CHAPTER 3

POVERTY, HEALTH, AND ECOSYSTEMS

SARS and Avian Influenza: Exploring the Role of Conservation and Veterinary Health in Addressing Zoonotic Diseases in Asia

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Introduction

The growing threat of animal-borne, or zoonotic, diseases in the Asia and Pacific region was made devastatingly clear with the outbreaks of severe acute respiratory syndrome (SARS) in 2003 and avian influenza in 2004. The real (and potential) geographic reach of these outbreaks, as well as their socioeconomic impacts and associated response measures, highlighted the changing landscape of human health. The metaforces of globalization, urbanization, and population expansion that have shaped much of Asia's development trajectory also have undermined environmental sustainability and animal health. The convergence of these trends—along with more culturally determined factors, such as food preferences and traditional farming practices—has inextricably linked the health of wildlife, people, and domestic animals. Zoonotic pathogens are estimated to be three times more likely to become emerging infectious diseases, signaling an urgent need to broaden the scope of public health to consider carefully animal health and its environmental determinants (Enserink, 2000). This implies the need for greater cooperation between disciplines and sectors, particularly between public health professionals, ecologists, and veterinary health specialists, to address a growing threat to human security in the Asia and Pacific region.

This case study examines the causes and impacts of, and responses to, two recent zoonotic disease outbreaks—avian influenza and SARS—in the Asia and Pacific region. In so doing, it aims to demonstrate the close connections between animal and human health, how these connections can lead to zoonotic disease outbreaks that disproportionately affect the poor, and why this calls for new and more integrated approaches to dealing with public health issues.

Background: the growing threat of zoonotic diseases

The World Health Organization (WHO) describes zoonotic diseases, or zoonoses, as "those diseases and infections [the agents of] which are naturally transmitted between vertebrate animals and man" (WHO/Food and Agriculture Organization [FAO], 1959). Such diseases are transmitted to humans in a variety of ways: (i) direct contact with infected animals; (ii) ingestion of contaminated food, water, or other organic matter (such as feces, urine, or saliva); (iii) inhalation; and (iv) through arthropod vectors, such as mosquitoes, fleas, and ticks (Lane and Anderson, 2001). Examples of zoonotic diseases (and their animal hosts) include bubonic plague (rodents), influenza (birds, horses, and pigs), West Nile fever (birds), Ebola (primates), and HIV/AIDS (primates). Of the 1,415 known pathogens,

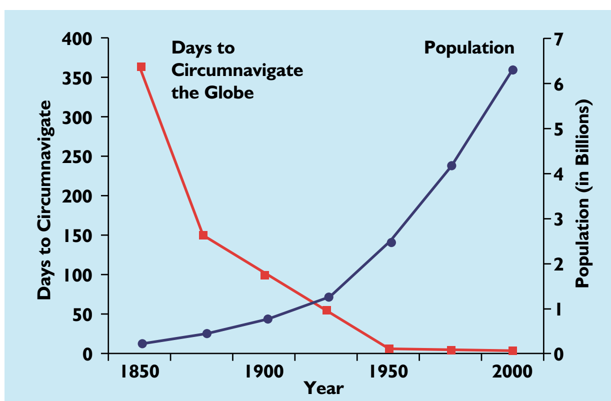
[19] Research and preparation for this study was made possible in part through a research support grant from the International Development Research Centre (IDRC) in Canada for a project entitled, "Animal Health and Human Health–IUCN World Conservation Conference, Bangkok 2004."

researchers estimate that 849 (60%) are zoonotic. Further, 73% of the 156 pathogens that are considered emerging reach human populations through animals (Enserink, 2000).[20]

The increased risk of transmission of these zoonotic pathogens can be attributed to a number of factors largely related to the allied trends of expanding human populations (in terms of numbers and settlement patterns), and an unprecedented globalization of agriculture, trade, and human travel. These determinants include

- **Increased contact between humans and animals.** Rapidly-growing and more concentrated human and farm animal populations are bringing people and animals into closer contact, especially in regions, such as Southeast Asia (Trust for America's Health, 2003). While population growth rates in Asia and the Pacific have declined rapidly, some 3.7 billion people—about 60% of the global population—still live in the region. Much of this growth is occurring in cities. The United Nations Human Settlements Programme reports that Asia's share of the global urban population has risen from 9% in 1920 to 48% in 2000, and many Asian cities are doubling their population every 15–20 years (UN–HABITAT, 2003). This increase translates into more crowded conditions, facilitating animal–human transmission of pathogens, as well as human–human transmission.
- **Movement of people and farming into wildlife habitat.** The growing need to accommodate more people—and the associated demand for increased agricultural production—has encouraged settlement in areas where humans have never lived. This, coupled with new or changing agricultural practices in previously wild areas, can put humans in contact with zoonotic pathogens by increasing proximity and/or creating conditions that favor an increased population of the microbe or its host (Morse, 1995).
- **Changes in animal husbandry and feeding practices.** Linked to the expansion of farming is the role of intensifying livestock production systems. Animals usually are limited to confined spaces with the waste from the production system, creating unhygienic conditions ideal for disease transmission. The increased use of rapid automated slaughter practices and industrial feedlots has been associated with *E. coli* outbreaks, while the practice of feeding animal protein to cattle to cut costs is believed to have resulted in Bovine Spongiform Encephalopathy or "mad cow" disease (Nierenberg and Garcés, 2004). Moreover, many industrial Animal farms are located beside or within rapidly–growing cities. This is especially the case in Asia, which has the fastest-developing livestock sector in the world, fueled by a steady increase in meat consumption in the region.
- **Increased movement of goods and people.** More efficient and far-reaching transportation networks and trading systems have facilitated the expansion of agriculture. In the past, disease outbreaks were more likely to be isolated geographically and, therefore, contained. The historical expansion of trade routes, colonialism, and the transportation revolution surpassed geographic boundaries and introduced infections to previously unaffected parts of the world. Cargo ships and especially air travel have allowed this to happen even more quickly. Pathogen reservoirs can travel across oceans in a matter of hours and infect unsuspecting hosts. When considered against the background of a rapidly-growing global population, the disease implications of increased mobility are clear (Figure 7).

Figure 7: Speed of Global Travel in Relation to World Population Growth



Source: Murphy and Nathanson, 1994.

[20] Emerging infectious diseases are defined as "diseases that have recently increased in incidence or geographic range, recently moved into new host populations, recently been discovered or are caused by newly-evolved pathogens" (Daszak et al., 2001).

- **Trade in exotic species.** Among the goods that are being moved around the world through expanded transport and trade networks are wildlife species. The $6 billion global exotic pet trade, legal and illegal, has been implicated in the spread of zoonotic diseases, such as monkeypox in the United States (Karesh et al., 2005). In this instance, Gambian giant rats carrying the monkeypox virus had been exported to the United States from West or Central Africa. These were housed with pet prairie dogs and sold as exotic pets. One of the prairie dogs went on to bite and transmit the virus to a young child in Wisconsin, leading to an outbreak of the disease in the Midwestern states in 2003.
- **Food habits.** Cultural food preferences in different parts of the world also have played a role in disease transmission between animals and humans. In Africa, for example, the consumption of so-called bushmeat has been implicated in outbreaks of HIV/AIDS and Ebola (Karesh et al., 2005). In the case of SARS, the masked palm civet—a cat-sized animal considered a delicacy by the Chinese—is believed to have been involved in the transmission of the virus. Moreover, the live animal markets that sell and slaughter these and other animals to meet the demand for fresh meat are potential hotbeds of the disease.
- **Lack or breakdown of public health measures.** Lapses in health and sanitation measures, particularly in developing countries and the inner cities of developed countries, can create conditions allowing the emergence or reemergence of pathogens. These are typically associated with issues of water supply, waste disposal, vector control, and maintenance of immunization programs.

Other factors contributing to zoonoses include pathogen mutation and new forms of transmission, for example, xenotransplantation, or the transfer of organs or other tissues from animals to humans (Murphy, 2002).

These determinants can come together in a variety of circumstances to increase the threat of zoonotic disease outbreaks in communities, countries, and regions. The transboundary nature of these diseases—in terms of outbreaks and impacts—can complicate response measures, as they are more difficult to isolate and control. Further, the impacts of these diseases are costly in terms of human health (morbidity and mortality) and socioeconomics (loss of local livelihoods, trade embargoes, tourism decline, etc.). The following two sections highlight the emergence and impacts of two recent zoonotic outbreaks in the Asia and Pacific region.

Avian influenza in South Asia

In 2004, Southeast Asia saw one of the most dramatic outbreaks of zoonotic diseases in recent history. Avian influenza—commonly known as bird flu—affected Cambodia, People's Republic of China (PRC), Indonesia, Japan, Republic of Korea, Lao People's Democratic Republic (Lao PDR), Malaysia, Thailand, and Viet Nam (CDC, 2004). These outbreaks resulted in the eradication of more than 120 million birds, and they were implicated in some human fatalities in Thailand and Viet Nam. The region continues to be at risk. A third wave of infection started in mid-December 2004, and cases were still being reported when this case study was being written. Cambodia and Indonesia confirmed their first human cases of the H5N1 virus strain in April and June 2005, respectively. Evidence suggests that the virus is now endemic in parts of Asia and is evolving in ways that favor the onset of a pandemic (WHO, 2005). Avian influenza poses significant risks to the region's economic and public health, and is likely to hinder poverty reduction strategies if preventive measures against more outbreaks are not taken. National and international efforts to control the disease are necessary to ensure economic, social, and political stability in Asia.

AVIAN INFLUENZA: AN OVERVIEW

Avian influenza is an animal disease that affects birds primarily, with occasional occurrences in other animals. Caused by Type A strains of the influenza virus, it manifests itself in two forms: (i) low pathogenic avian influenza, with symptoms ranging from mild illness and fatigue to reduced egg production; and (ii) highly pathogenic avian influenza, such as H5N1, a contagious and fatal form of the disease that can be detected by sudden onset, rapid and severe illness, and death (WHO, 2004c). It is extremely contagious among bird populations, particularly domestic chickens and turkeys, which have less resistance to the disease than wild birds. The virus is spread directly to humans through contact with secretions from infected birds. Once in humans, the virus causes severe disease with high mortality rates.

Human-to-human transmission is rare, although cases of infection through close personal contact are still being investigated.

The disease, initially detected in Italy more than 100 years ago, now exists worldwide (WHO, 2004c). Avian influenza, which surfaced primarily in Europe and the Americas a number of times between 1959 and 2003, is new to most Asian countries (WHO, 2004b). The first Asian outbreak of the H5N1 strain of avian influenza occurred in 1997 in Hong Kong, China. It prompted immediate and drastic action that included the culling of Hong Kong, China's entire poultry population—roughly 1.5 million birds—in a matter of days. Concurrent with this outbreak, the first human cases were documented. Eighteen people suffered from severe respiratory symptoms, six of whom died (WHO, 2004c). The disease was catapulted into the international spotlight during the massive 2003–2004 outbreaks in Asia, which occurred in three waves (January–April 2004, July–October 2004, and December 2004–April 2005).

The possible causes for the emergence of outbreaks are varied, including contact between wild and domestic birds. Migratory waterfowl are considered natural hosts and reservoirs for low pathogenic strains of the virus, and might infect poultry through exposure at live markets or in nature (WHO, 2004c). The virus becomes highly pathogenic by genetic changes in domestic poultry. Domestic chickens are highly vulnerable to the disease, requiring the adoption of extreme measures upon detection of illness to prevent epidemics, including extermination of entire populations. Domestic ducks, commonly raised outdoors in Asia, are known to carry pathogenic strains, such as H5N1, and shed the virus in feces, often without ever showing signs of the disease. Domestic ducks can infect wild birds sharing the same ponds or wetlands. Live markets—with their highly concentrated bird populations and wide geographic range of producers converging there to trade—have been implicated as sources of epidemics. This is particularly true in Asia, where poultry production has increased significantly in recent years. Thailand alone accounted for nearly 7% of the global meat trade in 2003, having increased production by 32% and exports by 74% between 1999 and 2003 (Newcomb and Harrington, 2004).

Poultry production is an important financial resource for economies throughout Asia. As a result, bird populations are growing, and farms are becoming more concentrated to meet the burgeoning demand. This leaves poultry in these regions increasingly vulnerable to avian diseases, and is likely to make prevention of outbreaks difficult. As much as 80% of poultry is being raised on backyard farms or in small-scale production, which can make containing bird flu more difficult (WHO, 2004b). These operations are harder to monitor and regulate than large farms.

What is particularly troubling about avian influenza is its potential to spark a global human flu epidemic (WHO, 2004a). Researchers are concerned that the H5N1 virus will change its genetic composition through gene reassortment with human or other types of flu viruses, using humans or pigs as "mixing vessels" (WHO, 2004c). This can lead to the emergence of more virulent and easily transmittable forms of influenza, against which humans will have little resistance in the absence of a vaccine or natural immunity.

IMPACTS OF AVIAN INFLUENZA ON ASIA'S ECONOMY AND POOR POPULATION

The emergence of avian influenza in South Asia has had severe repercussions on national economies and individual livelihoods, especially among the poor. Examining the standard practices for dealing with bird flu outbreaks—mass culling—can provide some insights into the economic impact of the disease. Hong Kong, China's quick response to the infection in 1997—the destruction of its entire poultry population—was widely seen as effective in preventing a larger disaster (WHO, 2004b). This set a precedent for other affected regions. Thailand, perhaps the hardest hit, has culled approximately 36 million birds, or 25% of its domestic flocks (Newcomb and Harrington, 2004); many local areas have lost more than half their poultry. The World Bank estimates that Viet Nam might have lost 0.3–1.8% of its gross domestic product (GDP) in 2003 due to bird flu (FAO, 2004). Overall, economic estimates place the total costs in Southeast Asia between $12 billion and $14 billion (Newcomb and Harrington, 2004).

Many countries in affected regions became major exporters of poultry products in recent decades, and the impact of infection has led to the loss of export markets. Outbreaks "disrupt markets, affecting demand for poultry products and prices, and they may destabilize employment and income for those in commercial poultry production, processing or retailing" (FAO, 2004). The enormous scope of the impacts of this disease poses significant challenges to countries facing the growing threat of avian influenza. They must work to regain trading status following an outbreak, and the mass culling of vulnerable bird populations is seen as a necessary measure to demonstrate response to the problem. This is also relevant to other economic sectors, such as tourism, where outbreaks can lead to drastic declines in foreign visitors.

The poor are disproportionately vulnerable to avian influenza in several ways. The International Livestock Research Institute reports that poultry is at the bottom of what is commonly referred to as the "livestock ladder," meaning the poorest tend to raise poultry (Perry et al., 2002). The intensive exposure of these farmers to bird populations, coupled with unsafe land-use practices where livestock live in proximity to homes, creates a situation of heightened susceptibility to the spread of avian diseases. The lack of information, limited or no access to animal health resources, and little protection against disease outbreaks (e.g., monitoring, surveillance, and response capabilities) exacerbate the situation. When birds are destroyed, poultry farmers lose an important food and protein source, as well as a primary income source. In the case of bird flu in Asia, monetary compensation for culled poultry has been inadequate, especially for rural backyard farmers and small-scale producers. This can act as a disincentive for farmers to report infections.

The larger political and social consequences of bird flu outbreaks include compromised public confidence, which hinders the stability of a region, and increased pressure to target small-scale village and backyard poultry production (FAO, 2004)—a move that will hurt already impoverished communities. This makes vulnerable populations even more insecure in the face of growing disease threats.

Severe acute respiratory syndrome in the PRC

The SARS outbreaks of 2002–2003 created one of the biggest health concerns in recent memory. Crossing borders and disseminating across multiple global networks, SARS poses unique challenges that threaten health and economic security. It has had "major economic, social, and psychological impacts on the populations of the countries most affected by it" (ADB, 2003). Of the more than 8,000 cases reported worldwide, 750 resulted in death (Sampathkumar et al., 2003). As the site of the disease's emergence and initial outbreak, the PRC bore the brunt of the resultant health emergency, serving as a valuable case study for building understanding of the links between animal health, human health, and poverty reduction.

SARS: AN OVERVIEW

SARS is a febrile respiratory illness caused by corona viruses. These are enveloped RNA viruses that can cause disease in humans and animals. Transmission occurs primarily through the spread of large droplets, although some evidence suggests links between airborne spread and surface contamination (Sampathkumar et al., 2003). SARS was detected first in the PRC in November 2002 when "a highly contagious atypical pneumonia first appeared in the Guangdong Province" (Sampathkumar et al., 2003). From there, a complicated chain of events led to the international spread of SARS, with airlines and hotels implicated as early conduits.

SARS has an incubation period of 2–10 days. Initial signs include flu-like symptoms, such as fever and headache. Patients exhibiting symptoms of the disease are classified into two categories (Sampathkumar et al., 2003):

- "Suspect cases, or persons with the onset of fever and lower respiratory tract symptoms within 10 days of either having traveled to an affected area or having come in contact with someone with SARS."
- "Probable cases or suspect cases, who also have chest radiographic findings of pneumonia, acute respiratory distress syndrome (ARDS), or an unexplained respiratory illness resulting in death, with autopsy findings of ARDS without identifiable cause."

The fatality rate of SARS is 3–12%, although this increases dramatically in patients over 60 years old (Sampathkumar et al., 2003). Currently, no specific treatment is available for SARS; infected persons are generally treated for pneumonia.

Much evidence suggests that SARS originated in animals and was subsequently transmitted to humans through contact with infected species. "SARS likely jumped from a domestic or wild animal host to humans in the context of intensifying human-induced pressures on wildlife populations and close interactions between humans, wildlife, and domestic animals" (Newcomb, 2003). Findings have pointed to live animal markets in Guangdong Province in the PRC as initial transmission points for SARS. Particular attention has been paid to the role of the masked palm civet sold in these markets. Similar genetic links were discovered between the SARS corona virus and other corona viruses in the masked palm civet and raccoon-dog, as well as in some species of fruit-eating bats which are commonly sold in markets. These wildlife species, as may others are sold for consumption in live markets that are notorious for their cramped and unhygienic conditions, i.e., conditions ideal for viral transmission (Sampathkumar et al., 2003; Karesh et al., 2005). One researcher noted that among the earliest SARS patients, a disproportionate number were chefs and food handlers who have been suspected as being original point sources in the jump of SARS from animals to humans (Newcomb, 2003).

Acknowledging the significant threat that wild and exotic species posed to the health of people throughout the PRC, experts from the Food and Agriculture Organization of the United Nations (FAO), WHO, and the Government of the PRC subsequently recommended enhanced monitoring of the trade in live animals (Normile, 2003). In addition, the PRC authorities became more aggressive in stemming the sale of at least 54 animal species.

IMPACTS ON THE PRC'S ECONOMY AND POOR POPULATION

The initial impact of SARS on the PRC's economy stemmed "mostly from public perceptions and fear of the disease" (ADB, 2003). SARS outbreaks led to restricted movement of people, which affected the tourism and service industries through reduced consumer spending within the country. Airlines particularly suffered the consequences of reduced travel to the PRC, and reverberations also were felt in hotels, restaurants, and other related industries. Consumer confidence decreased in the PRC among potential tourists and large-scale financial investors alike. The Asian Development Bank (ADB) issued a report (ADB, 2003) that stated if SARS persists it "could dampen investor confidence, resulting in weaker investment and lower inflows of foreign capital." One estimate placed the 2003 economic cost of SARS in the PRC at a loss of 0.5–2% in GDP growth (Gill, 2003).

In addition to reducing demand for goods and services from the PRC, SARS has the potential to wreak economic havoc by creating supply shocks. Illness, fear, or precautionary measures can disrupt the workforce, affecting the manufacturing and services sectors. This can lead to a reduction in international trade, the foundation of the PRC's economy, with even larger consequences for the global economy (ADB, 2003).

The high costs of health care for infected persons also will affect the economic impacts of SARS in the PRC. Treatment of this disease, especially among poor populations, likely will put pressure on the Government and strain resources in the case of a large-scale epidemic. Costs for monitoring and surveillance of animal and human populations also will fall on the Government.

Poor populations were, and continue to be, more vulnerable to the impacts of SARS outbreaks than most other groups. The high cost of treatment disproportionately affects those who cannot afford health care, or are not employed in the PRC's services sector, particularly migrant workers and the rural poor (ADB, 2003). The less affluent probably will experience higher mortality rates. Rural areas are especially at risk of SARS due to the lack of effective monitoring, surveillance, prevention, and treatment systems, as well as inadequate to nonexistent health and social services. In addition, the risk is higher for rural and poor populations because they live closer to, and interact more intensely with, animals and the environment—both of which are natural reservoirs for disease.

Zoonotic diseases and poverty

The outbreaks of avian influenza and SARS demonstrated how zoonotic diseases disproportionately affect the poor who depend on animals to support their livelihoods. Wild and domesticated animals are a growing source of protein and income in developing countries (Perry et al., 2002). Although wild animals are often reservoirs for disease, many exotic species are eaten by poor people or captured and sold in live markets. In the absence of other safer forms of subsistence, such risky behavior offers a viable economic outlet for many people.

The FAO reports that "the most vulnerable groups, for whom animal diseases are particularly devastating, are poor livestock farmers and farming communities" (FAO, 2002). When animal diseases strike a poor community, the implications are severe and include (i) loss of livestock productivity or death, (ii) loss of farm productivity, (iii) high treatment costs, (iv) reduction or elimination of market opportunities, (v) disturbance of human health or death, and (vi) impairment of human welfare (FAO, 2002). The implications of avian influenza are significant in this respect because chickens are the most widely kept livestock in the world; the poorest segments of society depend most on these animals (Perry et al., 2002).

The International Livestock Research Institute (Perry et al., 2002) cites two factors that are important in understanding why the poor are more at risk:

- **More disease prevalence in the developing world.** The most significant factors explaining this include unrestricted movement of animals, which increases the probability of exposure to infection; climates and ecosystems that are susceptible to disease spread; and poor sanitation and living conditions, where people live in proximity to livestock and other animals.
- **Less disease control in the developing world.** Lack of funding for research in animal disease control in the developing world limits progress in this area. In addition, numerous financial, infrastructure, logistic, and educational restrictions "often do not permit the optimal delivery and adoption of known disease control measures" (Perry et al., 2002).

In fact, most developing countries already carry a heavy disease burden. Other more common infectious diseases (e.g., HIV/AIDS, malaria, diarrhea) and health-related issues (e.g., malnutrition, reproductive health) play a much larger role in the overall health picture in the Asia and Pacific region than emerging zoonotic diseases. To a certain degree, the threat of SARS and avian influenza has been overstated due to their high epidemic potential and the international media coverage that accompanied the recent outbreaks. However, for countries already saddled with an under-equipped and overwhelmed health care system, the impacts of emerging zoonotic diseases could be devastating.

Efforts to reduce poverty in developing countries, therefore, should emphasize eradicating infectious animal diseases or at least increasing the coping capacity of regions and populations at risk, and increasing monitoring and surveillance. This requires cooperation at the national and international levels, as well as interdisciplinary cooperation of specialists from multiple fields, including veterinary health, public health, and conservation, among others.

Environmental and veterinary health: Reducing the risk of zoonotic diseases

Given the socioeconomic impacts of zoonoses in the Asia and Pacific region, and the role of environmental change and animal health in their emergence, can sound environmental management help reduce the risk of such diseases? Within this category of prevention and response measures, what is the potential role of animal or veterinary health?

Conservationists' skilled knowledge of ecosystem functions and dynamics and how these are linked to human activities is essential to understanding the epidemiology of zoonotic diseases, as well as to the development of appropriate response measures. Similarly, the expertise of veterinary health specialists on how to handle and conduct surveillance programs for wildlife should be considered, as it can help prevent and control emerging zoonoses. Investments in wildlife health, as well as cooperation between animal and human health officials, ultimately can protect human populations. For example, when avian influenza first appeared, wild birds in Northeast and Southeast Asia initially were implicated in the transmission of the virus. Conservation biologists and veterinarians were the first to point out that this was unlikely, given the migratory routes and timing of wild birds, and instead identified domestic birds as the more likely culprits (Karesh and Cook, 2005). In Africa, when animal health workers detected Ebola, villagers were warned not to hunt or handle animals, which minimized the risks of disease transmission and the potential for an outbreak (Karesh and Cook, 2005).

However, the involvement of conservationists or veterinary health specialists is less about developing a list of targeted "conservation" or "animal health" interventions, and more about incorporating their knowledge and experience into mainstream public health decision making. Such an approach clearly calls for more cooperation across disciplines, ministries, and sectors. Despite fundamental differences in their objectives, the integration of these different disciplines and approaches could lead to more effective measures to address the emerging threat of zoonotic diseases. Conservation and animal health input might limit the wholesale eradication of species and its potentially devastating economic impacts, using such a measure only as a last resort.

Yet this approach will require overcoming political, institutional, and policy challenges that already impede sustainable responses to human health threats. These include

- **Slow and/or reactive response to disease outbreaks.** The fear of negative economic and political ramifications can hinder the identification of—and response to—disease outbreaks.

- **Lax or nonexistent enforcement of laws, treaties, and conventions.** The failure or unwillingness to enforce regulations related to biosafety, environmental protection, animal trade (i.e., the Convention on International Trade in Endangered Species of Wild Flora and Fauna), and property rights can undermine efforts to develop sound disease prevention and control measures.
- **Lack of infrastructure and resources to cope with outbreaks.** Many developing countries—where the threat of zoonoses is the greatest—lack human resources and skills, technology and equipment for detection and treatment, and medical infrastructure. Even at the government and international agency levels, resources are limited. For example, the World Animal Health Organization's resources for considering wildlife-related diseases consist of a volunteer committee of six people that meets only 3 days a year.

At this time, no international agency is responsible for—or capable of—monitoring and preventing the countless diseases that cross borders and species (Karesh and Cook, 2005). Regulations and restrictions continue to prevent collaboration between countries and agencies. WHO can become involved in a country only if officially invited, "leaving it helpless to intervene in countries with governments that either do not know about or do not want to reveal the presence of a disease within their borders" (Karesh and Cook, 2005). Similarly, the World Animal Health Organization can accept information on wildlife diseases in a country only if such information is submitted by a national agricultural authority, and few of these monitor wildlife diseases.

To promote interdisciplinary cooperation in the fight against zoonotic diseases, human, animal, and wildlife health specialists met with practitioners in conservation biology, law, and public policy in September 2004 to draft the Manhattan Principles on One World, One Health. This document lays out priorities for action in tackling emerging zoonotic diseases in a holistic, interdisciplinary manner (Box 1).

Recommendations

Several important lessons emerging from the preceding analysis can be formulated into a series of recommendations for governments, policy makers, and organizations concerned with the emergence of zoonotic diseases in the Asia and Pacific region.

The outbreaks of the avian influenza in South Asia and of SARS in the PRC demonstrated how human vulnerability to animal diseases is increasing globally. For this reason, focusing on the nature and intensity of human exposure to domestic and wild animal populations is important. Further, interactions between animals, and between humans and animals favor the risk of disease transmission and should be reduced. Measures for achieving this might include

- **Regulating live animal markets.** This can include shifting the responsibility and cost of outbreak prevention to animal traders by requiring them to buy disease outbreak insurance on all animal imports.
- **Reducing risky cultural practices.** Appropriate public education campaigns can help reduce the consumption of exotic animals and other risky cultural practices.
- **Stemming the illegal trade in wildlife.** This can be achieved by enforcing existing laws and treaties, and investing in further enforcement resources.
- **Improving sanitation and living conditions in rural areas.** Maximizing potential bilateral and multilateral aid can be one means of improving rural conditions.
- **Identifying conservation practices to reduce the potential for disease transfer.** Further research and collaboration between disciplines can lower the risk of disease transfer from wild to domestic populations.

Moreover, the growing potential for disease spread due to globalization and breakthroughs in communication and travel necessitates other measures:

- Strengthen international cooperation to respond to outbreaks;
- Strengthen monitoring and surveillance networks that examine human and animal populations;
- Facilitate communication between detection and response networks;
- Facilitate cooperation across fields and disciplines, particularly veterinary health, public health, conservation, epidemiology, and wildlife studies;
- Increase the generation of field-based wildlife data through better surveillance of wild animal populations;
- Strengthen the public health capacities of vulnerable communities to treat infected animals and people; and

Box 1: The Manhattan Principles on One World, One Health

We urge the world's leaders, civil society, the global health community and institutions of science to

1. Recognize the essential link between human, domestic animal and wildlife health and the threat disease poses to people, their food supplies and economies, and the biodiversity essential to maintaining the healthy environments and functioning ecosystems we all require.
2. Recognize that decisions regarding land and water use have real implications for health. Alterations in the resilience of ecosystems and shifts in patterns of disease emergence and spread manifest themselves when we fail to recognize this relationship.
3. Include wildlife health science as an essential component of global disease prevention, surveillance, monitoring, control, and mitigation.
4. Recognize that human health programs can greatly contribute to conservation efforts.
5. Devise adaptive, holistic and forward-looking approaches to the prevention, surveillance, monitoring, control, and mitigation of emerging and resurging diseases that take the complex interconnections among species into full account.
6. Seek opportunities to fully integrate biodiversity conservation perspectives and human needs (including those related to domestic animal health) when developing solutions to infectious disease threats.
7. Reduce the demand for and better regulate the international live wildlife and bushmeat trade not only to protect wildlife populations but also to lessen the risks of disease movement, cross-species transmission, and the development of novel pathogen-host relationships. The costs of this worldwide trade in terms of impacts on public health, agriculture, and conservation are enormous, and the global community must address this trade as the real threat it is to global socioeconomic security.
8. Restrict the mass culling of free-ranging wildlife species for disease control to situations where there is a multidisciplinary, international scientific consensus that a wildlife population poses an urgent, significant threat to human health, food security or wildlife health more broadly.
9. Increase investment in the global human and animal health infrastructure commensurate with the serious nature of emerging and resurging disease threats to people, domestic animals, and wildlife. Enhanced capacity for global human and animal health surveillance and for clear, timely information-sharing (that takes language barriers into account) can only help improve coordination of responses among governmental and nongovernmental agencies, public and animal health institutions, vaccine / pharmaceutical manufacturers, and other stakeholders.
10. Form collaborative relationships among governments, local people, and the private and public (i.e., nonprofit) sectors to meet the challenges of global health and biodiversity conservation.
11. Provide adequate resources and support for global wildlife health surveillance networks that exchange disease information with the public health and agricultural animal health communities as part of early warning systems for the emergence and resurgence of disease threats.
12. Invest in educating and raising awareness among the world's people and in influencing the policy process to increase recognition that we must better understand the relationships between health and ecosystem integrity to succeed in improving prospects for a healthier planet.

Source: One World, One Health. 2004. **http://www.oneworldonehealth.org/**.

- Overcome institutional and legal barriers to effective and efficient cooperation across disciplines and levels of governance.

Animal disease threatens the economic, social, and political stability of all populations, particularly in vulnerable regions throughout the developing world. For this reason, additional measures to bolster adaptation and coping strategies for those communities most at risk should be taken. These include developing more equitable health care infrastructure, preventive strategies that protect livelihoods (e.g., the use of vaccines instead of culling), and poverty reduction strategies that stress improving education, nutrition, and public health.

Deforestation and the Nipah Virus in Malaysia

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Introduction

In late 1998, a novel paramyxovirus emerged in Malaysia, killing domestic pigs and humans and causing substantial economic loss to the local pig industry. Pteropid fruit bats have since been identified as a natural reservoir host of this virus, which was named the Nipah virus.

Over the last 2 decades, deforestation for pulpwood and industrial plantations has reduced substantially the forest habitat of these bats in Southeast Asia, including peninsular Malaysia. In 1997–1998, slash-and-burn deforestation in Kalimantan and Sumatra produced a severe haze that blanketed much of Southeast Asia in the months directly preceding the Nipah virus outbreak. The forest fire was exacerbated by a drought, which was driven by the severe 1997–1998 El Niño Southern Oscillation (ENSO) event.

This case study presents data suggesting that this series of events led to an acute reduction in the availability of flowering and fruiting forest trees for foraging by fruit bats. This culminated in the unprecedented encroachment of fruit bats into cultivated fruit orchards in 1997–1998. These anthropogenic events, in conjunction with the location of piggeries within orchards and the design of pigsties, allowed the transmission of a novel paramyxovirus from its reservoir host to domestic pigs and, ultimately, to humans.

Lessons learned from this study contribute to the body of knowledge aimed at better understanding the links between seemingly discrete events. Such information can contribute to efforts to address similar events in the future.

Impacts of the Nipah virus outbreak

The outbreak of the Nipah virus was a tragic event for the people of Malaysia, especially those in the pig farming industry. Although the start of the outbreak was officially recorded as September 1998 in Ampang village, Kinta District, in northern peninsular Malaysia (Center for Disease Control and Prevention, 1999b), the virus most likely had contaminated the swine population as early as 1997 (Chua et al., 2002). This was substantiated with the later discovery of six encephalitis patients admitted to Ipoh General Hospital in 1997, whose stored sera were found to carry the anti-Nipah virus IgG (Chua, 2003). Respiratory illness and encephalitis in pigs in the same district preceded the outbreak of febrile encephalitis in humans (Mohd Nor, 2000).

By February 1999, similar diseases in pigs and humans were recognized in the central and southern parts of peninsular Malaysia. These were associated with the southern movement of domestic pigs from Kinta District. A month later, a cluster of 11 cases of respiratory illness and encephalitis, with one death, were reported among abattoir workers in Singapore, who handled pigs coming from the outbreak regions in Malaysia (Paton et al., 1999). The Nipah virus isolated from the cerebrospinal fluid of an encephalitic patient from Sungai Nipah village was identified as the etiological agent responsible for the outbreak (Chua et al., 1999; Chua et al., 2000). The outbreak in Singapore ended after the importation of pigs from Malaysia was prohibited. The outbreak in Malaysia, on the other hand, ceased with the culling of more than 1 million pigs and the destruction of nearly half the pig farms in peninsular Malaysia. By May 1999, 265 cases of encephalitis associated with the outbreak—resulting

[21] We are thankful to the Meteorological Services of Singapore for their kind permission to use the NOAA/AVHRR-14 satellite image, the Meteorological Services of Malaysia for the rainfall data and the Alam Sekitar Malaysia Sdn Bhd for their kind permission to use the air quality data regarding peninsular Malaysia. We are grateful to the Wildlife Department of Malaysia for use of the map of peninsular Malaysia to demonstrate the land area of primary forest cover, and to the Forest Research Institute of Malaysia for the figures on the annual primary forested areas of peninsular Malaysia. Finally, we are thankful to Professor Looi Lai Meng, editor of the Malaysian Journal of Pathology, for her kind permission to reproduce a major portion of the paper that was already published in the stated journal.

in 105 deaths—were recorded in Malaysia (Centers for Disease Control and Prevention, 1999a).

Hosts of the virus

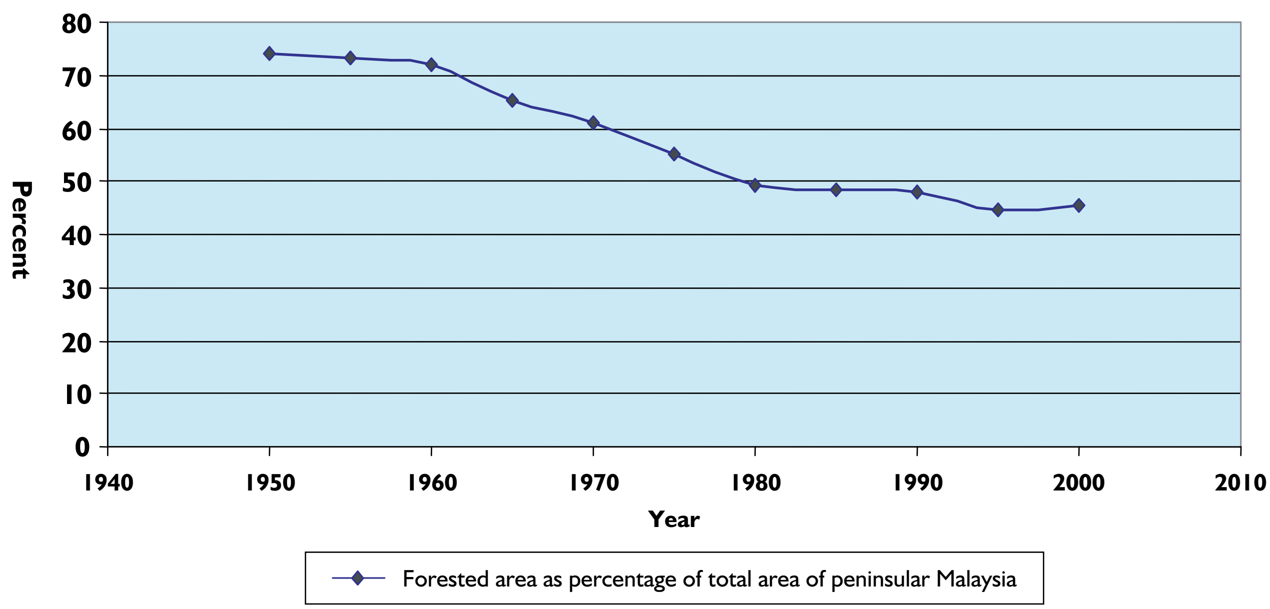
As in investigations on other emerging zoonotic diseases, the priorities for future prevention and control have involved identifying the natural reservoirs of the etiological agents and analyzing the underlying causal factors for the emergence. The Nipah virus has a close sequence homology and serological cross-reactivity with the Hendra virus, a lethal paramyxovirus found in humans and domestic horses that emerged from fruit bat reservoirs in Australia (Murray et al., 1995). In an initial survey of 14 species, neutralizing antibodies of the Nipah virus were detected in Malayan flying foxes (*Pteropus vampyrus*) and Island flying foxes (*Pteropus hypomelanus*), although the Nipah virus was not isolated (Yob et al., 2001). Subsequent work isolated the Nipah virus from two pooled urine samples of *P. hypomelanus* and a swab sample of partially eaten jambu air (*Eugenia aquea*) fruit (Chua et al., 2002). Therefore, *P. hypomelanus* and *P. vampyrus* (otherwise known as fruit bats) probably serve as the natural reservoir hosts of the Nipah virus.

Impacts of deforestation and haze on fruit trees

Over the last 2 decades, anthropogenic fire-mediated deforestation has become one of the greatest threats to tropical rainforests in the Amazon (Fernside, 1990; Setzer and Pereira, 1991), Africa (Isichei et al., 1995), and Southeast Asia (Malingreau et al., 1985). Fire is used for large-scale land clearing (e.g., for pulpwood and industrial crop plantations), as well as by small-scale farmers to clear land and burn agricultural waste (Malingreau et al., 1985; Schweithelm, 1998). Tropical deforestation by fire occurs on an immense scale in Southeast Asia. In 1982–1983, an estimated 3.5 million hectares (ha) of rainforests were burned in East Kalimantan due to the coincidence of drought and poor land-use management (Malingreau et al., 1985). A similar area was burned in Borneo and Sumatra in 1994 (Tang et al., 1996; Nichol, 1997). In 1950, before independence from British rule in 1957, more than 70% of peninsular Malaysia was covered with primary forests. By 1997, barely 45% of the area was covered with primary forests (Figure 8). Furthermore, most of the remaining primary forest was in the highlands that might not be such suitable habitats for Pteropid fruit bats. The impact of deforestation on wildlife habitat is clear (Chua et al., 2002; Setzer and Pereira, 1991). The extent of these anthropogenic changes affecting the food supply of highly mobile tropical forest species, such as fruit bats, is not known. However, the food supply could have been reduced to a critical level.

In the months of August, September, and October 1997, fires in Kalimantan and Sumatra destroyed approximately 5 million ha of tropical rainforests (Schweithelm and Glover, 1999). With the prevailing northwest winds, these fires created the most

Figure 8: Percentage of Forested Area in Peninsular Malaysia, 1950–2000

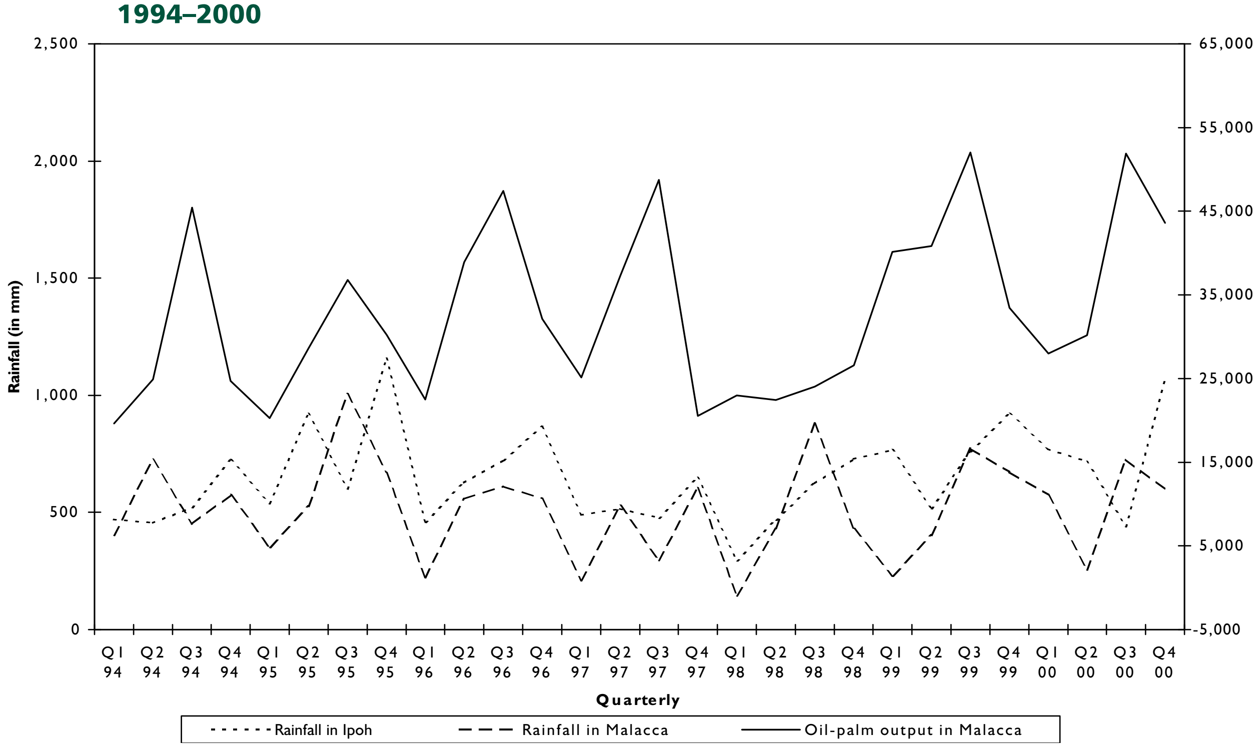


severe haze ever known in this part of Southeast Asia. The haze was particularly severe in the southern part of peninsular Malaysia (Malacca). Ipoh, the site of the initial Nipah virus disease outbreak, was less affected. Sulfate and organic carbon particles in the haze can obliterate 73–92% of total light (Ferman et al., 1981; Wolff et al., 1986), significantly affecting ecosystem functions, particularly in tropical rainforests (Barrie et al., 1981; Rosen et al., 1981; Fan et al., 1990; Davies and Unam, 1999). Hygroscopic particles in the haze grow in size with increasing relative humidity (Cass, 1979; Nochumson, 1982). In tropical rainforests, photosynthetic photon flux density generally limits photosynthesis. Tang et al. (1996) reported reduced photosynthesis by forest trees during a 1994 haze event in Malaysia despite the presence of higher levels of carbon dioxide, and demonstrated that the reduction of photosynthetic photon flux density within the forest was much greater than in open land.

The effect of the 1997–1998 haze on flowering and fruiting in tropical rainforest is not fully known. However, the haze substantially reduced the flowering and fruiting of orchard fruit trees in southern peninsular Malaysia. Orchard farmers in the states of Malacca and Johore reported severe crop failure in oral histories. Limited studies revealed a 10% reduction in rice yields following the 1997–1998 haze—even in the northeastern part of peninsular Malaysia (Trengganu), which was less affected by the haze—and a delayed reduction in oil-palm crops in Tawau, Sabah (East Malaysia) (Mohamed Shahwahid and Othman, 1999). Figure 9 shows the quarterly output of oil-palm crops in terms of fresh fruit bunches of a 10-acre oil-palm smallholding of uniform age in Malacca State entering its peak plateau phase of production from 1994 onwards (Hartley, 1977a). The 1997–1998 haze, with the concomitant drought, caused a severe reduction in fresh fruit bunch outputs in oil-palm crops. Furthermore, the decrease in oil-palm crop output, which was delayed by about 6 months, suggests that the primary impact is failure to flower (oil-palm fruits take 6 months to mature) (Hartley, 1977b).

Figure 9 also shows the quarterly rainfall data in two representative areas in peninsular Malaysia from 1994 to 2000, one in the north (Ipoh, site of the Nipah virus initial outbreak) and another in the south (Malacca). Both experienced a decrease in rainfall corresponding to the severe ENSO event; however, the southern part of peninsular Malaysia was affected more severely. Therefore, the 1997–1998 ENSO-related drought exacerbated the anthropogenic fires in Indonesia which, subsequently, might have aggravated the haze-related flowering and fruiting failure of forest trees.

Figure 9: Quarterly Rainfall Data and Oil-Palm Crop Output in Relation to Rainfall in Malacca, 1994–2000



Links between deforestation, fruit bats, and pig farming

This case study suggests that the loss of foraging habitat, in conjunction with increasing deforestation, compelled the fruit bats to migrate into cultivated orchards. The study supports this hypothesis through observations gleaned from examining the sites corresponding to the index cases of the Nipah virus. An example is a partially demolished pigsty in the midst of durian (*Durio zibethinus*) and rambutan (*Nephelium lappaceum*) orchards in Ampang village (approximately 8 km from Ipoh City) within the Kinta District in the northern part of peninsular Malaysia. More than 20 ha of these orchards surround the pig farming area where the index cases of human encephalitis (Chua et al., 1999) and pig diseases (Mohd Nor et al., 2000) due to the Nipah virus were reported. Oral histories of local hunters and orchard farmers confirmed that *P. vampyrus*—one of two fruit bat species in which the Nipah virus was identified serologically—is normally absent from this area. However, a colony of *P. vampyrus* roosted in the forest in 1997 and 1998, about 20 km from Ampang, and regularly visited the orchards surrounding piggeries to forage on durian flower nectar. At the piggeries associated with the human index case of the Nipah virus disease, pigsties were purposely constructed with low concrete walls around the pig enclosure that extended beyond the roof's edge to allow rainwater runoff to collect inside the enclosure for bathing the pigs. Partially eaten fruits found within pigsties suggest a mechanism for direct transmission of the Nipah virus from infected fruit bats to pigs.

This study proposes that encroachment of the Nipah virus-infected fruit bats throughout 1997 and early 1998 led to the initial transmission of the virus to pigs and the subsequent outbreak in humans in late 1998. This analysis provides another example of complex, anthropogenic environmental changes driving the emergence of zoonotic disease from wildlife reservoirs (Jones et al., 1998; Daszak et al., 2000). It suggests that the Nipah virus joined the increasing number of emerging pathogens driven by ENSO events (Epstein, 1999). The increasing severity of these events should be an impetus for us to better understand the phenomenon, as well as effectively predict and strategically combat the emergence of future zoonotic diseases.

Aquatic Resources, Food Security, and Nutrition in the Lao People's Democratic Republic: A Case Study from Attapeu Province

Richard Friend,[22] *Eric Meusch,*[23] *Simon Funge-Smith,*[24] *and Jintana Yhoung-Aree*[25]

Introduction

The growing interest in the potential of wild food resources to address food security and poverty reduction in the Lao PDR generates numerous opportunities for designing the most appropriate poverty-focused interventions. While considerable work has already been done on the role of nontimber forest products (NTFPs) in rural livelihoods in the Lao PDR, the importance of aquatic resources has received relatively little attention.[26] In many ways, the aquatic resources that are important in food security remain largely invisible. This is particularly important in the Lao PDR, where rice security is considered a key development strategy for reducing poverty and is an indicator of poverty and vulnerability. However, local livelihoods depend on a range of other resources besides rice, including aquatic resources.

The relationship between rice and aquatic resources is important. Increased rice production is one of the Lao PDR's national priorities for reducing poverty and ensuring food security. Intensification of rice production through development of irrigation systems, conversion of wetland areas, and the use of high-yielding varieties and supplementary inputs potentially could have negative impacts on wild aquatic resource production. While improved rice production is clearly needed, continuous viability of the wild aquatic resources found in rice fields, floodplains, and adjoining wetlands is equally important. Increased rice production would not necessarily offset the loss of these resources, which could have

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[26] Aquatic resources as used here include fish, amphibians, some reptiles, various invertebrates (prawns, crabs, snails, insects), as well as numerous varieties of wild aquatic plants.

a greater negative impact on poorer people. Further, the management of these aquatic resources offers considerable opportunities to improve food security and nutrition.

This case study is based largely on a participatory assessment of the nutritional value of aquatic resources in rural livelihoods, undertaken as a joint initiative of IUCN, FAO, and the Lao Aquatic Resource Research Centre in Attapeu Province (Meusch et al., 2003).[27]

A multidisciplinary team conducted the assessment during two missions in three villages in Attapeu: Tamoyot in Sanamsai District, Saisi in Saisetha District, and Gayeu in Samakisai District. The study applied a range of participatory methods to identify aquatic resource species and habitats, and to open the discussion with local people about the role of these resources in diversified livelihoods and their contribution to household food security. In addition, the study applied more quantitative methods, including an anthropometric assessment and a food frequency survey, to examine nutritional issues.

The main objective of the study was to gain a better understanding of how people living in rice production areas use aquatic resources and to evaluate the nutritional importance of these resources. The study was motivated by a concern that the production and value of aquatic resources often are not recognized fully, which results in missed opportunities for improving rural livelihoods through the wise management of aquatic resources. This case study, and the original report on which it is based, is intended to contribute to a broad discussion on appropriate food security strategies for the Lao PDR.

Invisible resources

Living aquatic resources often are overlooked in development planning. Yet evidence of the importance of fisheries and aquatic resources in the livelihoods of the Lao people can be found in many forms: the ubiquitous *padek* (fermented fish paste) that accompanies most meals; the wide variety of fish traps that can be found in markets or as decorations; and the many people who can be seen fishing or foraging in the canals, streams, floodplains, and rice fields throughout the country. Much of the aquatic resources consumed in rural areas also can be seen in the markets of Vientiane, the capital. In addition to the wide range of fish species, frogs, insects, crabs, mollusks, and shrimps, as well as a host of aquatic plants, can be found. Despite the diversity of aquatic resources, their importance in local livelihoods—and their potential to reduce poverty and promote national development—often has been overlooked.

The lack of information on aquatic resources has been recognized as an important constraint in the Lao PDR and the Mekong region as a whole (Souvannaphanh et al., 2003). An FAO review (Coates, 2002) pointed out that current information on fisheries and aquatic resources in the Mekong region is seriously limited. The review found that traditional methods of assessing the production of aquatic resources have had limited success, and improved approaches to collecting and analyzing data are needed urgently. Although estimates of production and consumption of aquatic resources have been revised regularly over the last 10 years, a sense persists that their true value is underestimated.

Obtaining reliable information on aquatic resources has been a persistent problem for development planners and policy makers. The nature of these resources, and the ways they are harvested, pose significant challenges to information gathering. A wide range of aquatic resources is targeted regularly in rural areas from a wide range of habitats. Often, aquatic resource production is highly seasonal and varies greatly from one year to the next. This diversity and variability is not captured easily in normal assessment approaches. Thus, considerable investments would be required to improve these information systems (Souvannaphanh et al., 2003).

To assess the significance of aquatic resources, they should be considered in the context of a wider portfolio of livelihood strategies. Although most rural people regard themselves as rice farmers, rural households are engaged in an array of activities—all of which contribute to household livelihood strategies and well-being. In Attapeu, these activities include rice farming, raising livestock, gardening, and various household and domestic activities. This diversity of activities is essential for coping with the seasonality of agricultural production and availability of other resources.

[27] The study was carried out with joint funding from IUCN Water and Nature Initiative and FAO Regional Office for Asia and the Pacific during the preparation of the UNDP-Global Environment Facility/IUCN/MRC Mekong Wetlands Biodiversity Conservation and Sustainable Use Program, which uses Attapeu Province as the Lao PDR demonstration site. The assessment has been used to inform the development of program activities in Attapeu.

Few rural people in Attapeu consider themselves fisherfolk, even though many fish or harvest aquatic resources. This is a common perception among rural people, who rate land owning and farming as their primary occupation. In addition, a significant proportion of time is spent making and repairing fishing gear and processing catches. Women and children are involved actively in these activities. The vast majority of the aquatic resources harvested are consumed within the household, with only a small proportion of higher-value species and specimens reaching the market. Thus, their economic value is not apparent immediately and becomes difficult to calculate.

Discussion and summary of main findings

The full range of the assessment's findings is presented in the original report. This case study will concentrate on the implications for biodiversity, nutrition, and food security. The following summary of the three villages of Attapeu Province where the study was carried out is taken from the main report.

Tamoyot Village. Tamoyot in Sanamxai District is a small village of 28 households, with a population of 158. Most of the people are of the Su ethnic minority, one of the many Mon Khmer groups that make up the Upland Lao or Lao Theung people. Tamoyot, about 13 km from the district town of Sanamsai, is fairly remote. The people of Tamoyot are relatively poor, earning their living from growing upland rice and foraging in the forests and wetlands. Food shortages are common, and many households produce only enough rice to last a few months. Most households rely heavily on fishing and foraging in local streams and swamps to support their livelihoods. While wetland rice production has been promoted, the people are reluctant to shift from their traditional upland cultivation.

Saisi Village. Saisi Village in Xaisetha District is on the banks of the Se Kamon River. The village has a long history, and currently consists of 200 households with a population of 1,062. The villagers, who are ethnic Lao, make a living producing wetland rice, growing vegetables, and fishing in the Se Kamon River. Because the village is easily accessible to provincial and district towns, villagers can easily access markets for buying and selling. Although most of the families produce enough rice for consumption, some produce a surplus for sale. However, since many families still suffer from rice shortages during certain months, they also rely on alternative sources.

Gayeu Village. Gayeu Village in Samakhisai District is near the provincial town on the main road to Sekong Province and Pakse town in Champasak Province. Gayeu is at the foot of a mountain, on the plain between the mountain and the Se Kong River. The villagers of Gayeu are primarily of the Oyi ethnic minority, a subgroup of Lao Theung. The village consists of 78 households, with a population of 428. The villagers, who have a history of producing wetland rice, have a highly developed system of terraced rice fields that extend to the foot of the mountain. Although the village's rice-growing land is considered productive, many households still experience food shortages. Thus, they supplement their livelihoods by fishing in a nearby oxbow lake and the Se Kong River. The people have developed unique systems of trap ponds in their rice fields.

The assessment illustrates that a wide range of food sources contributes to food security, and livelihood strategies involve the management of many resources. The study also aimed to compare the relative importance of aquatic resources and other food sources for villagers of different wealth. Villagers developed their own definitions and indicators of wealth and poverty within the village, and identified households that fit into their different wealth categories. While the criteria applied differed among the three villages, the common factors in determining wealth and poverty included food security, food availability, livestock ownership, type of house, and available labor within the household.

Although livelihood activities remain largely the same in different wealth groups, their relative importance is markedly different, as indicated in Table 15. Most significantly, men and women from better-off households attached relatively little importance to fishing and did not include the collection of aquatic animals on their list of priority activities. In contrast, men and women from worse-off families considered both activities priorities, with greater importance attached to the collection of aquatic animals.

Again, collecting aquatic animals and fishing are of great importance to poorer people.

Although rural people have difficulty calculating their own aquatic resource production, they consistently identify a wide range of species that they consume regularly. In Attapeu, local people identified an array of aquatic resource biodiversity, with aquatic animals largely referring to fish, eels, frogs, freshwater shrimp, snakes, snails, and turtles. The availability of

Table 15: Priority of Activities According to Wealth Category and Gender

Men from better-off households	Women from better-off households
Rice production Preparing food Clearing and/or preparing fields Raising livestock Collecting firewood Carrying water Fishing Cutting lumber	Rice production Collecting firewood Carrying water Raising livestock Preparing food Milling rice Fishing Gardening
Men from worse-off families	**Women from worse-off families**
Rice production Preparing food Raising livestock Collecting aquatic animals Fishing Gardening Clearing and/or preparing fields	Preparing food Collecting aquatic animals Raising livestock Fishing Gardening Rice production Child care

Source: Meusch et al., 2003, p. 10.

these resources differs among the three villages, with 61 species reported in Tamoyot Village and 102 species identified in Saisi Village.

Other aquatic animals, including several species of crabs, shrimp, frogs, shellfish, turtles, and various types of insects, were reported. In some cases, these animals (especially frogs, shrimp, and crabs) are as important to household consumption as fish.

Many aquatic habitats also are exploited in Attapeu. As each habitat supports particular aquatic organisms, the local people target them in specific ways. The main categories of aquatic environments are rivers and perennial streams, perennial ponds, marshes and oxbow lakes, seasonal ponds and streams, and rice fields.

The rivers and perennial streams provide important habitats for a wide range of fish and aquatic animals. The nature of these environments means that harvesting the aquatic resources often requires a relatively high degree of specialization, with additional investments in gear (including boats) and labor. Those unable to make these investments are restricted to less-intensive fishing along the edges of the rivers. Other aquatic environments are more accessible and require less-specialized gear and investment. These are particularly important to poorer people, especially when the environments are common property resources. By definition, poorer people have less access to private lands.

Summary of aquatic environments

RIVERS AND PERENNIAL STREAMS

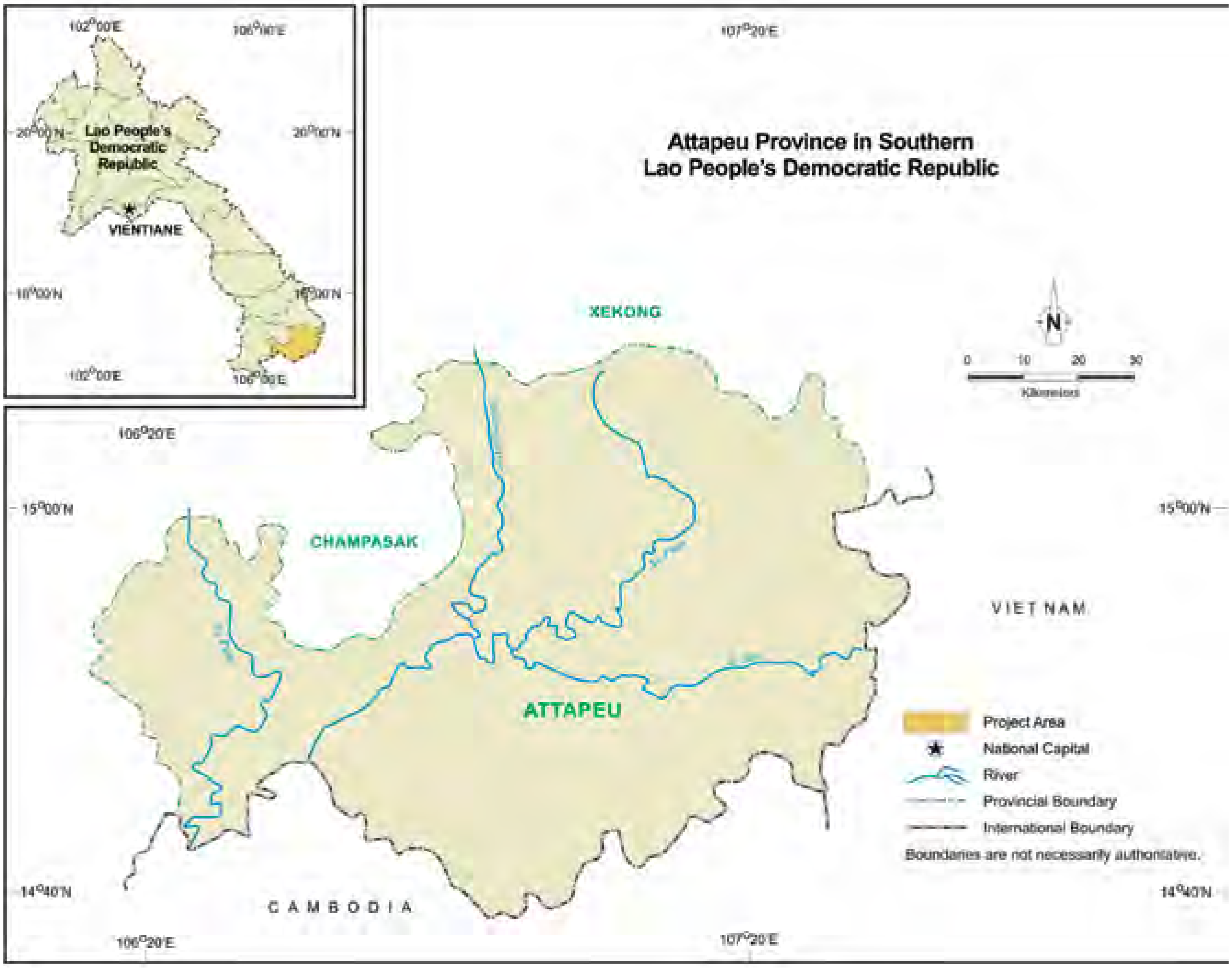
Rivers and perennial streams—key features in the lowlands of Attapeu—are important sources of fish and other aquatic produce. They are characterized by large amounts of water and sustain a range of aquatic organisms throughout the year. Between the rainy and dry seasons, the volume and flow of water fluctuate greatly. Being permanent, they are a dry-season refuge to a wide array of fish and other aquatic animals, and provide key habitats for a number of strictly riverine species.

Fishing in rivers requires some specialization. Variability in the water level, the changing nature of the environment caused by the fluctuation in water flows, and the seasonal activities of fish—some of which are migratory—based on the annual cycle of the river require specific knowledge and equipment. Boats, specialized nets, and other gear are required to fish in the rivers and large streams successfully. Much of the simpler, cheaper, and more common household gear have limited application in the river. This means that successfully accessing riverine aquatic resources requires financial investments in gear and some skills. Households that lack the means to purchase boats and equipment and to pay for the labor (typically strong males) needed to operate the specialized gear are limited to accessing resources along the edges of the rivers with smaller gear during periods when the water level is low. They also might assist others during peak fishing periods. While those who fish in the river are subject to seasonal scarcity of fish, they are able to fish to some extent throughout the year.

PERENNIAL PONDS, MARSHES, AND OXBOWS

Perennial ponds, marshes, and oxbows, which are fairly common in the lowland floodplains of Attapeu, have an important function in receiving excess water during the rainy season and holding it throughout the dry season. These water bodies are usually shallow and vary greatly in size over the course of the year—expanding during the rainy season and receding during the dry season. In many cases, they act as

Map 5



water stores (similar to the Cambodian Great Lake), receiving water directly from a rising river or stream during the rainy season, and draining back into the river or stream as the water level drops.

These water bodies also are refuges for fish and other aquatic organisms during the dry season. The key species found in these water bodies are mainly floodplain fish rather than those found in rivers and streams, with the notable exception of riverine fish that remain trapped when the water recedes following flooding. Because the water is relatively fertile and shallow in areas, many types of aquatic

Table 16: Number of Aquatic Species Reported

Aquatic species	Tamoyot village	Saisi village	Gayeu village
Finfish	61	102	95
Crustaceans	3	6	6
Mollusks	4	7	6
Amphibians	8	14	6
Reptiles	8	10	5
Insects	–	7	7
Aquatic plants	19	16	31

Source: Meusch et al., 2003, p. 22.

plants and nonfish organisms, including mollusks, crustaceans, amphibians, and reptiles, are typically abundant.

Fishing in these perennial water bodies is typically less specialized and requires less investment than river fishing. When the water recedes and seasonal water bodies have dried or been harvested, people exploit the permanent water bodies using various types of gear. Since these water bodies are generally shallow (or have shallow areas), they are easy to access and conducive to the use of small-scale household gear and foraging activities, such as collecting aquatic plants and animals by hand. These areas are often particularly important to poorer people.

RICE FIELDS, SEASONAL PONDS, AND SEASONAL STREAMS

These types of water bodies are an important and often overlooked source of aquatic resources. They are found in lowlands where seasonal rains inundate vast areas for much of the year, typically from June to October. Fish from perennial water bodies migrate out to take advantage of these newly created water bodies for feeding and reproduction. They migrate through seasonal streams that drain the plains into the rivers. Fish use these streams for dispersal at the beginning of the rainy season and return at the end of the rainy season. Rice fields and seasonal ponds play a similar role in local hydrology, holding water higher in the watershed for longer periods than otherwise would be possible. Water harvesting[28] in rice fields and man-made seasonal ponds extends the productive phase of the aquatic environment (in the case of rice fields, at least long enough to produce a crop of rice).

Several species of fish and aquatic animals have evolved to take advantage of these temporary aquatic environments. At the beginning of the rainy season, they quickly disperse and reproduce (or in some cases reproduce and disperse) to fill the empty ecological niches that rapidly form in the newly inundated areas. Soon after the rains begin, the newly developed systems are populated with organisms that have been dormant or relatively inactive in permanent water bodies during the dry season.

Much household fishing is focused on these temporary water bodies. This activity is highly seasonal, taking place from the beginning of the rainy season (June) until the water bodies dry up in the early to mid-dry season (November to January). Fish are harvested mostly using simple, inexpensive gear—a process that requires few specialized skills. Thus, poorer people are able to access this source. Fishing focuses on migration paths to and from water bodies and can be especially productive at the end of the temporary aquatic phase when fish move out of the floodplain back to permanent water bodies.

Harvesting aquatic resources and managing water and wetland habitats are important components of diversified livelihood strategies. As such, considerable time is dedicated to these activities. This level of diversification is an essential feature of livelihood strategies because the seasonal nature of rice and other crop production requires local people to adopt multiple strategies.

Maintaining food diversity and security

Diet and nutrition are key factors affecting health, food security, and poverty in the Lao PDR. An understanding of diet and nutrition is particularly important for vulnerable groups, such as poorer households and those with special needs, including pregnant and lactating women and children under 5 years old.

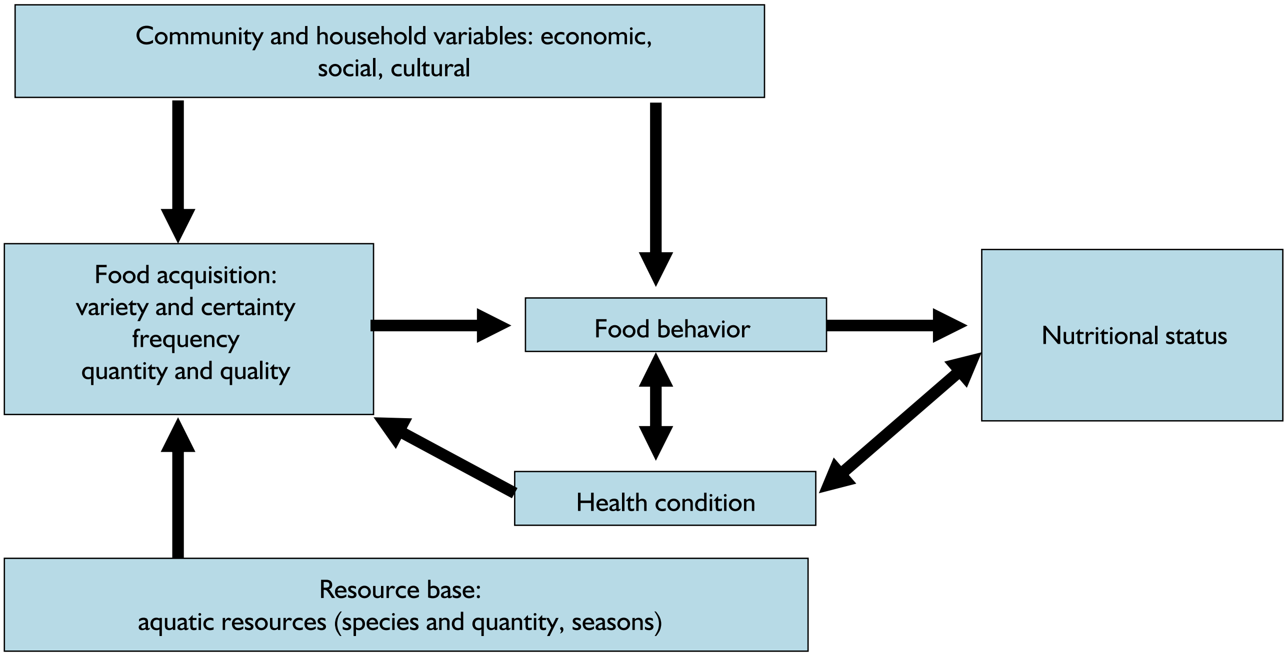
Nutritional status is the result of the interaction of a number of interrelated variables, as shown in Figure 10. This conceptual framework was used as the basis for understanding the link between health and nutrition and aquatic resources. In this framework, food is acquired from the aquatic resource base, which is expressed in terms of variety, certainty, frequency, quantity, and quality of acquisition.

Community and household variables, including family economics, social structure and organization, markets, and cultural beliefs, influence the acquisition and use of food (food behavior). The interaction between food acquisition and food behavior under the influence of community and household variables ultimately affects nutritional status. Underlying this interaction is the important aspect of health: poor health can limit an individual's food acquisition, consumption, and efficiency of assimilation or use. These will influence nutritional status.

Diets in most households are deficient in terms of quantity and quality. Local diets consist mainly of rice supplemented with insufficient amounts of

[28] Water harvesting refers to collecting water during the wet season and trying to prolong its availability into the dry season for productive use (for crops or aquatic animal production), typically by using water-harvesting structures, such as small ponds and rice fields.

Figure 10: Linking Aquatic Resources to Nutritional Status



animal protein and lacking important micronutrients, such as iron, iodine, and vitamin A. This contributes to poor health and low productivity, which are significant threats to women and children. The level of health and nutrition is lower among women than men. Weak nutritional status and dietary habits are important factors in determining the health of pregnant women and infants. Starting life with poor nutrition undermines health throughout a person's life.

The report also highlighted dietary practices that might contribute to the poor nutritional status of many local people. For example, the widespread practices of not feeding colostrum to newborn babies because it is believed not to be ripe, as well as feeding rice to newborn babies, might have nutritional and health impacts with permanent implications.

Managing food diversity

Food security is not only about the availability of food; it also encompasses variety and quality. The availability of rice and aquatic resources is important in determining food security and nutritional well-being. Aquatic animals are the main source of animal protein in protein-poor diets since viable alternatives are not available. Indeed, aquatic resources constitute the main coping strategy for dealing with rice shortages, whereas coping strategies for dealing with shortages of aquatic resources do not exist. Any degradation of these resources, therefore, is likely to have significant additional impacts on the fragile health and nutritional status of local people. Poorer people are likely to feel these impacts most severely.

Although degradation of aquatic resources is difficult to verify, the people of Attapeu commonly expressed the view that these resources are declining. Explanations for this included pressure from population growth; more widespread use of modern, efficient gear; increased market penetration; growing demand for aquatic resources; and environmental degradation. The increase in fishing was given more weight than environmental degradation.

Managing human fishing and aquatic environments is essential. Aquatic resource production depends on a number of factors. Maintaining habitats that are important for breeding, spawning, migration, and dry-season refuges is critical to ensuring the viability of aquatic resources.

This has implications for local land-use planning and agricultural development strategies. Increasing rice production by converting ponds, marshes, and other floodplain resources, as well as the management of rice fields, might have impacts on wild aquatic resources.

While the discussion regarding aquatic resources and fisheries tends to focus on the potential threats of degradation, the potential for improving rural livelihoods through the wise management of aquatic environments and resources is considerable. Local experience in managing these resources is substantial. However, few development initiatives have tried to harness this experience. Protecting important breeding and spawning grounds and dry-season refuges might prevent degradation as well as increase production.

Implications

The study in Attapeu illustrates the fundamental importance of adopting a range of livelihood activities and resources. While aquatic resources play an important role, their full significance is easily overlooked. Weighing this significance requires an understanding of wider household livelihood strategies. However, as obtaining information on aquatic resource production and values is notoriously difficult, a combination of approaches is required. Local participatory approaches are most appropriate for monitoring and assessment and for supporting consultation on suitable management. Because of the complexity, diversity, and seasonality of aquatic resources, regular monitoring requires extensive participation of local resource users.

Reliable information to measure the economic value of aquatic resources is also lacking. This type of information is essential for policy makers and development planners in assessing different development options (Souvannaphanh et al., 2003). Where economic valuation techniques have been applied, the full value of economic resources becomes apparent. Gauging the economic and nutritional value of aquatic resources, combined with an economic assessment of the viability of alternative food sources, would provide important evidence about their full value and contribute to the evaluation of development options.

The Lao PDR and the Mekong region have some experience managing critical aquatic environments—including dry-season refuges, rice fields, and breeding and spawning grounds—to ensure the sustainability of stocks. For example, farmers traditionally set aside small water bodies in or adjacent to their rice fields. This practice provides local habitats that help maintain stocks of aquatic resources during the dry season, which then repopulate during the flood season. Opportunities for testing these initiatives in Attapeu should be pursued.

When addressing nutrition and health, it is equally important to consider dietary habits, child rearing practices, and the preparation and storage of foods. Thus, supporting an integrated approach that combines managing aquatic resources with education and access to adequate health care services is critical. Improvements in nutrition are likely to have dramatic impacts on the rural people in Attapeu.

The integrated management of aquatic resources has significant institutional implications. Responsibilities lie with different government agencies: food security largely falls under the Ministry of Agriculture and Forestry; health and nutrition is under the Ministry of Public Health; and to complicate matters further, water management, irrigation, and agriculture are under different departments. Even within the fisheries sector, wild aquatic resources—other than commercial fisheries and aquaculture—receive little recognition. Applying an integrated approach to aquatic resource management for poverty reduction requires a level of cross-sectoral coordination that has been realized rarely.

Finally, aquatic resources and rice clearly are fundamental to food security, nutrition, and health. As the main animal protein source in protein-poor diets, aquatic resources are vital to maintaining the people's health and well-being. They tend to be managed as common property and are particularly important to poorer people who have less access to land and less capital to invest in improved rice production. Management of water resources and aquatic environments, therefore, is essential. Moreover, while increasing rice production is important and necessary, those efforts should not harm wild aquatic resources. The potential for improving food security and health through sustainable management of aquatic resources and improving rice production should be explored.