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A Spatial Econometric Analysis on Economic Rationalization and Human Capital Dynamics in Cambodia

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Sophat Phon[1] & Sophy Khan[2]

Corresponding Author. Email: sophatph9@gmail.com
1. Institute for Banking Studies, National Bank of Cambodia, Phnom Penh, Cambodia
2. Royal Academy of Cambodia, Phnom Penh, Cambodia

ABSTRACT

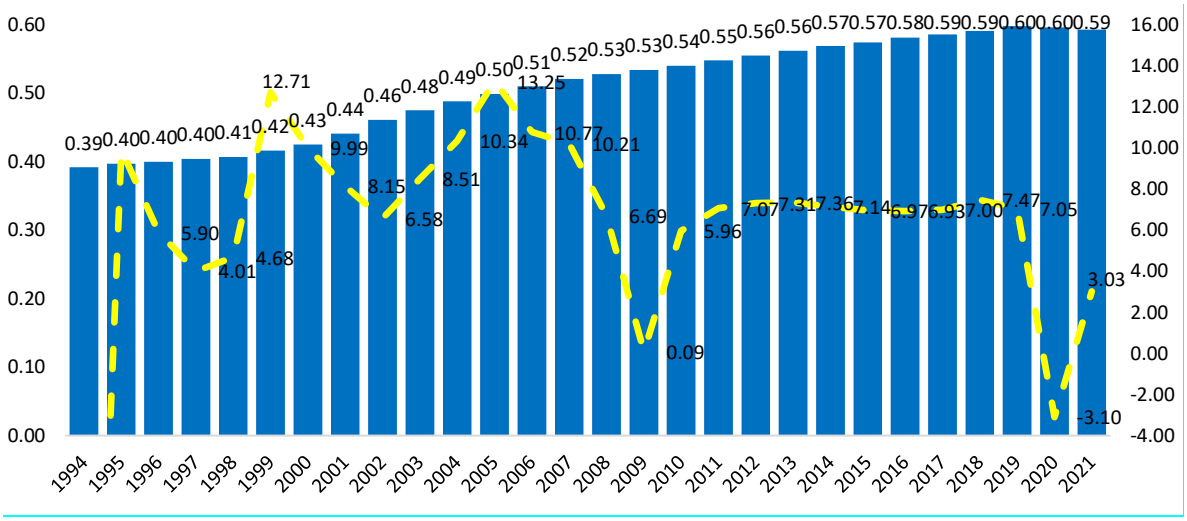
This paper aims to investigate how human capital constraints and geographical constraints impact economic rationalization across 25 provinces in Cambodia using a novel dataset with spatial econometric models. There are many econometrical approaches such as the Ordinary Least Squares model (OLS), the Spatial Autoregressive model (SAR), the Spatial Error model (SEM), and the Principal Component Analysis model (PCA) employed in this research for analysis and assessment. Specifically, some of the crucial variables related to economic rationalization and human capital constraints are assessed, including child nutrition, secondary school dropout rates of male and female students, educational expenses, migration, poverty rates, and access to electricity, water, and toilets. The spatial econometrical methodologies and spatial dependence analysis findings demonstrated that males dropped out of secondary school at a higher rate than females. Additionally, educational expenditure was fairly small based on geographical analysis and assessment. Structurally, according to the migration sector, only a few provinces in Cambodia had more access to electricity, clean water, and flush toilets, and men migrated at higher rates than women. This suggests that when people have higher access to electricity and water, poverty might be eradicated. Moreover, a rationalization analysis of these challenges suggests that Cambodia ought to enforce the spatial policies and embrace different policies according to different locations. Other advanced spatial analyses should use the regionalized analysis and its usefulness to identify the location for policy priorities in Cambodia.

Keywords: *Spatial Analysis, Econometrics, Rationalization, SEM, OLS*

1. Introduction

Cambodia's economy has increased over the growth for years, and GDP growth has increased noticeably by 7% since the past ten years (Figure 1). To support this growth, the labor force is an essential element to foster the growth. It can be said that increasing labor force participation through human resources might be the standard for economic growth. In Cambodia, the national poverty line now stands at $2.15 per day (World Bank, 2022). The new poverty level classifies around 18% of the population as impoverished (World Bank, 2022). Interestingly, the tourism sector, manufacturing exports, and construction are the main pillars of the economy of Cambodia.

In 2020, Cambodia's economic slowdown due to the COVID-19 pandemic was one of the most pronounced in East Asia. Because prompt and effective measures were taken to contain COVID-19, the economy recovered at 3 percent in 2021 and was projected to increase by 5.2 percent and 5.6 percent in 2022 and 2023, respectively. Furthermore, it also lifted per capita income from just USD 247 in 1993 to the level that moves the country from a least-developed country (LDC) to a lower-middle income country at USD 1,625 in 2021 (World Bank, 2023a). High growth has altered economic structure at a rapid pace. Agriculture's share of GDP dropped sharply from 45.3 percent in 1993 to 22.8 percent in 2021 (World Bank, 2023), while industry's share increased from 12.6 percent to 36.8 percent during the same period (World Bank, 2023c). The service sector declined slightly from 39.4 percent of GDP in 1993 to 34.2 percent in 2021 (World Bank, 2023).

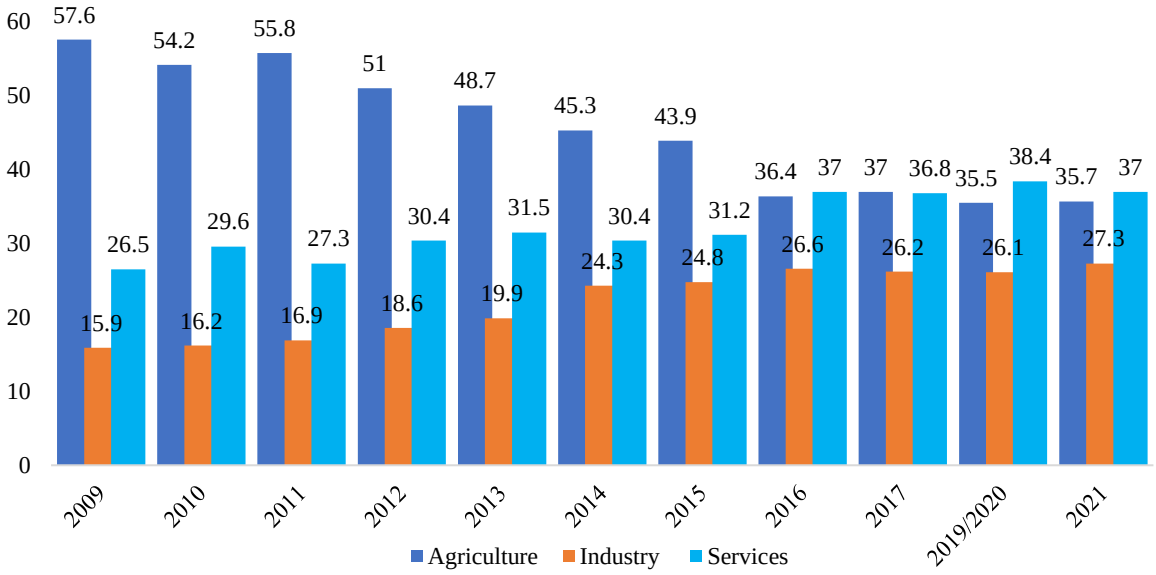


Note: HDI is in the bar chart (left) and the yellow line is the GDP trend by years (RHS).

Source: Authors' calculation from World Bank and UNDP data

Figure 1: The GDP Growth and Human Development Index (HDI) of Cambodia by Years

Along with the economic development, the landscape of the labor market has been transformed, as indicated by the change in the share of employment in the three main sectors; industry (increased to 27 percent in 2019 from 15.62 percent in 2009), agriculture (dropped to 33.1 percent in 2019 from 58.04 percent in 2009) and service (increased to 39.8 percent in 2019 from 26.34 percent in 2009) (O'Neil 2022). As mentioned in Figure 2, employment in agriculture is very crucial to developing Cambodia over the years. Since 2016, employment from service has become the top sector in the market (Figure 2).



Source: Authors' illustration from National Institute of Statistics (NIS) data

Figure 2: The Employment status of Cambodia by Years (percent)

Despite such significant accomplishments, the economy's structure is nevertheless narrowly based and susceptible to shocks from the outside world (Ferguson et al., 2011). Based on NIS (2022), construction, real estate, tourism, and the apparel and footwear industries have been the main drivers of growth. The labor-intensive, low-value-added manufacture of clothing and footwear dominates the industrial sector. These highlight the strong need for Cambodia to diversify its economy and upgrade its industrial structure. However, to achieve this goal, Cambodia requires a large amount of human capital. Based on the General Population Census of Cambodia in 2019, 29.5 percent of the population aged 15 years old or younger, and 17.2 percent was youth (15–24 years old), which gives Cambodia a certain degree of comparative advantage although their average education attainment is quite low. About 93 percent of children aged 6 to 14 years were attending school in 2021. About 84

percent of women and men (80 percent) in the 15 to 24 age group will have completed primary school. Men and women who have completed at least lower secondary education in the 18 to 24 age group were about 52 percent and 47 percent, respectively (NIS, 2022). Many experiences are unique because of the radically different political and economic environments. Furthermore, Cambodia differs from many other Southeast Asian countries due to specific variations in socioeconomic origins. The low-skilled workers continue to dominate the labor market, and there is a severe shortage of semi-skilled and skilled workers to meet the shifting demands of the labor market. Additionally, this research focuses on human capital constraints, poverty, and economic growth that Cambodia has been facing, regionalizes the spatial regions based on the similarities and challenges, and assesses the effectiveness of the policy currently implemented in those geographical regions.

Research objectives

Based on the research rationale, there are four research objectives as follows:

1. To assess the human capital constraints and geographical poverty in Cambodia
2. To analyze the spatial dependence and regionalization in Cambodia to support the objective
3. To explore the current situations and criteria growths in Cambodia by geography and regional government policy supports
4. To employ the spatial variables to analyze the development of the geography and education expenditures in Cambodia.

This means that the objective mostly investigates economic growth and human capital within the spatial context of Cambodia.

Research questions

To achieve the research objectives, this study develops the following research questions:

1. What are the human capital constraints and their spatial distributions in Cambodia?
2. Through spatial dependence and regionalization analysis, how can the 25 provinces be regionalized in Cambodia?
3. How does the current spatial policy affect the geographical regions with poverty and sustainable economic growth in Cambodia?

Literature and research from other countries are essential to benchmark this study and do robustness checks with models in further research and its illustrations. Following the introduction, this paper is divided into the following sections. Section 2 provides a broader variety of literature on this topic from around the globe, including Asian countries, especially Cambodia; Section 3 presents spatial econometric modeling; Section 4 illustrates the data use and its definition; Section 5 presents empirical analysis and findings; and Section 6 provides a conclusion with some policy implications.

2. Literature Review

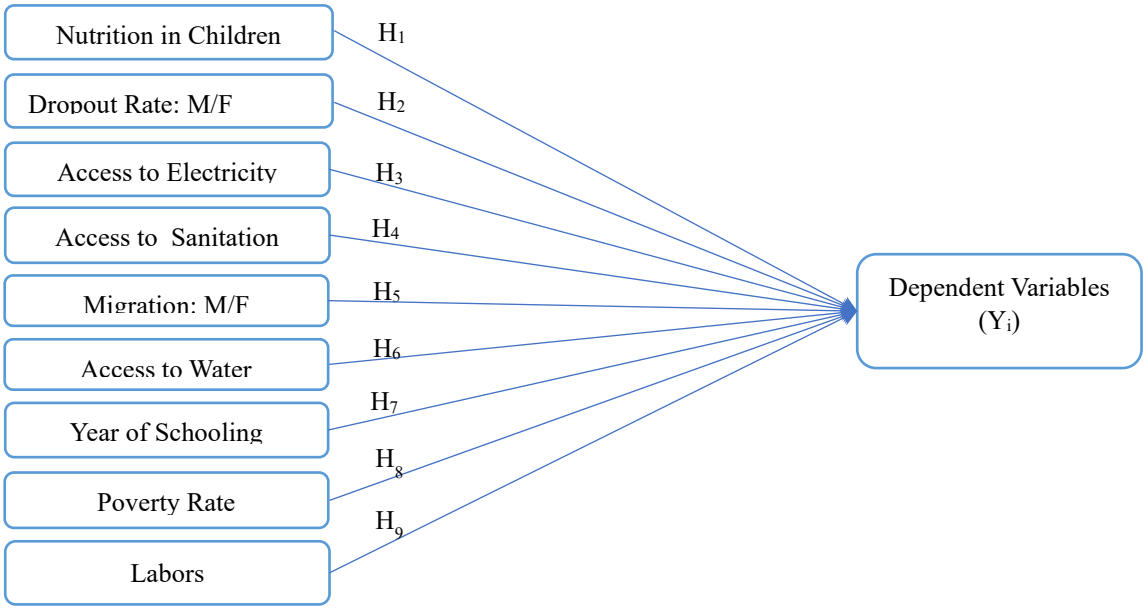
The geographical areas and their economic growth are comprehensively interconnected by their characteristics. Interestingly, some research also mentioned this importance and interconnectedness. There has been little research on the world's economic growth and human capital using spatial econometric analysis. Additionally, some ASEAN countries, such as Cambodia, Thailand, Vietnam, Laos, and Myanmar, appear to have conducted fewer studies on economic growth and human capital using spatial econometric analysis. In the context of Cambodia's development, Cambodia has undergone significant economic growth and human development in recent years. Hence, the country still faces several challenges related to human capital dynamics and economic growth. One of the primary challenges is the lack of access to education and training, particularly in rural areas. This has resulted in a skills gap, which hinders economic growth and development. Another challenge is the high rate of youth unemployment (ILO,1997).

To define economic growth, there are many sectors related to fostering the activities in the economy such as the production and service sectors in the country. This means that the continuous increase of the GDP per capita is very comprehensive to reduce inequality in society. All these are important and related to the quality of labor in production and human capital in one country. Hence, labor is a productive factor to enforce production growth and foster economic growth through the production of services and goods in the economy. The investments in labor advance the productivity of human capital with high production and sustainable growth. Özşahin and Karaçor (2013) mentioned that the theory of human capital is related to the individual not only as a component of the production function but also as a dynamic input in economic progress. Furthermore, there is a positive relationship between production capital and GDP growth. Production capital, which includes physical and human capital, plays a significant role in increasing the productivity of a country, leading to

economic growth. As the production capital of a country expands, it can produce more goods and services, which in turn boosts the GDP. Romer (1990) esteemed human capital as the source of economic efficiency. Human capital, in particular, is considered a crucial factor in this relationship, as it enhances the knowledge, skills, and abilities of workers, enabling them to perform better and contribute more to the economy. Solow (1956) explained well the long-run economic growth through the interplay of various factors such as capital accumulation, technological progress, and labor force growth. This model assumes that economies tend towards a steady state equilibrium where the growth rate of the economy is determined by the rate of technological progress and the rate of population growth, while the capital stock per worker remains constant. The neoclassical growth model remains one of the most widely studied and applied models in economics. Regarding the income sources, Kelley (1988) used data collected in 1966 in Bolivia, the findings showed that the differences in income from 95 percent to 100 percent are due to family background, individual education, and occupation and not because of ethnic differences. Additionally, human capital and spatial factors are important considerations for economic growth in ASEAN countries, including Cambodia. Investment in education and training can improve the skills and productivity of the workforce, which can lead to higher income levels and economic growth. However, spatial factors such as geographical data from infrastructure development and access to markets can play a crucial role in driving economic growth in the region. In particular, improving transportation and communication networks can facilitate the movement of goods and services, and promote regional integration and trade.

In Cambodia, there is less research on human capital development and economic growth using advanced spatial econometric analysis. Hence, this paper is created to foster the research and study deeply on the spatial areas data by using the econometric models to foresee the interconnectedness between spatial data and economic growth in Cambodia.

To meet this research objective and its research questions, a framework is conceptualized as shown in Figure 3.



Note: Dependent Variables: GDP per capita, Migrations, Drop school at secondary level by Male and Female, Human Capital Index (HCI).
Source: Authors' illustration

Figure 3: Conceptual framework

There are nine Independent variables (IV) as from H_1 to H_9 and one dependent Variable (DV) such as GDP (volume) or GDP per capita. Futhermore, this framework's implementation flows smoothly, taking into account the spatial and human limitations found in Cambodia. There are a number of relevant variables to make the regression as in the above illustration such as the following :

Nutrition in children (H_1)	: children under age 5 were malnourished with three anthropometric indices of nutritional status: height-for-age, weight for height, and weight-for-age.
Dropout Rate(M/F) (H_2)	: Dropout rates of Male and Female in Cambodia;
Access to Electricity (H_3)	: Households can access the electricity in their villages;
Access to Sanitation (H_4)	: Households can access the electricity in their villages;
Migration (M/F) (H_5)	: The number of migrations of males and females;
Access to Water (H_6)	: Households can access the water in their villages;
Year of Schooling (H_7)	: Number of years in schooling;
Poverty Rate (H_8)	: The percentage of poverty rate;
Labor Force (H_9)	: The amount of labor in Cambodia;
GDP per capita or GDP (Y_i)	: The GDP value as the dependent variable.

In Cambodia, investments in education and infrastructure have been identified as key priorities for promoting economic development and reducing poverty. To meet the objectives of this research, some data and econometric models are used to measure as discussed in the next section.

3. A Spatial Econometric Modeling and Data Analysis

To assess the economics and human capital with spatial analysis, some spatial econometric models are used such as the OLS model, spatial autoregressive model (SAR), and spatial error model (SEM) with the Cobb-Douglas production function. The principal component analysis (PCA) model was employed as a robustness check in this research. To apply these datasets, STATA, R studio, GIS, and Geoda Spaces software are employed in this section. In addition, the flow of this section is deemed as follows:

Ordinary Least Squared (OLS) Model and Spatial Autoregressive (SAR) Model

As the basis of the econometric model derived from Gujarati and Porter (2009), the Ordinary least squared (OLS) model is used to comprehensively discuss dependent and independent variables with random error terms, which constitutes the multiple linear regression model as mentioned below and derived by:

$$Y: f(x) = f(X_i, X_j) \quad (1)$$

Or

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \varepsilon_i \quad (2)$$

And deriving the SAR model from Waller and Gotway(2004) as follows

$$Y_i = \beta_0 + \beta_i X_i + \lambda W_j + \varepsilon_i \quad (3)$$

As mentioned gradually, the SAR model is seriously determined and discussed whether the main indicator (Y_i) is hugely affected by the region. The first simple spatial autoregression model is used to measure this object to assess its impacts as well as determinations.

Hence, the additional spatial Autoregressive (SAR) model can be made as follows:

$$Y_i = \beta_0 + \beta_i X_i + \lambda W_j + \eta + \mu + \varepsilon_i \quad (4)$$

Whereas, Y_i are the dependent variables such as GDP growth or GDP per capita, poverty rate, which is denoted i dimension and X is the independent variable such as education expenditure variable, secondary drop-out of females, secondary drop-out of male variable, nutrition in children, migrants, access to sanitation, access to safe water, and access to electricity and so on. λ is the spatial autocorrelation coefficient, showing the effect of neighboring regions' spillover to another region per se, and W is a spatial weighted matrix of n x n in order, as usually contiguity matrix, μ is the n_T x1 vector of individual effects, η determines that the n_Tx1 vector of time effects, and ε_i is the error term with the dimension of n x1.

Ordinary Least Squared (OLS) Model and Spatial Error Model (SEM)

Based on the Gujarati and Porter (2009), the OLS model and spatial Error model (SEM) are modeled as follows:

$$Y_i = \beta_0 + \beta_i X_i + \cdots + \varepsilon_i \quad (5)$$

And

$$\varepsilon_i = \lambda W_i \varepsilon + \eta + \mu + \xi \quad (6)$$

Whereas, ξ is the random error vector with Nx1 dimension. λ is the spatial autoregressive coefficient of regression residuals and measures the impacts of independent variables from neighboring regions. Other independent variables as mentioned above section. Hence, spatial dependence analysis is used to determine well as based on Moran (1948) and Cliff and Ord (1981) which is a well-known test for assessing the global spatial dependence as functioned as follows:

For a local indicator of spatial association (LISA) function:

$$\sum_i \sum_j w_{ij} f(x_i, x_j) \quad (7)$$

For Moran-I function:

$$I = \frac{\sum_i \sum_j w_{ij} Z_i Z_j / \sum_i \sum_j w_{ij}}{\sum_i Z_i^2 / N} \quad (8)$$

Whereas an observation at location i and $Z_i = x_i - \bar{x}$ and $Z_j = x_j - \bar{x}$ as $\bar{x}$ is the mean of the variable x_i and x_j and $\bar{x} = \mu$. with w_{ij} as elements for measuring spatial way matrix and observation N. Hence, this function can be written as follows:

For Local Moran-I:

$$I = \sum_i \sum_j w_{ij} .(X_i - \mu_i)(X_j - \mu_i)/\sum_i .(X_i - \mu_i)^2 \qquad (9)$$

Where w_{ij} is the weighting matrix which identifies with the spatial structure of data, X_i are the human capital constraints and other relates at province i, X_i are the human capital constraints, other main variables and other relates at province j. Hence, μ is the average of human capital constraints from X. Noticing that spatial data weighted w_{ij} with additional classifications in this research. Such as spatial space as weighted matrix W consisting of spatial structure data which can represent the "neighbor" relationship with geographical space. To measure more details, the SEM model with the Cobb-Douglas production function is illustrated as follows:

SAR and SEM model with Cobb-Douglas Production Function

The Cobb-Douglas Production function with spatial matrix is implemented and used to assess the impacts of spatial techniques on education expenditures and economic growth in Cambodia. GDP per capita and poverty are the main dependent variables to assess in this Cobb-Douglass function while other variables are independent ones. The production function is written with spatial variables:

$$Y_i = \varepsilon A_i^{\beta_1} K_i^{\beta_2} L_i^{\beta_3} \qquad (10)$$

This production function can be transformed into logarithm form as:

$$\ln Y_i = \beta_1 \ln A_1 + \beta_2 \ln K_2 + \beta_3 \ln L_3 + \varepsilon_i \qquad (11)$$

Additionally, (10) added spatial structure to get the Spatial Autoregressive (SAR) model as follows:

$$\ln Y_i = \rho W \ln Y + \beta_1 \ln A_1 + \beta_2 \ln K_2 + \beta_3 \ln L_3 + \varepsilon_i \qquad (12)$$

Or

$$\ln Y_i = \rho W \ln Y + \beta_1 \ln E_1 + \beta_2 \ln L_2 + \beta_3 \ln HCI_3 + \ldots + \mu + \eta + \varepsilon_i \qquad (13)$$

While E_1 is the educational expenditures, L_2: the labor force in markets sourced from MLVT (2022), HCI_3: the Human Capital Index is measured in scale by the World Bank, and so on. D_m is the male dropout school at the secondary school level and D_f is the female dropout school at the secondary school level.

Similarly, Spatial Error Model (SEM) function:

$$\ln Y_i = \rho W \ln Y + \beta_1 \ln E_1 + \beta_2 \ln L_2 + \beta_3 \ln HCI_3 + .. + \varepsilon_i \qquad (14)$$

Whereas,

$$\varepsilon_i = \lambda W \varepsilon + \mu + \eta + \nu \qquad (15)$$

ν is a vector of the random error metrics, λ: spatial autocorrelations coefficient of residuals, η is a vector of time effect, μ: a vector of an individual effect, W: spatial weighted matrix, and ε is a random error term. As mentioned above, other comprehensive variables such as dependent and independent variables are written above once.

Principal Component Analysis (PCA) Model

To identify this research and be a robustness check, the PCA method is used to run these datasets as mentioned. In the Cambodian context, some variables are available on the source to use while others are not on the source. As mentioned above, PCA handles an eigenvalue decomposition problem and finds the small values of variables derived from Carlos and Erick (2020), the PCA model is formed as follows:

$$z_j = \rho_1 x_1 + \rho_2 x_{2+} .... + \rho_k x_k \qquad (16)$$

Whereas,

z_j for each principal component j and $X^T X$ as κ x κ cross-product correlation matrix.
x_j for j = 1, 2, …., k

In this research, the PCA model was derived from 9 variables as mentioned in descriptive statistics. The goal is to identify smaller sets of variables, most of the variances of these variables are constrained to human capital or education expenditure and other main dependent variables. To deepen our research in this paper, some data sources are used to regress and model to achieve the research objectives.

4. The Data Use and its Definitions

To clarify the details of this research, mixed models which are descriptive statistics and inferential statistics techniques are more appropriate to assess some vital data from Cambodia. Some econometric models such as the OLS model, SAR model, and SEM model are employed with some other techniques like Moran-I, LISA cluster, and Map cluster with some data analysis software such as STATA, GeoDaSpace, and Excel – with spatial weighted

matrix measurements. This research approached more data sources from some sources as follows:

Table 1: The variable definition

Variables	*Definition*	*Symbol*	*Sources*
Labor	Population of employment	L_i	NIS, 2022
GDP per capita	Income per capita	Π_i	World Bank, 2023
Average Schooling Years	The average Schooling Years of the total population.	S_i	UN, 2023
Education Expenditure	Government expenditure on Education with million riel units	E_i	OCM, 2022
Dropout rate of Male	The number of Male students dropping out from secondary school as a percentage	D_m	MoEYS, 2023
Dropout rate of Female	The number of Female students dropping out from secondary school as a percentage	D_f	MoEYS, 2023
Nutrition in children	The numbers of children under age 5 are classified as malnourished according to three anthropometric indices of nutritional status: height-for-age,weight-for-height, and weight-for-age.	N_i	NIS, 2022
Poverty Rate	The rate of poverty in entry country.	PR_i	MRC, 2003
Migrants	The number of total migrants to work.	M_i	NIS, 2022
Male Migrants	The number of total Male migrants.	M_m	NIS, 2022
Female Migrants	The number of total female migrants.	M_f	NIS, 2022
Access to Safe Water	The proportion of people with access to safe water.	AW_i	MRC, 2003
Access to Sanitation*	The proportion of the population with access to Sanitation (..latrine, flush toilet).	AS_i	MRC, 2003
Access to Electricity	Proportion of people access to electricity.	AE_i	MRC, 2003
Human Capital Index (HCI)	Human Capital Index is measured in scale.	H_i	World Bank, 2023
Gender Parity Index (GPI) for GAR	Ratio of the female-to-male values of a given indicator for gross Admission rate (GAR).	GPG_i	MoEYS, 2023
GPI for NAR	Ratio of the female-to-male values of a given indicator for net admission (NAR)	GPN_i	MoEYS, 2023
Gender Parity Index (GPI)	The ratio of female-to-male values of a given indicator. A GPI of 1 indicates parity between sexes.	GPI_i	MoEYS, 2023

*Sanitation in this research refers to the availability of a latrine in or near the house or a flush toilet.

Source: Authors' illustration

All the above variables represent the geographical areas or provinces in Cambodia. The variables defined above are selected from some literature review and new variables are added to match the context of Cambodia.

Descriptive statistics and maps

Table 2 provides an overview of the data and other indicators. GDP per capita is the constant value with its original one but it is transformed into a natural logarithm as well as labor forces, education expenditure variable, and migrants. Table 2 describes each variable used in this regression with 25 provinces. Interestingly, poverty in Cambodia is scaled from 0% to 97% in spatial areas. This means that Cambodia is still having higher poverty in their spatial areas. Moreover, malnutrition in children is still less and should be taken into account. This nutrition is also mentioned in the results and regressions. GPI is still low if we see this minimum and maximum range. Dropout rates show that the that rate of males is higher than that of females. Around 11.70% to 23.50% are dropouts of males at secondary schools and 10.30% to 23.50% are drop-outs of female. This means that most males dropped out at secondary schools, which is a tremendous issue casting concern over the quality of labor in the future.

Table 2: Descriptive Statistics of Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Labor (L_i)*	25	11.070	1.12	8.95	13.74
GDP per capita (Π_i)*	25	7.480	0	7.48	7.48
Malnutrition in Children	25	501.68	370.104	31	1485
Total Migrants*	25	6.620	1.014	4.42	8.44
Average Schooling Years (ASY_i)	25	5.100	0	5.10	5.10
Secondary Dropout rate of Male (D_m)	25	18.712	3.52	11.70	23.50
Secondary Dropout rate of Female (D_f)	25	16.880	3.63	10.30	23.50
Total Secondary Dropout School (D_i)	25	17.760	3.432	11.50	23.50
Poverty Rate (PR_i)	25	30.670	20.57	0	97.20
Education Expenditure (E_i)*	25	11.202	0.823	10.21	14.24
Access to Safe Water (AW_i)	25	22.290	18.83	0	85.40
Access to Sanitation (AS_i)	25	19.870	16.81	0	87.90
Access to Electricity (AE_i)	25	14.260	16.98	0	80.20
Human Capital Index (HCI_i)	25	0.490	0	0.49	0.49
GPI for GAR	25	0.970	0.045	0.87	1.09
GPI for NAR	25	1.021	0.047	0.94	1.14

*Natural logarithm with these variables. Obs: 25 provinces

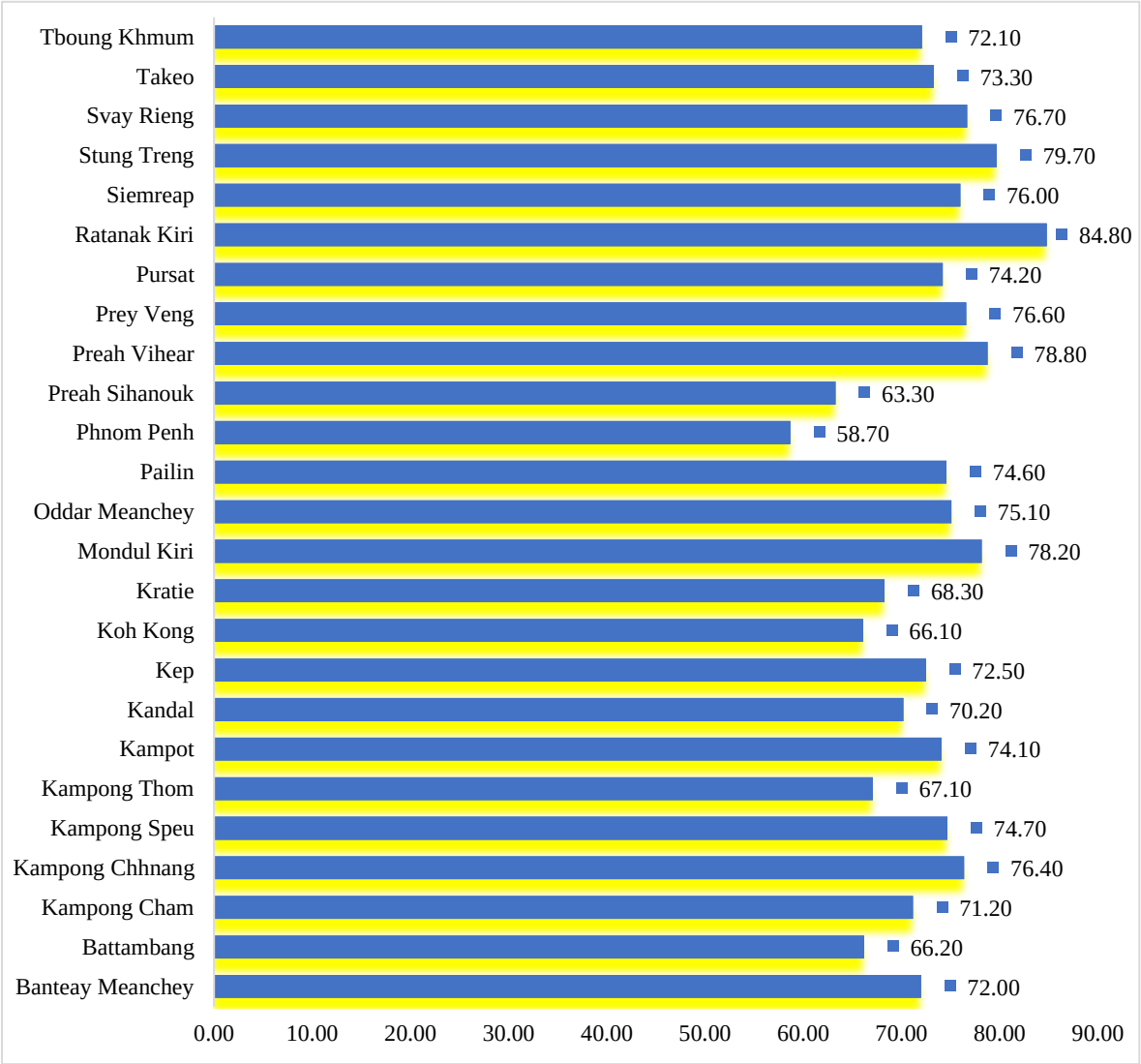
Source: Authors' illustration

To find out the correlation of these variables, Table 3 shows the pairwise correlations of variables. This means it indicates strong and positive correlations between expenditures in education and nutrition in children and labor in Cambodia. Another higher relationship is drop-out females and other main variables as in Table 3.

Table 3: Pairwise Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Education Expenditure	1.000								
(2) Nutrition in Children	0.853***	1.000							
(3) Labor Force	0.868***	0.888***	1.000						
(4) Drop Out Male	-0.258	-0.269	-0.213	1.000					
(5) Drop-Out Female	-0.242	-0.266	-0.194	0.846***	1.000				
(6) Poverty Rate	-0.093	-0.024	-0.119	-0.082	-0.080	1.000			
(7) Access to Safe Water	-0.104	-0.291	-0.172	-0.228	-0.255	-0.027	1.000		
(8) Access to Sanitation	-0.008	0.070	0.007	-0.307	-0.345*	-0.051	0.575***	1.000	
(9) Access to Electricity	-0.137	-0.122	-0.109	-0.363*	-0.403**	-0.119	0.664***	0.873***	1.000

*Note: *** p<0.01, ** p<0.05, * p<0.1, and (1) and (3) variables are in the logarithm*

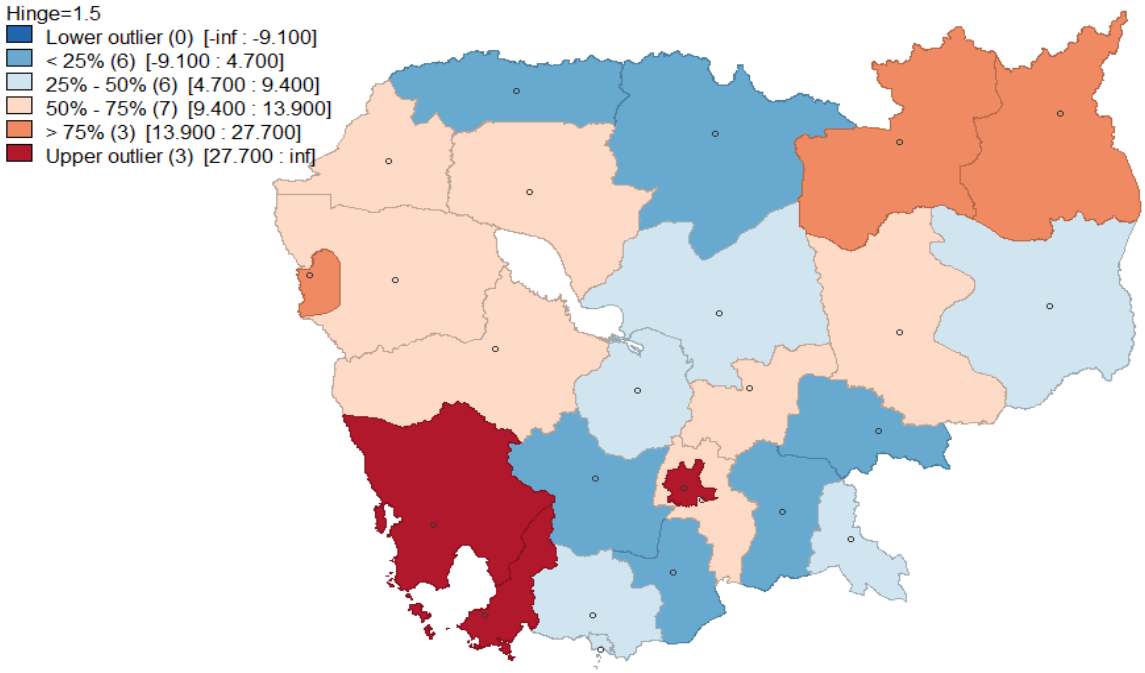


Source: Authors' calculation based on NIS (2022) with STATA version 14.

Figure 4: Cambodia's Labor Force in Percentage in 2022 by spatial data

We also analyze more deeply this spatial and human capital with growth. Figure 4 shows Cambodia's labor in 2022 by natural logarithm on labor. This figure illustrates that the labor force in Svay Rieng is the lowest in Cambodia while Kratie province is in second place. Conversely, Mondulkiri province has the highest labor rate in Cambodia using NIS data while Kondal province is in the second rank. Notably, according to page 28 of Cambodia labor force survey report defined that labor means almost all activities within the system of national accounts production boundary, including production for pay, profit or family gain, and production for own final use (NIS, 2019). Moreover, this labor data illustrates the number

of people who are employed in kinds of skilled job, their qualifications for their jobs, and their working patterns. To enhance the assessment of labor with geographical or spatial data, figure 4 depicts the proportion of Cambodian labor in 2022 by provinces; this figure shows that Phnom Penh has the lowest employment rate when compared to other provinces. This figure might include agricultural employment in provinces while fewer farmer employments are in Phnom Penh while the unemployment rate was higher for females than males (World Bank, 2008). Ratanak Kirri province has the greatest employment rate, followed by Stung Treng province. Interestingly, Prea Sihanoukville has a 63% employment rate as this province is a tourism area. Overall, the employment rate in the spatial rate by each province shows that employment rate is around 70% in each province. This means that Cambodia's economy seems to have more economic activities to produce more employments to reduce poverty as shown as follows.

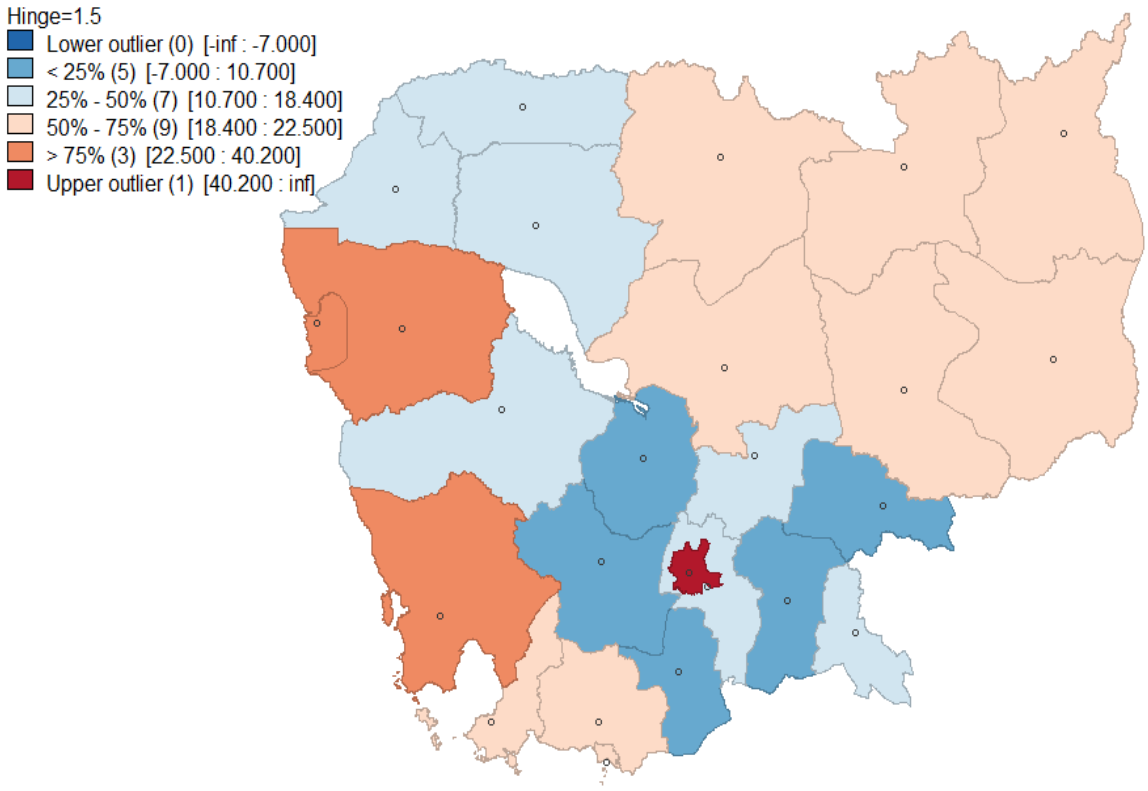


Source: Authors' calculation based on NIS (2022)

Figure 5: Access to Electricity with Spatial Analysis in Cambodia

Figure 5 shows access to electricity with spatial analysis in Cambodia. This figure demonstrates that the lowest and highest areas can access well to the electricity for the households. There are 12 provinces in which people can access electricity with less than 50%

such as Oddar Meanchey, Preach Vihear, Kompong Cham, Prey Veng, Kompong Speur, and others (Figure 5). On the other hand, only three provinces such as Phnom Penh, Koh Kong, and Sihanouk Ville can access electricity well. This means that some provinces have more electricity access and more development than other provinces that could not access electricity. Notably, Pailin province is one of the smallest provinces in Cambodia where people can access electricity for around 75%. However, regarding the sanitation section, only few provinces can have access to high sanitation such as latrines and flush toilets such as Phnom Penh, Koh Kong, Preah Sihanouk Ville.

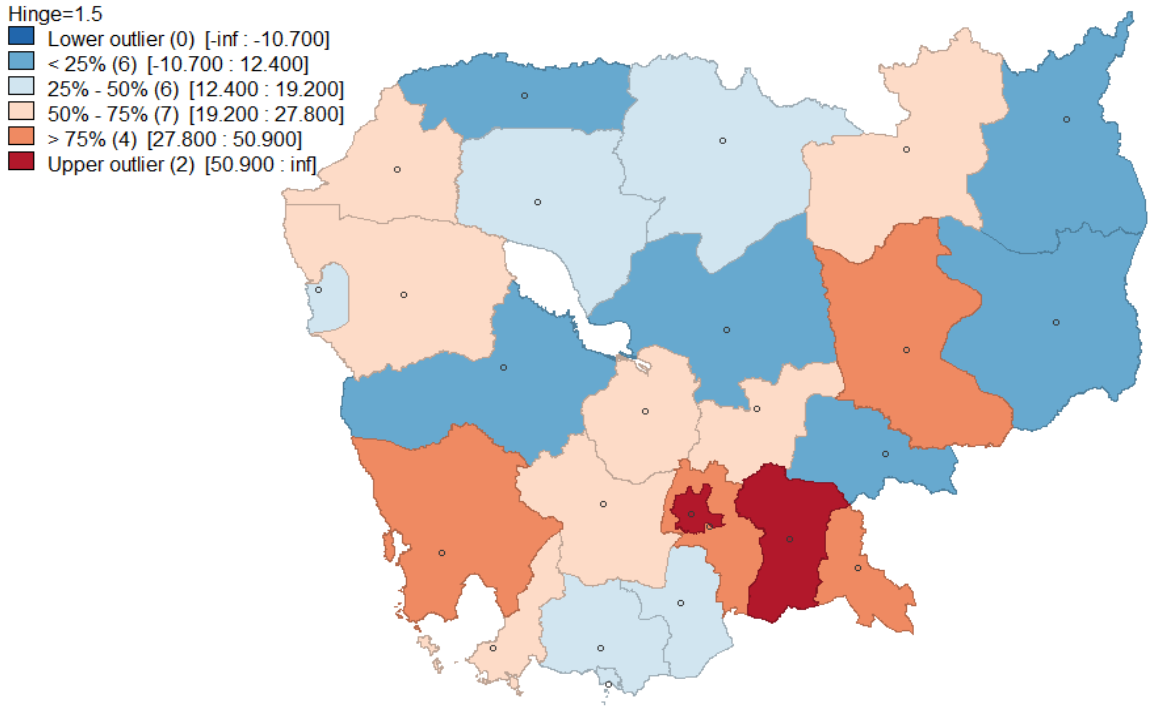


Source: Authors' calculation

Figure 6: Access to Sanitation with Spatial Analysis in Cambodia

About 50% of provinces in Cambodia might not have sanitation access while less than 25% of households living in 5 provinces can have latrines and flush toilets in their house. This demonstrates that many people cannot access sanitation with their good health and society. This sanitation can refer to the livelihood of the people and their characteristics. Some illnesses might be affected by their sanitation such as diarrhea and others. This might occur due to their higher expenditures on their healthcare and daily expenditures. If we think of

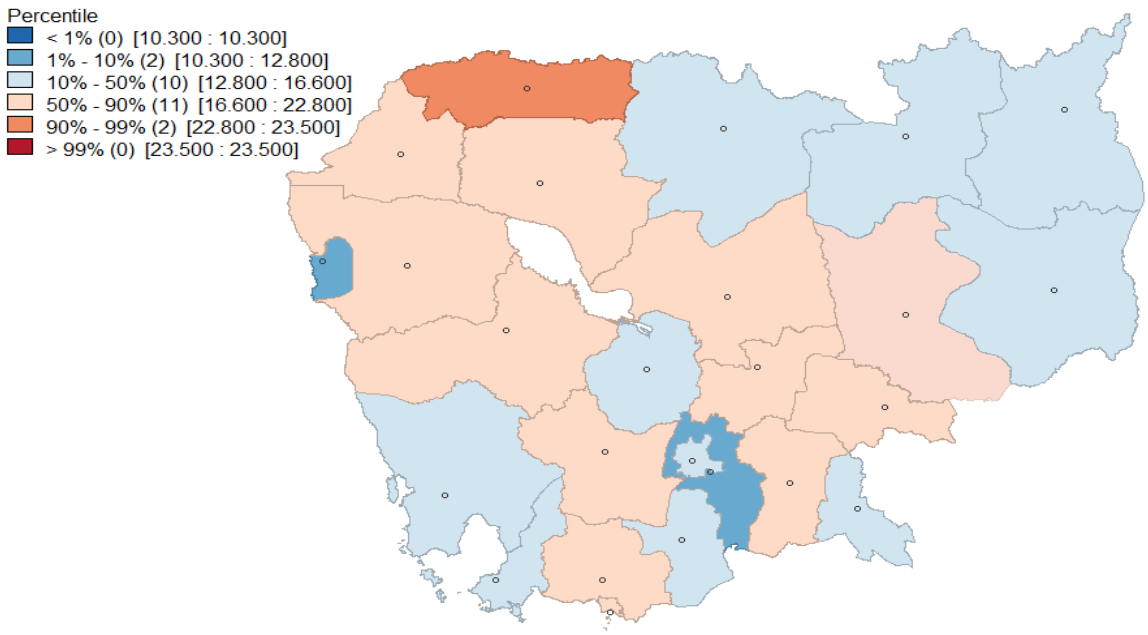
sanitation and other electricity access, we might think of safe water access for people too as in Figure 6.



Source: Authors' calculation based on the NIS.

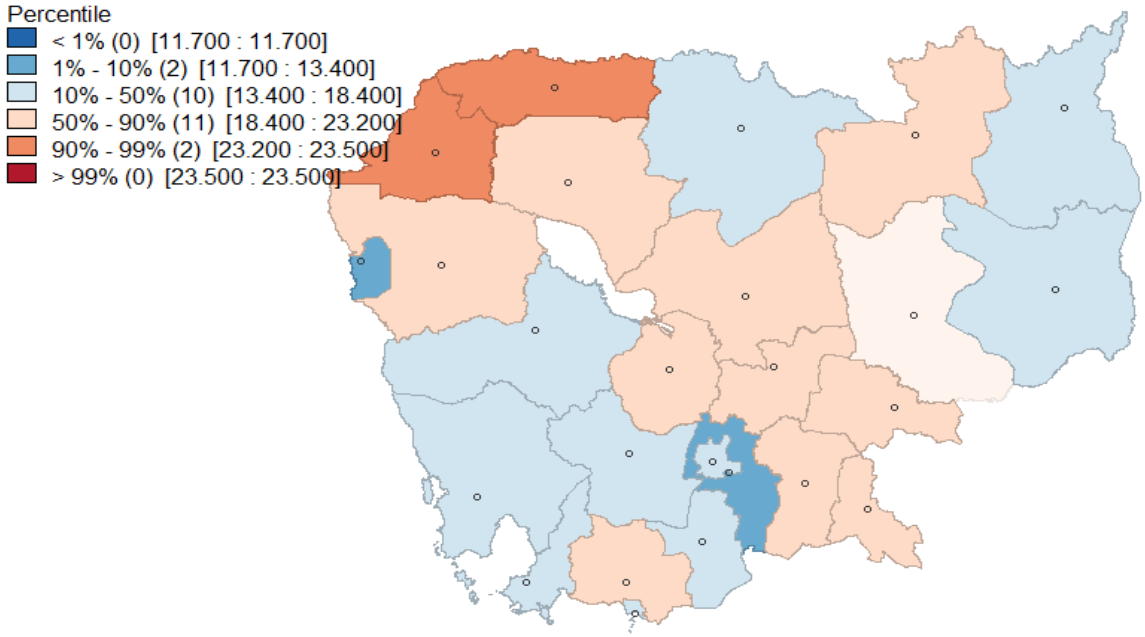
Figure 7: Access to Safe Water with Spatial Analysis in Cambodia

Among all provinces, only two provinces can access safe water in their areas (as shown in figure 7). While 4 provinces have access to safe water with more than 75% in their areas. Around 50%-75% of safe water access exists in 7 provinces, and 25% to 50% of safe water in 6 provinces respectively. In this sense, Cambodia should foster safe water access to reduce poverty and its development. One of the vital livelihoods of people is using clean and safe water The sustainability of development in Cambodia should be concerned with safe water for people and poverty reduction. Additionally, there is less than 26% of safe water access for people living in 6 provinces. This is tremendously notified that people living in those provinces might not access safe water and might face illness and higher expenditures in their livelihood. These can be from their knowledge as well. All mentioned are the norm for the poor too.



Source: Authors' calculation based on NIS.

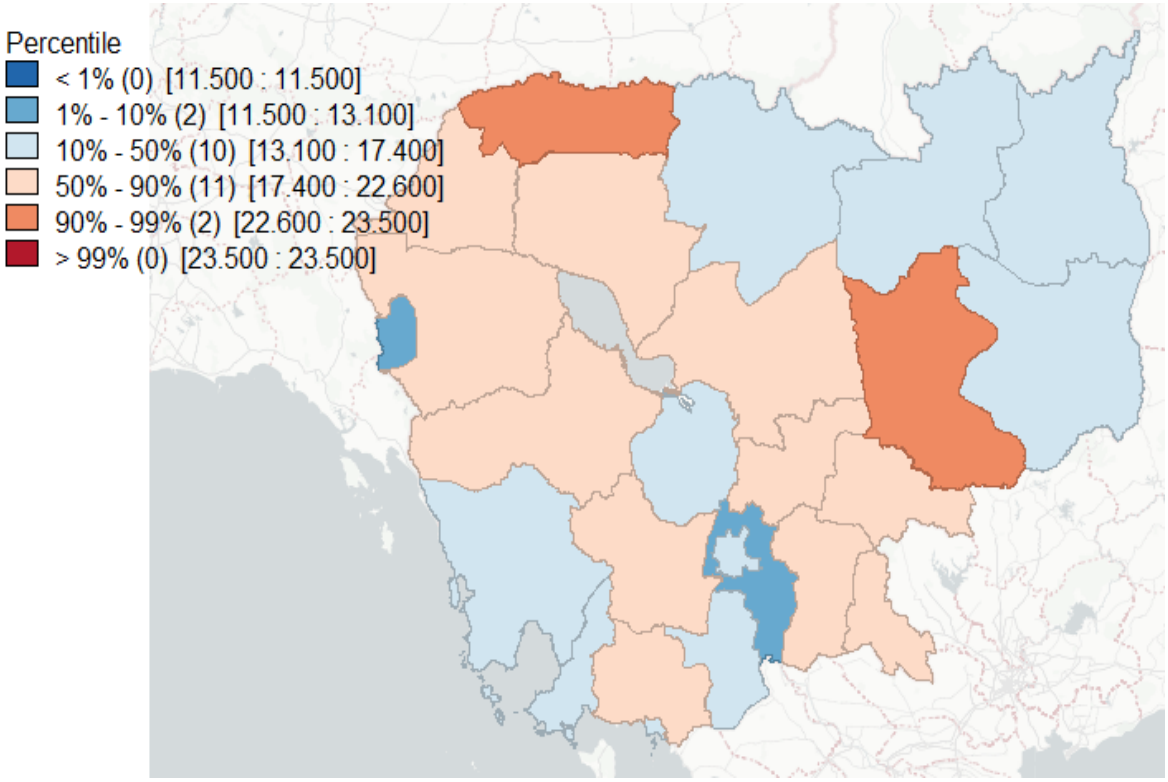
Figure 8: Spatial Analysis on Secondary drop-out of Females in Cambodia



Source: Authors' illustration

Figure 9: Spatial Analysis on Secondary drop-out of Males in Cambodia

Most poor have limited education and illiteracy and are likely to drop out of schools. To develop our society, education is very comprehensive to foster growth. Notably, school dropouts among males and females are shown clearly (Figures 8 and 9). Only 2 provinces have more than 90% of school dropouts as in this sample as in Oddar Meanchey and Kratie. Two provinces are comprised of around 1% to 10% of dropout students as shown in this figure. To clarify this, male and female proportions should be determined well as in the next figure. Most dropouts in Cambodia are dominated by males in secondary school.



Source: Authors' calculation

Figure 10: Spatial Analysis of Total Secondary drop-out in Cambodia

Figures 10 and 11 show that males and females drop out of school at the secondary school level with spatial analysis in Cambodia. For male dropouts at the secondary level, more than 75% of male dropouts at secondary schools, are in six provinces less than 25%. Kratie, Tbong Kmoumm, Kampot, Siem Reap, Oddar Meanchey, and Banteay Meanchey provinces have a very high proportion of males dropping out of school if compared to other provinces. As in geography for female dropout secondary schools, only 6 provinces such as Oddar Meanchey, Kampot, Kampong Speu, and Kraties have more female dropouts. If comparing

males and females at secondary school, the proportion of males is higher than females in dropping out the school at the secondary level. As shown in Figure 11, the details of dropping out of school might be from public education expenditure and years of schooling as well as mentioned below.

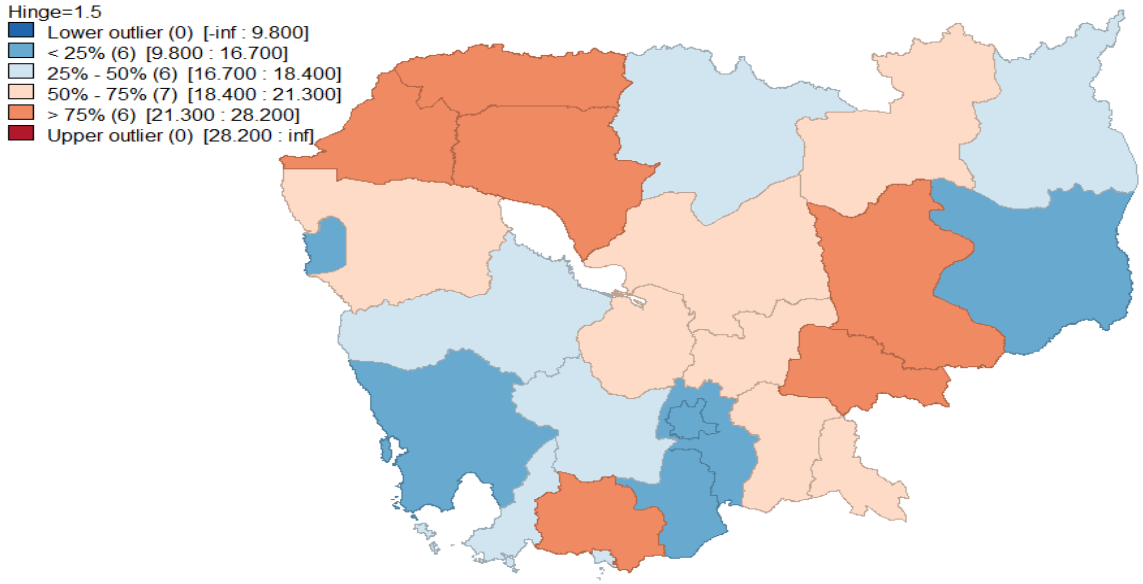
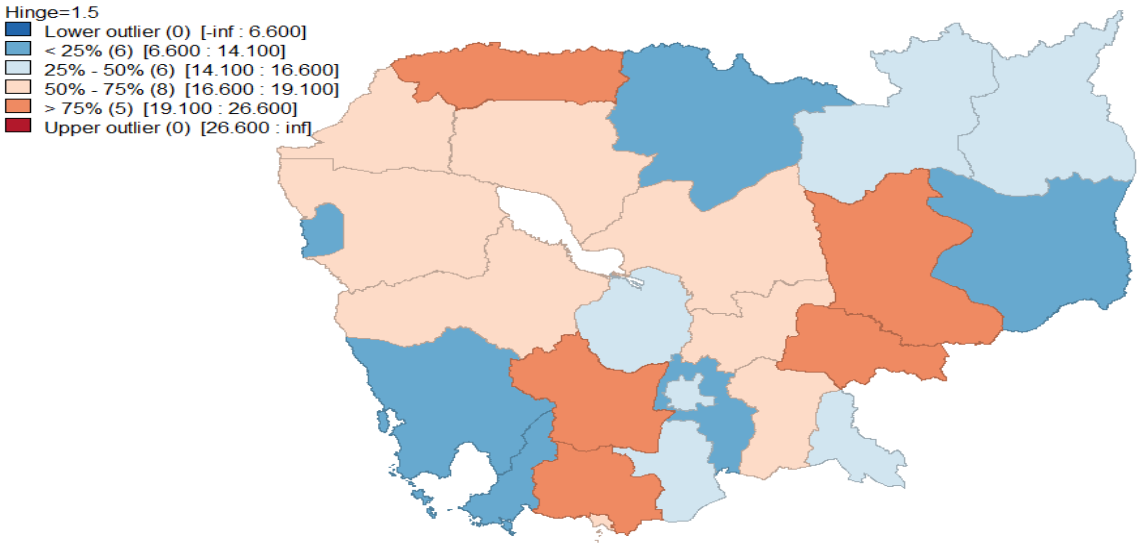


Figure 11: Spatial Analysis of Male Secondary drop-out and public expenditures in Cambodia



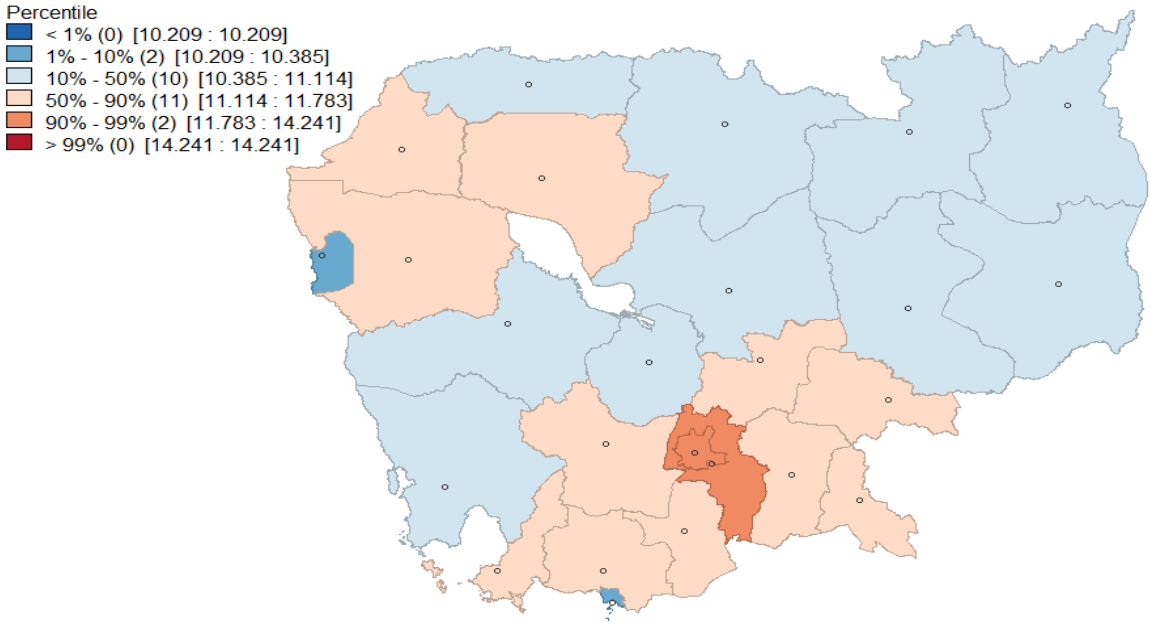
Source: Authors' illustration

Figure 12: Spatial Analysis of Female Secondary drop-out and public expenditures in Cambodia

In Figure 12, we mention the spatial analysis of education expenditure in Cambodia. This figure shows that only two provinces have more than 90% to 99% for education expenditures while there are 11 provinces with 50% to 90% of expenditures and others lesser. This means that Cambodia's expenditures are still limited. Many provinces need more expenditure on education. Cambodia's education system should be focused on this expenditure to qualify the education and labor force. In-depth, analysis of this education, the years of schooling are very comprehensive for households educating in school. This means that people from many provinces in Cambodia have fewer years of education by provinces. This identifies that the total school dropouts might be high and should be flexible strategies to encourage the students to enroll. Futhremore, it appears that the poverty in Cambodia during the school year of students varies depending on the geographical area. According to the World Bank website and UNCEF, some of the weaknesses of education in Cambodia are:

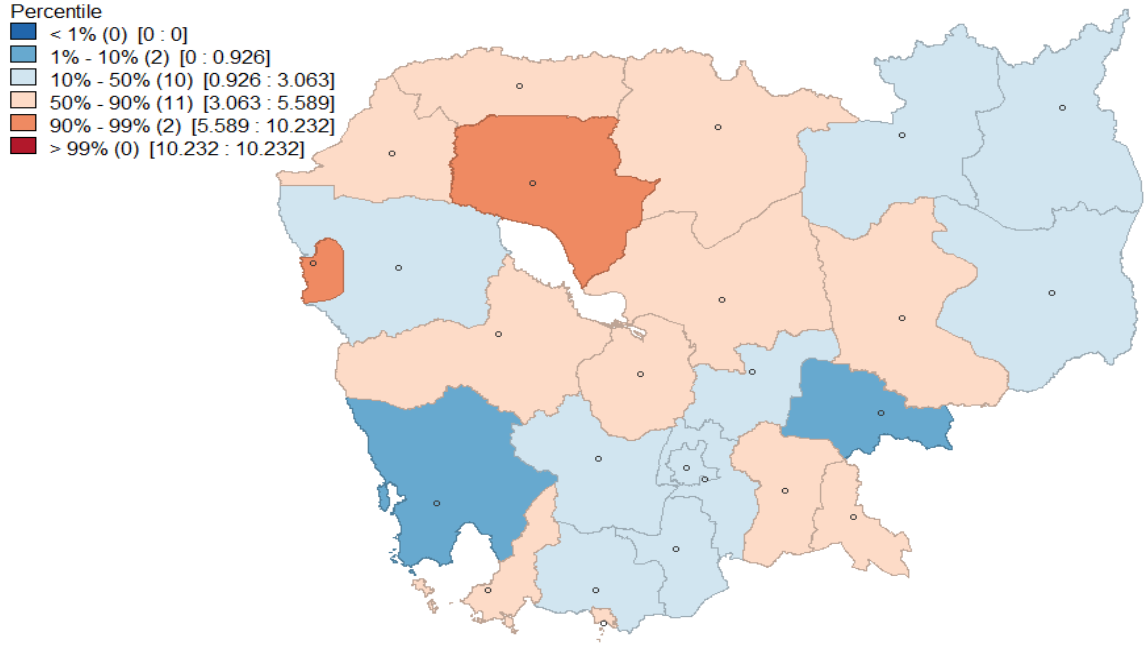
- Nutrition with children
- High dropout rates and low enrolment rates, especially in secondary and tertiary education
- Inequalities in access and quality of education across gender, location and socio-economics
- Lack of qualified teachers, adequate resources, and relevant curricula
- Violence and corporal punishment in schools
- Low investment in education by the government.

These weaknesses pose serious challenges for the development of human capital and the competitiveness of the Cambodian economy in the era of Industry 4.0. In Figure 12, we will present malnutrition in children in Cambodia. This reveals that more than 10 provinces face less nutrition in children. Cambodia still needs to face many issues regarding education and its quality. This issue can be an obstacle to sustainable growth in education and development. Additionally, poverty level in Cambodia is evident in both this educational system and the underprivileged.



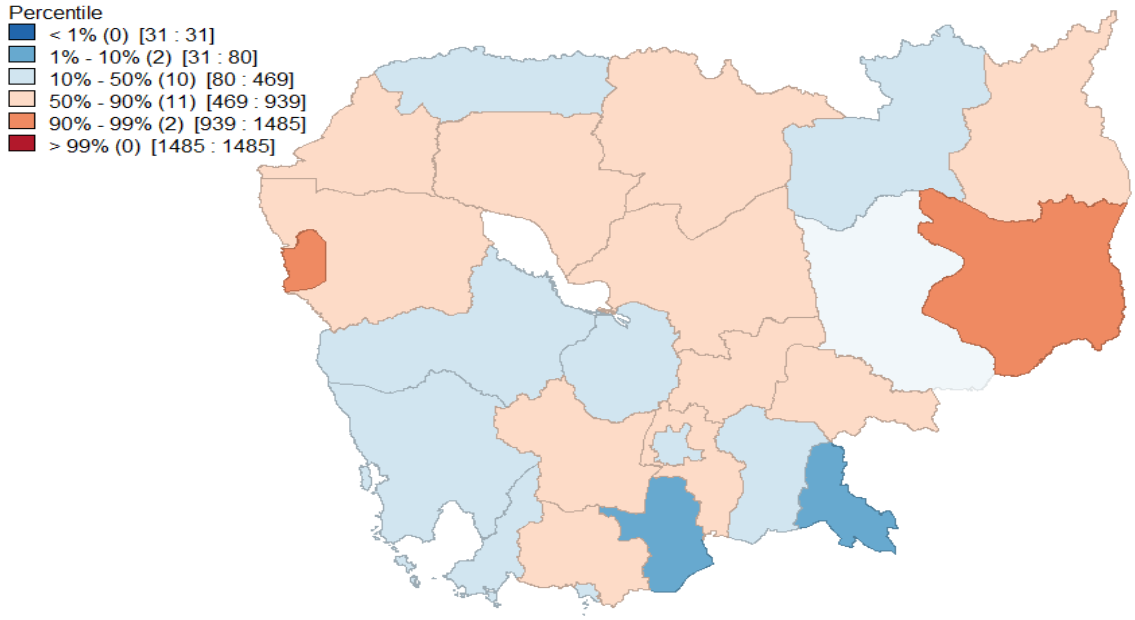
Source: Authors' calculation

Figure 13: Spatial Analysis of Education Expenditures in Cambodia



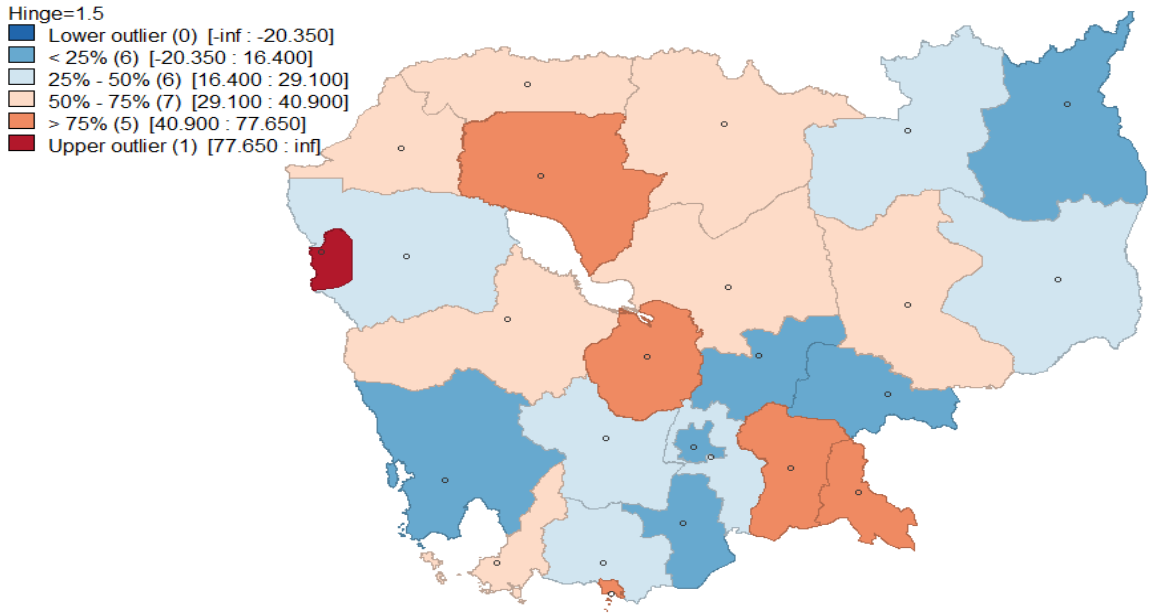
Source: Authors' calculation

Figure 14: Spatial Analysis of poverty on years of education in Cambodia



Source: Authors' calculation

Figure 15: Spatial Analysis of Malnutrition in Children in Cambodia

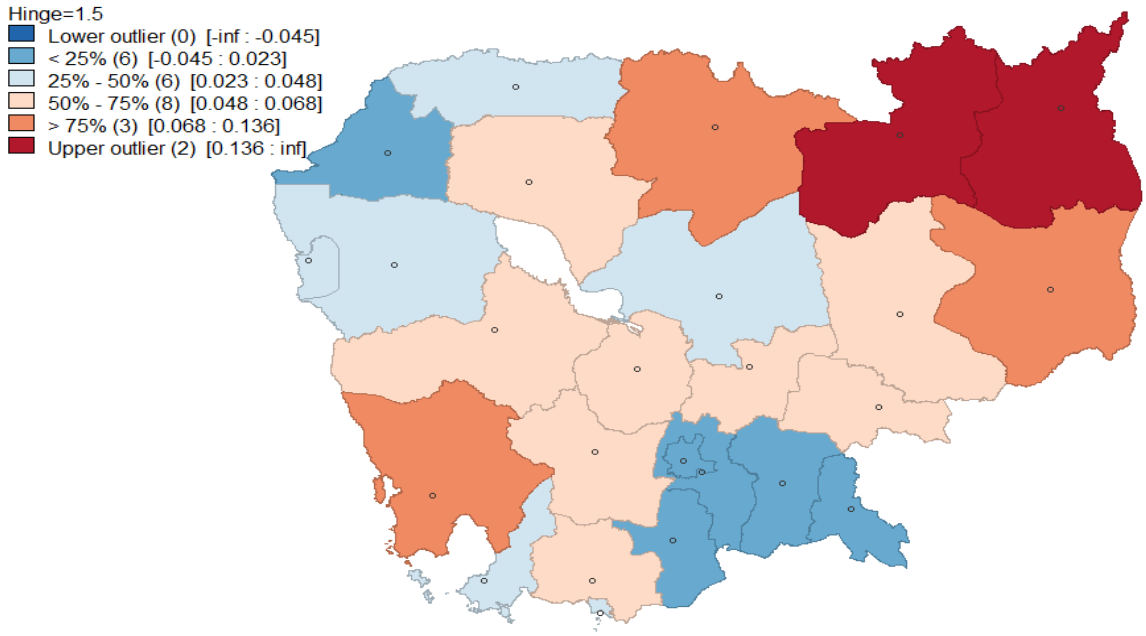


Source: Authors' calculation

Figure 16: Spatial Analysis of Poverty Rate in Cambodia

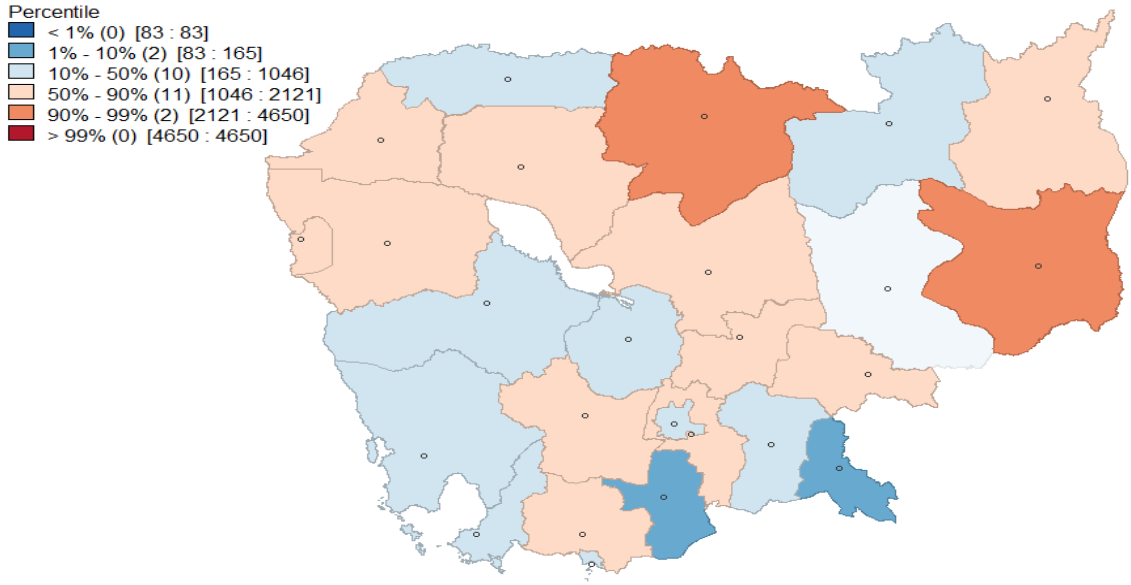
According to the World Bank (2022), Cambodia has made remarkable progress in reducing poverty over the past decade, but some recent gains have been threatened by the impact of the COVID-19 pandemic on the economy. The report relies on new poverty lines, based on the Cambodia Socio-Economic Survey (CSES) 2019-20, in which the Royal Government of Cambodia set the national minimum at 10,951 riel per person per day. The Cambodia Poverty Assessment 2022 shows that the country's national poverty rate fell by almost half between 2009 and 2019, but the COVID-19 pandemic has recently reversed some of the progress made.The report also reveals that poverty in Cambodia is severe in rural regions, where 90 percent of the poor live. Agrarian farmers, women, internally displaced persons and those in poor fishing communities account for 4.8 million impoverished Cambodian individuals. Living standards have improved, helping Cambodia to narrow urban-rural gaps; but low-income and rural households still lag behind in access to basic services and earning opportunities. During COVID-19, the government used the existing “IDPoor” registry to deliver relief cash transfers to registered households. Cash transfers provided valuable income support to poor households during the pandemic and curbed the increase in poverty and inequality. Though assistance was rapidly scaled up, cash transfer coverage has room for improvement. As in figure 16, spatial data with severe poverty shows Cambodia has more poor provinces such as Ratanak Kiri, Modul Kiri, and Stung Treng province (Figure16). Furthermore, other provinces also seem to serve poverty as well as in this figure. As in percentage by hinge 1.5, there are 12 provinces with lower poverty from lower than 50%. This can tell that the government or policymakers should generate and think of these areas to help the poor households living in those areas by any supportive programs or other spatial assistances. In Cambodia , many people migrate because of their livelihood or poors status. To see more details of this challenges , figure 16 reveals the migration and spatial analysist. Two provinces are many migrations such as Mondul Kirir, and Preah Vihea province. Only two provinces are having the lowest migration to work such as Svay Rieng, and Takeo province. This is true that poor people can be enforced to migrants by some reasons such as loan expenditures and other livelihood costs, the same findings as Susex(2012). Improverished individuals travel not only abroad but also domestically. The number of internal migrants is almost four times more than the total number of foreign migrants, according to a recent United Nations Development Program Report (UNDP 2009). Around 214 million individuals were residing outside of their countries of birth in 2010. Globally, migrants sent an estimated US$440 billion home in 2010 (World Bank 2011b). To shed light

on this migration, we will examine the migratory patterns of men and women in Cambodia (Figures 15 and 16).



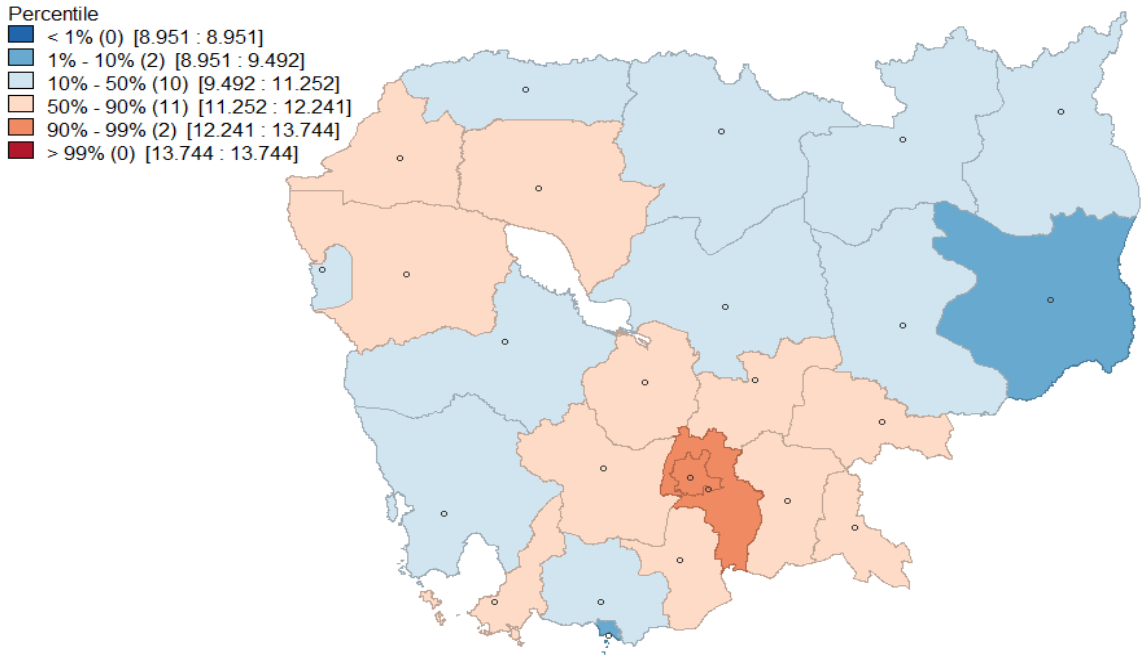
Source: Authors' calculation

Figure 17: Spatial Analysis of Severe Poverty Areas in Cambodia



Source: Authors' calculation

Figure 18: Spatial Analysis of total migrations in Cambodia

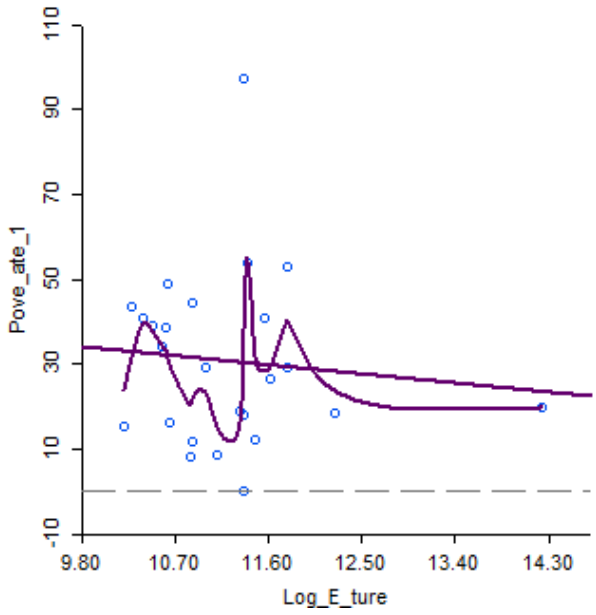


Source: Authors' calculation from NIS (2022)

Figure 19: Spatial Analysis of labors (%) in Cambodia

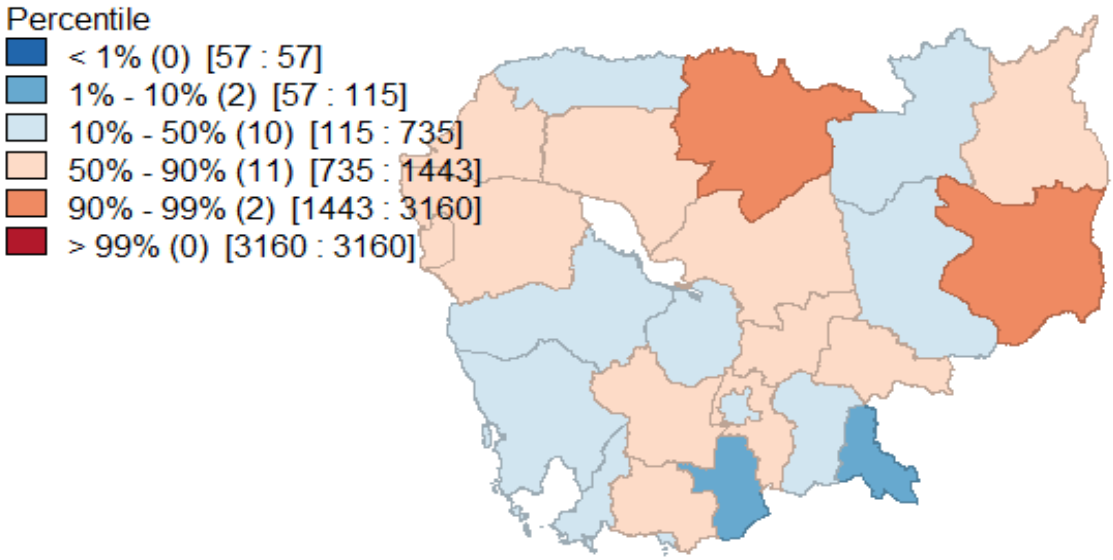
A spatial analysis of labor in Cambodia is shown in Figure 19. This demonstrates that Mondul Kirri province is the province in Cambodia with the lowest employment rate. However, the Kandal and Phnom Penh provinces have the highest employment rates in Cambodia. Twelve provinces, including Oddar Meanchey, Preah Vihear, Stung Treng, Kraties, Pursat, Koh Kong, Pailin, Kompot, and others, have a percentage of geographic data ranging from 1% to 50%. Twelve provinces also have 50% to 99% in the spatial analysis. It names the provinces of Banteay Meanchey, Preah Sihanouk Ville, Takeo, Prey Veng, Kampong Chnang, Kampong Cham, Siem Reap, Battambang, and Svay Rieng Province (Figure 19).

Figures 19 and 18 show that only two provinces in Cambodia had higher rates of movement between men and women. The provinces of Mondul Kirri and Preah Vihear are indicated by these figures. Less than 1% of provinces have lower percentages of female migration. These are just two provinces. The geographical data revealed that the percentage of female migration ranged from 50% to 90% among the country's 11 provinces. The migration rates are comparable between the places. Furthermore, migration increased in over ten provinces, representing 50% to 99% of the projected geographical areas. Poverty and migration within each area should be studied in depth (Figure 20).



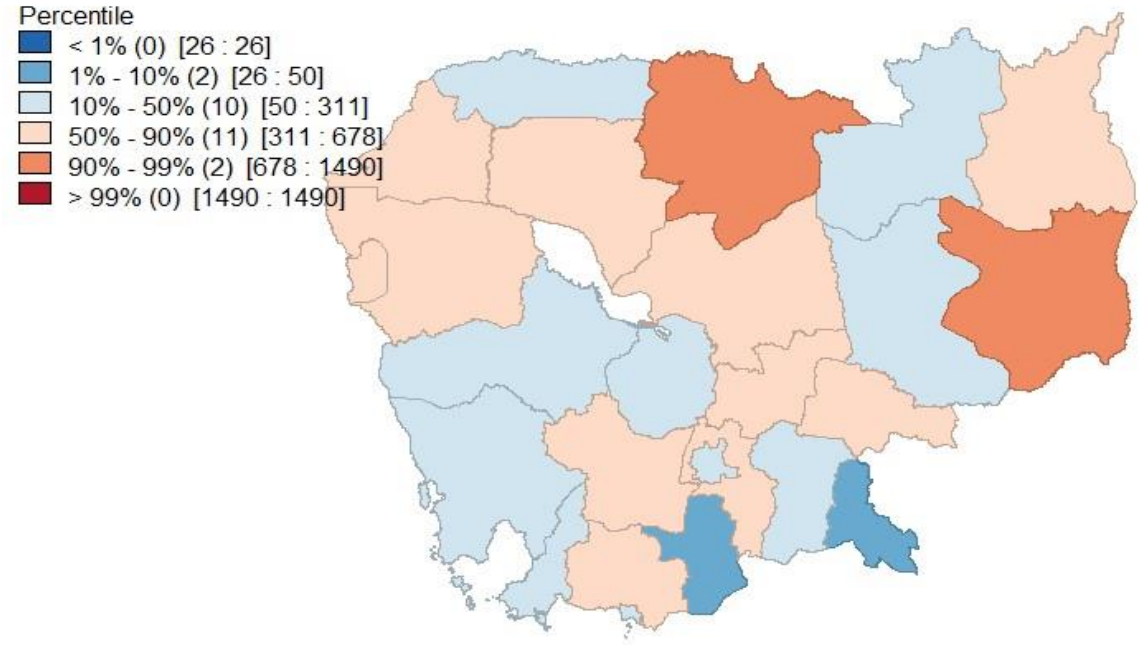
Note: Education expenditures are the axis while poverty rate is the dependent variable.
Source: Authors' calculation

Figure 20: Relationship of Education Expenditures and Poverty Rate in Cambodia



Source: Authors' calculation from NIS (2022)

Figure 21: Spatial Analysis of Female migrations in Cambodia

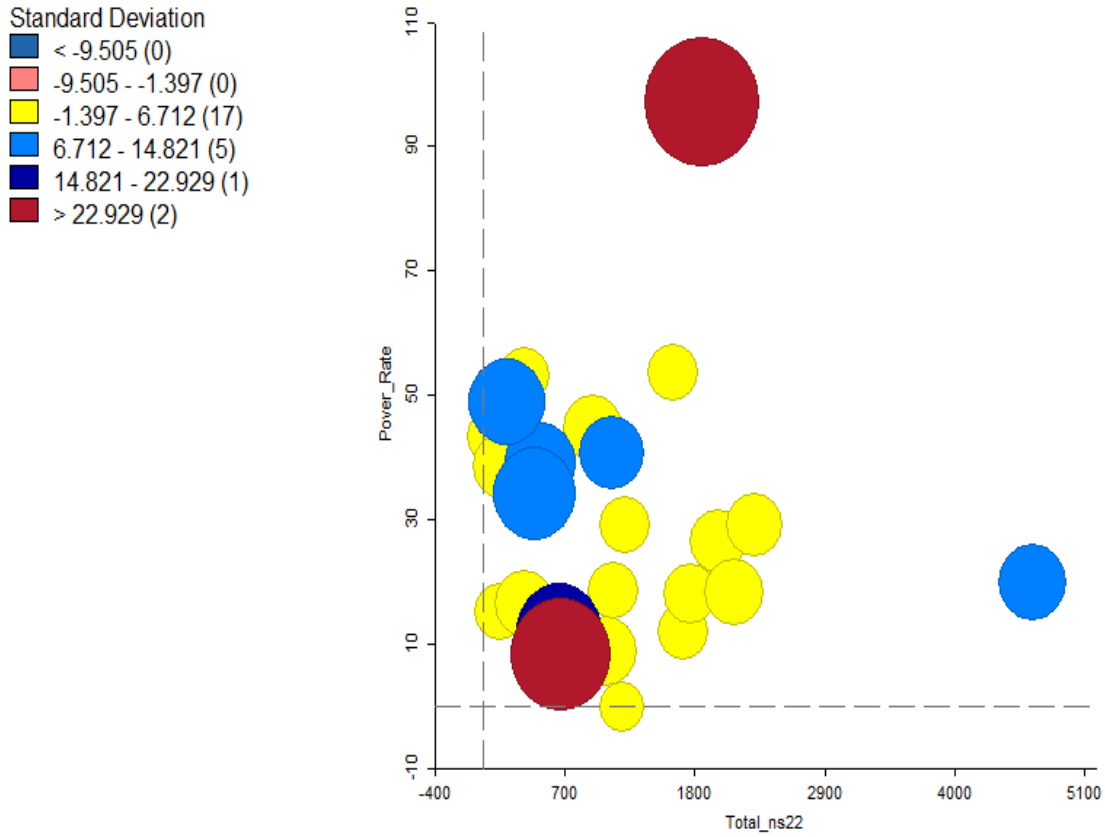


Source: Authors' calculation from NIS (2022)

Figure 22: Spatial Analysis on Male migrations in Cambodia

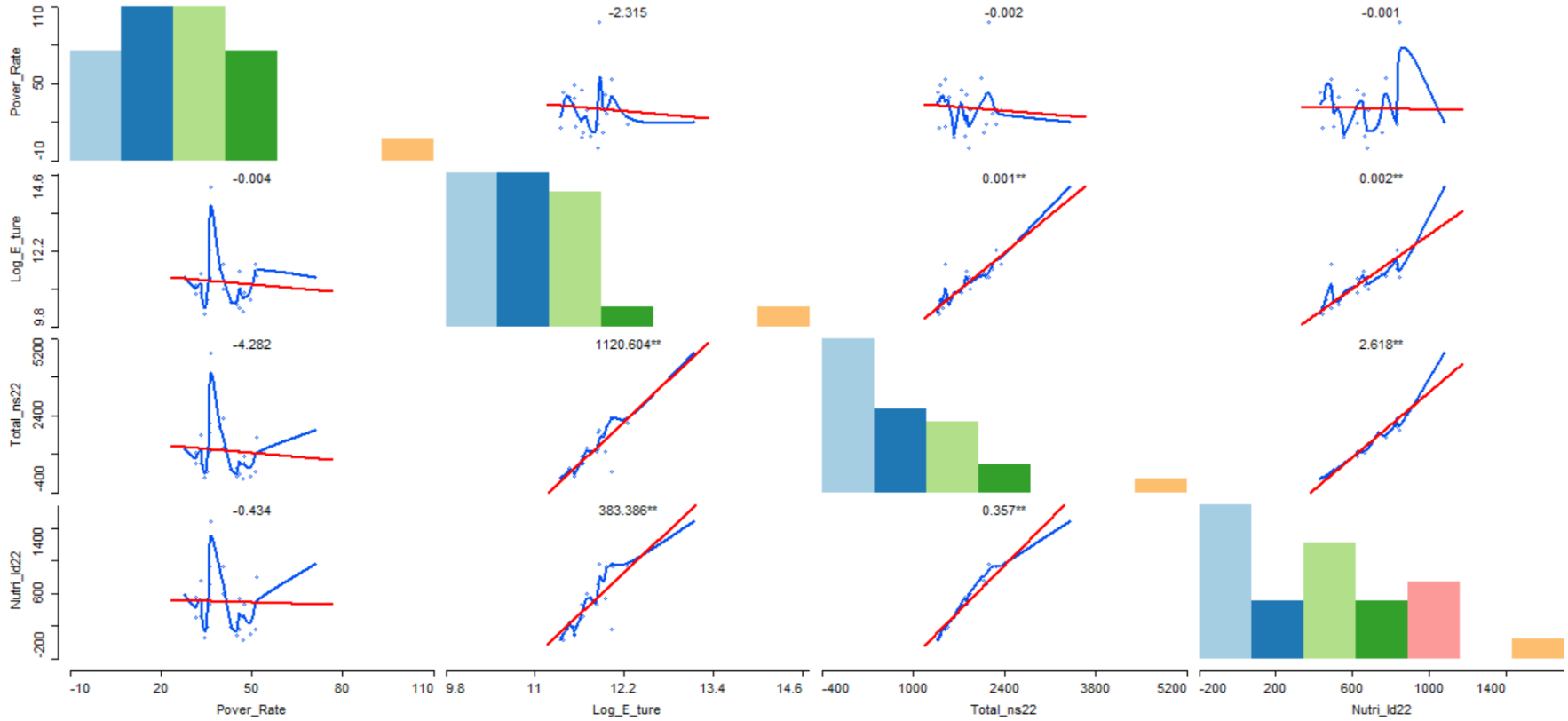
As previously stated, Figure 22 uses geographical data to establish the migration and poverty rates in Cambodia. This graph indicates that migration is also connected to poverty. It also indicates that further migrations may be compelled in order to alleviate poverty in Cambodia. Only two provinces appear to be more impoverished, although their migration remains high. Each male propotion is identified as all provinces in Cambodia. There is greater migration and might be less poverty. The province with higher poverty states that there is less migration in certain provinces. As a result, on this curve, migration may be associated with poverty level. We may argue that exposure to poverty declined among migrants.

As seen in Figures 21-22, a matrix of graphs and the smoothing line derived from its regression are used to evaluate and identify clearly the female and male migration in Cambodia. The matrix of school spending, poverty, child nutrition, and overall migration is determined by this. This suggests that increasing educational spending and increasing migration might both help to lessen poverty in Cambodia. Moreover, greater education is pushed by children's better nutrition.



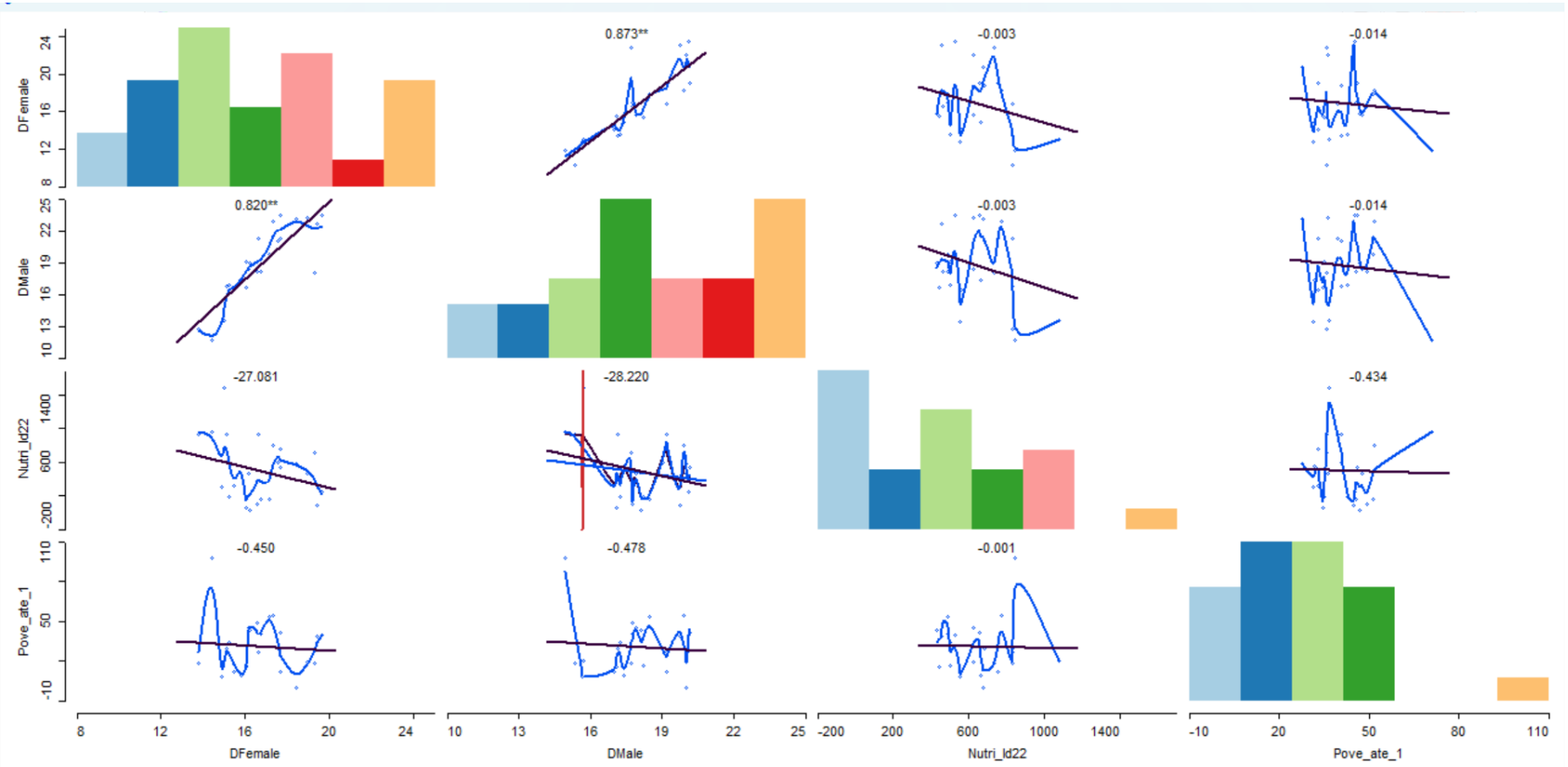
Source: Authors' Calculation based on NIS (2022) from STATA Version15

Figure 23: Migration and poverty rate in Cambodia



Source: Authors' calculation

Figure 24: Regressive Smoothing Line Matrix with Education Expenditure, Poverty, Nutrition in Children, and Total Migrations



Source: Authors' calculation based on data

Figure 25: Regression Smoothing line Matrix with genders; drop school at secondary school levels, nutrition in children, and poverty rates.

5. Empirical Analysis and Findings

As previously said, the following econometric models; OLS, PCA, SAR, and SEM models are developed to satisfy our objective research:

Regression and findings

To make the spatial regression estimation, Moran -I and other spatial techniques are used to conduct the assessments of the spatial correlation of each province. The result indicates that SAR and SEM models are more accurate models than OLS due to R2 values (0.700 & 0.742) and signs of significant levels. Both SAR and SEM estimation models determine similar impacts of education, nutrition in children, access to water, access to sanitation, access to electricity, and poverty on migrations. Education expenditure seems not significant at any level. According to the SEM model, a 1% increase in educational spending is expected to result in a 1.726% rise in migration. The health of students is very comprehensive for their study whenever they have more nutrition in school. As in this result, it is stated that there is no statistically significant impact or significance in terms of nutrition on children. On the other hand, the SEM and SAR models show a statistically significant negative association and a 10% significant level between the access to clean water variable and other factors. This establishes that the availability of clean water for domestic consumption reduces the rate of migration as well. It may be stated that the use of contaminated water by Cambodians in certain locations may lead to various illnesses while the access sanitation variable is not significant at any level. This may be a result of the sparse supply of clean restrooms or flush toilets in certain locations, but it also has an inverse relationship with migration. Noticing that all significant levels of these regressions are accepted to these models.

Table 4: Spatial Econometric Estimation of Educational Expenditures on Migrations

Variable	OLS	t-statistics	SAR	t-statistics	SEM	t-statistics
Education Expenditure	0.941	(0.329)	0.821	(0.338)	1.726	(0.802)
Nutrition in Children	0.00028	(0.0419)	0.0007	(0.119)	-0.002	(-0.512)
Access to Water	-0.188**	(-2.102)	-0.194**	(-2.576)	-0.201***	(-3.409)
Access to Sanitation	-0.047	(-0.328)	-0.049	(-0.408)	-0.073	(-0.701)
Access to Electricity	0.494**	(3.371)	0.506***	(4.094)	0.560***	(4.865)
Poverty Rate	0.208***	(3.930)	0.205***	(4.569)	0.217***	(4.764)

(to be continued)

Table 4: Spatial Econometric Estimation of Educational Expenditures on Migrations (continued)

Variable	OLS	t-statistics	SAR	t-statistics	SEM	t-statistics
Constant	-12.301	(-0.421)	-10.359	(-0.415)	-20.158	(-0.899)
R^2	0.695		0.700		0.742	
ρ			-0.149	(-0.708)		
λ					-0.548**	(-2.363)

Note: *, **, *** indicate rejection of the null hypothesis at 1%, 5%, and 10% levels of significance respectively.
Source: Authors' calculation based on the data source

Another interesting example is the fact that migration and the poverty rate in Cambodia are both strongly and positively associated. The impoverished indeed have access to more powerful mechanisms for encouraging migration. According to this, there are more and more migrants in Cambodia; the poorer people are in their rural areas. These migrations may eventually lead to more social inequality in the economy (Table 4). Those who are living in poverty often lack the resources to stay in their home countries, and they are forced to move to other countries in search of better opportunities. To investigate more on all of these issues, education and dropout school are interesting to assess and to look at seriously as follows:

Table 5: Spatial Econometric Estimation of Educational Expenditures on Female drop-out at secondary school levels

Variable	OLS	t-statistics	SAR	t-statistics	SEM	t-statistics
Constant	22.798	1.162	25.444	1.55	26.253	0.099
Education Expenditure	*-0.185*	*-0.096*	*0.038*	*0.024*	*-0.467*	*0.761*
Nutrition in Children	-0.003	-0.799	-0.004	-1.111	-0.003	0.363
Access to Water	-0.010	-0.328	-0.033	-0.664	-0.035	0.416
Access to Sanitation	0.077	0.809	0.061	0.775	0.035	0.634
Access to Electricity	-0.154	-1.564	-0.147**	-1.811	-0.121	0.130
Poverty Rate	-0.028	-0.807	-0.023	-0.793	-0.018	0.555
R^2	0.315		0.349		0.363	
ρ			-0.259	-1.057		
λ					-0.366	-1.482

Note: *, **, *** indicates rejection of the null hypothesis at 1%, 5% ,and 10% level of significance respectively.
Source: Authors' calculation based on the data

Table 5 assesses secondary school female dropout rates and expenditures on education. According to the results, there is a negative correlation between expenditure on education and female dropout rates at secondary school (t-value = 0.761). On any level, this is not

significant at any level. We may conclude that a 1% increase in educational expenditure would result in a 0.467% decrease in female dropout rates. This suggests that more educational spending may reduce the number of female secondary dropouts in Cambodia. In addition, there exists a negative correlation between female secondary school dropout rates and some variables including poverty rate, access to electricity, water, and nutrition for children. These factors have an adverse relationship with female school dropout rates in Cambodia (see SEM). To see more details on this drop-out school, male drop-outs might be interested to deepen assessment and more details on this section as shown in Table 6.

Table 6: Spatial Econometric Estimation of Educational Expenditures on Male drop-out at secondary school

Variable	OLS	t-statistics	SAR	t-statistics	SEM	t-statistics
Constant	26.806	1.381	0.248	1.116	22.211	1.459
Education Expenditure	-0.427	-0.225	23.749	1.464	*0.0284*	*0.018*
Nutrition in Children	-0.003	-0.667	-0.591	-0.373	-0.004	-1.144
Access to Water	-0.015	-0.255	-0.002	-0.735	0.0006	0.011
Access to Sanitation	0.0759	0.797	-0.004	-0.092	0.081	1.008
Access to Electricity	-0.144	-1.485	0.075	0.962	-0.134**	-1.695
Poverty Rate	-0.028	-0.805	-0.135**	-1.676	-0.052**	-1.925
R^2	0.286		0.321		0.370	
ρ			0.248	1.116		
λ					0.426**	2.128

Note: *, **, *** indicates rejection of the null hypothesis at 1%, 5%, and 10% significance level, respectively.
Source: Authors' calculation based on the data

As shown in Table 6, SEM model has more appropriate than SAR and OLS model (R^2 = 0.370). Educational Expenditure has a positive association with male school drop-out rate at secondary level but it is not significant. Only two variables as access to electricity, poverty rate, are statistically significant at 5% levels on male drop outs. One percent increase of access to electricity is estimated to decrease by 0.134% (t-value = 1.69). As a result, poverty has a negative correlation with male school dropout rates in Cambodia. This indicates that poverty and male dropout rates have significant negative spatial spillovers in Cambodia. The expenditures on education and GDP growth should be carefully evaluated using the aforementioned econometric methods to define the concept and its relationships (Table 7).

Table 7: Spatial Econometric Estimation of Educational Expenditures on GDP per capita

Variable	OLS	t-statistics	SAR	t-statistics	SEM	t-statistics
Constant	7.488***	17.27	0.671***	12.391	7.488***	2.12 × 10-7
Education Expenditure	-14.44***	-3.983	-1.33	-1.452	4.294	0.160
Nutrition in Children	-6.755**	3.474	2.563	1.156	-1.792×10^{-8}	-0.053
Access to Water	-7.977**	1.857	1.788	0.622	-7.919×10^{-8}	-0.053
Access to Sanitation	-16.677	-0.847	-1.332	-0.289	$-2.633^{**} \times 10^{-7}$	-1.674
Access to Electricity	-24.68	-0.240	-3.525	-0.074	-1.55×10^{-7}	1.0218
Poverty Rate	-24.77	-0.672	-3.959	-0.232	$-3.299^{**} \times 10^{-7}$	-1.663
R^2	0.33		-		-	
ρ			0.910***	125736		
λ					0.899***	15.0118

Note: *, **, *** indicates rejection of the null hypothesis at 1%, 5% and 10% level of significance respectively.
Source: Authors' calculation based on the data

Since it is difficult to determine the GDP in Cambodian provinces, GDP per capita is used as a proxy in this study's regress. As is well known, the natural logarithms of GDP per capita and expenditure on education regress in OLS, SAR, and SEM models. Using the OLS model, it finds that there is a statistically significant negative correlation (Coef = -14.44) between expenditure on education and GDP per capita. This implies that there may be a 14.44% drop in GDP per capita with a 1% rise in educational expenditure. One may say that people's income is subject to drop anytime, as the costs of schooling and raising students are high. The finding in Table 7 appears to be derived differently from the SEM model. There is a positive correlation between educational expenditures and GDP per capita (Coef = 4.294) but it is not significant at any significant levels. This implies that escalating education expenses may drive people's incomes to soar by 4 times. It might apply the long-term situations with this increase in households' incomes. The results of Principal Component Analysis (PCA) from various data sources are shown in Table 8. There are four sections to the table: 8a, 8b, 8c, and 8d. The eigenvalues and criteria for determining the number of components, such as PC1, PC2, and PC3, are shown in Table 8a. Three components were selected for this criterion and eigenvalue, as in the aforementioned table. In this instance, it indicates that three components account for 84% of the variance overall. We approach the examination of these spatial distributions using three variables (PC1, PC2, and PC3), which make up the majority of the six variables related to human capital constraints and its economy. This table provides more details about the degree of spatial dependence and partial

regionalization of these primary components, as well as the contiguous cluster's economic and human capital constraints in Cambodia.

Table 8: Principal Component Analysis (PCA) Model

a) Eigenvalues and Criterion to select the number of components:						
	PC1	PC2	PC3	PC4	PC5	PC6
Eigenvalues	2.764	1.311	1.008	0.62	0.225	0.07
Kaiser criterion: 3						
95% threshold criterion: 3						
b) Cumulative Proportion:						
	PC1	PC2	PC3	PC4	PC5	PC6
	0.46	0.679	0.847	0.95	0.988	1.000
c) Eigenvectors/Variable Loadings:						
	PC1	PC2	PC3	PC4	PC5	PC6
Migrants	0.407	-0.499	-0.215	0.397	-0.523	-0.325
Poverty Rate	0.038	-0.797	-0.015	-0.47	0.298	0.226
Access to water	0.438	0.244	0.157	-0.73	-0.358	-0.246
Access to sanitation	0.549	0.111	-0.127	0.123	0.709	-0.389
Access to electricity	0.575	0.136	0.0164	0.157	-0.059	0.788
Education Expenditure	-0.083	0.153	-0.95	-0.216	-0.041	0.094
d) Squared Correlations:						
	PC1	PC2	PC3	PC4	PC5	
Eigenvalues	2.764	1.311	1.008	0.62	0.225	PC6
Migrants	0.458	0.327	0.046	0.098	0.061	0.007
Poverty Rate	0.004	0.834	0.0002	0.137	0.02	0.0035
Access to Water	0.532	0.078	0.024	0.330	0.028	0.004
Access to Sanitation	0.833	0.016	0.016	0.0094	0.113	0.010
Access to Electricity	0.915	0.024	0.0002	0.0154	0.0007	0.043
Education Expenditure	0.019	0.03	0.919	0.029	0.0003	0.0006

Source: Authors' calculation from STATA version 15.

6. Conclusion

Using an advanced econometric model for measurement, we investigate in the geospatial analytical techniques and human capital constraints on the economic rationalization in Cambodia. This study conveys many econometrical methodologies, including OLS, SAR, and SEM models, and the PCA model has been employed for robustness checks with spatial dependence and regionalization analysis. Furthermore, Cambodian provincial data levels are utilized for regression with regional disparities in some variables such as nutrition in children variable, secondary dropout school variable, educational expenditures, migrants, poverty rates, access to water, access to sanitation, and access to electricity.

The comprehensive findings show that with cluster and geographical analysis at around 11.70% and 10.30%, respectively, by using the spatial econometrical methodologies demonstrate that males drop out of secondary school at a higher rate than females. Additionally, educational expenditure is fairly small based on both geographical factors and assessment. Based on both geographic and structural aspects, the migration sector claims that males reach at a higher rate than women. Only a few provinces in Cambodia have more access to clean water, electricity, and flush toilets. This implies that if certain provinces have more access to electricity, clean water, and toilets, poverty will also be eliminated. Furthermore, the greatest employment rate is found in Phnom Penh City, whilst lower employment rates are found in several distant provinces, including Mondul Kirir, Rattanak Kirri, Siem Reap, and Oddar Meanchey (Percentile Map Analysis).

Moreover, most of all spatial econometric models have been used in this research, SEM model is the most appropriate model to assess these data and to meet this objective research (R^2-Value). The spatial analysis on regionalization determines all provinces and spatial econometric models in those regions. These findings from spatial econometric models may provide further evidence of the consequences of growth and other significant variables on educational expenditures. The expenditure on education and the duration of education are two highly significant determinants of Cambodia's growth. Both factors have a spillover effect on the neighboring provinces in Cambodia. Additionally, there is a positive correlation between education expenditures and migration in every province (Coef=1.72). Interestingly, increasing education expenditure in regions forces secondary school dropout rates for females to be lower (Coef=0.46) whereas secondary dropout rates for males are higher. These findings are similar to the result from Chikhungu et al. (2020) and Martin et al.(2022) in Malawi country. Interestingly, more expenditure on education enforces to increase the income and spillover in regions (Coef=4.29). This is the same result from Elizabeth N. Appiah (2017) which studies in developing countries. All mentioned above, we can say that to increase the quality of education in Cambodia, education expenditure and years of schooling are very important. Additionally, the dropout rate might be caused by poor levels in their households. Hence, dropping out of school to migrate to other provinces or abroad to find more opportunities should be considered carefully.

Finally, the quality of Cambodia's labor force as a whole should improve the standard of education through government funding for the expenditure of education and its educational strategy. Furthermore, the government should strengthen its policy on education for spatial

areas. The use of innovative technology to boost the educational system, as well as inclusive technology, has a significant impact on Cambodia's growth and employment quality. To foster sustainable growth, policymakers should take seriously the major issues for female and male dropout schools at the secondary school level to mitigate this drop rate. The economy may suffer severely from this sign, and skilled migration ought to be prohibited. Up-to-date data and other advanced spatial econometric models might need to be included in future research and its better scope.

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Authors' Biography

Sophat Phon was born in 1986 in Prey Veng province, and he earned his first Ph.D. in Economics in 2019 from Thammasat University, Thailand with BOT/ADB scholarship. Currently, he is a second Ph.D. candidate in International Development at Nagoya University, Japan, with a Nagoya University Scholarship from 2023 to 2026. He graduated with two master's degrees: the first master's degree in Public Administration (MPA) from Cambodia and the second master's degree in Management in 2013 from Lublin University of Technology, Poland, with an Erasmus Mundus scholarship from the European Union. He has participated in many national and international conferences and has been a speaker at many well-known institutions such as UNESCAP, NBC, Sophia University in Japan, and Konrad International in Germany, among others. Dr. Phon 's filed of research includes microfinance sector, econometrics, business and macroeconomics. His main focus is econometric applied on the modelling of economic trends on the macro levels. Currently, he has authored more than 20 research papers and books. He is a professor at the National University of Myanmar, Global campus, Royal Academy of Cambodia, Human Resource University and RULE-Lumiere Lyon2 University, France, for undergraduate and graduate levels. His current position is CLO in Econometrics, Institute of Banking Studies, Cambodia. And he has been teaching at higher educational levels for nearly 20 years in the relevant fields.

Sophy Khan was born in 1985 in Prey Veng province, and she is a Ph.D. candidate at the Royal Academy of Cambodia, cooperated with a Korean University. She graduated with a master's degree in private law from the Royal University of Law and Economics, Cambodia, from 2011 to 2013. Furthermore, she has participated in many local and international conferences in Thailand, Malaysia, Indonesia, and Europe. Her main focus is on monitoring and evaluation (M&E) of business and project implementation. Also, she was granted the Excellent Women Leadership Award from Marissa Wesely, USA in collaboration with Harpswell Foundation, USA, in 2019.

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