The Longitudinal Effects of the “Green Revolution” on the Infant Mortality Rate in Rural Thailand

JMAJ 49(7-8): 236–242, 2006

Yukinori Okada,*1 Susumu Wakai*2

Abstract

Objectives  A rapid increase in the ratio of rented farming land to total farming land and the stratification of peasantry has been reported in rural Thailand since the 1960s. The problem is especially severe in the central region, where the commercialization of agriculture called the “Green Revolution” has been rampant with enhanced integration of agricultural resources by absentee landlords. We analyzed the problem by evaluating its effect on the health status of infants in rural Thailand.

Methods  We examined three indicators; IMR, NMR and PNMR as dependent variables in relation to the ratio of rented land as independent variable. The surveyed period was between 1963 and 1998. ANCOVA analyses were applied.

Results  IMR and NMR showed a statistically significant association with the ratio of rented land ($F=7.77, P<0.01; F=32.88, P<0.0001$). The longitudinal time-trends of IMR and NMR also showed a significant association with that of the ratio ($F=10.97, P<0.05; F=29.87, P<0.001$). PNMR did not show any significance.

Conclusion  The ratio of rented land is a factor that reflects the extent of commercialization of agriculture and explains the substantial regional diversity of the mortality rates in Thailand. The existence of nutritional deterioration and vulnerability induced by the “Green Revolution” is suggested, since NMR reflects endogenous factors of the area and is sensitive to nutritional and sanitary conditions rather than PNMR. Further empirical studies that emphasize the linkage are necessary to attain a lower IMR in Thailand.

Key words  Ratio of rented land, Green revolution, Infant, neonatal, and post-neonatal mortality rate, Nutritional deterioration

Introduction

The ratio of rented farming land to the total farming land in rural Thailand has increased rapidly since the 1960s, and the effect on the rural society has been studied.1-10 This problem is especially severe in the central region, where the commercialization of agriculture is rampant. Numerous studies have warned of the increase in the number of landless peasants and their indebtedness to landlords.1-4 Sein and Brouse concluded that such deteriorating land tenure problems are a major deterrent to higher productivity, resulting in the lower average rice yield of Thailand compared to that of other Asian nations.3

On the other hand, the World Bank has concluded that there is little evidence of exploitation and indebtedness, and the studies had exaggerated the issue.5 Laurence surveyed two Changwats (provinces in Thailand) of the central region from 1910–1972 concluding that there was no evidence of a dramatic increase in land concentration among wealthy landlords since landlords were too heterogeneous to build

---

*1 Fujieda Municipal General Hospital, Fujieda
*2 Department of Community Health, School of International Health, Graduate School of Medicine, the University of Tokyo, Tokyo
Correspondence to: Yukinori Okada MD, Fujieda Municipal General Hospital, 4-1-11 Surugadai, Fujieda-shi, Shizuoka 426-8677, Japan.
Tel: 81-5-4646-1111, Fax: 81-5-4646-1122, E-mail: yokada-tky@umin.ac.jp
typical exploiting relationships with landless peasants in traditional Thai rural villages, although some studies suggested that the commercialization of agriculture around the 1970s symbolized as the “Green Revolution” had restructured traditional Thai rural villages, and the inequitable distributions of resources might be expanded.

While the effect of such problems has been discussed, few studies have evaluated its association with health statuses in rural Thai societies, partly because of the lack of sufficiency and credibility of the statistical data. The purpose of this research is thus to evaluate the effect of the inequitable land tenure and the “Green Revolution” on health statuses of infants in rural Thailand with the aid of both cross-sectional and longitudinal analyses.

The Ratio of Rented Land

The ratio of rented farming land to total farming land in Thailand underwent a rapid increase, particularly in northern and central regions (Fig. 1). In 1963, the ratio was less than 5%, but increased rapidly in the 1960s and 1970s, and reached as high as 15% in 1985. Although the agricultural land reform law passed the Legislative Assembly of Thailand in 1975, the raised ratio remained high and unchanged afterward. The Thai government proclaimed that the reform was failed. At the same time, regional diversity had widely enlarged. The central and northern regions marked rapid increase of the ratio while the northeast and southern regions maintained a low ratio of approximately 5% throughout the surveyed period.

Thailand has a politically stable history and a high proportion of the population is engaged in agriculture. The rice export policy enhanced the commercial value of rice and the tenure of rice fields, and speculative trade on agricultural lands by absentee landlords living in urban areas has been active since the 1910s. However, the heterogeneous relationships between peasants and landlords supported by land renting performed mostly by relatives hampered the inequitable accumulation of land to absentee landlords, and the increase of the ratio was repressed until the 1960s.

The ratio was dramatically increased by the commercialization and modernization of agriculture in the 1970s during the so-called “Green Revolution.” It provided new seeds with high harvest, mechanical cultivators, fertilizers, and significant progress in land productivity was achieved. Since it demanded large-scale capital investment, which was difficult to meet for small farmers and caused soaring land prices, integration of agricultural resources (=land) by the absentee landlords and stratification of peasantry was rapidly promoted. Kitahara reported that small farmers under 20 rais (1 rai = 0.16 ha) were unable to compete because of the difficulty in meeting investment demand and indebtedness.

The central and northern regions have wide, flat plains with abundant rainfall. Irrigation systems double the rice yield. The commercialization of agriculture and the effects of the “Green revolution” were most evident in these two regions, especially around Bangkok in the central region.

IMR/NMR/PNMR in Thailand

We selected infant mortality rate (IMR), neonatal mortality rate (NMR) and post-neonatal mortality rate (PNMR) as health indicators. These three mortality rates are good indicators of health statuses in developing countries, and many previous studies have suggested strong negative associations with socioeconomic and environmental factors in societies. Mortality rates reflect unique characteristics of societies. While NMR is more sensitive to the sanitary
and nutritional conditions of the area, PNMR is more sensitive to the social and economic development or the availability of health resources. 14–16,19 Within the first year, endogenous causes of death (e.g. prematurity and congenital disorders) occur mainly during the neonatal period, while exogenous causes (e.g. infectious and parasitic diseases caused by environmental factors) are responsible for deaths occurring during the post-neonatal period. 19

Thailand has experienced a considerable decline in IMR in recent decades like other developing countries (Fig. 2). 22,23 Not only the medical technical imports from the developed world but economic growth, the development of health care systems and socioeconomic conditions have contributed to this decline. 25–27 However, substantial regional and urban-rural (municipal/non-municipal) differences exist within the country. 24–27 Children born in urban areas have a significantly higher chance of survival. Although the differences in socioeconomic development have been used to explain these diversities, typical socioeconomic factors, such as primary education and average income, have failed to explain these diversities. 24,27 Moreover, IMR marked little progress, or even recession, around the 1970s, when the “Green revolution” was in full swing. Thai society has unique socioeconomic factors. NMR and PNMR have also been in a similar situation.

**Methods**

Data used in this paper were obtained from the statistics and censuses published by the Thai government. 20–23 The ratio of rented land and other agricultural data were taken from agricultural statistics (published annually) and censuses (conducted in 1963, 1978, 1983, 1993), and mortality rates and population data from the Ministry of Public Health.

Although the Thai government has systematical record systems, it has suffered under-registration in vital statistics. 25,28 Gaps occurred between IMR estimated by the Ministry of Public Health and the Office of the Prime Minister. 22,24,26,28 In our research, we adopted the former because they were the only sources that covered the basic vital statistics of all four regions of rural Thailand. Analytical efforts were also made to complement imperfections in the data.

Thailand consists of four major regions and about 80 Changwats (provinces). Although these classifications were adopted in Thai official statistics, provincial data were insufficient in some variables. Since most previous studies referring to rural Thai societies put emphasis on the comparisons between regions, we adopted regions as basic units of our analyses (n = 4).
Variables used in the analyses were IMR/NMR/PNMR (dependent variables), the ratio of rented farming land to total farming land (independent variable), and the ratio of population in non-municipal area (control variable). Variables were calculated from the data for every year of the surveyed period 1963–1998. There were, however, lags in the data because of restrictions in the data available. Most of the following analyses were applied for the years when necessary data were available.

Although we firstly adopted other typical indicators as control variables, including household income and the extent of maternal education, our previous research did not show any significant association between these indicators and IMR, except for the ratio of population in non-municipal areas, as some documents pointed out. Thus, the ratio of population in non-municipal areas was finally adopted as the control variable in addition to the year and region. Since the urban-rural diversity of the mortality rates was substantial in Thailand, the Thai government divided all country areas into municipal (=urban) and non-municipal (=rural) areas, and the ratio of population in non-municipal areas had been recognized as the most influential factor in determining the mortality rates in previous studies.

After we checked the correlation among the variables and certified the suitability of the model for multi-variant analysis, we performed the ANCOVA (analysis of co-variance) tests to analyze a more integrated association between them.

Since the ratio of rented land and the effect of the “Green Revolution” had not been directly associated with the mortality rates in Thailand, we also evaluated the association among the longitudinal time-trends of these variables to achieve further analysis, in addition to the non-trend evaluations. To smooth data and clarify the time-trends of the variables, we divided the whole surveyed term, 1963–1988, into three terms (1963–1975, 1975–1985, 1985–1998) in accordance with the situation of Thai agricultural and the governmental policy. The land reform law was passed in 1975, and it was rethought in 1985 because of its insufficient impact. For these three terms, the slopes of each variable were calculated from linear regression. They were defined as new variables, which reflected the longitudinal movements of the original variables, or whether they were increasing or decreasing. As for the mortality rates, slopes were calculated from log-linear regression to control their natural decline. The correlation check and ANCOVA tests were also applied for these new variables in the same way as the non-trends analysis. (Twelve measurements for three terms and four control variables.) We used Stat 8.0 for analyses. The study design was approved by an ethics review board.

Results

The correlation tests showed significant association between variables, and verified that our model was appropriate for ANCOVA tests. Table 1 and 2 show the results of the ANCOVA tests. The associations of the variables are summarized in Table 1, and the associations between the longitudinal time-trends of the variables are summarized in Table 2. Region and year were treated as categorical variables, and the others as numerical variables. In longitudinal time-trends analysis, region was omitted from the control variables because of the fitness of the models. All the models marked $R^2$ more than 0.80.

In Table 1, the ratio of rented land had a significant association with IMR ($F=7.77, P<0.01$) and NMR ($F=32.88, P<0.0001$), but not with PNMR. The year had a significant association with all mortality rates. Although the control variables had a significant association with NMR, their $F$ values were less than that of the ratio of rented land. This suggests that the ratio of rented land significantly associates with IMR and NMR through the surveyed period compared to other control variables.

In Table 2, longitudinal time-trends analysis shows similar results. The slopes of the ratio of rented land had a significant association with those of IMR ($F=10.97, P<0.05$) and NMR ($F=29.87, P<0.001$), but did not have such an association with PNMR. The period had a significant association with all mortality rates. Although the slopes of the ratio of the population living in non-municipal areas had a significant association with those of NMR, its $F$ value was less than that of the ratio of rented land, and this gap was wider in longitudinal time-trends analysis than in non-trend analysis. This suggests that the longitudinal movement of the ratio of rented land also links more significantly...
to that of IMR and NMR than to other control variables.

These results suggest significant longitudinal associations between the ratio of rented land and IMR/NMR in rural Thailand, and the ratio is a better indicator than the previous discussed control variables. Although IMR and NMR marked a general progression throughout the surveyed term, they show a temporal stagnation around the 1970s especially in the central region. Our results suggest that this stagnation is significantly associated with the rapid rise in the ratio of rented farming land, reflecting the negative effects of the “Green Revolution.”

**Discussion**

Since NMR reflects the endogenous factors of the area and greater sensitivity to nutritional and sanitary conditions rather than PNMR, our results indicate substantial longitudinal linkage from the rapid increase of the rented land to the temporary recession of IMR/NMR, and finally to the nutritional and sanitary deterioration in the rural area of Thailand in the 1960s and 1970s.

Sociological studies on Thai rural communities indicate this linkage. The formation of typi-
cal landlordism itself is unsatisfactory to explain the linkage. Paul DF and Dennis PH reported that the IMR for children born to small farmers and farm laborers in rural Thailand was nearly the same as that of children born to landlords and did not reflect the income differences. Despite previous studies that predicted the disaggregation of rural hierarchy, no substantial change in the distribution of farm size is reported in Agricultural Censuses of Thailand. The high ratio of rented land in Thailand might have been achieved without forming landlordism, and the linkage which our results suggest would integrate downward pressure to entire rural societies rather than inequalities within each villages.

Instead of typical landlordism, the commercialization of agriculture accelerated by the “Green Revolution” complements our linkage to endogenous deterioration. Some researches have reported nutritional deterioration and vulnerability caused by the introduction of commercialization of agriculture. The shift to cash cropping destroys traditional farming, which provides nutritionally balanced diets to buffer seasonal shortfalls. It also leads to high income dependence on international pricing policy of cash crops, and instabilities of the prices increase the vulnerability. Children of the households engaged in small sized farming are most sensitive to the vulnerability, and greater morbidity among children is reported. Although higher productivity is achieved, increased income is not translated directly into nutritional condition because of increased expenditure and deprivation from non-agricultural capital though price controls. Kitahara J noted that the rapid rise of gas prices and the low price of rice controlled productivity is achieved, increased income is not translated directly into nutritional condition. Thus, it has been suggested that the rapid penetration of commercialized agriculture, or the “Green Revolution,” caused a deterioration in the nutritional and sanitary vulnerability in rural Thai society, especially around the 1970s.

The high ratio of rented land reflects the extent of commercialization of agriculture. Michel L noted the concentration of land and the displacement of marginal and landless farmers as being important consequences of the “Green Revolution.” Our results also suggest that the ratio of rented land is a good indicator of IMR/NMR and explains substantial regional diversity of these mortality rates in Thailand compared to the conventionally discussed indicators.

In the course of economic development, the negative aspects of the “Green Revolution” for rural dwellers had not been emphasized. Further discussion from various aspects is necessary to explore this issue. The incomplete government statistics and following methodological restrictions need to be overcome by analyses in based on thorough empirical committee based research.

In addition to regional and urban-rural disparities, substantial international gaps of IMR between developing and developed countries still exist even in the 21st century. On the other hand, the commercialization of agriculture is now strongly promoted worldwide to improve self-sufficiency in food products. The results of our study indicate the importance of evaluating health status of community residents in the course of rapid induction of commercialized agriculture, and also contribute to following researches and enhancement of public health policy towards attaining lower IMR not only in rural Thailand but also in other developing countries.

References