IMPOVERISHMENT RISKS ANALYSIS OF POPULATION DISPLACEMENT USING STRUCTURAL EQUATION MODELING*

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1. Introduction

Development projects ultimately aim to improve people's well-being. Yet, such projects frequently result in direct negative impacts on some portions of the population. Frequently, such people become involuntarily displaced and have to resettle elsewhere. Experts[1)] estimated that roughly 14 million people around the globe are displaced each year due to dam construction, urban development, transportation, and infrastructure programs. For those affected people, involuntary displacement means a drastic disruption fraught with risks of impoverishment.

The theoretical framework of *Impoverishment Risks* and *Reconstruction* (IRR) model was proposed by Cernea[2)], a counteracting the anticipated and predictable risks factors to work towards double sustainable development; but effective assessments of the model require individual observations of risk factors and construct them into meaningful patterns. To improve the realm of impact evaluation of population displacement and to evaluate casual relationships of complex instruments, Structural Equation Modeling (SEM) and Geographic Information System (GIS) were used in this research.

The three objectives of impoverishment risks analysis are: (a) to ascertain the scales and causations of conceptual framework of involuntary resettlement in the IRR model, (b) to analyze additional covering relationship by using modification indices; and (c) to identify recurrent problems affecting performance, and propose reconstruction strategy for addressing resettlement more effective. This paper outlines an impact assessment model to improve theory-led fieldwork on the socio-economic and environmental impacts of involuntary resettlement.

2. Materials and methods

(1) Study area

Research was conducted in the relocation sites and affected villages under Emergency Flood Protection Project, Kob Srov Dike Rehabilitation subproject in 2001 supported by Asian Development Bank (ADB), loan CAM-1824[3)], implemented by Ministry of Water Resources and Meteorology (MOWRAM). The project was carried out immediately after the floods in 2000, which had raised up to 0.6m above emergency levels from the greatest Mekong river and hit over 50% of both rural and urban infrastructure of Cambodia and caused 186 people deaths due to lack of food, economic instabilities, and infectious diseases.

The dike initially built in 1972–1973 for two functions, flood protection and as a road for heavy traffic to bypass the city, was at high risk of failure for one month. During the flood, MOWRAM undertook force account to prevent failure. The work directly affected 2,898 persons living in 499 households, and 390 of them were relocated to two identified resettlement sites covered 76,380.29 m^2 prior to civil construction works. This research was conducted in a 63.46 km^2, its geographical coordinates are 11° 37' 0" North, 104° 49' 0", located in Dangkor (urban) and Ruessei Kaev (rural) district consisted of 3 communes (1–Kork Roka, 2–Khmounch, and 3–Svay Pak) with 26 villages (see Fig.1), with the total population of 41,569 people, and 8,434 households as of 2005.

(2) Indicator measurement

The measurement in the questionnaire was derived from quality of life[4)] and impoverishment risks indicators[5)]. The former included 8 sustainability topics – socio-economic information, waste management, environmental sanitation, housing, opportunities and risks, health and well being, community safety, and community infrastructure; where the later is a conceptual framework used in population displacement to indicate the predictable injurious affect-losses and destruction, and counter-concept to security: the higher the risks, the lower the security of displaced populations.

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(3) Sampling design and data collection

The respondents from resettlement sites were randomly selected from detailed measurement survey (DMS) databases conducted by MOWRAM in 2001, and others from the affected villages surrounding target resettlement sites from commune databases in 2006. The field observations and interviews were conducted from July to August 2007. The surveys were carried out through face-to-face interview of post-displacement situation at the physical sites using structure and unstructured form consisted of 32 questions measured by 76 main indicators, and a sample of 30% of affected households and 5% of indirectly affected residents were targeted. As the results, 85% of response rate was received with 500 respondents.

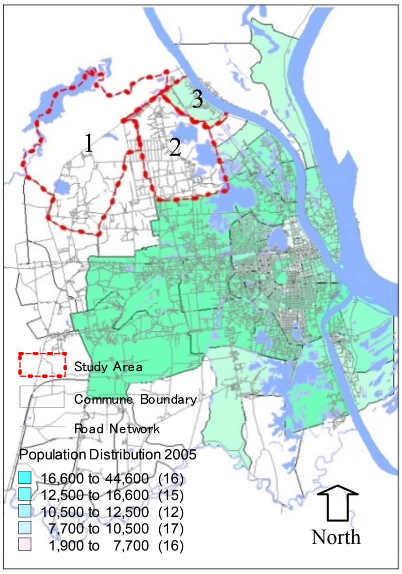


Fig 1: Phnom Penh and Study Area

(4) Procedure

Missing values were removed from 500 databases, and remained a valid 439 responses of 2 affected and 24 neighboring villages with 128 and 311 samples respectively. Due to limited of samples sizes, databases were combined from 26 to 14 zones/villages with minimum 10 and maximum 93 valid responses per zone; and then were computed in SPSS 16.0, MapInfo 8.5, and Amos 16.0 Application. The respondents were divided into two groups: *affected group* (resettlers) as shown in zone 1 and 8, and *non-affected group* (neighboring residents/ communities) at the remaining zones for comparisons of changes and casual relationships of resettlement on living environment (see Fig. 2).

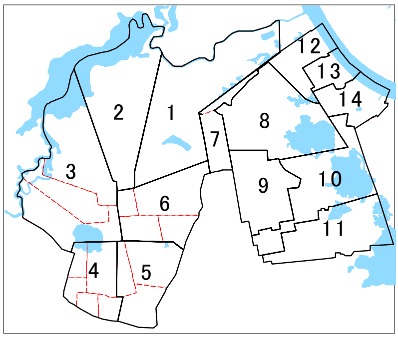


Fig 2: 14 zones after recoding

(5) Conceptual framework of impoverishment risks model

The model components[5)] consisted of inter-linkage 8 common variables identified as *landlessness, joblessness, homelessness, economic marginalization, increased morbidity, food insecurity, loss of access to common property*, and *social disarticulations*. Because the IRR incorporates as theoretical knowledge derived from prior empirical researches, it did not "probe in the dark": it pointedly guided risks measurement in new projects to recurrent risks. Therefore, anticipated relationships and paths of the model were proposed as shown in Fig 3.

(6) Structural equation modeling

The specification of the model which consisted of the translation of verbal hypotheses into a series of equations was represented in the form of a path diagram as shown in the causal relationships among all variables in the system. Firstly, in the path diagram of structural equation modeling, *community satisfaction* was hypothetically contributed by the risks variables: *landlessness, joblessness, marginalization, food security, morbidity, common property,* and *social disarticulation.* These hypothetical factors were defined by respective indicators as shown in Fig 3. Two latent variables, *socio economic aspects* and *environmental factor,* were constructed in the path diagram. Secondly, the factors which affect among variables were to be estimated by given 15 hypotheses, and the maximum likelihood method was applied to estimate standardized path coefficients. In addition, the tests of goodness-of-fit were asymptotically distributed as a chi-squared under the assumption of multivariate normality [6)]. Because a chi-squared test to

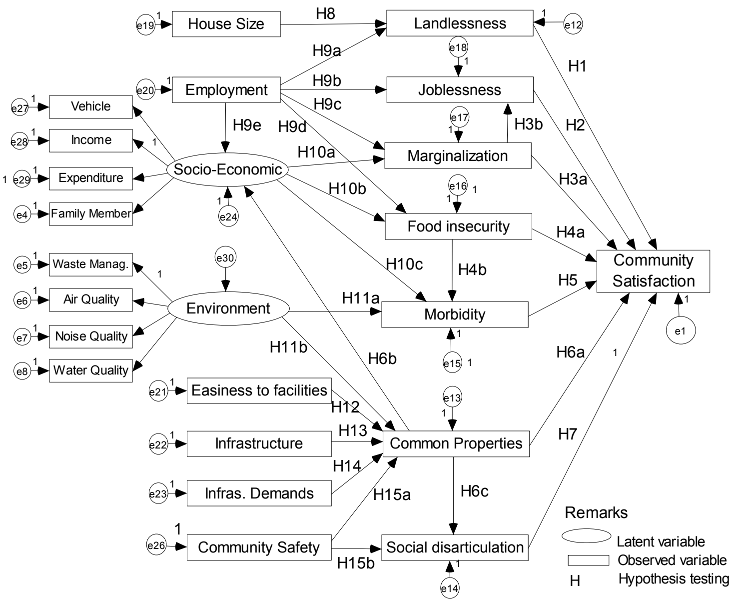


Fig 3: Path diagram of the impoverishment risks model

evaluate the goodness-of-fit of a SEM was required a multi-normal distribution which produced error failures, 24 errors were constructed in the model. Moreover, the norm fit index (NFI) and the goodness-of-fit index (GFI)[7] were inspected at range between 0 and 1; the values >0.90[8] for indicating a good fit. Thirdly, the model was validated to improve the fit by using modification indices at threshold 4. The fits were then flagged as potential changes to the model if it had made theoretical senses. Finally, a multiple-group analysis was then conducted to identify potential developmental differences in factor structure. The pattern of factor loadings for the model structures consisting of constrained and unconstrained model were tested across these two groups.

3. Results Finding

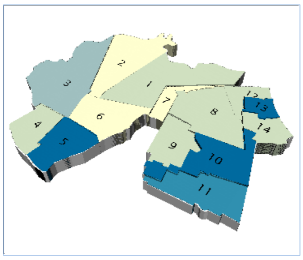
(1) Descriptive statistic analysis

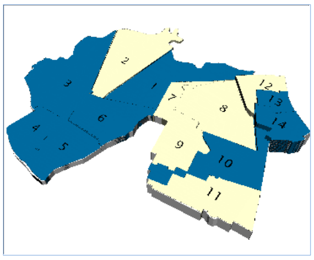
In general, the affected group was found out that their socio-economic, living environment and infrastructure, and health poorer than *non-affected group*. The mean size, standard deviation of 439 samples were estimated as shown in Table 1. The *affected group* can be found in zone 1 and 8, while the remaining are *non-affected group*. The higher the score, the darker color and the more sustainable community percieved as illustrated in following maps estimated by mean size per zones.

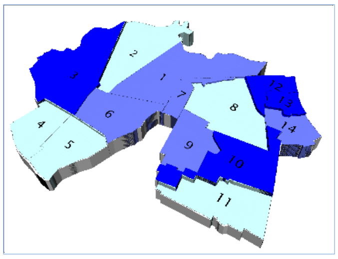
Remarks: (Score 1-3): 1= getting worse/ staying poor/ less sustainable; 2= standing still/ no significant change; 3= getting better/ staying good/ more sustainable. (Score 1-5): 1= highly dissatisfied/ moving away from sustainability, 2= fairly dissatisfied/ less moving away from sustainability, 3= standing still/ no significant change, 4= fairly satisfied/ less moving towards sustainability, 5= highly satisfied/ moving towards sustainability.

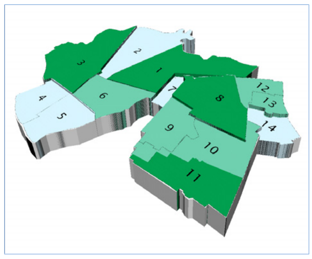
Table 1: Summary discriptive statistic analsyis

Indicators	Unit	Affected		Non-Affected	
		Mean	*Std.*	*Mean*	*Std.*
Family member	*N*	5.89	0.07	5.61	0.84
Monthly income	*USD*	109.97	5.59	127.81	35.16
Monthly expenditure	-	71.03	9.41	91.40	19.26
House size	m^2	35.63	0.11	38.62	6.51
Infrastructure	*1-3*	1.66	0.13	1.68	0.16
Infrastructure demands	*N*	0.27	0.69	0.19	0.46
Easiness to facilities	*1-5*	2.60	0.06	2.72	0.25
Waste management	-	2.46	0.04	1.79	0.53
Air quality	-	2.83	0.07	3.06	0.50
Noise quality	-	3.70	0.08	3.55	0.31
Water quality	-	4.22	1.02	3.63	0.61
Health and welfare	*1-3*	1.75	0.07	1.88	0.37
Community safety	*1-5*	2.85	0.42	3.47	0.53
Risks and opportunities	-	3.15	0.11	3.45	0.26
Community satisfaction	-	2.56	2.64	2.72	0.25


Map 1: Income distribution

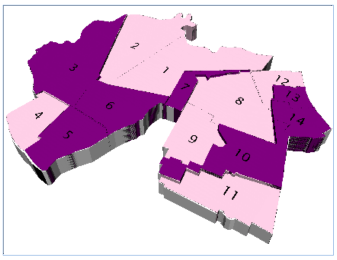

Map 2: Infrastructure score

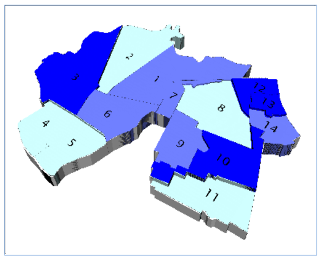

Map 3: Easiness to facilities


Map 4: Environment Score


Map 5: Health and welfare


Map 6: Community safety


Map 7: Risks and opportunities


Map 8: Community satisfaction

(2) Structural equation modeling analysis

To test if the observed and unobserved variables influence over the others, 15 hypotheses were tested at p<0.001 using maximum likelihood estimations. Some of the constructs were dropped from the causation paths (H4b, H6a-b, H9c-d, H10a, H11a, and H15a). The model was modified as shown in Fig 4 &5. The statistic analysis of model fit indicates a reasonable fit at chi-square (χ^2) values 7286.89 (222 *df*, $p<0.001$, χ^2/df=32.82), GFI and NFI >0.90. In addition, the model was validated, and some of error terms of income and expenditure found to be correlated for both comparing groups. Therefore, the model was reconstructed by correlated between these two error terms, and the final model was specified. Furthermore, the multiple group analysis was tested and shown no significant differences between the constrained and unconstrained model was tested, indicated that the model was valid for *affected* and *non-affected group* for unconstrained model with chi-square value 7272.67 (456*df*, p<0.0001, χ^2/df =15.94); where the unconstrained model have similarity results with a range chi-square between 7318.29 to 7688.10 (458–496 *df*, p<0.0001, χ^2/df (15.28–15.88). Finally, the standardized regression weights among two groups were compared; the results were shown in the following path diagrams.

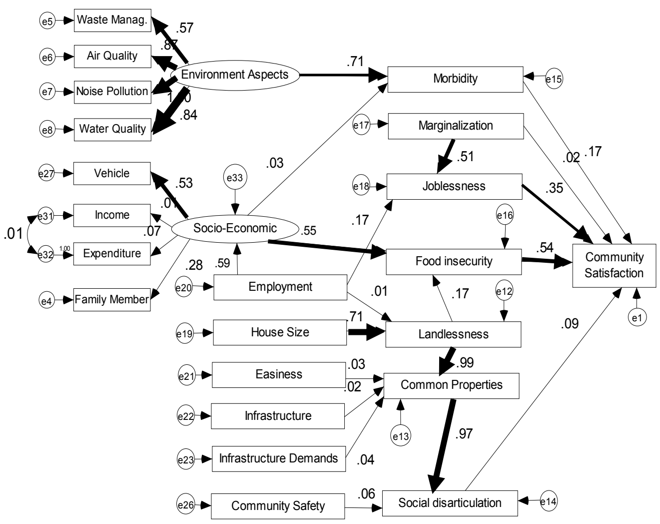


Figure 4: Standardized regression weight of non-affected group

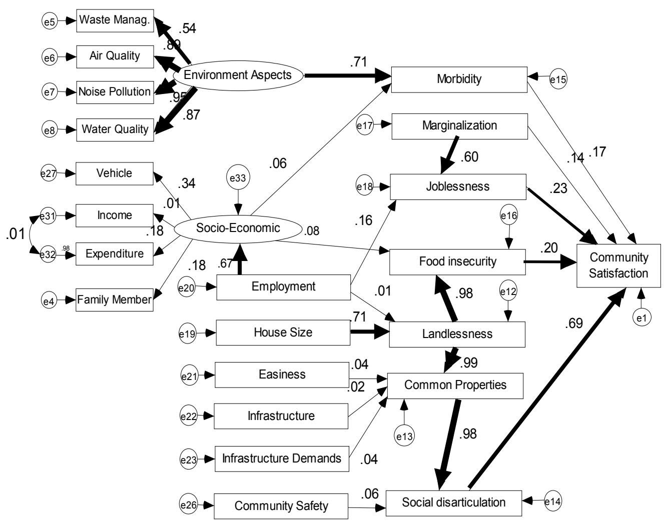


Figure 5: Standardized regression weight of affected group

4. Conclusion

In summary, the affected group's standard living was poorer than non-affected group as compared by zones and in descriptive statistics. In SEM, by testing hypothesis some paths were removed from the models, and one correlation between *income* and *expenditure* was constructed as tested by modification indices. Moreover, two indicators: *landlessness* and *common properties* were indirectly contributed to community satisfaction. In risks assessment, the factor strongly affecting community was *social disarticulation* comparing to other two indicators: *food security* and *joblessness* in the model; therefore, for project implication, resettlement action plan shall highly focused on these aspects as of post-resettlement. For research implications, this research may need to be validated IRR model by empowering constrains and indicators.

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