Environmental Risk Transitions in Southeast Asia and the Role of Peri-urbanization

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Introduction

This paper describes the environmental risk transition framework that is currently used to study the link between development and health. The paper highlights the risks that societies in transition face as they move from a situation where only traditional risks exists to a situation where only modern risks exist. It is argued that within developing countries, peri-urban areas are places where traditional and modern risks overlap in complex ways. As an example, the regional problem of avian influenza in Southeast Asia is discussed as it is most likely to occur in peri-urban areas.

Environmental Risk Transition

There are many conceptual frameworks that systematically organize information to study the links between health and economic development. The most influential of these has been the Demographic and Epidemiologic Transitions framework that focuses on changes in fertility, mortality and morbidity. These variables are key components in the overall Health Transition approach.[1] Modifying these frameworks to include environmental determinants of health (such as waterborne biological and chemical pollutants) is a more recent development.[2] For instance, the 'Risk Transition' conceptual framework merges the concepts of health transition and environmental health risk assessment.[3] The Demographic Transition involves a shift from Stage 1 (traditional equilibrium) where population sizes are stable due to high death rates and high birth rates; to Stage 2 (population explosion), when death rates decline more rapidly than birth rates; and eventually to Stage 3 (modern equilibrium), when birth rates decline and catch up with death rates.[4] The Demographic Transition is linked to the Epidemiologic Transition, a concept that first emerged in the late 1960s.[5] It describes the phenomenon where the majority of developing countries simultaneously experience great reductions in certain kinds of diseases and illnesses along with increases in others. The historically high 'traditional' diseases associated with rural poverty trend downward during economic development, although at different rates in different places and periods. As the traditional diseases decline, there tends to be an increasing fraction of deaths due to modern diseases, number of disease types and morbidity. Modern diseases include degenerative diseases, such as cancer, heart disease and stroke, along with certain new types of accidents and occupational hazards. Industrialization, urbanization and agricultural modernization bring attendant environmental pollution hazards that primarily cause 'modern' diseases.

The shift of disease patterns from traditional to modern is due to changes in the underlying risk factors for the various forms of ill-health. It might be argued that there is no particular advantage in differentiating between ill-health and risk. This might be true for certain classes of diseases, particularly those where there is a fairly short delay between changes in the risk factors and changes in ill-health. For these, monitoring disease rates are expected to be a fair indicator of what is happening and thus be a reasonably good guide for decision making. For other classes of disease however, present patterns of ill-health are quite poor indicators of actual risk, e.g. tobacco smoking. The distinction between risk and ill-health is also important for another category of hazards – pollutants that make their way slowly through the environment and reaching humans through water, air or food. The release of pollutants into the environment is a risk even though it may be many years before the disease manifests itself due to environmental and physiological latencies. Most importantly, modern risks differ from traditional risks in that many important outcomes do not have a unique cause. Traditional diseases like cholera are caused by a limited number of specific identifiable agents. Modern diseases like cancer cannot easily be linked to one specific cause. The impacts of 'modern' risks are less 'visible' than the impacts of 'traditional' risks.

Risk Overlap

The swiftness of the risk transition creates a situation where traditional risks persist while modern risks start earlier in the development process (figure 1). This results in a larger degree of 'risk overlap,' where some populations are exposed to a significant amount of both types but in a rapidly changing pattern. In the overlap phase, modern risks are beginning to rise while traditional risks are still significant although dropping rapidly. An example is when pesticide runoff starts to add to water pollution due to poor sanitation. Another example is offered by those places where urban air pollution from fossil fuel combustion is rising while large village and urban air pollution exposures from household combustion of traditional biofuels still exist.

Another way to view the transition is shown in figure 2 (p. 157). It highlights phenomenon where certain environmental risks first increase with development, and then begin to decrease once a certain level of affluence is reached. Examples are urban air pollution and deforestation that operate mainly at the community level. Traditional risks, e.g. sanitation, operate essentially at the household level. The modern risks generally have a regional or global spatial character (such as Chloro Fluro Carbons or greenhouse gases).

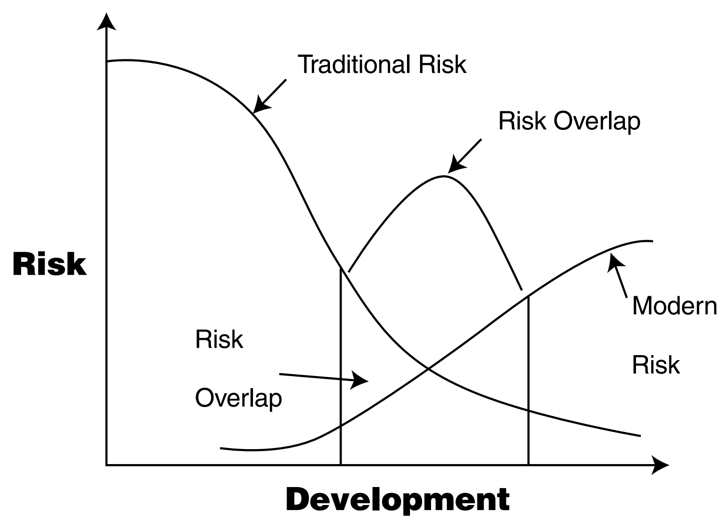

FIGURE 1 Development and Risk Overlap
SOURCE: Adapted from Kirk R. Smith, "The Risk Transition," *International Environmental Affairs 2* (1990): 230.

The risk overlap can lead to interactions with important implications for risk assessment by magnifying or masking the separate impacts of modern and traditional risks. Six kinds of interactions are identified:[6]

- *Risk genesis* – where risk overlap may lead to the creation of an entirely different sort of risk, e.g., mixing of modern (motorized) and traditional (muscle-powered) vehicles leads to new kinds of accident risks and risk management needs;

- *Risk synergism* – where exposure to one agent causes immunity or sensitivity to other agents, e.g., where traditional intestinal diseases due to poor water quality increase sensitivity to waterborne and airborne modern pollutants;

- *Risk mimicry* – where morbidity and mortality may be attributed to traditional sources of risk but may be actually due to modern or synergisitic risks, e.g., lung cancer being attributed to acute or chronic lung diseases;

- *Risk competition* – where abnormally high or low risks of one disease may actually be an indication of the increase or decrease in the risks of an entirely different disease, e.g., where low lung-cancer rates may not necessarily mean that the risk of lung cancer is low but just that people are dying of other diseases first and not living long enough to develop cancer;

- *Risk layering* – where the movement of people or their activities concentrates risk in one region and dilutes risk on another, e.g., where rural-urban migrants are healthier than the average person left back in the villages; and

- *Risk transfer* – where efforts to control risk from traditional hazards may enhance modern risks (or vice-versa), as when pesticides are used to control malaria.

Global Risk Overlaps

Most of the examples discussed above are cases of *local* risk overlap involving the interaction of traditional and modern risks on a local scale. These can be serious but are amenable to various local solutions. *Global* risk overlaps, in contrast, will continue as long as there are great disparities anywhere in the world between risk patterns of different groups. The most important examples are ozone- and climate- threatening chemical

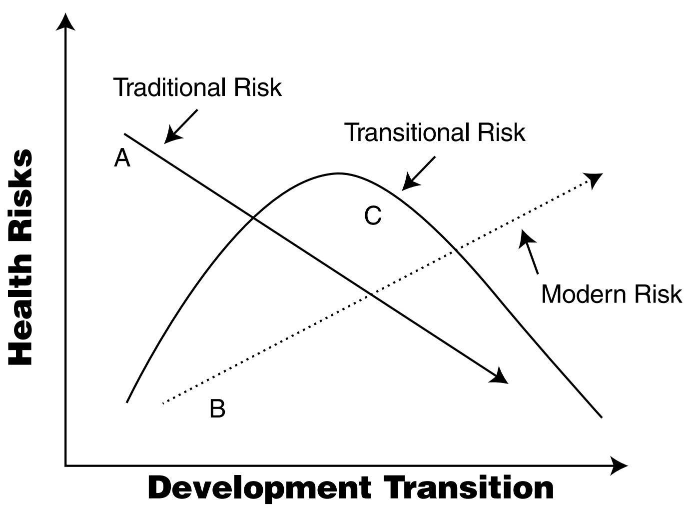

FIGURE 2 Transitional risks
SOURCE: Adapted from Kirk R. Smith, "The Risk Transition," *International Environmental Affairs 2* (1990): 230.

releases. Although mostly created by modern activities in countries well along the health transition, these pollutants affect the whole world. They will probably have their biggest impacts among communities still burdened by traditional risks. Unlike local risks, the global overlaps cannot be eliminated by releasing pollutants elsewhere.

Implications for Risk Assessment and Monitoring

Understanding the overall or net risk from any particular technology, project, policy, regulation or activity requires evaluation of both classes of risk. Developing countries will find that to adopt risk assessment methods from developed countries – which focus on modern risks – will be misleading. Indeed, focusing only on the modern risk curve for each new project as part of what might be called micro-risk analysis could lead to skewed macro-risk results. There are numerous studies on the overall relationship of economic development with health status, but few have conducted project-level analysis. It is at the project level, however, where individual decisions are made and policies are implemented. To do such an analysis would necessitate understanding the changes created by a project on income, employment, training, education, housing and other relevant factors, and analysis of the impact of each of these factors on risk is also imperative. The evaluation of net risks is complex, considering the trend of some modern risks to become significant at earlier stages of the development process than in the past because of the impact of international and internal trade, information technology and foreign aid. As the period of risk overlap increase, so will the need for net risk assessment.

The rationale for focusing on risk rather than ill-health is its suitability for management, especially for modern risks. For these hazards, we need to monitor further back along the causal chain, which runs from pollutant emissions to environmental concentration, exposures, doses, pre-clinical changes and ill-health.

Peri-urbanization and Risk Overlaps

Urbanization is one of the most important determinants in the transition from traditional to modern risks. In many developing countries, economic growth results in places that simultaneously have rural and urban characteristics. These peri-urban areas are linked to an urban center but are themselves not urban in the usual sense. They are characterized by rapid increases in the variety and intensity of workplaces and land uses intermixed with traditional farming areas. This overlap causes the release of toxic materials from small-scale industrial activities like electro-plating directly into wet rice paddies, creating a particularly acute form of water pollution. Peri-urban areas at the same time also become the hotspots for emerging infectious diseases such as avian influenza.

Highly Pathogenic Avian Influenza: A Regional Transitional Risk and its Links with Peri-urbanization

Since late 2003, avian influenza (often referred to in the media as 'bird flu') has become one of the most publicized emerging infectious diseases. This followed the detection of highly pathogenic avian influenza (HPAI) caused by viruses of the H5N1 subtype in many countries in Asia. These Asian-lineage HPAI viruses produced a fatal disease in poultry, wild birds, humans and other mammals, with subsequent spread of disease to some 60 countries across three continents. Affected countries and the international donor community mobilized hundreds of millions of dollars to assist in controlling this disease, mainly because of concerns about the potential of these viruses to unleash a global pandemic of human influenza.

Over the last 10 years, more than 200 million domestic birds died or were culled. Tens of thousands of wild birds have died. Since 2003, there have been more than 240 human cases and 141 deaths, most of these in Southeast Asia. Migratory water fowl – most notably wild ducks – constitute the natural reservoir of the virus. Though wild bird migration is a major risk factor, the critical role of other variables such as agriculture production systems and poultry trade largely remain unexamined and have not been well-studied.

Kaplan et al.[7] maintain that the ongoing process in Southeast Asia of replacing traditional farming methods such as multi-species livestock husbandry with industrial, mass-production-oriented operations, pose significant environmental health risks[8] due to increases in livestock pools, thus creating opportunities for disease transmission. Simultaneously, rapid urban and peri-urban development in these countries is often accompanied by more refuse, standing water and animals in and around homes, all of which are correlated with environmental health risks.[9] With respect to HPAI, expansion of the urban fringe has placed a larger proportion of the human population in contact with formerly dispersed farm environments that include potentially infected poultry and swine populations. Such urban–rural interfaces become hotspots of other infectious diseases such as leishmaniasis.[10]

An array of anthropogenic and ecological studies of the determinants of HPAI in Southeast Asia support these hypotheses. Gilbert et al.[11] show that the interaction of poultry and particularly domestic duck populations within the rice paddy production system is an important factor for the maintenance and spread of HPAI virus in Thailand. Pfeiffer et al. demonstrate that rice paddy production intensity and density of domestic chickens and water birds are also associated with a higher risk of HPAI outbreaks in Vietnam,[12] lending support to the rice-duck-chicken hypothesis. The same study shows that increased distance from high density human population areas consistently decrease HPAI risk.[13] The study finds support for the hypothesis of "the presence of a fairly widespread infection reservoir in Vietnam …, possibly in domestic and wild water birds."[14] Gilbert et al. find that a few key factors such as human population density, rice cropping intensity, and to some extent poultry density, manage to explain a large proportion of the spatial variation in HPAI disease risk.[15] The same study also notes that considerable variations remain unexplained, and suggests a consideration of other factors such as poultry production and marketing systems, agricultural seasonality, the potential for contacts between domestic and wild birds, and climatic and other conditions affecting the persistence of the virus in the environment. Another study finds the minimal distance to the nearest national highway, annual precipitation and the interaction between the nearest lake and wetland were important predictive environmental variables for the risk of HPAI in China.[16]

Finally, of particular interest is the claim by Gilbert, Xiao, Wint and Slingenbergh (in press) that the highest risks of HPAI impact in Southeast Asia are to be expected where extensive and intensive systems of poultry production co-exist.[17] This is usually observed in the peri-urban areas: while the extensive systems allow virus circulation and persistence, the intensive systems promote disease evolution. Factors that explain this phenomenon include the global and regional risk overlap aspect of avian influenza, the dramatic globalization of poultry trade involving large multi-national companies, as well as the illegal cross boundary trade by individuals and small operators.

Developing policy options for peri-urban area development requires explicit attention in improving transportation and connectivity in order to strengthen rural–urban linkages. Peri-urban livelihoods are constructed across both urban and rural spaces, and transportation has a role in bridging the rural–urban divide. This translates into an increased emphasis on intermediary transport between the villages and the towns. For peri-urban areas located along highways, this requires the creation of platforms for dialogue and coordination across the village, province and national levels of government.[18] However, the increasing movement of humans and animals that modernized transportation systems enable both locally as well as internationally has further increased the spatial and temporal scope of human exposure to people and livestock infected with HPAI and other infectious diseases and could well increase the subsequent spread of H5N1 to novel hosts as it did in the SARS epidemic.[19] Thus, policy development should entail a fine balancing act between the needs of peri-urban areas and disease prevention.

At the same time, there is a need to protect common property institutions upon which the livelihoods of the poor and landless depend – and to which they lose access as they are converted to other uses. The acquisition of common property resources – either through their takeover by the village authorities or by means of their conversion into urban uses and purposes – makes the landless more vulnerable and dependent upon those who have land for their supplies of subsistence items. Thus, the peri-urban interface creates clear implications for social and power relationships among peri-urban dwellers.

Finally, siting and location norms can have an important role in improving the quality of life of people residing in peri-urban settlements. These areas often serve as dumping grounds for industries that are relocating from bigger cities and towns because the urban periphery is less subject to stringent controls and regulations. This situation has adverse impacts on the health and quality of life of peri-urban settlement inhabitants. Concerted action such as strong social mobilization or political will are required to prevent the relocation of factories to the boundaries of peri-urban settlements.

Utilization of the Risk Transition Framework

Policymakers rarely apply the risk transition framework described above to real life problems involving emerging infectious diseases such as avian influenza. To counter threats of avian influenza pandemics, bodies such as the United Nations, World Health Organization (WHO) and the Food and Agricultural Organization (FAO) prefer what is referred to as 'evidence-based' or 'science-based' approaches to risk management.[20] These techniques reduce the multiple, complex and indeterminate dimensions of knowledge to just two readily quantified kinds of parameters: outcomes and probabilities. The resulting numbers are used objectively to justify certain particular interventions over others. Unfortunately, in the case of avian influenza, the so-called 'evidence-based' and 'science-based' approaches ignore the complex, open-ended, nonlinear interactions between the tightly coupled ecological, agronomic and institutional systems.

Early risk models for avian influenza imply that the global problem could easily be mitigated by focusing on containment at the source of the outbreak.[21] Yet competing but equally scientific analyses that are based on an appreciation of complex dynamics suggest alternative policy framings. These complex dynamics include the interplay between viral ecology and genetics (such as patterns of antigenic shift and drift), transmission mechanisms (e.g., the role of wild birds or poultry, backyard chickens or large factory units) and impacts including the consequences of immuno-compromised individuals and populations. The risk transition framework helps introduce complex dynamics in traditional risk assessments, especially at the meso- and macro-scales while examining links to economic growth.

Conclusion

The occurrence of infectious disease in poor countries is attributable to household environmental risks such as poor sanitation, water and hygiene. Household environmental risks, however, decline markedly and nearly uniformly with development. Although in a global context community risks are about half those from household risks, they are spread differently across the development spectrum, with the highest rates in middle-income regions. Thus, developing countries face a major and unique challenge in smoothly managing the risk transition such that traditional risks continue to fall *and* modern risks are minimized. This is especially true in peri-urban areas where agriculture interfaces with industrialization.

In the case of emerging regional risks such as avian influenza in Southeast Asia, policymakers need to focus beyond surveillance and outbreak control at source. Using the risk transition framework would imply greater multi-sectoral risk assessments and policy formulation, with a focus on poverty reduction, social justice and development.

Notes

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