugo 2013; Elliott 2007). Migration is complex because it usually involves multiple drivers that promote a decision to move; these include economic, social, political, cultural, and environmental factors (Hugo 2013; Elliott 2007; Maltoni 2007). The following is a brief overview of migration theory. However, because the literature is so extensive, only a short selected summary is included.

Migration theory has developed over time as human experience and human movements continue to unfold. Ernest George Ravenstein, in 'Laws of Migration' (1885), was the first to recognize distance as an important factor of migration (Muniz-Solari, Li and Schleicher 2010). The classic theory states that migration is more likely to occur at shorter distances rather than long distances. This is partly due to lower costs and the social networks associated with short distance movements. In addition, Ravenstein suggested that certain "push" and "pull" factors influence the decision to migrate, and humans have a natural disposition to improve their material living conditions (Afifi and Warner 2013). For example, a person with a low salary may migrate to a place with higher earning potential, or to gain access to certain amenities. The limitation of Ravenstein's theory was that he did not take into account obstacles or opportunity costs

that might affect the decision to migrate (Afifi and Warner 2013). Lee's 'Push-Pull theory' (1966) did account for obstacle and opportunity costs and hypothesized that "the number of migrants is directly proportional to the number of opportunities at a given place and inversely proportional to the number of intervening obstacles" that lie in between the place of origin and the receiving location (Muniz-Solari, Li and Schleicher 2010). Gary S. Becker (1964) was interested in how individual characteristics influence migration decisions and suggested that people who embrace risk are more likely to migrate than those who are risk-adverse (Afifi and Warner 2013). 'Chain Migration theory' refers to the network of information that results from the migration of friends and families. This 'network of information' flows back to the point of origin, reducing the obstacles to migration for later migrants (Muniz-Solari, Li and Schleicher 2010). The decision to migrate is usually made, not by one person, but by the entire household or community (Afifi and Warner 2013). Engel and Ibanez (2001) introduced 'violence' and 'insecurity' as important push factors in the sending countries (Afifi and Warner 2013).

2.1.1 New Economics Theory of Migration

The 'New Economics of Migration theory' sees migration as one of the strategies employed by households and families in low-income countries who often act collectively not only to "maximize expected income, but also to minimize risks and to loosen constraints associated with a variety of market failures" (Hugo 2013, xvii). The theory focuses particular attention on the way in which households and families deploy family members to work elsewhere. This serves as a mechanism to reduce households' vulnerability to reductions in their ability to earn a local livelihood (Hugo 2013). In addition, the New Economics of Migration theory is relevant where families and

communities respond to the onset of environmental change by diversifying their income by sending family/community members out to work in other areas in order to send remittances back home.

2.2 Environmental Change and Migration

There is great uncertainty in understanding the relationship between environmental change and migration (Hugo 2013). As with the other four important migration drivers--- economic, social, political, and cultural--- the environment is rarely viewed as an exclusive cause of migration. Human movements are generally perceived as being initiated by one or more drivers, therefore, environmental change is not recorded as a primary cause. For example, a migrant moving because he can no longer earn a livelihood from agriculture because of environmental deterioration will often see the causes of his movement being economic rather than environmental.

Current literature on migration acknowledges that environmental change, environmental degradation and climate change, are all problems that warrant serious consideration (Hugo 2013; Afifi and Warner 2013; Martin 2013). In addition, there is agreement among researchers on migration that climate change and environmental degradation are problems for the future (Afifi and Warner 2013) and that climate may act as a 'catalyst that acts with other ethnic, economic and political problems, rather than climate being the causal force of migration' (Afifi and Warner 2013, 6). Further research is needed to understand how environmental change affects migration (Asian Development Bank 2012; Elliott, Ewing, Mayer, and Hugo 2012; Heinonen 2006; Keskinen 2003; Lavell and Ginnetti 2014; NCDM 2012; Martin 2013).

2.3 Characteristics of Migrants in Cambodia

Migration in Cambodia most often occurs within the country rather than across international borders (Maltoni 2007). Nearly thirty percent of Cambodia's total population are internal migrants and most movements occur within a province and are of very short distances (Ministry of Planning 2013). Indeed, "internal migrants constitute 97.4 percent of all migrants in Cambodia and the number of migrants has increased by about 19 percent from 2008 to 2013" (Ministry of Planning 2013, 91). Migration within a province, or intra-provincial migration, is effective because it provides immediate community, resources, and other forms of employment during difficult times (Maltoni 2007). Once the crisis subsides, the family or family member returns to their respective village and resumes life as normal.

The reasons for migration in Cambodia are mostly driven by survival and coping strategies rather than on life planning and improving of economic standards (Maltoni 2007). The decision to migrate also depends on historical trends and culture. For example, Cambodia has a long history of migration that was typically intra-provincial and temporary, with a strong reliance on family and community connections. Social ties between families who reside in neighboring villages and districts continue to be a strategy for resilience and survival when times get tough.

2.3.1 Rural-to-Urban Migration

Rural-to-urban flows can be characterized as internal labor migration and are mostly driven by industrial jobs located in urban areas. In Cambodia, the garment sector is the primary industry attracting workers to urban areas. According to the Ministry of Commerce, garment exports from Cambodia have risen 22 percent over the first

11 months of 2013 and reached $5.07 billion (Freeman 2014). Exports of garments to the

United States alone increased 9 percent in the same period, reaching $1.96 billion

(Freeman 2014). The wages of garment workers, however, are quite low, at about $95

per month, which is the most recent mandated minimum wage in Cambodia (Freeman

2014). Because the minimum wage is not enough to pay the most basic of living

expenses in a city, the garment industry is doing little to improve the lives of urban

migrants. Construction jobs and education are also reasons why people migrate from the

rural to urban areas.

2.3.2 Rural-to-Rural Migration

Rural-to-rural internal flows make up the majority of migrants and result from a

complex combination of push and pull factors such as, political instability, low economic

development, poverty, and natural disasters. In addition, population growth, land issues,

and decreased productivity caused by soil degradation are all factors that drive an

increase in rural-to-rural migration. The *Migration in Cambodia: Report of the

Cambodian Rural Migration Project* (CRUMP) found that rural-to-rural migrants are

typically older than rural-to-urban migrants, are less educated, and are considered poor

(Ministry of Planning 2012). Labor accounts for the reason why most rural migrants

move to other rural areas. Although the report found that non-migrants are more likely to

work in agricultural occupations such as farming, farm labor, fishing, and forestry, there

are still a good number of migrants who work in these occupations but move to find work

in construction or as garment workers (Ministry of Planning 2012).

2.4 Variables that Drive Natural Disaster Migration in Cambodia

The main categories of independent variables I selected for my conceptual model on Natural Disaster Migration are: (1) Natural disasters, (2) Environmental change, and (3) Socioeconomic consequences (Figure 6 and Table 3). When confronted with a natural disaster, a migrant has a choice to either migrate or adapt to the conditions in situ (Hugo 2013: Elliott 2012). When attempts at adaptation fail, or when peoples' ability to make a living is made more difficult, the decision to migrate becomes more certain (Hugo 2013; Martin 2013; Keskinen 2003). The literature supports the idea that if moving is necessary, permanent displacement is less likely as a strategy and temporary or circular migration is more likely. In addition, poor migrants are more likely to travel shorter distances rather than migrate across regions due to the costs of travel and resettlement (Afifi and Warner 2013; Deshingkar and Grimm 2004). In addition, migrants that move because of a crisis are more likely to return to their place of origin once the crisis has passed (Elliott 2012). While temporary and circular migration is a result of dramatic environmental events, a more permanent migration may be necessary where slow onset environmental change makes remaining in an area impossible (Hugo 2013).
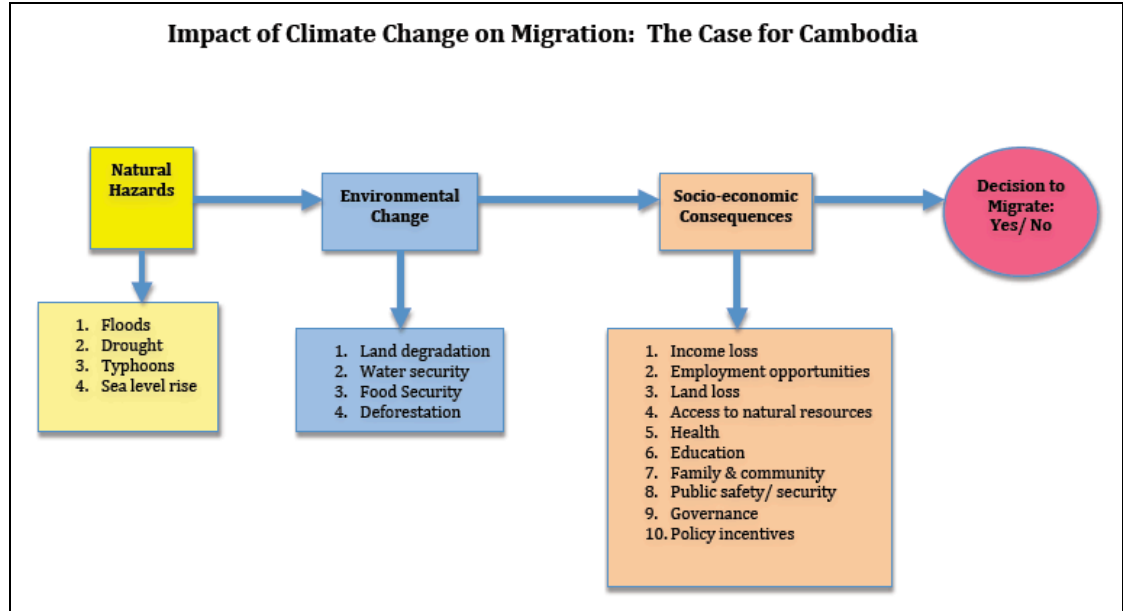
Figure 6: Conceptual Model: The Impact of Climate Change on Migration.

Table 3: Conceptual Factors and Variables Associated with Migration in Cambodia.

Conceptual Factors	Variables	Measurements
Environmental	Climate *Long term climate change *Short term climate events (Floods, droughts, typhoons) Land Degradation (deforestation) Land productivity Food, energy, water security	Annual mean temperature change Annual number of natural disasters by district Land area Reports Reports
Social	Education, family, community, public health (access to health facilities, infectious disease, animal disease), population	Demographic/ census data
Economic	Income, wages Employment opportunities Land loss	Per capita income % Employment % Land loss
Political	Governance, conflict/insecurity, policy incentives, coercion	Reports
Industry, Technology	Dams, logging, mining, industrial agriculture. Internet, cell phones, access to information	% Service sector Survey data

2.4.1 Natural Disasters

There are two types of disasters that influence migration: (1) The sudden onset of cataclysmic events which destroy or rapidly change livelihoods or displace population on a permanent or temporary basis, and (2) The more long term, slow onset processes which see an incremental decline in the ability of an area to provide a livelihood for its resident population (Hugo 2013, xxiv). The Internal Displacement Monitoring Center (IDMC) reports that Cambodia is most vulnerable to storms, floods and droughts (Lavell and Ginnetti 2014). Each year over 500,000 Cambodians are affected by natural disasters, often resulting in large-scale displacement (Lavell and Ginnetti 2014). Floods, in particular, are becoming more frequent and are forcing many people to move. Some migrants, however, eventually return to the vulnerable areas to resume life as normal. In situations where there are losses in agriculture production, many households will send family members to earn a living elsewhere, such as the urban area of Phnom Penh. One benefit of this coping strategy is an increase of migration-induced remittances. Although remittances contribute to the economy overall, they have had negligible effect on the most recent poverty rate (ADB 2014).

2.4.2 Environmental Change

Environmental change includes water security, food security and deforestation. Research supports the idea that the push factors driving migration in Cambodia are often tied to the environment and that deteriorating environmental conditions are creating the pressure to move (Heinonen 2006). Deforestation in Cambodia is a serious problem, as the country has one of the worst deforestation rates in the world. Since 1970, Cambodia's primary rainforest cover went from over 70 percent in 1970 to 42.1 percent

in 2014 (Butler 2014). This accelerated deterioration is largely due to industrial plantations, logging, and conversion of land for agriculture use. Deforestation is not only destroying dense forests, but it is also causing soil erosion and run-off that is impacting the water quality and depth of the Tonlé Sap. In addition, dam projects along the Mekong River are threatening remote fishing communities by either causing low water levels when the river is held back or flooding when water is released. Most critical is that dams are interfering with fish migration and spawning. Because so many people living along the Mekong rely on fishing for subsistence, dam construction is causing many families to move to higher ground or abandon fishing activities altogether.

2.4.3 Socioeconomic Consequences

Natural disaster migration is influenced by economic, social, and cultural factors. In Southeast Asia, there is a long history of temporary migration being employed by families and households as a way of coping with reductions in income or loss of production caused by drought or crop failure. In provinces surrounding the Tonlé Sap Lake, fishing and rice cultivation are the primary occupations for people living in the region. Variations in rainfall can greatly impact economic output and productivity, forcing some families into coping strategies such as migration (Heinonen 2006).

In his thesis, *Socioeconomic Survey of the Tonlé Sap Lake, Cambodia* (2003), Keskinen analyzed socioeconomic data of the six provinces surrounding the Tonlé Sap Lake: Siem Reap, Bantang Meanchey, Battambang, Pursat, Kampong Chhnang, and Kampong Thom. The data was collected from a variety of sources including the Cambodia Inter-Censal Survey (1998), participatory village surveys and current literature. Instead of looking at each province individually, Keskinen created five zones

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that were determined by village elevation and distance from the lake. Zone 1 was comprised of villages closest to the lake and Zone 5, the farthest. He then analyzed the economic activities of each zone and determined their vulnerability to floods. Keskinen's research is significant because it demonstrates that proximity to a lake or river can determine vulnerability. By mapping recent flood and drought events, specific zones can be targeted that represent greater instances of future displacement.

There are other studies that look at how socioeconomic factors affect migration. Again, there is no single factor that causes migration, but for individuals who are already vulnerable because of economic reasons, migration may be the only viable adaptation strategy to changing environmental conditions (Martin 2013; Deshingkar and Grimm 2004). Heinonen, in referencing the 2004 Inter-Censal Survey, confirms that the primary driver for migration in Cambodia is economic and that "environmental stress filters through the local economy" (Heinonen, 2006). He also acknowledges that the causes of migration are complex and involve many different components (population growth, poverty, water quality, water quantity, arable land, environmental problems and natural resources) and that more research needs to be done to understand migration in Cambodia.

Deshingkar and Grim (2004) suggest that 'poor people are most vulnerable and tend to move shorter distances because of limited resources, skills, networks, and market intelligence' (Deshingkar and Grimm 2004). This is true for many Cambodians as poverty is closely related to cultivable land, water supplies, and an abundance of fish. Migration is an attractive option when the place the person is migrating to offers resources critical to maintaining a livelihood. For provinces that experience repeated floods and droughts over a period of years, the lack of resilience combined with a need to

make a living are causing the poor to move at greater distances to find new opportunities.

Long-term, inter-provincial migration, or migration that takes place from one province to another, is increasing because of improved infrastructure, communications, and economic development. In the urban areas, such as Phnom Penh, new opportunities are being created, and the young are migrating to find new personal identities or simply a means to supplement their family's income back home. Graeme Hugo, a leading demographer on migration, suggests that, "It is important to recognize that the bulk of climate change induced forced migration will involve poor people since they will be the most vulnerable to climate change impacts and will likely have been impoverished further by the deteriorating local situation" (Hugo 2013, xxvi).

2.5 Migration Impacts on the Sending and Receiving Location

Migration poses impacts on both the sending and receiving location. The CRUMP Migration Report surveyed village chiefs and asked them to identify the positive and negative impacts of migration on their respective villages (Ministry of Planning 2012). For the sending location, the chiefs reported improved quality of life and economic well-being due to incoming remittances; on the negative side, the chiefs reported a loss of workforce and loss of food production. Impacts on the receiving location include increased competition for jobs, increase in the demand of resources, and matters of regional security (Elliott et al., 2012). Regional security is an important issue as increasing numbers of environmental migrants are expected to put regional pressures on available resources, which might then result in human security challenges.

CHAPTER III

METHODOLOGY

3.1 Research Questions and Hypotheses

Six working hypotheses address this study's purpose statement by analyzing

quantitative data for environmental and socioeconomic variables of natural disaster

migration in Cambodia:

RQ1: Which districts in Cambodia are most impacted by migration caused by
floods and drought?

HY1: Rural and primarily agricultural districts will be most impacted by floods
and drought. Nearly 80 percent of the population of Cambodia lives in rural areas
and 85 percent rely on agriculture, forestry, or fishing for their livelihood.
Increased incidents of floods and drought will put people at risk and increase the
likelihood of migration.

RQ2: What socio-economic indicators impact migration decisions?
HY2: People who are poor, have less education, and are agriculturally dependent
are likely to migrate as a result of floods and drought. This is the sector of the
population that is most vulnerable to natural disasters because they do not have
necessary resources to rebound from them.

RQ3: What is the relationship between poverty and natural disaster migration?
HY3: Poverty is a significant indicator of natural disaster migration. The poorest
of the poor typically do not migrate when faced with adversity, however,
increased incidents of floods and drought will displace the most vulnerable
populations when all attempts at adaptation have failed.

RQ4: What is the relationship between education and natural disaster migration?
HY4: People with less education are more likely to migrate as a result of natural
disasters because they more dependent on their current occupation and are usually
poor. Thus, they are less resilient and have fewer adaptation strategies to mitigate
natural disasters.

RQ5: What is the relationship between occupation and natural disaster migration?
HY5: People who depend on agriculture for their livelihood are more likely to migrate as a result of natural disasters, more so than other occupations. The majority of rural households rely on agriculture and fishing for subsistence, therefore, incidents of floods and drought will impact the earning ability of many rural households. Migration to urban areas or other rural areas in Cambodia will be necessary in order to gain alternate forms of employment.

RQ6: Is there a difference between urban and rural migration in natural disaster migration decisions?
HY6: Rural-to-rural and circular migration will continue to be the adaptation strategy for rural households that experience floods and drought, especially for older Cambodians over 35 years old. Rural-to-urban migration will continue to increase as younger generations move to urban areas for education, opportunities, and alternate forms of work.

3.2 Study Area

Cambodia (13^0 00'N, 105^0 00' E) is located on the mainland of Southeast Asia and borders the countries of Laos to the north, Vietnam to the east, and Thailand to the west (Figure 7). The Gulf of Thailand is situated along the southern border, providing a coastline of 443 km. Cambodia's total land area of 468,878 km^2 is characterized by several major physiographic divisions, such as the Cardamon and Elephant Mountains in the southwest, the Dangrek Mountains in the north, and the Eastern Highlands in the northeast. Fertile wetlands and paddy fields are found in the central plains and surround the Tonlé Sap, or otherwise called, the Great Lake. Forested areas are found in the northeast and southwest. Temperatures remain relatively consistent throughout the year, with an average-mean temperature of 27.7° Celsius (81.86 °F) and a relative humidity of 80 percent. The current research is focused on migration flows of twenty-three provinces, their respective districts, and one municipality in Cambodia. The scale of analysis is at the district and individual level.

Figure 7: Physical Map of Cambodia.
Source: University of Texas, Perry Castaneda Library Map Collection 2015

3.3 Data Collection and Analysis

For this research I used two datasets: (1) The *Cambodia Inter-Censal Population Survey* (2013), which provided quantitative data at the district and individual level on certain population characteristics, and (2) the *Analysis Report 1996-2013: Cambodia Disaster Loss and Damage Information System* (CamDi), which provided quantitative data on provinces and their respective districts affected by natural disasters between 1996- 2013.

The CIPS 2013 is a nationally representative survey of 955 primary sampling units and 28,650 households. The objective of the survey was to provide demographic and socioeconomic data, necessary for policy-making, monitoring, and evaluation. I first analyzed the data to determine the independent variables that characterize migration. Survey respondents were given the following options for their reason for migration: (1) Family moved, (2) Searching for employment, (3) Marriage, (4) Transfer of work place, (5) Insecurity, (6) Other, (7) Repatriation, (8) Lost land or home, (9) Visiting, (10) Education, (11) Orphaned, and (12) Natural calamities (Ministry of Planning 2013). For the purpose of my study, I isolated the following variables which are characteristic of environmental and socio-economic impacts: (1) Searching for employment, (2) Transfer of work place, (3) Insecurity, (4) Lost land or home, and (5) Natural calamities. I then created a new category called, "Natural Disaster Migration". The responses for "family moved" and "marriage" were dropped from the analysis altogether in order to avoid skewed results. For example, for "family moved", the respondents are children and spouses of the head of household, thus the description it too vague for this study as it does not contribute towards a primary motive for migration. The definitions of

"insecurity" and "natural calamities" are unclear from the official report descriptions, however, it can be presumed that "natural calamities" include natural disasters, such as floods and droughts, and "insecurity" may include access to natural resources and food insecurity. A logistic regression model of analysis determined the relative importance of each of the independent variables in migration decisions.

The *Analysis Report 1996-2013: Cambodia Disaster Loss and Damage Information System* (CamDi), was used to identify provinces and their respective districts that were most affected by natural disasters between1996 and 2013 (NCDM 2014). The purpose of the report was to collect and analyze disaster loss and damage data in order to understand risks and vulnerabilities in Cambodia. The report is a thorough analysis of recorded natural disasters in each of the twenty-six provinces in Cambodia and their respective districts. The results provide district level data on the damages and losses caused by floods and droughts, such as deaths, houses destroyed, hospitals affected, schools affected, paddy fields destroyed (Ha), rural roads destroyed (m), and farm crops destroyed (Ha) (NCDM 2014). For the current research, I analyzed data for each province and their respective districts that experienced losses as a result of floods and droughts from 1996-2013. The data was then put into STATA and was included as two separate variables being, "Floods" and "Droughts". Analysis was run on all the independent variables to prove, or disprove, my hypothesis on natural disaster migration.

CHAPTER IV

RESULTS

4.1 Purpose of the Study

This study examines the environmental and socioeconomic factors that contribute to the decision to migrate due to natural disasters in rural Cambodia using secondary data from the *Cambodia Inter-Censal Population Survey 2013* (CIPS) and the *Analysis Report 1996-2013: Cambodia Disaster Loss and Damage Information System* (CamDi). This chapter will provide an overview of the quantitative analysis utilized to answer the research questions, starting with the treatment of the data, followed by the primary analyses conducted to answer the research questions.

4.2 Treatment of the Data

Prior to conducting the primary analyses, the data set was examined for missing data and tested the statistical assumptions of the primary analysis. First, some categorical variables used in the analysis had relatively low frequencies for several categories; therefore, they were collapsed into fewer categories. Specifically, water source, light source, and fuel source were collapsed from multiple categories into dichotomous variables. These variables were intended to capture components of socioeconomic status, therefore, sources typically used in less developed communities were categorized as less advanced sources and sources typically used in more developed communities were categorized as advanced sources. For example, Cambodians who received their water from piped water, pipe wells, or bought sources were categorized as receiving their water

from advanced sources and Cambodians who received their water from dug wells, rain water, springs/rivers, or other sources were categorized as receiving their water from less advanced sources.

Because this study was focused more on the relationship between natural disasters and migration for Cambodians working in farming and agricultural rather than Cambodians working in other economic sectors, the industry variable was collapsed from 155 industries into a five-category variable including agriculture, livestock, forestry, fishing, and all other industries combined. Lastly, the raw variable for disabilities distinguished between not having any disabilities and having one of eight types of disabilities, though each specific type of disability had relatively low frequencies. The disability variable was then collapsed into a dichotomous variable distinguishing between those who had no disabilities and those who had at least one type of disability.

4.3 Sample Description

Prior to conducting the primary analysis, descriptive statistics were calculated in order to investigate the final sample. Frequencies and percentages of categorical variables are shown in Table 4. As shown, just under 10.0% of the full sample (9.2%) reported they migrated on account of natural disasters. Just over one third of the sample (34.9%) reported being in agriculture. The large majority of the sample indicated that their previous residence was in a rural area (79.8%). Even more also stated that their current residence was in a rural area (86.7%). Gender across participants was relatively split between males and females, 49.2% and 50.7% respectively. The vast majority of participants (98.1%) indicated that they did not have a disability. Further characteristics of the sample are outlined in Table 5.

Table 4. Frequencies and Percentages for Categorical Variables.

	n	*%*
Natural Disaster Migration		
Did Not Migrate	90,967	90.8
Did Migrate	9,256	9.2
Industry		
All Other Industries	63,881	63.7
Agriculture	34,984	34.9
Livestock	181	.2
Forestry	84	.1
Fishing	1,091	1.1
Previous Residence Urban/Rural		
Urban	20,213	20.2
Rural	80,010	79.8
Current Residence Urban/Rural		
Urban	13,341	13.3
Rural	86,882	86.7
Gender		
Female	50,880	50.8
Male	49,343	49.2
Disability Status		
No Disability	98,359	98.1
Has Disability	1,864	1.9
Adult Without Diploma		
Adult With at Least High School Diploma	33,611	50.7
Adult With No High School Diploma	32,697	49.3
Water Source		
Basic	46,744	46.6
Advanced	53,479	53.4
Light Source		
Basic	37,898	37.8
Advanced	62,325	62.2
Fuel Source		
Basic	17,630	17.6
Advanced	82,519	82.4

Note. Frequencies not summing to N = 100,223 and percentages not summing to 100 reflect missing data.

The continuous variables can be seen in Table 5. As shown, participant ages ranged from 0 (newborn) to 98 years old ($M = 23.65$, $SD = 18.29$). On average, participants reported completing education up to Class 5 ($M = 5.59$, $SD = 3.70$). The average number of floods in a province was just under 140 ($M = 138.85$, $SD = 95.73$) and the average number of droughts was just under 50 ($M = 48.69$, $SD = 52.33$).

Table 5. Means and Standard Deviations for Continuous Variables.

	N	*M*	*SD*	Min	Max
Age	100,223	23.65	18.29	0	98
Highest Education Level Completed	66,289	5.59	3.70	-1	19
Flood	95,882	138.85	95.73	0	333
Drought	95,882	48.69	52.33	0	197

Note. *N* not equal to 100,223 reflects missing data.

4.4 Analysis of Natural Disaster Migrants

In order to examine the factors related to migration patterns, a series of logistic regressions were conducted in order to predict natural disaster migration. First, a logistic regression predicting natural disaster migration from environmental and socioeconomic factors was conducted (Table 6). The overall model was significant, χ^2 (16) = 11,545.28, $p < .001$, Pseudo R^2 = .361. Levels of significance of p=0.10 to .001 were established for individual variables. Meaningful variables were determined to be those with an odds ratio *(OR)* less than .85 or greater than 1.15.

Table 6. Logistic Regression for Natural Disaster Migration.
(Full Sample)

	Full Sample OR
Agriculture Industry	.721**
	-(.120)
Livestock Industry	1.241
	-(.549)
Forestry Industry	23.710***
	-(23.390)
Fishing Industry	1.215
	-(.295)
Previous Residence Rural	2.331**
	-(1.000)
Current Residence Rural	.376***
	-(.077)
Male	2.043***
	-(.193)
Age	1.065***
	-(.005)
Highest Grade Completed	1.096***
	-(.016)
Has Disability	1.261**
	-(.136)
Adult without Diploma	3.170***
	-(.380)
Flood Frequency	.997*
	-(.002)

Note. Robust standard errors in parentheses. χ^2 (16) = 11545.28, $p < .001$, Nagelkerke R^2 = .361.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6-Continued. Logistic Regression Predicting Natural Disaster Migration.
(Full Sample)

	Full Sample *OR*
Drought Frequency	.990*** -(.003)
Advanced Water Source	.905 -(.129)
Advanced Light Source	1.164 -(.262)
Advanced Fuel Source	.317*** -(.042)
Constant	.018*** -(.012)
Observations	63,314

Note. Robust standard errors in parentheses. χ^2 (16) = 11545.28, $p < .001$, Nagelkerke R^2 = .361.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Being in an agricultural industry was associated with decreased odds of migrating due to natural disasters ($OR = .721$, $p = .05$) compared to other industries, whereas being in the forestry industry was associated with being nearly 24 times more likely to migrate ($OR = 23.71$, $p = .001$) compared to those in other industries. Having previously lived in a rural area was associated with increased odds of migration due to natural disasters ($OR = 2.331$, $p = .048$), whereas currently living in a rural area was associated with decreased odds of migration related to natural disasters ($OR = .376$, $p < .001$). Males were twice as likely to have a natural disaster migration compared to females ($OR = 2.043$, $p < .001$). Compared to those with no physical disabilities, having a disability was associated with increased odds of migration related to a natural disaster ($OR = 1.260$, $p < .05$). Adults without a high school diploma were over three times more likely to have a natural disaster migration ($OR = 3.170$, $p < .001$). Lastly, having an advanced fuel source was associated with decreased odds of disaster migration ($OR = .317$, $p < .001$). The remaining predictors (i.e., livestock industry, fishing industry, age, highest grade completed, flood frequency, drought frequency, advanced water source, advanced light source) were either non-significant or not meaningfully significant, meaning that their effect size was so small that the statistical significance can be attributed simply to the large sample size.

In order to examine the potential difference in the impact of these environmental and socioeconomic factors on the likelihood to migrate for Cambodians who had migrated from rural areas versus Cambodians who had migrated from urban areas, the sample was stratified by previous residence type and separate logistic regressions were conducted on each sample. The overall model predicting disaster related migration

among individuals who had lived in an urban area was significant, χ^2 (15) = 2796.79,

$p < .001$, Pseudo R^2 = .335 (Table 7). For those who had previously lived in urban areas,

individuals in a forestry industry were over 60 times more likely to migrate compared to

individuals in other industries (OR = 63.82, $p < .001$). Individuals who had previously

lived in an urban center but had migrated to a rural environment were less likely to

experience disaster migration (OR = .478, p =.003) than were individuals who had

previously lived in an urban center but had migrated to an urban environment. Compared

to females previously from urban areas, males previously from urban areas were over

twice as likely to have migrated due to a disaster (OR = 2.146, $p < .001$). Adults without

a diploma were nearly three times more likely to have a disaster-associated migration

(OR = 2.850, $p < .001$). For people previously living in urban areas, having an advanced

source of light was associated with being more than twice as likely to have migration

related to a disaster (OR = 2.313, p = .002). Lastly, having better fuel sources was

associated with decreased odds of migrating (OR = .318, $p < .001$) for Cambodians who

had previously lived in urban areas. The remaining predictors were either non-significant

or not meaningfully significant.

Table 7. Logistic Regression for Natural Disaster Migration.
(Urban Sample)

	Urban Sample OR
Agriculture Industry	.581*
	-(.170)
Livestock Industry	1.227
	-(.420)
Forestry Industry	63.820***
	-(22.640)
Fishing Industry	.802
	-(.282)
Current Residence Rural	.478***
	-(.120)
Male	2.147***
	-(.324)
Age	1.080***
	-(.009)
Highest Grade Completed	1.112***
	-(.022)

Note. Robust standard errors in parentheses. χ^2 (15) = 2796.79, $p < .001$, Nagelkerke R^2 = .335.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 7-Continued. Logistic Regression Predicting Natural Disaster Migration. (Urban Sample)

	Urban Sample OR
Has Disability	1.272
	-(.205)
Adult without Diploma	2.850***
	-(.407)
Flood Frequency	.999
	-(.002)
Drought Frequency	1.000
	-(.003)
Advanced Water Source	.703*
	-(.144)
Advanced Light Source	2.313***
	-(.614)
Advanced Fuel Source	.318***
	-(.057)
Constant	.012***
	-(.005)
Observations	14,589

Note. Robust standard errors in parentheses. χ^2 (15) = 2796.79, $p < .001$, Nagelkerke R^2 = .335.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

The overall model predicting disaster related migration among those coming from rural areas was significant, χ^2 (15) = 3,069.63, $p < .001$, Pseudo R^2 = .386 (Table 8). Of those who had previously lived in rural areas, individuals in the forestry industry were just over 10 times more likely to migrate ($OR = 13.48, p = .018$) compared to individuals in other industries. Comparing this relationship to the previous model, there is evidence that the relationship between working in the forestry industry and odds of natural disaster migration may be 6 times greater for those who had come from urban areas than it was for those who had come from rural areas. Cambodians who had come from rural areas and were living in a rural area had lower odds of a disaster migration ($OR = .396, p = .001$) than did Cambodians who had come from rural areas and were living in an urban area, and this effect size is approximately the same as that found previously for Cambodians coming from urban areas. Compared to females coming from rural areas, males coming from rural areas were nearly twice as likely to have migration related to a disaster ($OR = 1.994, p < .001$), which is proportionate to the effect size from the previous model. Adults without a diploma coming from rural areas were over three times more likely to have a disaster-associated migration ($OR = 3.230, p < .001$), which might be a slightly stronger relationship than it was for those coming from urban areas. Lastly, among Cambodians coming from rural areas, having advanced fuel was associated with decreased odds of migrating ($OR = .311, p < .001$), with a similar effect as for Cambodians coming from urban areas. The remaining predictors were either non-significant or not meaningfully significant.

Table 8. Logistic Regression Predicting Natural Disaster Migration.
(Rural Sample)

Variables	Rural Sample OR
Agriculture Industry	.807
	-(.138)
Livestock Industry	1.144
	-(.747)
Forestry Industry	13.490**
	-(14.970)

Note. Robust standard errors in parentheses. χ^2 (15) = 3069.63, $p < .001$, Nagelkerke R^2 = .386.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 8-Continued. Logistic Regression Predicting Natural Disaster Migration.
(Rural Sample)

Variables	Rural Sample OR
Fishing Industry	1.458
	-(.415)
Current Residence Rural	.396***
	-(.107)
Male	1.995***
	-(.165)
Age	1.062***
	-(.005)
Highest Grade Completed	1.092***
	-(.022)
Has Disability	1.309*
	-(.200)
Adult without Diploma	3.230***
	-(.476)
Flood Frequency	.996**
	-(.002)
Drought Frequency	.988***
	-(.004)
Advanced Water Source	.974
	-(.162)
Advanced Light Source	.977
	-(.274)
Advanced Fuel Source	.311***
	-(.054)
Constant	.132***
	-(.083)
Observations	48725

Note. Robust standard errors in parentheses. $\chi^2 (15) = 3069.63, p < .001$, Nagelkerke R^2 = .386.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

CHAPTER V

DISCUSSION AND CONCLUSIONS

5.1 Summary of Findings

The results of the analysis of the full sample and stratified samples of urban and rural migrants confirmed that working in the forestry industry, being male, and having no formal education were all significantly associated with increased odds of natural disaster migration. Conversely, across all samples, having an advanced fuel source and currently living in an urban area were both associated with decreased odds of a disaster migration. In the full sample, having a disability was associated with increased odds of disaster migration, but this relationship was not seen in the stratified samples, indicating that those with disabilities were more likely to migrate, regardless of origin.

Though the number of floods and the number of droughts were associated with a decrease in the likelihood of migration in the full sample and the rural sample, this statistical relationship is limited due to the extremely small effect size and large sample size. In other words, the *effect size* (the measure of the strength, or magnitude, of the relationship between two variables in a statistical population) suggests a decrease in odds/likelihood of .004% and .012%, respectively. Furthermore, because the effect sizes are small, coupled with the data set being large (1,000 observations or more), the results are just noise in the data and are likely due to random chance.

5.2 Interpretation of the Study's Findings

This research asked the following questions: (1) Which districts in Cambodia are most impacted by migration caused by floods and droughts? (2) What socioeconomic indicators impact migration decisions? (3) What is the relationship between poverty and natural disaster migration? (4) What is the relationship between education and natural disaster migration? (5) What is the relationship between occupation and natural disaster migration? (6) Is there a difference between urban and rural migration in natural disaster migration decisions? The following will summarize the research questions in relation to each hypothesis, the analytical results, and related literature.

5.2.1 Which Districts in Cambodia are Most Impacted by Migration Caused by Floods and Droughts?

The hypothesis of the study was that rural and primarily agricultural districts are most impacted by floods and droughts. Given that nearly 80 percent of the population of Cambodia lives in rural areas and 85 percent rely on agriculture, forestry, or fishing for their subsistence, increased incidents of floods and droughts will put more people at risk and increase migration. The *Analysis Report 1996-2013: Cambodia Disaster Loss and Damage Information System* (NCDM 2014) is a record of natural disasters that occurred in Cambodia between 1996-2013. When a district within a province experiences a natural disaster, a data card is submitted with a description of specific damages. The report reveals that the provinces and their respective districts most impacted by damages caused by floods and droughts between 1996-2013 were located in the vicinity of the Tonlé Sap Lake, the Mekong River, and the Bassac River (Table 9).

Table 9: Natural Disasters by Province in Cambodia 1996-2013.
Source: CamDi Analysis Report 1996-2013 (NCDM 2014)

	Flood	Fire	Epidemic	Drought	Storm	Pest Outbreak	Lightning	River Bank Collapse	Other
Baneay Meanchey	281	35	4	33	8	0	27	0	0
Battambang	158	76	2	50	95	0	44	0	0
Kampong Cham									
Kampong Chhnang	189	10	2	33	17	0	29	0	0
Kampong Speu	78	23	6	197	12	8	20	0	0
Kampong Thom	128	10	2	46	16	0	15	0	0
Kampot	162	12	12	153	50	14	25	0	0
Kandal	154	49	4	68	91	0	51	24	0
Koh Kong	34	7	0	1	18	31	6	0	0
Kratie	259	166	0	31	30	0	0	0	8
Mondulkiri	29	58	0	1	4	12	10	0	0
Phnom Penh	0	0	0	0	0	0	0	0	0
Preah Vihear	333	47	0	5	25	0	4	0	0
Prey Veng	221	49	5	68	69	17	33	0	0
Pursat	109	7	0	56	6	2	54	0	0
Ratanakiri	93	5	0	1	14	0	0	0	0
Siem Reap	301	404	0	102	285	0	43	0	0
Preah Sihanouk	14	24	0	1	14	5	14	0	0
Stung Treng	133	4	0	29	2	5	3	0	0
Svay Rieng	187	6	0	74	12	4	28	0	0
Takeo	111	77	0	124	119	0	65	0	5
Otdar Meanchey	101	33	0	19	38	0	7	0	0
Kep	2	4	0	1	12	0	4	0	0
Pailin	34	5	1	12	36	0	20	0	0

These findings are consistent with what is already known regarding locations where floods and droughts typically occur in Cambodia, however, this research found that districts having more frequent floods and droughts had lower odds of migration. Recent reports suggest otherwise. For example, the *IPCC Fifth Assessment Report on Asia* (IPCC 2014) found that floods have exposed many Cambodians to conditions such as lack of access to alternative livelihoods, difficulty in maintaining existing livelihoods, and household debts leading to migration in the Mekong region (Barros et al. 2014). In addition, the *CamDi Analysis Report 1996- 2013* reports that floods in Cambodia have been responsible for 1091 deaths and destroyed 21,418 houses since 1996 and that each year, during the months of September through October, floods are expected to cause loss of life and damages to housing and property, and displacement (NCDM 2014).

The analysis found that, of the sample size (N=100,223), 9.2 percent of respondents migrated because of natural disasters. Of these migrants, 34.9 percent work in agriculture and 86.7 percent are currently located in rural areas. The migration map below represents these results at the district level. The provinces most impacted by natural disaster migration are Oddar Meanchey, Banteay Meanchey, Battambang, Pursat, Kampong Thom, Kampong Cham, Kratie, Kandal, PreyVeng, Takeo, Kampot, Koh Kong, and Kampong Speu (Figure 8 and Table 10). Interestingly, all the provinces mentioned above experienced high instances of floods between 1996-2013.
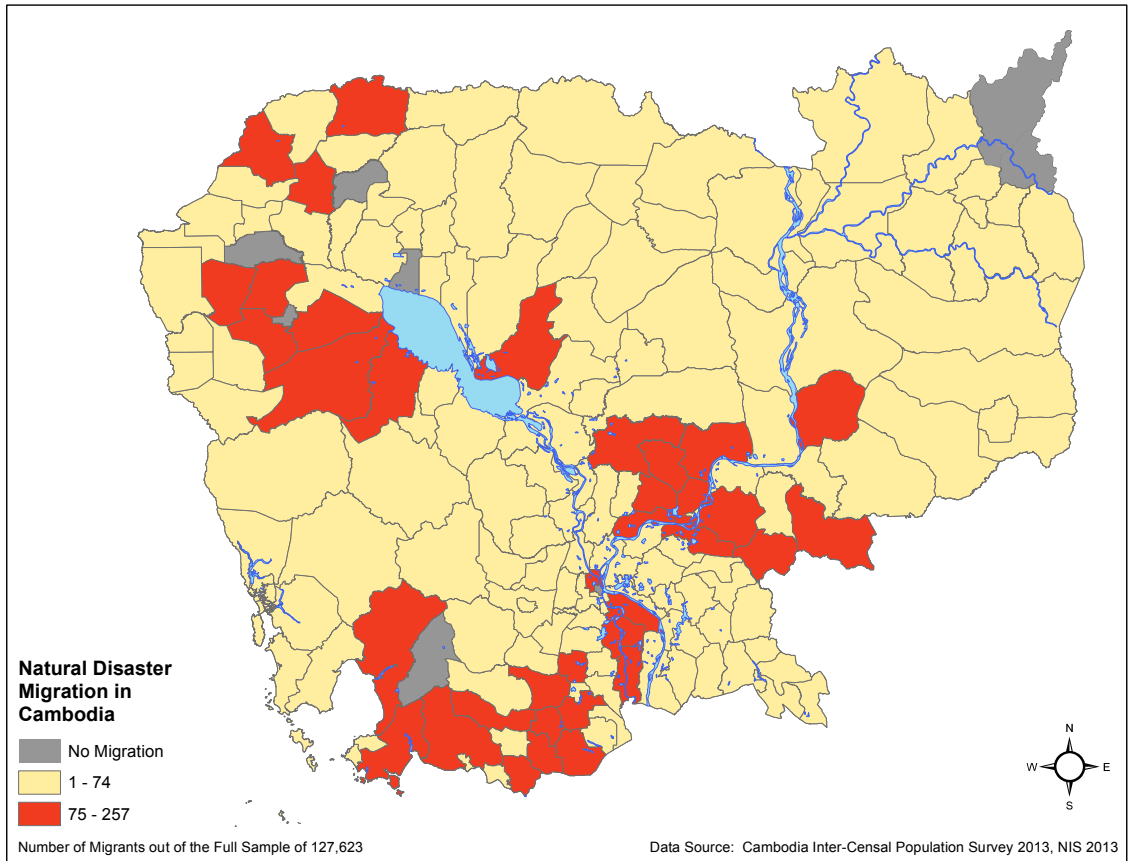
Figure 8: Natural Disaster Migration in Cambodia by District.
Source: Map generated by data used from the CIPS 2013 survey and the CamDi Analysis Report 1996-2013

Table 10: Provinces Most Affected by Floods and Natural Disaster Migration.
Source: CamDi Analysis Report 1996-2013 and data analysis for this study

Province	Number of Floods by Data Cards 1996-2013
Oddar Meanchey	101
Banteay Meanchey	281
Battambang	158
Pursat	109
Kampong Thom	128
Kampong Cham	Data cards not collected
Kratie	259
Kandal	154
Prey Veng	221
Takeo	124
Kampot	153
Koh Kong	Data cards not collected
Kampong Speu	197

5.2.2 What Socioeconomic Indicators Impact Migration Decisions?

The hypothesis was that people who are poor, have less education, and are agriculturally dependent are more likely to migrate as a result of floods and droughts. This sector of the population is vulnerable to natural disasters because they do not have the necessary resources to rebound from loss of crops and income, and damages to housing and infrastructure. The analysis found that males who do not have a high school degree, who work in the forestry industry, and currently reside in rural areas have higher odds of migrating due to natural disasters than any other group.

5.2.3 What is the Relationship Between Poverty and Natural Disaster Migration?

The hypothesis was that poverty is significantly associated with natural disaster migration. The literature supports the view that the poor typically do not migrate when facing adversity, however, increased floods and droughts are likely to displace the most vulnerable populations when attempts at adaptation have failed. Because the CIPS 2013 survey did not provide per capita income information, some categorical variables were used to determine the economic status of respondents. For example, water source, light source, and fuel source were collapsed from multiple categories into dichotomous variables. These variables were intended to capture components of socioeconomic status; sources typically used in less developed communities were categorized as less advanced sources and sources typically used in more developed communities were categorized as advanced sources. For example, Cambodians who received their water from piped water, pipe wells, or bought sources were categorized as receiving their water from advanced sources, whereas, Cambodians who received their water from dug wells, rain water, springs/rivers, or other sources were categorized as receiving their water from less

advanced sources. In the full sample, the analysis found that having advanced fuel decreased the odds of natural disaster migration and advanced light and water sources were insignificant. For the urban sample, having an advanced light source increased the odds of natural disaster migration and advanced fuel decreased the odds of migration; the water source was insignificant. The rural sample found that having an advanced fuel source decreased the odds of natural disaster migration and water and light sources were insignificant.

5.2.4 What is the Relationship Between Education and Natural Disaster Migration?

The hypothesis was that people with less education are more likely to migrate as a result of natural disasters because they are more dependent on their current occupation and are usually poor, making them less resilient and having fewer adaptation strategies to mitigate natural disasters. The analysis found that adults without advanced education have higher odds of natural disaster migration, and that adults without a diploma were nearly three times more likely to have a disaster-associated migration ($OR = 2.850$, $p < .001$). In rural areas, Cambodians average five years of completed education and many do not earn a high school diploma. This decreases their resilience and adaptive capacity to natural disasters and impacts their ability to find other types of work or income when needed.

5.2.5 What is the Relationship Between Occupation and Natural Disaster Migration?

The hypothesis was that people who depend on agriculture for their livelihood are more likely to migrate as a result of natural disasters, more so than other occupations. Because the majority of rural households in Cambodia depend on agriculture, forestry, and fishing for subsistence, a higher incidence of floods and droughts will negatively

impact the earning ability of rural households, thus making them more vulnerable to natural disaster migration. The analysis found that working in the agricultural sector was associated with decreased odds of migrating due to natural disasters ($OR = .721, p = .05$) compared to other industries, whereas working in the forestry sector increased the odds of natural disaster migration by nearly 24 times ($OR = 23.71, p = .001$) compared to those in other industries.

5.2.6 Is There a Difference Between Urban and Rural Migration in Natural Disaster Migration Decisions?

The hypothesis was that rural-to-rural and circular migration will continue to be adaptation strategies for rural households that experience floods and droughts, especially for Cambodians over thirty-five years of age. Rural-to-urban migration will continue to increase as younger generations move to urban areas for education opportunities and alternate forms of work. The analysis found that, for those who had previously lived in urban areas, individuals in a forestry industry were over 60 times more likely to migrate compared to individuals in other industries ($OR = 63.82, p < .001$). Individuals who had previously lived in an urban center but had migrated to a rural environment were less likely to experience disaster migration ($OR = .478, p = .003$) than were individuals who had previously lived in an urban center but had migrated to an urban environment. Compared to females previously from urban areas, males previously from urban areas were over twice as likely to have migrated due to a disaster ($OR = 2.146, p < .001$). For people previously living in urban areas, having an advanced source of light was associated with being more than twice as likely to have migration related to a disaster ($OR = 2.313, p = .002$). Lastly, having advance fuel sources, compared to less advanced

fuel sources, was associated with decreased odds of migrating ($OR = .318$, $p < .001$) for Cambodians who had previously lived in urban areas. The results of the analysis found that natural disasters cause rural people to move to other rural areas. However, the CIPS 2013 Report states that rural-to-urban, as well as urban-to-urban migration has decreased in the last five years.

5.3 Limitations of the Study

The results of this analysis partially support my hypothesis that floods and droughts influence migration decisions in Cambodia; however, there were limitations with the study. First, the 2013 Cambodia Inter-Censal Population Survey is a national survey with a large sample size and does not specifically address the complexity of underlying migration reasons. In addition, the large sample size of the national survey resulted in insignificant values of some variables important to this study. Because migration often involves several push and pull factors, no single migration reason provided in the survey could account for natural disaster migration. As an attempt to address this problem, the following reasons for migration were combined to create a new migration category called "Natural Disaster Migration": (1) Searching for employment, (2) Transfer of work place, (3) Insecurity, (4) Lost land or home, and (5) Natural calamities. These combined reasons for migration approximate situations when natural disaster migration or displacement occurs. For example, a respondent may claim he moved because of needing to find work. The migration reason, however, does not provide a specific explanation as to *why* seeking work was necessary. Is it because he lost his job or because he can no longer afford to grow rice due to damage caused by floods and droughts? It is important to consider the different 'push' factors involved in

the decision to migrate.

In addition, the national survey does not collect data regarding losses resulting from natural disasters, such as crops, housing, or material goods. This type of information is important when determining the magnitude of a disaster and migration in a particular area. To address this limitation, data from the *Analysis Report1996-2013: Cambodia Disaster Loss and Damage Information System* (NCDM 2014) was included in the analysis. Although the data was useful to this study, the report was missing natural disaster data for many districts. Based on the results of the analysis, further investigation into the results is necessary but was not possible due to time limitations.

Another limitation to this study was the methodological approach and decision to collapse the occupation categories into five categories: (1) Agriculture, (2) Forestry, (3) Fishing, (4) Livestock, and (5) All Others. Because the primary hypothesis of the study was that people who work in agriculture AND live in rural areas are more likely to migrate due to natural disasters, a better approach would have been to collapse the occupations into two categories: 1) Agriculture and, 2) All Others. A surprising result of the analysis for all samples (Full Sample, Urban Sample, and Rural Sample) found that those who work in the forestry industry have higher odds of migrating due to natural disasters than any other industry, but yet, agriculture is the predominant industry in Cambodia. Further investigation into this result is necessary but was not possible due to time limitations.

5.4 Implications for Further Study

This research was an attempt to understand how natural disasters, such as floods and droughts, impact migration decisions in Cambodia. The results of the analysis partially support my hypotheses, however, more research is needed to better understand the characteristics of populations vulnerable to natural disasters. In addition, more consideration needs to be made to identify push factors that cause migration and displacement.

One place to begin is in the methodological approach conducted in the national census survey. The quantitative data provided by the 2013 Cambodia Inter-Censal Survey was useful for understanding the overall demographics of the country, but did not provide critical information needed in order to assess the specific reasons for migration. This is largely due to the fact that the survey has a very large sample size and was too generalized. Although respondents were given a selection of causes to explain their reason for migration, the nature of migration itself is complex and may involve several different push factors. A second tier of qualitative questioning is needed so that responses can be more accurately accounted for in the final results of the survey.

More research is also needed in understanding occupations in Cambodia. For example, the analysis concludes that males working in the forestry sector have higher odds of natural disaster migration than any other occupation. Because many Cambodians work for themselves and are informally employed, it may be assumed that workers in the forestry sector are dependent on harvesting forest products in order to provide a livelihood for their families. In many provinces in Cambodia, rural peoples' livelihoods have traditionally been closely associated with the forest, especially for firewood,

building material, and timber. In addition, Cambodia uses a lot of fuel-wood for energy, with ninety-two percent of the population dependent on fuel-wood as a major source of energy (UNDP 2011). Populations in the northeast, parts of the west, and mountain areas depend on forests for their livelihoods. In some areas, rural households sell forest products at the market, making 1,500 to 2,000 riels per day (2000 data). However, more research is needed on the characteristics of people working in the forestry sector and how natural disasters impact them. In addition, further research could determine if money earned from forest products is sent to other provinces as a form of remittances to family members struggling to cope with crop losses or housing damages caused by floods and droughts. This is a question not addressed in this research but certainly deserves further investigation.

5.5 Conclusions

The decision to migrate is most often the result of several "push" and "pull" factors be they economic, social, political or environmental; rarely is migration caused by a single reason. In the last couple of decades, however, there has been an increase of displacement due to environmental degradation and natural disasters. The Red Cross reports that more people are now displaced by environmental disasters than by war (IFRC 2001). In addition, the Internal Displacement Monitoring Centre (IDMC) reports that 22 million people were displaced by natural disasters in 2013 and the global trend is on the rise due to more people living in disaster-prone areas and the future impacts of climate change (Internal Displacement Monitoring Centre 2014). The connection between environmental disasters and migration is generating much debate, mainly concerning the following issues: (1) the definition of who is classified as an environmental migrant,

(2) the question over whether environmental migrants actually exist, and, (3) who is responsible for the protection of such people if they do exist (Renaud, et al. 2013).

The literature on migration supports the idea that people living in poverty will move once all attempts at adaptation have failed. For the many Cambodians living in rural areas, natural disasters are putting more of a strain on livelihoods and their ability to adapt to changing economic conditions and ways-of-life. In the Mekong Delta, droughts are forcing farmers to plant crops that require less water and the fear of crop loss is causing many farmers not to plant a second rice crop. This uncertainty is driving many farmers to seek new off-farm jobs and change their way of life because their crops (rice, coffee, sugar etc.) are frequently damaged and stressed (Barros et al. 2014, 83). Migration is a form of adaptation and can be an important survival strategy for alleviating poverty (Deshingkar and Grimm 2004) and that, "as long as poverty exists and the adaptation skills are low, climate change will exacerbate the situation" (Deshingkar and Grimm 2004, 22).

For this type of research to be more effective, there needs to be a mixed methods approach that combines a national population survey as well as targeted qualitative surveys at the local level. It is important that governments understand the demographics of society, however, the benefit of qualitative research is that it provides more specific information on complex social problems that have social and behavioral aspects to consider. Qualitative surveys, such as the *Cambodia Post-Flood Relief and Recovery Survey* (2012*)*, the *CRUMP Migration Project* (2012), and the Vulnerability Reduction Assessments (VRAs) from the Community Based Adaptation Program (CBAP 2012) (Appendix), have been beneficial as supplemental resources to this study because they

specifically identify natural disaster impacts on individuals and their reasons for migration. This information can help ascertain public reaction of climate change, which is vital when planning adaptation strategies and public acceptance of adaptation programs.

As natural disasters make adaptation to a new environment more difficult, migration, whether in the form of temporary or permanent displacement, will become more common as a coping strategy, especially for poor populations with few resources and adaptive capacity. The consequences of this type of forced migration include human security challenges, potential for human conflict, and increasing poverty. Local and regional governments need to understand the evolving nature of migration in the face of climate change so that effective adaptation strategies can be put in place to alleviate poverty while increasing adaptive capacity. Future research on natural disasters and migration can hopefully guide this process, however, the methods by which national population surveys are conducted need an updated approach so that today's more complex problems can be understood more comprehensively. Quantitative data analysis can give us a picture of what is happening or what may happen, but we still need to understand "Why?" in order to solve our current problems.

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