Whether environmental factors matter out migration in KDSS

Evidence from past migration events suggest that adverse environmental condition can have influence on population's decision to migrate. Environmental degradation can promote migration in several ways. Droughts and loss of land productivity can become important factors accelerating the movement of people from dry lands to other areas, particularly once coping mechanisms and adaptation strategies of the ecological system are impaired. William Petersen's early typology of migration of impelled and forced migration (1958, 1975) describes that innovative or conservative migration behaviors cause by specific incorporation of ecological "pushes" factors such as cool, drought, flood, earthquake, forest fire and deterioration of soil quality as a type of migratory force. He argued, however, that ecological forces tended to shape migration in primitive times and that a conservative response would yield within the risky area in an effort to recreate status quo without long-distance relocation. Innovative response would, instead, entail a flight from the risky area more generally to find a less risky ecological context (Hunter, 2004)

Robert McLeman and Barry Smit, 2005 also discussed that environmental changes may stimulate increased levels of migration out of the source region. At the same time, worsening environmental conditions in the source area may result in worsening economic and political conditions there which resulting in less frequent travel of visitors and business travellers between the two areas. Migration out of areas affected by environmental degradation and adverse environmental changes is one possible response by vulnerable populations. (McLeman and Barry Smit, 2005) This argument is relevant to the Kingsley David's multi-phasic response which specifying that the intervening social relations and behaviour response of people would influence how population growth affects the environmental outcomes, specifically land use practices. However, Curan (2002) argued that this theory consider only migration and environmental relation. These relations include migration to place where there is "available" land presumably organized under open access to common property relations and out migration in response to limited environmental resources (Curan, 2002). She also pointed out that this theory does not consider the varying forms of migration – return, repeat, circular, permanent, temporary – nor the selectivity of migration, nor how social networks and social capital may be important intervening variables for understanding the effects of migration on environment. She also argued that empirical literature shows that 1) the selective nature of migration has an effect on environmental outcomes, including variability in the type of migration; 2)environmental considerations at both places of origin and destination can serve as push or pull factors respectively; 3) remittances to places of origin may play an important role in redirecting consumption in either positive or negative ways for environmental outcomes; 4) migration affects the environment through social and economic institutions, such as land tenure and poverty (Curan, 2002).

Hunter (2004) also argued that migration as a demographic process can be associated with environmental hazards in several ways. On the one hand, proximate environmental hazards might influence residential decision-making by shaping their desirability to stay in any location. In this case, environmental hazards become factors

shaping migration. On the other hand, migration can represent force with regard to environmental hazards as a result of increasing population density in vulnerable location. In this case, migration become a factor shaping the scale of environmental hazards, and the scope of the resulting disaster can be occurred (Hunter, 2004).

Henry (2006) suggested that some environmental degradation forces are slow moving; others are faster. Cumulative environmental degradations (e.g., soil erosion) are largely slow-moving and manmade. Their effects are permanent and relatively dispersed. For the gradual deterioration of environmental conditions, households can determine how they respond to environmental change because environmental degradation is gradual (use of water and soil conservation techniques, use of fertilizers, migration, off-farm job, etc). However, the natural disasters (e.g., storms) are largely idiosyncratic. Their effects on migration are temporary, fast acting, and localized. Without adequate adaptive capacity, household may face difficulty to survive after the disaster. In addition, he also extended his argument to the effect of production accidents and development project by saying that the effects of production accidents (e.g., chemical spills) can advance quickly, but tend to be temporary. In addition, development projects (e.g., artificial lakes) can change the environment; their effects on migration are permanent (Sabine, 2006).

Migration due to environmentally related factors can take many forms. The majority of them occurred as internal migrations by displacements of populations within national boundaries. The migrations associated with desertification in China and sub-Saharan Africa, deforestation in the Amazon Basin are the examples of internal migration due to environmental factors. In addition, international migrations can also occur as a result of adverse environmentally related conditions. The evidence of this argument can be seen in the migration from the South to the North, that is, from the developing countries towards the industrialized countries. The migration of labourers into a region in which mining or forestry is introduced or intensified, as has occurred recently in both Indonesia and Brazil are the examples. In such cases, indigenous populations are often forced out of their homelands as a result of commercial activities that transform the traditional resource base (Hay, 2006)

Various studies in recent years suggest that, if environmental change is to be of the projected magnitude and rapidity, there could be as many as 150 million "environmental refugees" by the end of the 21st century (Hay, 2006). Some have noted that current projections of sea level rise and increased tropical cyclone intensity may make many small island states uninhabitable. Others take a more pessimistic view and suggest that mass movements of people will occur, especially from developing countries that lack the capacity to cope with recurrent droughts and associated food shortages. Still others suggest that climate change-related migrations will pose serious international security challenges in coming decades. However, most governments are today ill-equipped to deal with this type of situation. The political and economic tensions that will be raised by an increasing number of environmental refugees could inevitably lead to conflict (McLeman and Barry Smit, 2005).

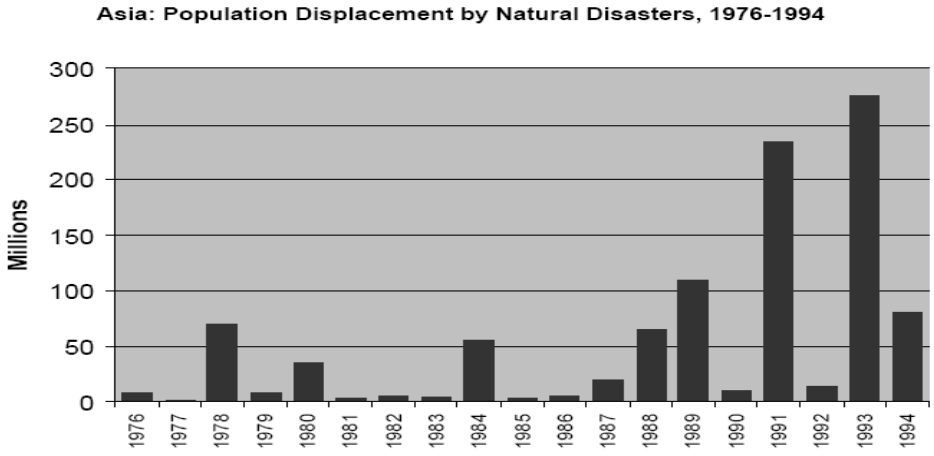
Theoretical perspective on environmental change and migration

Number of studies suggested that root causes of migration are due to mixture of push and pull factors. These causes include economic factor; i.e. poverty, unemployment, wage disparities; social factors i.e. poor welfare or education and demography; environmental factors i.e. degradation of ecosystems; disgraded security conditions such as disrespect for human rights and lastly existence of migrant networks

Hunter (2004) argued that within the neoclassical economic perspective, environmental context has been less emphasis. The neoclassical economic perspectives tend to focus more on the human capital and economic dimensions of migration decision-making. Through these perspectives, migration is viewed as shaped by cost-benefit calculation with personal investment. Migration behavior is only being justified by sufficient returns to the behavioral investment. Thus within the neoclassical framework, individuals might accept lower pay to reside in a location with environmental amenities. On the contrary, some individuals might try to receive higher compensation to continue to live in an environmentally unattractive or hazardous location (Hunter, 2004).

However, Hunter (2004) also discussed that there are other several classic theoretical perspectives on migration at both micro and macro level which try to provide foundations for examination of the association between migration and environmental hazards. She discussed that Hugo (1996) presentation on analysis of Asian environmental migrants also demonstrated that over the last 2 decades there has been a trend toward increasing numbers of people displaced by environmental disasters (see Table 1).

Table 1: Environmentally-Related Population Displacement, Asia and Africa.



Source: Compiled from UNDRO News, 1976-1994.

Hugo argued that within developing regions, millions migrate annually as a result of environmental conditions. This phenomenon suggested that environmental decline may be an important "push" factor fuelling urbanization (e.g., Hugo 1996; Jacobsen 1988). In some cases, local mobility is a more typical response to regularly occurring natural hazards. Thus environment can interacts with individual, household and other community characteristics to shape household migration decision-making.

Lee (1966) argued in his article on "The Theory of Migration" that push and pull factor at the place of origin and destination will effect individual migration decision making. These factors are individual characteristic which ties to the community and household. However, the macro environmental factors such as climate, consistence rain, and drought have also been emphasized in his article as one of the major push factor at the origin. When push factors are negative, huge out migration stream will occur (Thanut, 2000).

Wolpert's theoretical "stress-threshold" model (1966) posited migration as a response to stress experienced from the current residential location, with residential "stressors" including environmental disamenities such as pollution, congestion and crime. The model suggests that these "stressors" bring about "strain" which may lead to consideration of residential alternatives. Further, potential migrants can determine the "place utility" of alternative residential locations based upon their satisfaction derived from relocation to a particular location (Wolpert, 1966).

Speare (1974) outlined characteristics of the individual, household, housing unit location and social bonds as they influence residential mobility. He argued that individuals experience a "threshold of dissatisfaction" after which they may consider residential relocation. Within Speare's framework, physical amenities (or their opposite, physical disamenities) as "locational characteristics," are of most relevance for consideration of environmental hazards (Hunter, 2004). This argument gets along well with Slovic (1987) who conducted a study on the relocation of people in hazardous areas. He argued that people respond to the hazards they perceive as such, while amenities may act as migratory "pulls" factors. As a result, disamenities act as migratory "push". Specifically, relocation in response to nearby environmental hazards cannot simply be assumed since individuals may not be aware of, or concerned with, the danger posed. Risk assessment reflects human judgments, with these judgments influenced by various psychological and social factors (Slovic,1987).

Zelinsky (1971) also argued in his explication of the "mobility transition hypothesis." that social and economic change inherent within modernization yield increases households' ability to act freely upon these preferences for less risky residential environments. (Zelinsky, 1971)

When considering environment as contextual factors, human ecological models pay more attention to contextual factors related to the natural environment. The POET model, conceptually considers the interrelationships between **P**opulation, **O**rganization, **E**nvironment, and with migration subsumed with "population" and environmental hazards potentially represented by both "environment" and "technology." (Hunter, 2004)

Even though all of these perspectives reflected that many classic migration frameworks had try to include environmental factors as contextual characteristics for migration, some scholars argued that the migration and environment literature has not systematically or completely developed a theoretical or conceptual framework for considering new concepts in the migration (Curran, 2002). Hay (2006) also support that the topic of environment and human migration is still in an embryonic state. The current literature on migration and environment is far from having a well-developed theoretical or conceptual framework for addressing these issues, though one is beginning to emerge,

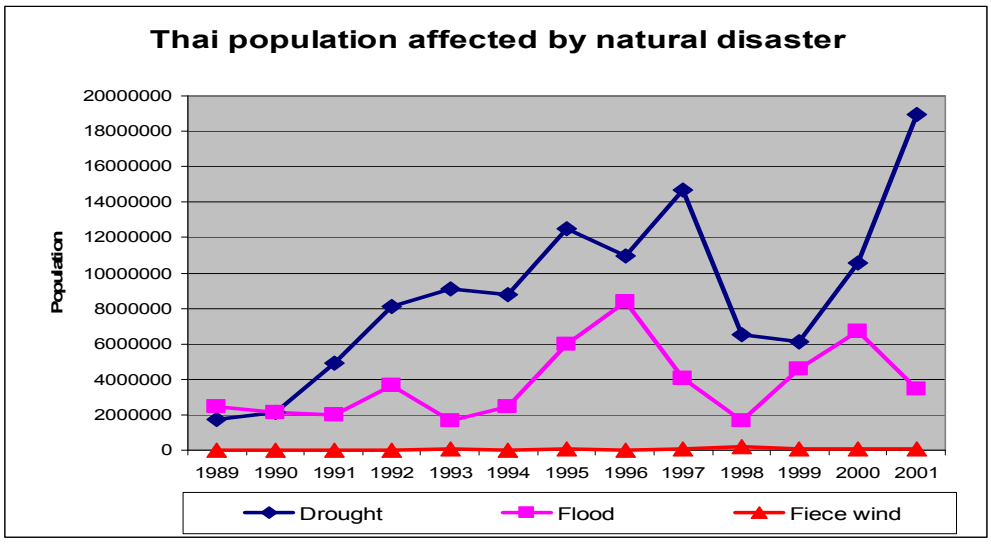
partly as a consequence of the modelling studies that have been initiated in recent years (Hay, 2006). Therefore, more studies related to the various dimension of migration and environment is becoming more important.

Trend toward environmental migration in Thailand

Dramatically change of environmental condition in Thailand has led to several environmental problems. Dramatically reduce in number of forest areas also effect biodiversity and climatic condition of the country. Several environmental and geological experts noticed that changing environmental condition in Thailand such as increasing quantity of rain fall, longer drought, disappearing of 13,000 rais beach areas are direct effect caused by climate change and global warming. Raising sea temperature which effect coral reef will directly creates impact to the quadratic animal. Increasing fluorocarbon, methane and carbon dioxide cause by industrial activities, rice planting and improper waste management can accelerate deterioration of atmosphere. In addition, hydrological experts also argued that raising sea level only 10 cm. can cause severe damage to the flood plain area along the Chaopraya river especially in Bangkhunthean area. (Warawut Khuntiyanun, 2007)

Change in environmental condition can directly increase trends toward natural disaster which can affect population mobility in Thailand. The Ministry of environment had indicated that increasing frequency and severity of climatic variability will increase more natural disaster. In 2000, more than 2 million people were affected by flooding. Drought in 2002 also affects more than 10 million people in Thailand. Even though number of people affected by fierce wind are less when compare with other natural disaster, but the trend of effected people are also raising as presented in figure 1 (Pollution Control Department, 2007). These changing environmental conditions will effect living condition of people and change decision for out migration of people.

Figure 1 Thai population affected by natural disaster.



Source: Combine data from statistical report of Pollution Control Department, Ministry of Environment, 2007

Wongsaicheau (2003) did a study on relationship between quantity of rain and migration of people in the Northeast of Thailand. He founded that area where there are high or low humidity will encourage people to migrate out of the district. Adequate quantity of water use in agricultural sector can reduce migration out of the district. In addition he also found that quantity of rain, drought, poverty, quality of soil and level of economic development also effect migration rate. (Wongsaicheau and Swangdee, 2003)

Even though there are growing evidences that environmental factors can influence out migration decision of people, there are less studies focusing on this issue. Most of the study on environment and migration mainly focus on environmental deterioration at the destination rather than at the origin. As a result strategic management to counter environmental problems and out migration at the origin was left behind. In order to fulfil this gab, this study intends to find out how environmental factor can influence out migration of people at the origin by applying Karnchanaburi Demographic Surveillance System (KDSS) developed by Institute of Population and Social Research, Mahidol University as source of information.

This study will be useful for developing strategic environmental management plan as appropriate with changing environment and population condition in the origin. In addition, it will also provide information that can lead to further study on the relationship between environment and migration.

Environmental condition in KDSS

Environmental conditions in Karnchanaburi DSS had gradually changed in the last 5 years. Rain water has been used as a main source of water for agricultural activities in this area. Irrigation system and well water are only available in semi-urban area. Other sources of water are rivers and cannels. Most of the people in these areas are farmers. Those who stay in upland area collect forest products for sell. Around 81 of 89 villages plant crop, plantation, vegetable and fruit. Only 43 villages are rice planting areas. Some villages also raise cattle, pigs and chickens for sell. Around 30 villages have total 49 industries in their villages especially in semi-urban and mixed economy areas. These industries are brick producing, pulp and paper, fertilizer, and noodle making industries (IPSR, 2004).

Infrastructure in KDSS had change dramatically during the last 5 years. Most of the villages can access to mobile phone signal except some villages in upland areas. The villagers had more personal automobile such as motorcycles when compare with the last 5 years. Many villages had bus pass to go to the city. Only 9 villages had bus route station in their village. Some village face flooding problem resulting in difficulty for commuting to the district (IPSR, 2004).

Most of the diseases found in this area are cold and malaria. Only 13 villages have health centers in their villages. The rest of them have to seek care from outside (IPSR, 2004). In the last 5 year, there are around 90 people in mixed economy areas and 33 people in crop planting areas got sick due to the exposure to chemical substances in agricultural farm and industries. Water pollution can be found in 2-3 villages. Soil quality deterioration can be found almost in every stratum especially in crop planting and mixed

economy areas. Air pollution caused by dust and smoke are also the main environmental problems in these places (IPSR, 2004). 39 villages in rice planting, crop planting and mixed economy area face with natural disaster problems such as fierce win, hall, flood and drought. Only 1 village in semi-urban area faces natural disaster (IPSR, 2004).

In KDSS there are total 12,462 households. 36 percent of the populations are under 15 years old which are in upland area. The highest proportion of labour force age is in semi-urban area. Most of the elderly are in rice planting area (IPSR, 2004).

Punpung and Guest (2004) had analyzed migration data in the fifth round of Karnchanaburi Demographic Surveillance Survey. They founded that around 75% of people in that area are not migrate. Out migration rate in the previous year equal to 15 while in migration rate equal to 10 per 100 population. Net migration rate in that area is equal to 5 (IPSR, 2004). Male are more likely to migrate out when compare to female. Out migration rate of male are between 8 to 36 per 100 population in the same age group. While out migration rate of female are between 2 to 24 per 100 population in the same age group. Out migration rate of both male and female in 15-19, 20-24 and 25-29 age groups are larger than other age groups (IPSR, 2004). Most of the reasons for migrating out relates with economic or social condition.

Research Methodology

This study applied information collected by the Institute of Population and Social Research, Mahidol University, Thailand on Karnchanaburi Demographic Surveillence Survey (KDSS) to analyze influence of demographic, socioeconomic and environmental factors on the number of out migration population at village level. A cross sectional analysis was conducted by employing the fifth round KDSS 2004. Information from household and village questionnaires were combined in order to get appropriate demographic and environmental factors variables which will effect population out migration in KDSS. After cleaning all outliers and missing cases, multilevel regression analysis has been applied to analyze data from 2025 cases in 72 villages. This kind of analysis was utilized in order to understand whether contextual factors such as environmental factors have any influence on out migration when compare with individual or household level factors. Only the out migrants cases who migrated out of their villages were selected in this study. Number of out migrants in each village was used as dependent variable. 4 Models were developed to compare how each group of environmental factor variables have any influence on number of out migration at village level. F test was also employed to test how each insignificant variables can increase explanatory power to the model or not. This test also has been used to explain differences in explanatory power of each model.

The first model employed demographic characteristics of the migrants as control variables for number of out migration in each village. These variables include, migrant's age, sex and mean education of the migrant in each village. Numbers of studies have shown that age of population especially the labour force age is highly related with out migration. Age of the migrant can affect labour demand, pattern of labour utilization and adaptation of the household at the origin in order to response to changing labour force

pattern due to out migration. Thus age of the migrant was applied to understand influence of migrant age on number of out migration in each village.

In addition, some studies also found that gender of the migrant also influence out migration. Male are more likely to migrate than female. Thus sex of the migrants has been applied to see whether sex of the migrant had any influence on number of out migration in each village.

Village mean education of the migrants was selected in order to understand whether migration selectivity especially among those who have high education or high qualification will have any impact on number of out migration at village level or not.

The second model employed socio-economic variables that can influence out migration at household and village level. According to household economic theory, labour migration is an economic strategy exercised by the household to allocate human resources rationally in order to increase flows of income and to decrease the scope of economic risk (Messey, 1990). As a result, mean household asset and mean household debt in each village were applied to find out whether household economic status will have any influence on migration decision of members in the household. So it will influence number of out migration in the village.

Social factors such as number of people who receive impact from factory inside the village and number of people utilization of health care facility outside village also applied to find out how existing industry and health care facilities will have any influence on number of out migration.

The third model employed physical environmental factors that can influence out migration. Kingsley David's multiphasic response explained the effect of population growth upon land use change. He argued that out migration of people at the origin was also the response of population on limited environmental resources. Thus migration is a mechanism by which rural community can relieve population pressure on limited areas of land. As a result, total land area in each village and geographical types of land such as upland area were applied to find out whether limited land area or different type of land in each village can influence number of out migration of people. Moreover number of people utilized water resources in each village also can reflect whether population pressure on water resource can have any influence on out migration of people or not.

Distance of asphalt road that connect village to district can reflect village development level. It also can imply influence of development project on out migration of people in the village. Moreover, Evert Ravenstien also mentioned in the laws of migration that quantity of migration has negative relationship with increasing distance. Lee theory of migration selectivity also argued that distance can become an intervening obstacle for migration. As a result, distance of asphalt road connected village to district was also select as independent variables to understand this relationship.

The fourth model employed biological environmental factors at village level which can influence out migration. Various migration literatures had emphasised that environmental stress and disamenities from environmental pollution can influence residential mobility. As a result number of people affected by environmental problem in each village due to air, water, noise pollution and insect disturbances was selected to find

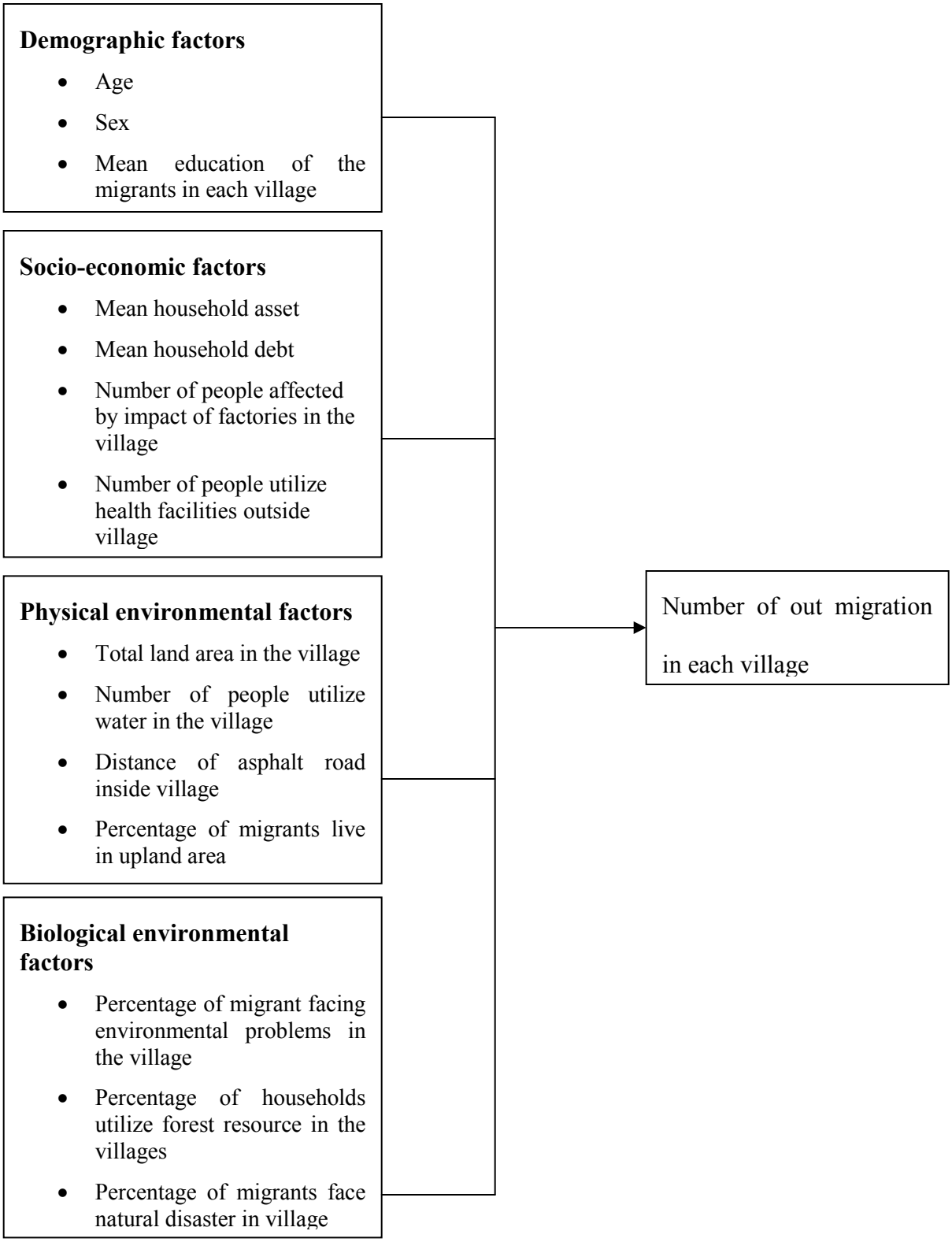
out whether environmental pollution have any influence on out migration of people in the village.

Concept of common property regime was developed in order to governing population relationship with resource exploitation. This system affects population response to natural resource management such as forest utilization. As a result number of household utilize forest resource in each village was selected in order to understand relationship between migration and common property regime in the community.

William Peterson also suggested that forced and impelled migration especially among conservative migration is mainly forced by environmental factors. This kind of migration is a response to uncontrolled natural disaster. In order to understand whether forced and impelled migration have any relationship with number of out migration from the village, percentage of migrants affected by natural disaster in each village was selected.

Detail list of each variable used in this analysis are present in table A1 in the Annex1. Conceptual Framework of the study is presented in Figure 2.

Figure 2 Conceptual Framework



Detecting missing data, outliers and collinearity

From the KDSS data in 2004, there are more than 3000 people migrate out of the KDSS since 1983 till August 2004. However, this study selected only the cases that migrate out of the village to other districts and provinces until August 2004. After detecting missing data and outliers by using Z score, there are only 2,025 cases from 72 villages left for the analysis in this study. The Z score of each variable range between -3 and 3 or within 3 standard deviation or 99% confident interval. Range of Z score of all 15 variables are presented in table A2 in annex 1. Number of cases and value of each variable after detecting Z score were also presented in table A3 in annex 1.

Correlation matrix was applied to measure collinearity among independents variables on number of out migration in each village. Independent variables which has collinearity higher than 0.65 were take out of the analysis. Detail of these correlations matrix is presented in table A4 in Annex I

The result of correlation matrix shown that there was no independent variables applied in the models have collinearity with each other higher than 0.65.

Age, gender, mean education, mean household asset and mean household debt of the migrants, distance of asphalt road connected between village and district and percentage of household utilize forest resource in each village have negative relationship with number of population migrate out of the village. On the contrary total land area in the village, number of people affected by number of factories in the village, number of people utilize health facility outside village, number of people who access to water in each village, percent of migrant who live in upland area, percent of migrants who affected by environmental pollution in the village and percent of migrant population affected by natural disaster in each village had positive relationship with number of out migration in each village. Most of the variables except age and sex of the migrant and percentage of migrants who migrate out of upland area have signification relationship with number of out migration from the village at 95 and 99% confident interval.

Multilevel regression analysis on the influence of environmental factors on number of out migration in the KDSS villages.

Even though economic and social conditions are the main reason for out migration of the population in KDSS, environmental factors also play important role behind the migration decision. From the analysis on influence of environmental factors on out migration of population at village level in KDSS by using multi-level regression models, the results of this study are presented as in table 2

Table 2 Multilevel regression models of village factors influencing number of out migrants in KDSS 2004

	Model1			Model 2			Model 3			Model 3		
Independent variables	**Coef.**	**Robust Std. Err.**	**t**	**Coef.**	**Robust Std. Err.**	**t**	**Coef.**	**Robust Std. Err.**	**t**	**Coef.**	**Robust Std. Err.**	**t**
Constant	72.026**	20.643	3.49	57.072***	11.997	4.76	10.835	5.723	1.89	11.978	7.970	1.50
Demographic factors												
Age	-.0528	.0639	-0.83	-.006	.035	-0.18	.0195	.021	0.89	-.004	.015	-0.28
sex	-.139	1.088	-0.13	-.744	.551	-1.35	.081	.364	0.22	-.125	.306	-0.41
Village mean education	- 4.346	2.710	-1.60	-1.835	2.154	-0.85	-2.938*	1.294	-2.27	-2.511*	.966	-2.60
Socio-economic factors												
Household asset index				-1.112	.659	-1.69	.9233	.567	1.63	.325	.344	0.95
Mean household debt in each village				-.00006	.000	-1.55	.00004	.00003	1.49	-.00001	.00002	-0.65
Number of people received impact from industry in the village				.0249***	.004	5.39	.008	.004	1.75	.009**	.003	2.90
Number of people utilize health facilities outside village				.0142*	.006	2.18	.0178***	.005	3.40	.0137***	.003	3.83
Physical environmental factor												
Total land area in the village							.001***	.0005	3.32	.001***	.0003	4.71
Percentage of migrants live in upland area							3.574***	.528	6.77	2.451***	.453	5.41
Number of people utilize water in the village							.0131**	.004	3.13	.014***	.004	3.31
Distance of asphalt road inside village							-.0001	.0001	-1.17	-.0001	.0001	-1.50
Biological environmental factor												
Percentage of migrant facing environmental problems in the village										.407*	.178	2.28
Percentage of households utilize forest resource in the villages										-.148***	.040	-3.70
Percentage of migrants face natural disaster in village										41.108***	10.350	3.97
N	2025			2025			2025			2025		
Prob>F	0.431			0.000			0.000			0.000		
2R-squared	0.105			0.565			0.795			0.872		
F	0.93			7.02			46.56			147.54		
degree of freedom	3, 71			7, 71			11, 71			14, 71		
Number of clusters (vill)	72			72			72			72		
Root MSE	22.424			15.648			10.755			8.4929		
Residual sum of square	1016263.047			493889.605			232824.075			144980.565		

* significant at the 0.01 level or 90% confident interval

** significant at the 0.05 level or 95% confident interval

*** significant at the 0.001 level or 99% confident interval

Model 1

The result in model 1 revealed that when employed demographic variables including age, sex and mean education of the migrant in each village, this study found that migrant's age and sex do not have significant relationship with number of out migrants in each village. However, mean education of the migrants in the village is significantly influence number of out migration in KDSS. It has negative relationship with the number of out migration in each village. Thus, if mean education of the migrants in village increase 1 unit, the number of out migration in each village will decrease by 3.78 times when controlling with age and sex of the migrants. Thus it indicates that if people in the village get higher education, they will be less likely to migrate out of the village. However, this model does not significant. R^2 of the model is equal to only 0.1052 which means that demographic variables applied in this model do not have much influence in explaining number of out migrant in each village.

Model 2

Mean household asset in each village and mean household debt also do not have significant relationship with number of out migration in KDSS. Even though migration is a way that household strategy applied in response to economic situation of the household, however, when considering these variables at village level, they do not have much influence on the number of out migration.

However, other social factors including number of people in the village who affected by impact of number of factories in the village and number of people who utilize health facility outside the village are influential factors on number of out migration in each village. If numbers of people who affected by impact of number of factories in the village increase one unit, the number of people who migrate out of the village will increase around 23 times. Simultaneously if number of people who utilize health facilities outside the village increase one time, the number of people who migrate out will increase around 7 times at 95 percent confident interval.

Model 3

In model three, physical environmental factors including total land area in the village, percentage of migrant who live in upland area and number of people utilized water resources have positive relationship with number of out migration. The more total land area the village have the more people will migrate out.

In Karnchanaburi KDSS, upland area has the highest out migration rate when compare with other strata. The result of this study also shown that percentage of migrant living in upland area has positive relationship with number of out migrants. If percentage of migrants who lives in upland area increase 1 unit, the number of out migrants will also increase 2.3 times at 99% confident interval when controlling other variables. It means that type of land areas also influence number of out migrants in KDSS.

Number of people utilize water resources also influence number of out migration. If numbers of people who utilize water resource increase one unit, the more people will migrate out around .014 times due to conflict on water resources utilization. It also reflected that longer drought due to changing environmental condition will effect number of out migration of people from the village

On the contrary, distance of asphalt road connect village to district has negative relationship with number of out migration. The more distance the road increase, the less people will migrate out of the village. This result coherent with the laws of migration of Evert Ravenstien who explains that quantity of migration has negative relationship with increasing distance. This result is also support Lee explanation that distance between the origin and destination will be alleviated by the intervening obstacle during migratory process. The more distance of the destination, the less people will migrate.

When considering the result of the whole model, it reflected that physical environmental factors can increase explanatory power on the number of out migration from the village. R^2 of this model also increase from 59 to 78 percent.

Model 4

In model 4, biological environmental factors including percent of migrants face environmental problems in the villages, percent of households utilize forest resources in the village and percent of migrant face natural disaster in the village were applied. The results show that percent of migrants face environmental problems and natural disasters have positive relationship with number of out migration. It means that when migrant face environmental problem such as air water and noise pollution and natural disaster in the village, number of migrants who migrate out of the village will increase around 4 times and 41 times respectively. Thus increasing severity of environmental problems and natural disaster are influential factor which affect number of out migration in the village.

On the contrary percent of household utilize forest resources in the village have negative relationship with number of out migration. It means that the more number of household utilize forest resource, the less household will migrate out. It reflected that forest resources are importance source of living condition of the household. If household know how to use forest resources properly, they can simultaneously help protect the forest.

R2 of this model also increased from 78 percent in model three to 87 percent. This means that environmental factor can increase explanatory power to the model. The more people facing environmental problems and natural disaster, the more number of out migration will increase.

Model comparison

When comparing result of each model, this study founded that when adding socio-economic, physical and biological environmental factors into the model, these factors have both positive and negative relationship with the number of out migrants in KDSS. F test was employed to understand whether these variables can increase explanatory power to the model or not. The test also can reflect whether the results in each model are better than the others or not. The results of F test on model comparison can be calculated by applying the following formula.

$$F = \frac{(RSSc-RSSu)/(dfc-dfu)}{RSSu/dfu}$$

RSS = Residual Sum of Square

c = Constrained model

u = Unconstrained model

df = Degree of freedom (N-K)

N = Cases

K = Parameters which include intercept

Comparison goodness of fit of in model 1 and model 2

$$F = \frac{[(1135701.84 - 493889.605)]/[(2025-3)-(2025-7)]}{493889.605/(2025-7)]}$$

$$= 655.6005$$

DF = (dfc-dfu)

= (2025-3) – (2025 – 7)

= 4, 2018

Opened F table at df = 4, 2018 (∞) = 2.37 at 95% confident interval

The result from F calculation is higher than F value from F table. It means that the model 2 is better than model 1. This result showed that when adding socio-economic factors to the model, these variables could increase explanatory to the model. It reflected that socio-economic factors also have influences on number of out migration in KDSS.

Comparison goodness of fit in model 2 and model 3

$$F = \frac{[(493889.605-232824.075)]/[(2025-7)-(2025-11)]}{232824.075/(2025-11)]}$$

$$= 564.5743$$

DF = (dfc-dfu)

= (2025-7) – (2025 – 11)

= 4, 2014

Opened F table at df = 4, 2014(∞) = 2.37 at 95% confident interval

The result from F calculation is higher than F value from F table. It means that the model 3 is better than model 2. This result showed that physical environmental factors could increase explanatory power to the model and have influences on number of out migration in KDSS.

Comparison goodness of fit in model 3 and model 4

$$F = \frac{[(232824.075-144980.565)]/ [(2025-11)-(2025-14)]}{144980.565/(2025-14)]}$$

$$= 406.145$$

$$DF = (dfc-dfu)$$

$$= (2025-11) – (2025 – 14)$$

$$= 3, 2011$$

Opened F table at df = 3, 2011(∞) = 2.61 at 95% confident interval

The result from F calculation is higher than F value from F table. It means that the model 4 is better than model 3. This result showed biological environmental factors could increase explanatory power to the model and have influences on number of out migration in KDSS.

Constrained and unconstrained model for testing insignificant variables

Constrained and unconstrained model were also applied in this study to test whether insignificant variables including age, sex, mean household asset and mean household debt still have explanatory to the model or not. Percent of migrant migrated from upland area has the highest explanatory power (t = 5.41) on number of out migration. Thus this variable was selected to be a comparative variable. The comparison of constrained and unconstrained model also applied F test formula to test this relationship.

Table 3 Constrained and unconstrained model for testing age of migrant variable

	Constrained Model			**Unconstrained Model**		
Independent variables		**Robust**			**Robust**	
	Coef.	**Std. Err.**	**t**	**Coef.**	**Std. Err.**	**t**
Constant	35.307***	3.384	10.43	34.761***	3.583	9.70
Percentage of migrants migrate from upland area	3.470**	1.290	2.69	3.477**	1.289	2.70
Age of migrants				.022	.037	0.59
N	2025			2025		
Prob>F	0.0089			0.0250		
R-squared	0.2600			0.2601		
F	7.23			4.19		
degree of freedom	1, 71			2, 71		
Number of clusters (vill)	72			72		
Root MSE	20.383			20.385		
Residual sum of square	840460.907			840277.946		

F = [(840460.907-840277.946)]/ [(2025-2)-(2025-3)]

840277.946/(2025-3)]

= 0.4402

DF = (dfc-dfu)

= (2025-2) – (2025 – 3)

= 1, 2022

Opened F table df = 1, 2022(∞) = 1.04 at 95% confident interval

The result from F calculation is lower than F value from F table. It means that age of the migrant cannot increase explanatory power to the model. R^2 of the model also increased very little. Therefore, this variable can be dropped out of the model

Table 4. Constrained and unconstrained model for testing variable sex of the migrants

	Constrained Model			**Unconstrained Model**		
Independent variables		**Robust**			**Robust**	
	Coef.	**Std. Err.**	**T**	**Coef.**	**Std. Err.**	**t**
Constant	35.307***	3.384	10.43	34.606***	2.905	11.91
Percentage of migrants migrate from upland area	3.470**	1.290	2.69	3.4726**	1.289	2.69
Sex of migrants				.4786	1.035	0.46
N	2025			2025		
Prob>F	0.0089			0.0167		
R-squared	0.2600			0.2601		
F	7.23			4.34		
degree of freedom	1, 71			2, 71		
Number of clusters (vill)	72			72		
Root MSE	20.383			20.386		
Residual sum of square	840460.907			840345.938		

F = [(840460.907- 840345.938)]/ [(2025-2)-(2025-3)]

840345.938/(2025-3)]

= 0.2766

DF = (dfc-dfu)

= (2025-2) – (2025 – 3)

= 1, 2022

Opened F table df = 1, 2022(∞) = 1.04 at 95% confident interval

The result from F calculation is lower than F value from F table. It means that sex of the migrants can not increase explanatory power to the model. R^2 of the model also increased only a little. Thus this variable can be dropped out of the model.

Table 5 Constrained and unconstrained model for testing mean household asset

	Constrained Model			Unconstrained Model		
Independent variables		**Robust**			**Robust**	
	Coef.	**Std. Err.**	**t**	**Coef.**	**Std. Err.**	**t**
Constant	35.307***	3.384	10.43	43.290***	8.738	4.95
Percentage of migrants migrate from upland area	3.470**	1.290	2.69	3.064**	1.111	2.76
Mean household asset				-.565	.600	-0.94
N	2025			2025		
Prob>F	0.0089			0.0230		
R-squared	0.2600			0.2675		
F	7.23			3.98		
degree of freedom	1, 71			2, 71		
Number of clusters (vill)	72			72		
Root MSE	20.383			20.283		
Residual sum of square	840460.907			831853.923		

$$F = \frac{[(840460.907 - 831853.923)]/[(2025-2)-(2025-3)]}{831853.923/(2025-3)]}$$

$$= 20.9211$$

$$DF = (dfc-dfu)$$

$$= (2025-2) - (2025 - 3)$$

$$= 1, 2022$$

Opened F table df = 1, 2022(∞) = 1.04 at 95% confident interval

The result from F calculation is higher than F value from F table. It means that mean household asset can increase explanatory power to the model. R^2 of the model also increased. Thus we cannot drop this variable from the model.

Table 6 Constrained and unconstrained model for testing mean household debt

	Constrained Model			Unconstrained Model		
Independent variables		**Robust**			**Robust**	
	Coef.	**Std. Err.**	**t**	**Coef.**	**Std. Err.**	**t**
Constant	35.307***	3.384	10.43	30.157***	6.318	4.77
Percentage of migrants migrate from upland area	3.470**	1.290	2.69	3.807**	1.396	2.73
Mean household debt				.000065	.0000774	0.84
N	2025			2025		
Prob>F	0.0089			0.0273		
R-squared	0.2600			0.2681		
F	7.23			3.79		
degree of freedom	1, 71			2, 71		
Number of clusters (vill)	72			72		
Root MSE	20.383			20.276		
Residual sum of square	840460.907			831261.876		

$$F = \frac{[(840460.907-831261.876)]/ [(2025-2)-(2025-3)]}{831261.876/(2025-3)]}$$

$$= 22.376$$

$$DF = (dfc-dfu)$$

$$= (2025-2) – (2025 – 3)$$

$$= 1, 2022$$

Opened F table df = 1, 2022(∞) = 1.04 at 95% confident interval

The result from F calculation is higher than F value from F table. It means that mean household debt can increase explanatory power to the model. R^2 of the model also increased. Thus this variable cannot be dropped out from the model.

Discussion and conclusion

Even though some of the neoclassical theory on migration paid less attention to the environmental context as push factor for out migration, the result of this study reveal that environmental factors also have significant influence on number of population out migration in KDSS. Demographic factors at individual level such as age, sex of the migrant in each village did not have much influence on the number of out migration at village level. Therefore, these two variables can be dropped out from the model. However, mean education of the migrants in each village, in turn, can reduce number of out migration from the village. Providing more education to local people at village level will help reduce number of out migration.

Socioeconomic factors including mean household asset and mean household debt do not have significant relationship with the number of out migration. However, they can

increase explanatory power to the model. So we cannot drop these variables from the model.

On the contrary, the number of people affected by impact of industry inside the village have significant relationship with the number of out migration. As Wolpert's theoretical "stress-threshold" model (1966) argued that migration is a response to stress experienced from the current residential location, with residential "stressors" including environmental disamenities such as pollution, congestion and crime (Wolpert, 1966). Thus potential migrants may determine to move out of the "stressors" area such as the polluted industrial areas to find a better residential location.

The number of people utilize health facilities outside the village have positive and significant relationship with number of out migration. The more people affected by industry and utilized health facility outside, the more number of people will migrate out of the village.

Physical environmental factors including total land areas in the village, percentage of migrant migrate out of upland area and number of people utilize water resource in the village are significantly influence the number of out migration. Type of land areas especially the upland area have influence on increasing number of out migration in KDSS village. The more people live in upland area in the village, the more people will migrate. It might be due to the fact that environmental condition in upland areas also play importance role as push factor for people to migrate out.

Numbers of studies have show that out migration relate with drought. As Sabien (2006) argued that migration is more likely to incorporate by low-income rural households, mostly if their incomes are drought-sensitive. Lucas and Stark (1985) also showed that the remittances from migrants were positively related to the degree of drought (the worse the drought, the higher the level of remittances)(Sabine, 2006). The study of Wongsaichue (2000) on influence of relationship of access to water source on out migration in Northeastern Thailand also support this argument. Adequate quantity of water use in agricultural sector can reduce migration out of the district. Thus if people could not access to enough water resources, it will accelerate number of out migration. The result of this study also show that the more number of people utilize water resource in the village, the more number of out migration will increase. It might be due to the fact that water demand may lead to water conflict when numbers of people utilizing the same source of water increase. Thus it can lead to increasing number of out migration.

Some of the scholar had already defined the relationship between distance and out migration. The result of my study also reflected Ravenstiens and Lee argument that quantity of migration may reduce by distance and intervening factors during migratory process. As the distance of asphalt road from village to district increase the less number of out migration will occur. It means that distance from the origin to the destination can reduce number of out migration.

Biological environmental factors also have high influence on number of out migrants. Even though environmental problems face by the village is not the major push factor for people out of the village, increasing severity of environmental problems will simultaneously affect health of the people at the origin. Even though the result of this study have show that percentage of migrant effected by environmental problem such as

air, water and soil pollution will have positive relationship with number of out migration. However, the coefficient of out migration due to this factor is quite low. As Slovic (1987) argued that there are several reasons why residents might not migrate from hazard-prone areas. He argued that residents might not be aware of hazard; or be aware, but do not expect a disaster. They may expect a disaster, but do not anticipate loss. They may expect loss, but not expect a serious loss. They may expect serious loss and have undertaken, or planning to undertake but loss reduction actions will happen. Moreover, they may expect loss, but accepted as costs of gaining from the benefit of location. Some of them may have no choice in location to move (Kates 1962; expaned by Fordham 1992) Thus if these environmental problems at the origin have not been solved, people at the origin will become the vulnerable groups who are affected by environmental problems.

In addition, the result of this study also shown that percentage of household utilize forest resources could reduce the number of out migrants from the village. It might be due to the fact that household can gain benefit from the forest resources. Therefore, proper management of community forest as a source of food and income of local people while maintaining quality and diversity of the forest will help reduce number of out migration of people.

Number of natural disaster faced by the village is one of the major push factors for people to migrate out. In a period of unpredictable climatic stress, a short-term move seems to be preferred by migrants. William Petersen argued that forced and impelled migration especially among the conservation migrants can accelerated by changing environmental condition at the origin such as natural disaster, cool, drought, flood, earthquake or forest fire. Primitive migration is mainly caused by uncontrolled environmental condition. However, for the innovating migrants, environmental condition may not be the main driving forces for them. This group of migrants intends to adjust or adapt themselves to the new environmental conditions at the destination. As a result, awareness on increasing severity of environmental disaster due to changing environmental condition will help people at both origin and destination to adapt themselves in order to confront with increasing number of environmental disaster. Disaster planning and management program, therefore, should be encouraged in order to safe life of people and be able to tackle with the increasing number of environmental refugee due to the natural disaster in the future.

Recommendation

From the result of this study, policy implications that can derive from this study include the following:

1. Since mean education of the migrants at village level can influence decision to move out of people at village level, providing adequate and appropriate education to local people can help reduce number of out migration from the village.
2. Since access to social infrastructure in the village such as health care facilities, access to water resources can reduce number of out migration. Thus, providing adequate health care services and accessing to water resource, and technology for combating environmental problems due to increasing number of industry in the village can reduce household demand to move out.

3. Since some of the household are not be able to move out even though they have to face with environmental hazard and pollution at the origin, environmental management programs to alleviate environmental problems at the origin must be encouraged. Educational program on adaptive management strategy in countering with natural disaster and other kind of environmental problems must be encouraged. Maintaining quality and diversity of forest at the origin not only reduce problem of out migration but it also can help increase income of people at the origin.

In summary, the results of these study reflected that environmental factors at both household and village level must be taken into consideration when studying number of out migration from the origin. Influence of both physical and biological environmental factors at both household and village level should be explored more. Applying multi level analysis to study influence of contextual factors on out migration should be encouraged. Expansion of study on environmental hazard caused by new environmental technology and the possible increasing number of environmental refugee in relation with migration should be developed. Policies and actions that deal with the immediate and or forthcoming issue of environmental migration refugees should be initiated so that it can help reduce severity of problems caused by tensions of environmental condition in the future.

Annex 1

Table A1 Type of variables and level of measurement

Variable description	Type of variable
Dependent variables	
X1: Number of people migrate out of the village	Interval
Independent variables	
A. Demographic Factors	
X2: Migrants age	Interval
X3: Migrants sex	Nominal
X4: Mean migrant education in each village	Interval
B. Socio-economic Factors	
X5: Mean household asset in each village	Interval
X6: Mean household debt in each village	Interval
X7: Number of people affected by impact from factory in the village	Interval
X8: Number of people utilize health facilities outside the village	Interval
C. Physical Environmental Factors	
X9: Total land area in the village	Interval
X10: Percentage of migrants migrant out of upland area	Interval
X11: Number of people utilized water resource in the village	Interval
X12: Distance of asphalt road connect between village and district	Interval
D. Biological Environmental Factors	
X13: Percentage of migrants affected by environmental problem in the village	Interval
X14: Percent of household utilize forest resource in the village	Interval
X15: Percentage of migrants face natural disaster in the village	Interval

Table A 2 Descriptive Statistics of the variables applied in this study

		N	Minimum	Maximum	Mean	Std. Deviation
1	Number of people migrate out of the village	2025	5.00	107.00	43.231	23.687
2	Age of the migrants	2025	.00	70.00	23.921	13.588
3	Sex of the migrant	2025	1.00	2.00	1.455	.498
4	Mean education of migrant in village	2025	1.79	10.63	6.287	1.761
5	Mean household asset of migrant in village	2025	1.08	21.08	12.471	4.420
6	Mean household debt of migrant in village	2025	2122.64	238527.78	67416.877	37430.610
7	Number of people affected by impact from factory in the village	2025	.00	1676.00	398.465	531.127
8	Number of people utilize health facilities outside the village	2025	.00	1358.00	523.067	402.745
9	Total land area in the village	2025	300.00	20000.00	4988.803	4735.656
10	Percentage of migrants migrant out of upland area	2025	.00	107.00	18.610	30.800
11	Number of people utilized water resource in the village	2025	.00	1676.00	654.419	389.821
12	Distance of asphalt road connect between village and district	2025	.00	50000.00	15979.407	12112.572
13	Percentage of migrants affected by environmental problem in the village	2025	.00	11.24	2.940	2.5809
14	Percent of household utilize forest resource in the village	2025	.00	100.00	28.497	33.0580
15	Percentage of migrants face natural disaster in the village	2025	.06	.72	.377	.118

Table A 3 Z score of all 15 variables after deleting outliers

	Z score	N	Minimum	Maximum	Mean	Std. Deviation
1	Number of people migrate out of the village	2025	-1.76	2.76	-.0640	1.05076
2	Age of the migrants	2025	-1.63	2.98	-.0545	.89469
3	Sex of the migrant	2025	-.92	1.09	-.0014	.99999
4	Mean education of migrant in village	2025	-2.66	2.59	.0152	1.04531
5	Mean household asset of migrant in village	2025	-2.52	1.84	-.0384	.96372
6	Mean household debt of migrant in village	2025	-1.08	2.51	-.0906	.56971
7	Number of people affected by impact from factory in the village	2025	-.78	2.45	-.0109	1.02139
8	Number of people utilize health facilities outside the village	2025	-1.27	2.10	.0262	1.00159
9	Total land area in the village	2025	-.91	2.44	-.1155	.80465
10	Percentage of migrants migrant out of upland area	2025	-.61	1.80	-.0424	.86309
11	Number of people utilized water resource in the village	2025	-1.65	2.63	.0206	.99760
12	Distance of asphalt road connect between village and district	2025	-1.32	2.81	.0000	1.00000
13	Percentage of migrants affected by environmental problem in the village	2025	-1.14	2.98	-.0106	.99500
14	Percent of household utilize forest resource in the village	2025	-.88	2.03	-.0496	.96218
15	Percentage of migrants face natural disaster in the village	2025	-2.32	2.32	-.0807	.84193

Table A4 Correlation Matrix of all variables

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1: Number of population migrated out of the village	1	-.027	-.004	-.323**	-.360**	-.167**	.596**	.389**	.497**	.510**	.596**	.018	.210**	-.067**	.482**
X2: Age of the migrants	-.027	1	-.079**	-.008	.028	.044*	-.034	.015	-.044*	-.079**	.013	-.088**	-.003	-.079**	-.032
X3: Gender of the migrants	-.004	-.079**	1	.011	.009	.047*	.041	-.013	.017	-.028	.001	.034	.017	-.033	-.025
X4: Mean education of migrants in that village	-.323**	-.008	.011	1	.772**	.224**	.045*	-.112**	-.145**	-.305**	-.105**	-.046*	-.155**	-.339**	-.212**
X5: Mean household asset index of the migrants	-.360**	.028	.009	.772**	1	.330**	.009	-.069**	-.210**	-.566**	-.101**	-.252**	-.186**	-.441**	-.288**
X6: Mean household debt of migrant in that village	-.167**	.044*	.047*	.224**	.330**	1	.062**	.025	-.057**	-.482**	-.039	-.126**	-.141**	-.390**	-.108**
X7: Total land area in the village	.596**	-.034	.041	.045*	.009	.062**	1	.213**	.586**	.055*	.491**	-.065**	-.134**	-.060**	.002
X8: Number of people affected by number of factories in the village	.389**	.015	-.013	-.112**	-.069**	.025	.213**	1	-.227**	-.010	.375**	-.378**	-.055(*)	-.296**	-.012
X9: Number of people utilize health facility outside village	.497**	-.044*	.017	-.145**	-.210**	-.057**	.586**	-.227**	1	.149**	.268**	.226**	-.020	.293**	.162**
X10: Number of people has utilized water resource in the village	.510**	-.079**	-.028	-.305**	-.566**	-.482**	.055*	-.010	.149**	1	.130**	.410**	.369**	.329**	.535**
X11: Distance of asphalt road within village	.596**	.013	.001	-.105**	-.101**	-.039	.491**	.375**	.268**	.130**	1	-.095**	-.026	-.060**	-.005
X12: Percentage of migrants who migrate out of upland area	.018	-.088**	.034	-.046*	-.252**	-.126**	-.065**	-.378**	.226**	.410**	-.095**	1	.120**	.246(**)	.238(**)
X13: Percentage of migrants who affected by environmental problem in the village	.210**	-.003	.017	-.155**	-.186**	-.141**	-.134**	-.055*	-.020	.369**	-.026	.120**	1	.029	.394**
X14: Percentage of household utilize forest resources in each village	-.067**	-.079**	-.033	-.339**	-.441**	-.390**	-.060**	-.296**	.293**	.329**	-.060**	.246**	.029	1	-.045*
X15: Percentage of migrant population affected by natural disaster in each village	.482**	-.032	-.025	-.212**	-.288**	-.108**	.002	-.012	.162**	.535**	-.005	.238**	.394**	-.045*	1
N	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**	**2025**

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

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