การศึกษาผลกระทบของการเปลี่ยนแปลงประชากรที่มีต่อ* สิ่งแวดล้อมในประเทศไทย

IMPACT OF POPULATION ON ENVIRONMENTAL CHANGE IN THAILAND

อมรทิพย์ แท้เที่ยงธรรม**
Amorntip Tacthiengtam

บทคัดย่อ

การศึกษานี้มุ่งหมายที่จะค้นหาผลกระทบของประชากรที่มีต่อคุณภาพและปริมาณของสิ่งแวดล้อมในช่วงปี ค.ศ.1980 และปี ค.ศ.1990 ทั้งในด้านคงที่ และพลวัตร ในเบื้องต้น ความสัมพันธ์ระหว่างประชากรและคุณภาพและปริมาณของสิ่งแวดล้อมได้ถูกกำหนดขึ้นโดยการทดสอบ Box-Cox ในอันดับต่อมา การทดสอบการถดถอยภาคตัดได้ถูกใช้เพื่อวิเคราะห์ถึงปริมาณของความเชื่อมโยงในระดับภูมิภาค ท้ายที่สุด ความเชื่อมโยงในระดับจังหวัดได้ถูกวิเคราะห์โดยใช้แนวทางของ Ehrlish และ Ehrlich

จากการศึกษาพบว่ารูปแบบที่เหมาะสมของความสัมพันธ์ระหว่างประชากรและคุณภาพและปริมาณของสิ่งแวดล้อมคือ Polynomial จากการศึกษายังพบว่า ในระดับท้องถิ่นนั้น ความหนาแน่นของประชากรมีผลกระทบอย่างมากต่อคุณภาพและปริมาณของสิ่งแวดล้อม ในขณะที่การย้ายถิ่น การเปลี่ยนแปลงของความหนาแน่นของประชากร และการเปลี่ยนแปลงอัตราการย้ายถิ่นไม่ก่อให้เกิดผลกระทบที่สำคัญต่อคุณภาพและปริมาณของสิ่งแวดล้อม ในระดับจังหวัดพบว่าจังหวัดที่มีผลกระทบของความหนาแน่นของประชากรต่อคุณภาพและปริมาณของสิ่งแวดล้อมสูงคือ กรุงเทพมหานคร ภูเก็ต ชลบุรี นนทบุรี สมุทรสงคราม อ่างทอง สงขลา สมุทรสาคร ระยอง พระนครศรีอยุธยา สระบุรี และนครปฐม จังหวัดดังกล่าวยังได้รับผลกระทบต่อคุณภาพและปริมาณของสิ่งแวดล้อมเนื่องจากการย้ายถิ่นเข้าด้วย ส่วนการย้ายถิ่นออกในจังหวัดดังกล่าวไม่ก่อให้เกิดรับผลกระทบที่มีความสำคัญต่อคุณภาพและปริมาณของสิ่งแวดล้อม

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** นักศึกษาหลักสูตรปรัชญาดุษฎีบัณฑิตทางสถิติ คณะสถิติประยุกต์ สถาบันบัณฑิตพัฒนบริหารศาสตร์

Abstract

This study aimed to explore the impact of population on the environmental quantity and quality in Thailand in 1980 and 1990 in both static and dynamic aspects.Firstly, the appropiate functional forms of the relationship between population and environmental quantity and quality were examined using the Box-Cox Test. Next, cross-section regression analysis was used to investigate the magnitude of the regional linkages. Finally, the provincial linkages were worked out based on the concept of Ehrlich and Ehrlich (1990) .The study revealed that the most appropriate functional forms for the population-environmental quantity and quality linkages were polynomial both in the static and dynamic aspects. At the regional level, population density found from the, study to have a significant effect on both environmental quantity and quality while in-migration and out-migration does not show a noticeable significant effect on environmental quantity and quality. The study further revealed that the environmental quantity and quality has low sensitivity with respect to population changes, i.e., changes of population density, in-migration and out-migration changes. However, the population density was found to be relatively dominant.At the provincial level, it was shown from the study that the provinces that received high population density-environmental quality impacts were Bangkok, Phuket, Chon Buri, Nonthaburi, Samut Songkram, Ang Thong, Songkhla, Samut Sakhon, Rayong, Phra Nakhon Si Ayutthaya, Saraburi, and Nakhon Pathom. These were the same for the in-migration-environmental quality impacts. Few changes were discovered when the out-migration-environmental quality impacts were examined.

Introduction

Spatial mobility is one of the most important demographic process affecting population size, composition and distribution, particularly in countries where fertility and mortality has successfully decreased (Chamratrithirong et al. 1995 : 1). Specifically, internal migration plays an important role in redistributing population and resource utilization within a nation. Man's ability to move has played a significance part in helping the developing world to maintain some balance between population and available resources.

The relationship between population and environment has been a major concern since the time of Malthus (Martine, 1992:33). At the Fourth Asian and Pacific Population Conference which was held in Bali, Indonesia from 19 to 27 August 1992, it was declared that among the ultimate objectives of sustainable development are to achieve a balance between human needs and aspirations within population, resources and the environment; and to enhance the quality of life of the present as well as future

generations. Moreover, there is an urgent need to bring into balance of population dynamics, socio-economic development, the use of natural resources and environmental quality (United Nations, 1992).

The contour of population and environment are still unmapped territory (Martine, 1992:33). How population affects and is affected by the environment is still questionable. An important question for policy is whether population pressures have a significant effect on environmental degradation.

Therefore, it is the consideration of this study to explore the impact of population on the environmental changes (the changes of environmental quantity and environmental quality) in Thailand both in the static and dynamic aspects. That is the relationship between population distribution and environmental changes (static aspect) and the internal migration and environmental changes (dynamic aspect) will be examined. More specifically, this study will, first, find the appropriate functional forms of the relationship between the population distribution, internal migration, environmental quantity and quality in 1980 and 1990. Next, the linkage magnitude of each pair of the above relationships both at the regional and provincial level as well as their regional changes will be investigated.

Objectives of the study

General Objective

The general objective of this study is to explore the impact of population on environmental change in Thailand.

Specific Objectives

The specific objectives of this study are:

a) To find the appropriate functional forms of the relationships between the population distribution, internal migration, as well as environmental quantity and quality in 1980 and 1990.

b) To examine the magnitude of the population distribution, internal migration as well as environmental quantity and quality linkages both at the regional and provincial level in 1980 and 1990 as well as investigate the regional linkages of population and environmental change between 1980-1990.

Conceptual and Tentative Frameworks of the Study

Population pressures are frequently cited as a cause of environmental degradation. The important questions for policymakers are whether population pressures have significant effect on environmental degradation. To the best of knowledge concerning these important issues, the empirical evidence for Thailand will be provided in this study.

Figure 1 depicts the conceptual framework showing the interrelationship between population growth and distribution as well as physical environment quantity and quality.

Data and Methodology

Sources of Data

Data used in this study were from the secondary sources. The variables being used and sources of data were shown in Table 1.

Scope and Limitations of the Study

Due to the availability of reliable data of internal migration, this study examined the various aspects of population relationships only in 1980 and 1990.

The limitations of this study involved the classification of the regions and provinces being used in the study and the overage of the definition of the environment. There were differences of the division of regions and provinces recorded in the regional and provincial data from several secondary sources. Comparing among all sources of data, the least number of regions and provinces being listed was selected. The data used in this study, therefore, were divided by four regions, i.e., north, south, east, west as well as 72 and 73 provinces in 1980 and 1990, respectively.

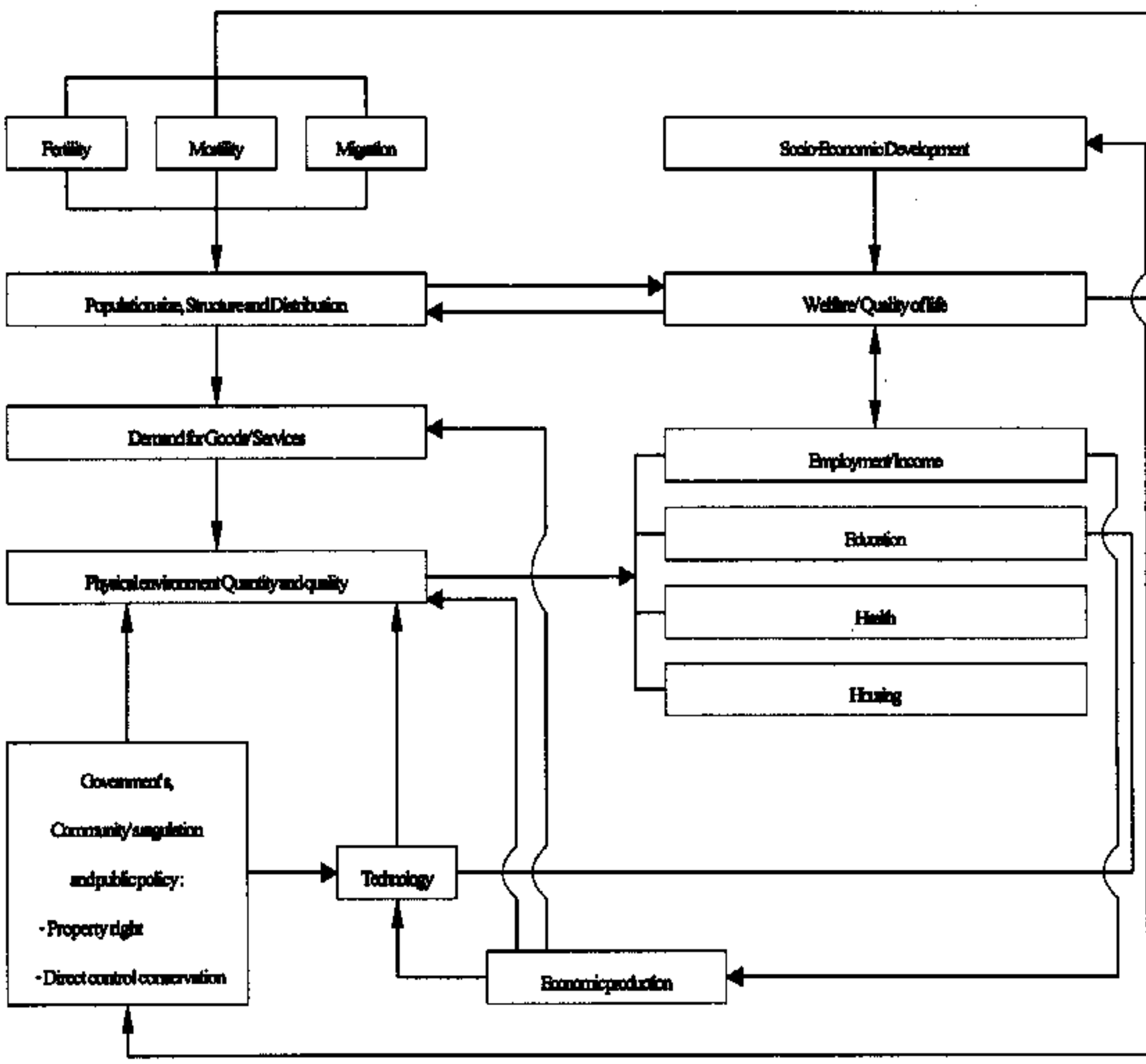

Figure1 Conceptual Framework of the Study

Source : ESCAP Secretariat, U.N., 1988.

Table 1 Variables Used in the Study and Sources of Data

Variables used for Caculating ENVQUAN	Sources of Data	Variables used for Caculating ENVQUAL	Sources of Data	Demographic Variable	Sources of Data
Forest Area per population	Royal Forest Department	Amount of Water Used	The Provincial Waterworks Authority and Metropolitan Water works Authority	Population Density	Population and Housing Census
The Proportion of the Agricultural Land Used per Population	Royal Forest Department	Agricultural Product per Area	Office of the National Economics and Social Development Board	In-migration	Population and Housing Census
Annual Rainfall	Thailand Meteorological Department	Cultivated Area per Population	Royal Forestry Department Out-migration	Out-migration	Population and Housing Census
Annual Catch of Fresh Water Fish	Ministry of Agriculture and Cooperatives	Livestock Farm per Population	Royal Forestry Department		
Mineral Royalty Fee	Department of Mineral Resources	Agricultural Use of Chemical Fertilizer	The Marketing Organization of Farmer		
		Wood Domestic Product	Royal Forestry Department		
		Value Added of Mining and Quarrying	Office of the National Economics and Social Development Board		
		Value Added of Fisheries	Office of the National Economics and Social Development Board		
		Area of Fish Farms	Office of the National Economics and Social Development Board		

1/ ENVQUAN = Environmental Quantity Indicators. 2/ ENVQUAL = Environmental Quality Indicators.

Furthermore, owing to the availability of data from secondary sources, it confined the full coverage of the environment. Hence, as it was in this study, defined the environment to the possible full extent of the existing data.

Methods of Analysis

This study is based on the application of a multivariate analysis techniques, i.e., multiple regression analysis as well as an econometric technique, i.e., Box-Cox Test.

Firstly, the appropriate functional forms of the relationship between population distribution, internal migration as well as environmental quantity and quality were examined using the Box-Cox Test. Next, cross-section regression analysis was used to investigate the magnitude of the regional linkages. Finally, the provincial linkages were worked out based on the concept of Ehrlich and Ehrlich (1990).

Findings

The results obtained from the study can be summarized as follows:

1. The Effects of Population Pressures on Environmental Changes:The Regional Model

1.1 The Appropriate Functional Forms

1.1.1 The Population-Environmental Quantity Linkages

The static aspect of population (population density) revealed that most of the appropriate functional forms for the population-environmental quantity linkages of the whole kingdom and almost all regions were polynomial. The population-environmental quantity linkages of the southern region both in 1980 and 1990 as well as the linkages of the central region in 1990 were exceptional.

Viewing the dynamic aspect of population (internal migration), it also showed that the most appropriate functional forms for the population-environmental quantity linkages of the whole kingdom and almost all regions were polynomial except for the northern region in 1980, and the southern and central regions in 1990.

1.1.2 The Population-Environmental Quality Linkages

Considering the static aspect of population, it was discovered that most of the appropriate functional forms for the population-environmental quality linkages of the whole kingdom and almost all regions were polynomial. It was an exception for the northeastern region in 1980 and the northern and southern regions in 1990.

The dynamic aspect of population indicated that most of the appropriate functional forms for the population-environmental quality linkages of the whole kingdom and almost all regions were polynomial except for the northern region in 1990.

The addition of quadratic terms helps mostly to add to the considerable explanatory power of the overall regression models both in dynamic and static aspects.

1.2 The Regional Effects of Population Pressures on Environmental Quantity

1.2.1 The Static Aspects

It was found that the variables in the study were significantly related to the environmental quantity for the whole kingdom and all regions except for the northeastern region both in 1980 and 1990. The variables in the equations were able to explain about 26.8 to 59.5 percent of the environmental quantity's variation. The explanatory power of the variables were higher for the central and southern region than for the northern region. However, the overall fit of the regression equations was not very high implying that variables other than development indicators and population densities also matter to the environmental quantity.

Population density was found to have a significant negative effect on the environmental quantity of the whole kingdom and all the regions except for the northeastern region. This means that the more dense populations, the less the environmental quantity.

In the case when the polynomial population-environmental patterns were used, the quadratic terms of population density had significant effects on environmental quantity. And the addition of these quadratic terms helped to add considerable explanatory power to the overall regression patterns.

The environmental quantity had a significant relation to the development of the whole kingdom in 1980 and the central region for 1990. This signified that development mostly played unnoticeable roles over environmental quantity when it was viewed coupled with the static aspect of population. The quadratic terms of development were mostly found to be insignificantly related to the environmental quantity. In sight of the static aspect of population, the development-environmental quantity relationships were mostly found to be less dominant than the population density-environmental quantity relationships for the whole kingdom and almost all the regions in Thailand.

1.2.2 The Dynamic Aspects

The variables in the study were significantly related to the environmental quantity for the whole kingdom and the central region both in 1980 and 1990 as well as for the southern region in 1990. The variables in the equations are able to explain about 33.1 to 72.3 percent of the environmental quantity's variation. However, the overrall fit of the regression equations was not very high implying that variables other than development indicators, population growth, in-migration, and out-migration also affected environmental quantity.

In-migration was found to have a significant effect only on the environmental quantity of the whole kingdom, the southern region (1990), and the central region (1980). It was expected of the negative relationship between in-migration and the environmental quantity. That is the increase of in-migration would lead to a reduction of environmental quantity. But surprisingly, in-migration was found to have a positive relationship with environmental quantity for Thailand, in 1980 and 1990. The study revealed that the more the overall new environment quantities were found to couple with an increase of in-migrants. This was confirmed by the increase of the whole kingdom environmental quantity indicators shown. However, these are dangerous signs for the increase of the future deterioration of the environment unless appropriate measured implemented are provided. Furthermore, the study indicates that the in-migration did not dominantly affect the environmental quantity.

Table 2 The Conclusions of the Regression Results of the Regional Population-Environmental Quantity Linkages[1/]

Area	Year	Fit Functional Form	Static Aspect: Significant Independent Variables	Relationship Direction	R^2	Fit Functional Form	Dynamic Aspect: Significant Independent Variable	Relationship Direction	R^2
Whole Kingdom	1980	Polynomial	DEVI[2/]	-		Polynomial	IMI[4/]	+	
			DEVI Squared	-			IMI Squared	-	
			POPDENT[3/]	-	.387		OMI[5/]	+	.331
			POPDEN Squared	+			OMI Squared	-	
	1990	Polynomial	POPPDEN	-	.268	Polynomial	DEVI	-	
			POPDEN Squared	+			DEVI Squared	+	
							IMI	+	.339
							IMI Squared	-	
Northeastern Region	1980	-		-	-		-		-
	1990	-		-	-		-		-
Northern Region	1980	Polynomial	POPDEN	-	.382	-	-		-
			POPDEN Squared	+		-	-		-
	1990	Polynomial	POPDEN	-	.351	-	-		-
			POPDEN Squared	+					
Southern Region	1980	Semi-Log (Log dependent variable)	ln POPDEN	-	.415	-	-		-
	1990	Double-Log	ln POPDEN	-	.522	Semi-Log (Log dependent variable)	DEVI (F-M)	- -	
							IMI	+	.723
							OMI	+	
Central Region	1980	Polynomial	DEVI Squared OOPDEN POPDEN Squared	-	.595	Polynomial	IMI IMI Squared	+ -	.600
	1990	Semi-Log (Log dependent variable)	ln POPDEN ln DEVI	- -	.529	Linear	DEVI	-	.528

[1/] Envrionmental quantity is dependent variable

[2/] DEVI = Development Indicator

[3/] POPDEN = Population Density

[4/] IMI = In-migration

[5/] OMI = Out-migratio

Table 3 The Conclusions of the Regression Results of the Regional Population-Environmental Quantity Linkages[1/]

Area	Year	Fit Functional Form	Static Aspect			Fit Functional Form	Dynamic Aspect		
			Significant Independent Variables	Relationship Direction	R^2		Significant Independent Variable	Relationship Direction	R^2
Whole Kingdom	1980	Polynomial	DEVI[2/]	-		Polynomia	IMI[4/]	-	
			DEVI Squared	-		l	IMI Squared	+	
			POPDENT[3/]	-	.547		OMI[5/]	-	.622
			POPDEN Squared	+			OMI Squared	+	
	1990	Polynomial	DEVI	-		Polynomia	DEVI	-	
			DEVI Squared	+		l	DEVI Squared	+	
			POPDEN	+	.528		(F-M)	-	.643
			POPDEN Squared	-			IMI	-	
							IMI Squared	+	
Northeastern Region	1980	Inverse	1/DEVI	+	.468	Polynomia	OMI[6/]	+	.955
			1/POPDEN	-		l	OMI Squared	-	
	1990	Polynomial	POPDEN	-	.485	Polynomia	(F-M)	+	
						l	(F-M) Squared	-	.962
							OMI	+	
							OMI Squared	-	
Northern Region	1980	-	-	-	-	-	-	-	-
	1990	Semi-Log (Log depeadent variable)	DEVI	-	.733	Semi-Log (Log dependent variable)	DEVI	-	.737
Southern Region	1980	Polynomial	DEVI	-		Polynomia	DEVI	-	
			DEVI Squared	+	.861	l	DEVI Squared	+	.958
			POPDEN	-			(F-M)	-	
	1990	Inverse	1/DEVI	+	.478	Polynomia	DEVI	-	.938
			1/POPDEN	-		l	DEVI Squared	+	
							(F-M)	-	
							(F-M) Squared	+	
Central Region	1980	Polynomial	DEVI	-			-	-	-
			DEVI Squared	-	.865		-	-	-
			POPDEN	+					
			POPDEN Squared	-					
	1990	Polynomial	DEVI	-		Polynomia	DEVI	-	
			DEVI Squared	+	.693	l	DEVI Squared	+	.840
			POPDEN	+			(F-M)	-	
			POPDEN Squared	-			(F-M) Squared	+	

1/ Envrionmental quantity is dependent variable
2/ DEVI = Development Indicator
3/ POPDEN= Population Density
4/ IMI = In-migration
5/ (F-M) = Population Growth
6/ OMI = Out-migration

Out-migration was found to have a significant effect only on the environmental quantity of the whole kingdom (1980) and the southern region (1990) .Not surprisingly, the environmental quantity would be increasingly left over when there was more out-migration.

The relationship between population growth and the environmental quantity of the whole kingdom of Thailand was found to be significant. The direction of the relationship was negative. This implied that the increase of population growth will bring out a lessening of the environmental quantity. However, the relationship was not found to be meaningful between population growth and environmental quantity at the regional level except for the southern region in 1990.

The higher the development level was found to be coupled with the lesser environmental quantity mostly in 1990 for the whole kingdom as well as the southern and central regions. This reflected a depletion of natural resources and will ultimately cause problems for future generations. Hence the compromise of obtaining a certain development level with careful use of natural resources will provide optimal benefits to all.

1.3 The Regional Effects of Population Pressures on Environmental Quality

1.3.1 The Static Aspect

The variables in the study were mostly significantly related to the environmental quality except for the northern region in 1980. The variables in the equations were able to explain about 47.8 to 86.5 percent of the environmental quality variation. It was noticeable about the quite high power of explanation of the development indicators on the environmental quality of the northeastern region in 1990. And for the development indicators and population density on the environmental quality of the southern and central regions in 1990.

Almost all regions had a negative significance relationship between the level of development and environmental quality. This implicitly point out that the production processes being used harms the environmental quality, i.e., dangerous chemical substances and polluted technology, etc.

The population density was found to be significance with the environmental quality of all regions except the northern region. Surprisingly, for the whole kingdom and the central region indicated a positive relationship. For the northeastern and, the southern regions, it was discovered that the more the population density, the worse the environmental quality.

In the case when the polynomial population-environmental quality patterns were used, it was found that the quadratic terms of development indicators and population density helped to add to the considerable explanatory power of the overall regression patterns.

The static aspect of population revealed significant development-environment quality relationships and the population density-environmental quality relationships for the whole kingdom and the central region in 1980 and 1990.

1.3.2 The Dynamic Aspects

The variables in the study were mostly significantly related to environmental quality except for the northern region in 1980. The variables in the equations are able to explain about 62.2 to 96.2 percent of the environmental quality variation. It is noticeable involving the quite high power of explanation of the proposed variables on environmental quality.

Except for the northeastern region, the development indicators were found to be negatively related to the environmental quality. This signal a trade-off between the development and the quality of environment in the above mentioned areas.

Besides the northern region, the population growth provided a dominant role on the environmental quality of all region especially in 1990. For the northeastern, northern, and central regions, there was at first not found a significant relationship between population growth and environmental quality in 1980, but in 1990 the above relationships turned out to be signiricant. Except for the northeastern region, the population growth in the whole kingdom as well as the southern and central regions were found to be negatively related to environmental quality. This implied that the higher the population growth, the higher the population density and then the worse the environmental quality.

In sight of the dynamic aspect of population, it was mostly not found to be a dominant role of in-migration over the environmental quality in 1980. It was further discovered to be of meaningful relationship between population growth and environmental quality for the whole kingdom in 1990. At the regional level, in-migration did not show any clear relationship with the quality of environment.

Out-migration-environmental quality relationships had a significant positive relationship only for the northeastern region in both years. This points out that an increase of the out-migration will lead to better environmental quality.

In the case when the polynomial population-environmental quality patterns were used, the quadratic terms of development indicators, the population growth squared, the in-migration squared and the out-migration squarcd helped to add to the considerable explanatory power of the overall regression patterns.

2. Regional Population Changes and Environmental Changes

2.1 The Elasticities of Environmental Quantity Changes with respect to Changes inPopulation

Environmental quantity had quite little sensitivity to the changes of population density for the whole kingdom and almost all the regions except for the northeastern region. This displayed an insignificant relationship. All the elasticities revealed a decline in environmental quantity coupled with a rise of population density. However, there were just only the slight changes. The results implicitly implied that 1 percent increase in population density ensued in about 0.1195 to 0.2366 and 0.258 to 0.2169 percent decrease in the environmental quantity in 1980 and 1990, respectively.

Of all the regions, the central and the northern regions seemed to have the highest elasticities of environmental quantity changes with respect to changes in population in 1980 and 1990, respectively. Except for the whole kingdom (1980 and 1990), the southern region (1990), and the central region (1980), the changes of in-migration did not have the significant impact on the environmental quantity changes. The results implicitly implied that a 1 percent increase in in-migration followed by not more than 0.20 percent decrease in the environmental quantity both in 1980 and 1990. Changes in out-migration was mostly found not to be significantly associated with the environmental quantity changes. The environmental quantity changes were found to be more sensitive to population density than in-migration and out-migration

2.2 The Elasticities of Environmental Quality Changes with respect to Changes in Population

Environmental quality had little sensitivity to the changes of population density for the whole kingdom and almost all the regions except for the northeastern region displaying an insignificant relationship. The elasticities of the whole kingdom and the central regions exhibited an increment of the environmental quality coupled with the rise of the population density and vice versa was for the northeastern and southern regions. This implicitly reflected the more concern on environmental quality of the people in the central region than the other regions.

The elasticity of environmental quality with respect to the population density was quite slender. However, it was the highest for the central region. Both changes in in-migration and out-migration were mostly found not to be significantly associated with the environmental quality changes. The environmental quality changes were more sensitive to population density than in-migration and out-migration.

2.3 The Regression Results between Environmental Changes and Population Changes

The regression results revealed weak relationship between environment quantity changes and population changes as well as environmental quality changes and population changes. These confirmed the results of the elasticities of environmental quantity and quality changes with respect to population changes.

3. The Provincial Effects of Population Pressures on Environmental Changes

3.1 Provincial Total Environmental Impacts

Viewing the static aspect of population, in 1980 about 68 percent of the provinces in the central region had the total environmental impact indicators higher than the country's average. And it decreased to 56 percent in 1990. About 36 percent of the provinces in the southern region and 18 percent of the provinces in northern region had total environmental impact indicators higher than the whole kingdom's average in 1980 and decreased to about 29 percent and zero in 1990. Hence this revealed that the central and southern regions were the areas that needed to pay more attention to the environment.

Prospecting the dynamic aspect, if in-migration was used, it was discovered that in 1980, about 60 percent of the provinces in the central region had total environmental impact indicators higher than the country's average. And it reduced to about 52 percent in 1990. About 43 percent of the provinces in the southern region and 18 percent of the provinces in the northern region had the total environmental impact indicators higher than the whole kingdom's average in 1980. It increased to 50 percent for the southern region and decreased to 12 percent for the northern region in 1990. This comes with the same conclusions as the static aspect of population that the central and southern regions were the areas in need more attention.

Considering the dynamic aspect when out-migration is used, it revealed a high proportion of the provinces with above average total environmental impact indicators for the central region in 1980 and 1990. For the southern region, there were no changes involving the proportion of the provinces in this region compared to the obtained results of the dynamic aspect when in-migration was used. It was a little higher in proportion for the northern and northeastern region both in 1980 and 1990.

No matter which population aspects were used, it indicated that the provinces that demanded more concern on their environment were located mostly in the central regions. Bangkok, Chon Buri, and Phuket were the top three provinces that needed a swift concern about their environmental quantity and quality.

Comparing the effect of the static and dynamic aspects of population on the environment, it was discovered that, in 1980, Kamphaengphet, Mae Hong Son, Phang-nga, Phuket, Bangkok, Pathum Thani, and Trat were the 7 provinces that in- migration had significant effects on their environment. Nan, Phrae,

Phuket, Narathiwat, Bangkok, Nonthaburi, Samut Sakhon, and Samut Prakarn were the 7 provinces that the static aspect of population (population density) played an important role on the environment.

Table 4 The Percentages of the Provinces in Each Region with the Above Average Total Environmental Indicators in 1980 and 1990

Area	Static Aspect		Dynamic Aspect (In-migration)		Dynamic Aspect (Out-migration)	
	1980	1990	1980	1990	1980	1990
Northeastern Region	0	6	0	0	6	6
Northern Region	18	0	18	12	24	18
Southern Region	36	29	43	50	43	50
Central Region	68	56	60	52	76	68

In 1990 Mae Hong Son, Phuket, Bangkok, Pathum Thani, Samut Sakhon, and Suphan Buri were the 6 provinces with high in-migration-environmental impacts. And Phuket, Songkhla, Pattani, Narathiwat, Bangkok, Nonthaburi, Nakhon Pathom, Samut Songkhram, Samut Prakarn, Prachinburi, and Ranong were the 11 provinces that static aspect of population played an important role on the environment. It can be generally concluded that the dynamic aspect of population had an higher affect on the provincial environment than the static aspect both in 1980 and 1990.

3.2 The Causes of the Provincial Environmental Changes Population Changes, Production Changes, and Pollution Changes

Compared to production changes and changes of pollution per unit, it demonstrates a significance of the strength of in-migration over the environmental changes of almost all the provinces in Thailand. The population density mostly dominated the environmental changes of the provinces in the southern and central regions. Out-migration positively affected the environmental changes in 11 out of 17 provinces in the northern region.

Compared to the population density and the changes in pollution per unit of production, it revealed the importance of the effect of production changes over the environmental changes mainly in the

northeastern and northern regions. Compared to out-migration and the changes of the pollution per unit of production, revealing a meaningful affect involving production changes over environmental changes in the northeastern and central regions.

Summary and Recommendation

Although the population-environment relationships were not quite high for now, it doesn't mean that it will not increase in the future. Therefore, it is recommended from this study to have some preventive measures concerning population pressures on the environment, i.e., the construction of houses, taxes and subsidiary measures, etc. for controlling the use of the environment. In spite of the differences in each province, the specific preventive measures should also be different. Therefore, preventive measures should also be proposed by the local related government agencies. The several proposed local measures will provide guidelines for undertaking suitable preventive measures concerning population pressures on the environment. Educating migrants to increase their concern for the environment is also proposed as a supportive measure besides the local and national preventive measures .

Table 5 The Top Ten Provinces of Each Region that Demand More Concern on Their Environment in the Different Aspects of Population in 1980 and 1990

Rank	Static Aspect				Dynamic Aspect (In-migration)				Dynamic Aspect (out-migration)			
	1980	Region	1990	Region	1980	Region	1990	Region	1980	Region	1990	Region
1	Bangkok	C[1/]	Bangkok	C	Bangkok	C	Bangkok	C	Bangkok	C	Bangkok	C
2	Phuket	S[2/]	Phuket	S	Phuket	S	Phuket	S	Chon Buri	C	Chon Buri	C
3	Chon Buri	C	Chon Buri	C	Chon Buri	C	Chon Buri	C	Phuket	S	Phuket	S
4	Nonthaburi	C	Nonthaburi	C	Nonthaburi	C	Nonthaburi	C	Saraburi	C	Saraburi	C
5	Sumut Songkram	C	Sumut Songkram	C	Sumut Songkram	C	Sumut Songkram	C	Phetchabun	N[3/]	Kancjamabiri	C
6	Ang Thong	C	Songkhla	C	Ang Thong	C	Songkhla	C	Lob Buri	C	Chantaburi	C
7	Samut Sakhon	C	Nakhon Pathom	C	Samut Sakhon	C	Nakhon Pathom	C	Kanchanaburi	C	Ratchaburi	C
8	Nakhon Pathom	C	Rayong	C	Nakhon Pathom	C	Rayong	C	Ang Thong	C	Rayong	C
9	Songkhla	S	Pra Nakhon Si Ayutthaya	C	Songkhla	C	Pra Nakhon Si Ayutthaya	C	Yala	S	Nakhon Sawan	N
10	Pra Nakhon Si Ayutthaya	C	Saraburi	C	Pra Nakhon Si Ayutthaya	C	Saraburi	C	Nakhon Nayok	C	Nakhon Nayok	C

[1/]C = Central Region
[2/]S = Southern Region
[3/]N = Northern Region

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