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A Living from Livestock
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External Shocks, Producer Risk, and Adjustment in Smallholder Livestock Production: The Case of HPAI in Viet Nam

D. Roland-Holst, M. Epprecht and J. Otte

1. Abstract

Smallholder production remains the majority enterprise model in global agriculture, largely because of the predominance of household farms in low income countries. Two salient challenges for the world's rural poor smallholders are risk and vulnerability. Because of poverty, these farmers are more likely to experience adverse external shocks than higher income farmers. In response to this, smallholders have developed strategies for (*ex ante*) risk management and (*ex post*) risk coping. Policies that seek to alleviate rural poverty can be more effective if they recognize farmer's own capacity for adjustment and facilitate this constructively, helping farmers secure the basis for more sustainable improvements in their livelihoods. To achieve this requires deeper insight into smallholder behaviour, including a better understanding of how household enterprises respond to adverse shocks.

This paper examines the case of smallholder poultry production and adjustments arising from the risk of HPAI infection in Viet Nam. We consider how farmers can mix three risk reduction strategies: product diversification, investment in product quality (biosafety), and development of off-farm income opportunities, to mitigate the adverse effects of significant animal disease risk. With our findings we aim to provide a basis for complementary policies that promote smallholder viability while achieving risk reduction, an approach that increases both individual and economy-wide welfare.

2. Introduction

The poor in rural areas face economic risks that differ substantially from groups with other economic, demographic, and environmental characteristics. Even though some urbanites may be as poor individually as their rural cousins, infrastructure and other public goods provide them with insurance against exogenous shocks of all kinds, including adverse weather, and other national disasters, disease, as well as and certain kinds of political and economic exploitation. For example, poor urban dwellers are less likely to have disease affect their non-human capital and economic assets, including animals and crops, yet this is a significant risk for farmers everywhere.

In this report we evaluate a specific kind of risk in a specific context, namely stock losses to Viet Nam poultry producers arising from HPAI outbreaks and control measures taken in response to this disease. Using methods of Integrated Poverty Assessment for Livestock Policy (IPALP), developed for FAO's Pro-Poor Livestock Policy Initiative (PPLPI), we evaluate initial conditions and policy scenarios to elucidate the adjustment alternatives open to farmers and policy makers. While our results focus on a single production activity, threat, and country, they have implications for understanding more general smallholder responses to risk and adjustments to adverse shocks. Risk can be seen from two temporal perspectives with respect to an adverse event (shock), *ex-ante* and *ex-post*. These have strategic counterparts in *Risk Management* and *Risk Coping*.

Risk Management

An essential strategic capacity for the poor is the ability to manage risk *ex-ante* relative to income realization: reduce variability in current income. Instruments for risk management are varied in their characteristics and relevance to different situations. Some of the more universal ones include income diversification (e.g., crop/livestock portfolios, on-farm and off/non-farm work, migration), less risky technology choice at the cost of lower expected income (e.g., traditional seeds instead of high yielding varieties). For its part, livestock can contribute to risk management in many ways.

Livestock as Complements

Livestock used as factors of production are complements for labour and capital. They also have the attractive property of being readily reproducible, so they can offset variations in labour/capital availability and capital quality/reliability. Redundant draft animals, for example, are generally much cheaper than redundant capital or labour. They are generally also easier and more expedient to replace or retire from production.

Livestock as Substitutes

With respect to labour, livestock can also act as a substitute. This is extremely when managing risks arising from labour markets, where seasonal demands may draw workers to higher value temporary activities, and with migration, when family members may depart the household production system for extended periods.

Livestock as Financial Assets

Because of their intrinsic value in nutrition and marketability, livestock represent an asset class. Given livestock reproduce, this asset can appreciate even when prices are stable, and timing to realize asset value can be more flexible than for many other agricultural products. However, financial resources embodied in livestock pose an exposure risk in terms of price dynamics and other determinants of asset value like health status. The financial dimension of risk coping must take this exposure into account.

Risk Coping

Another important and related strategic capacity for the poor is risk coping, i.e. dealing with shocks *ex-post,* e.g. reducing variability in consumption in spite of income fluctuations (consumption smoothing). Characteristics of risk coping include adaptability, dis-savings of liquid assets, credit, and insurance (individual or mutual).

Livestock Adaptability

Livestock are generally more adaptable to environmental shocks than crops and often more so than their keepers themselves. They are mobile, which can increase survivability by moving across diverse natural resources. They may be relatively omnivorous, and thereby able to survive dramatic effects on feedstock of natural or induced environmental change. Native animal varieties in particular are adapted to local environmental risk and use natural resources efficiently. For all these reasons, superior survivability of livestock can actually increase survivability of livestock keepers and poor people keeping livestock, to a significant extent, transfer environmental risk to their animals.

Insurance Mechanisms

Because they represent durable (and often appreciating) assets with intrinsic value, livestock are an important source of economic insurance for poor households. Animal stocks can be depleted in exchange for cash in times of income shortfalls. They also give households a means of timing transactions that may be easier to control than seasonal crop cycles or itinerant employment.

Finally, the comestible potential of animal stocks provides nutritional insurance and consumption smoothing opportunities for households.

The present analysis is focused on poultry, a form of livestock that provides commodity (food) and income services only. Because of this, risk management and coping issues addressed here are limited primarily to financial, e.g. income and asset value. Other types of livestock provide different services and present more complex risks, but the financial issues raised here are nearly universal across agricultural assets.

3. General Features of Viet Nam's Livestock Economy

The following series of digital maps represents a synoptic atlas of Viet Nam's livestock sector. What emerges from these descriptive results is a nationwide agricultural practice, highly dispersed across rural and peri-urban areas, with an overwhelming numerical majority of birds and people in smallholder production (Figures 1 and 2). Poultry density is geographically concentrated near urban centres (Figure 3), but density of bird populations within households is low across the nation (Figure 4). Chickens are the dominant bird variety across most of the country (Figure 5), and commercial operations are nearly all in the periphery of a single large urban area (Figure 6), HCMC.

Figure 1 Share of rural households keeping livestock

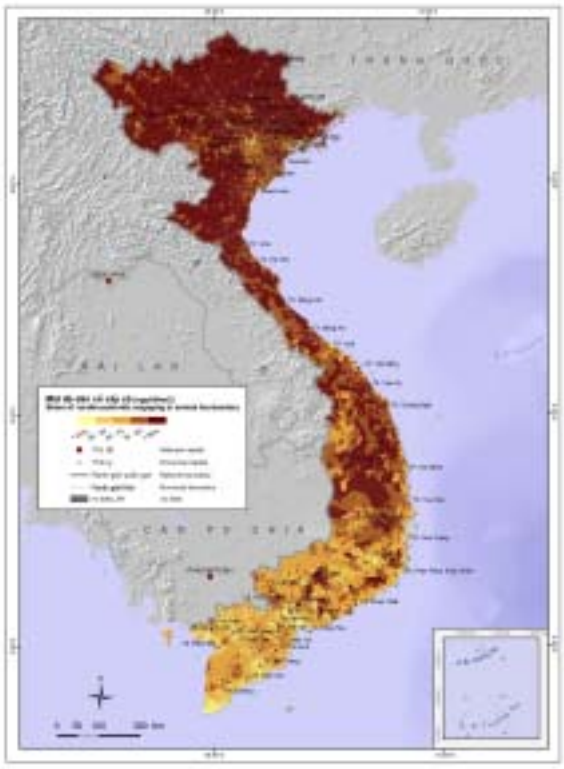


Figure 2 Share of rural households keeping poultry

Figure 3 Poultry density

Figure 4 Average poultry flock size

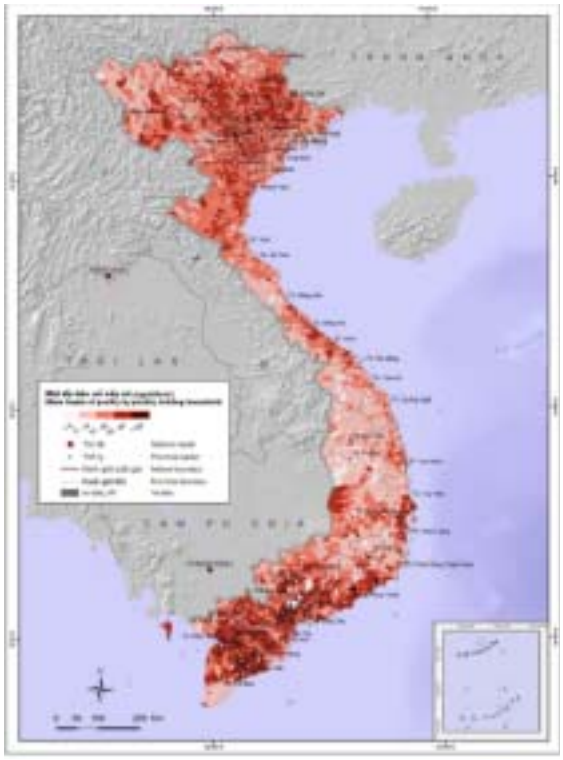


Figure 5 Chicken : waterfowl ratio

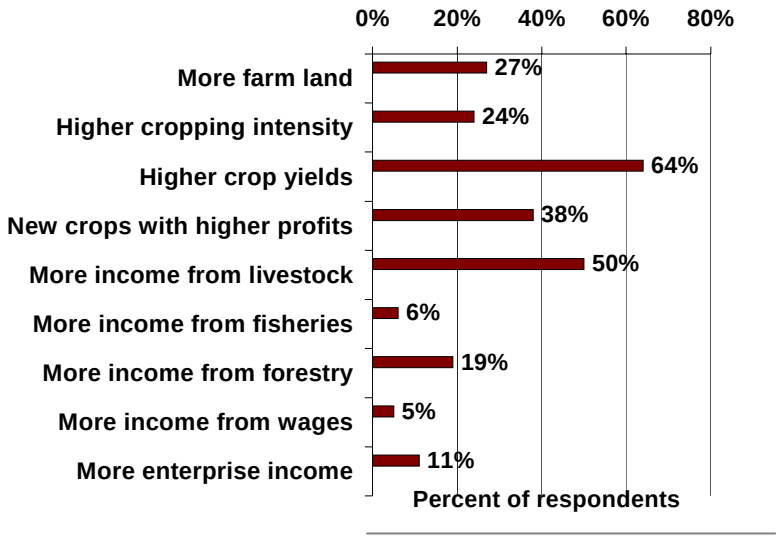
Figure 6 Commercial farms per commune

4. The Importance of Poultry to Rural Households

Livestock production in Viet Nam remains nearly ubiquitous, with poultry keeping still widespread in peri-urban areas. The overwhelming majority of producers are households and, despite emergence of more intensive production systems serving urban markets, their total production still dominates national poultry output. The importance of livestock keeping to households is reaffirmed by farm survey information, as indicated in Figure 7. When Viet Nam farmers were asked directly, majorities identified increased crop productivity and enhanced returns to livestock as primary drivers of improvements in their living standards.

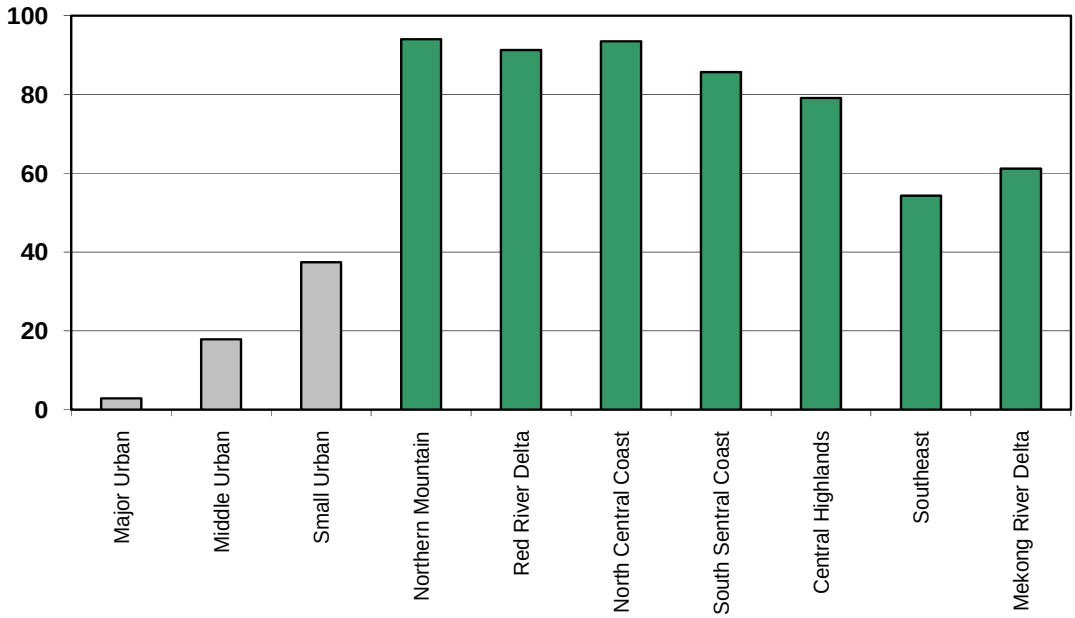
The economic importance of livestock to the rural sector in Viet Nam is further reinforced by results in Figures 8-10. As suggested in the opening discussion, Figures 8 and 9 show a national pattern of extensive poultry holding but low intensity production systems. Figure 8 shows that household chicken keeping is nearly ubiquitous outside major urban areas. Figure 9, by contrast, reveals that these practices are generally not intensive, with flock sizes of less than 25 birds dominating this sector.

Figure 7 Reasons given by farmers for improved living standards



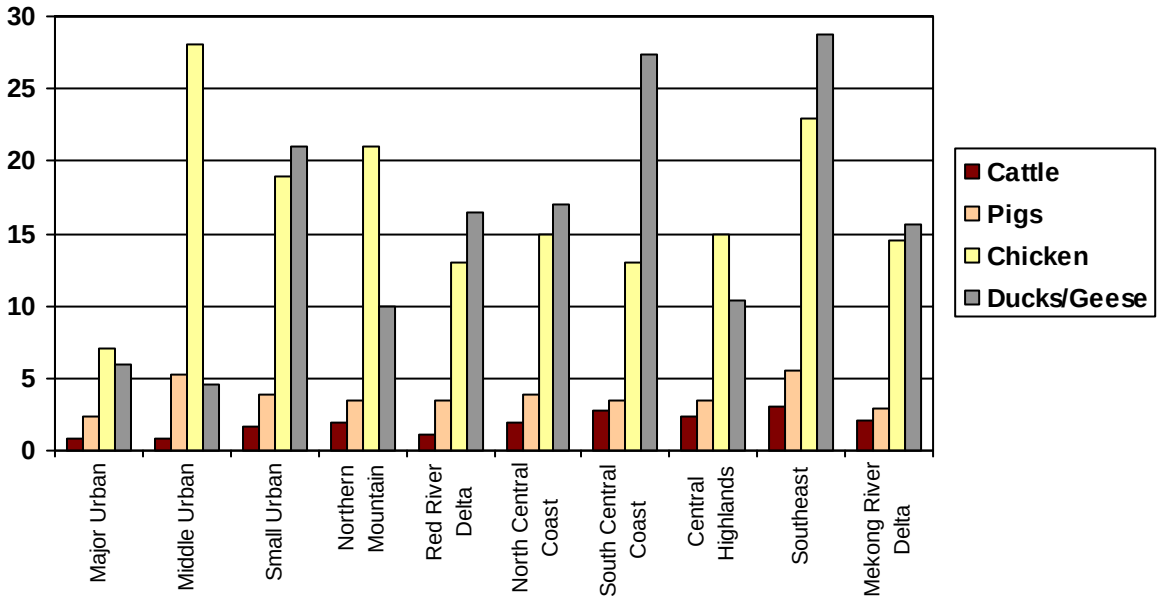
Source: IFPRI (2003).

Figure 8 Proportion of households owning livestock by region



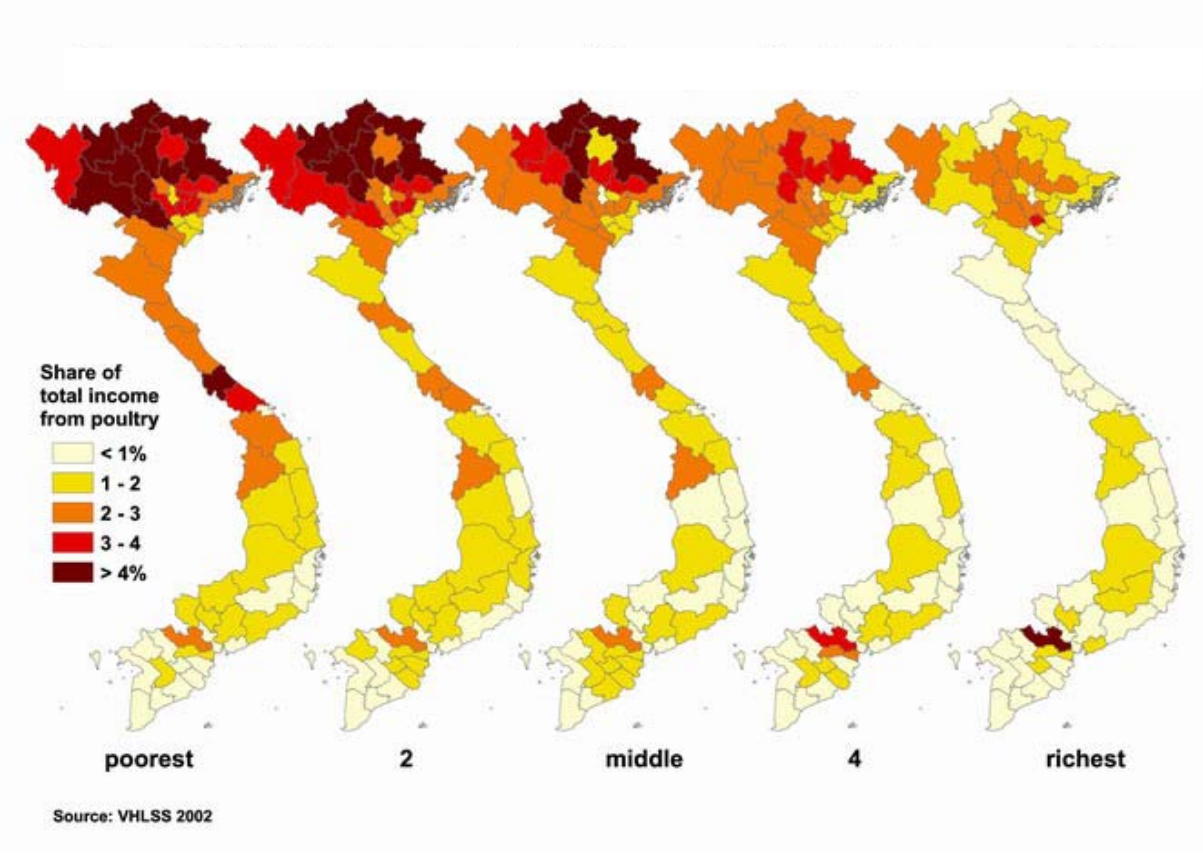
Source: VHLSS 1998

Figure 9 Average size of household flocks / herds



Source: VHLSS 1998

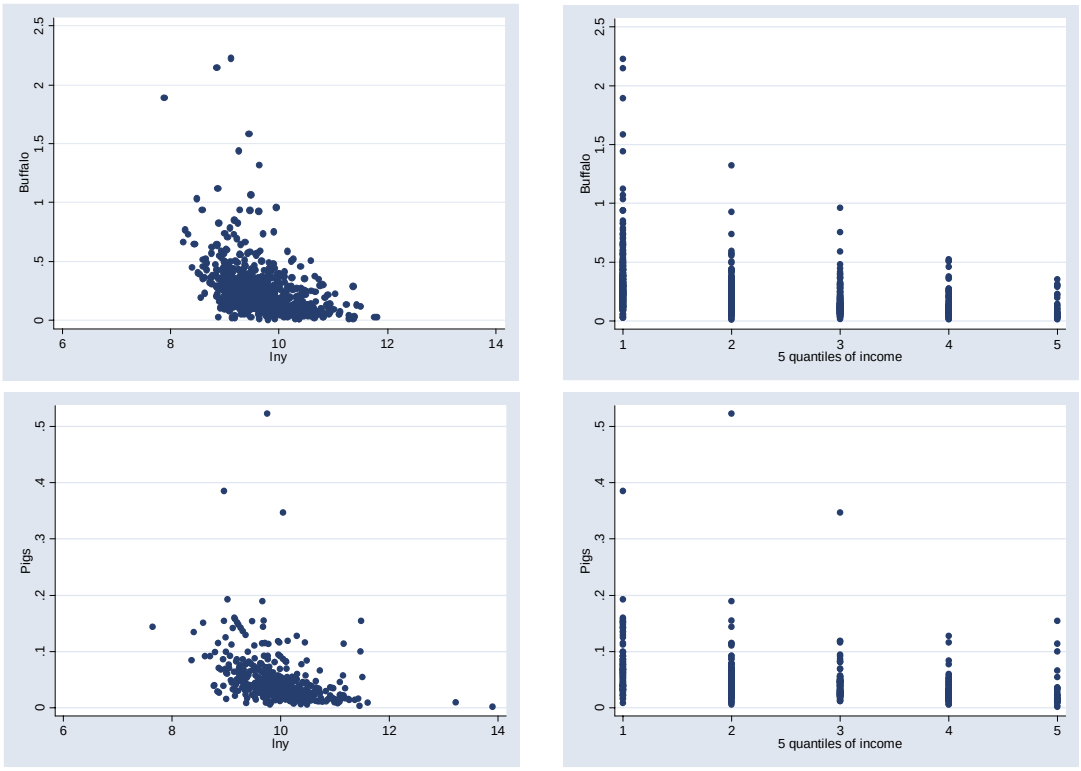
Figure 10 Share of poultry income by poverty status



To better understand the economic significance of this sector to the poor, Figure 10 depicts the share of household income from poultry by household income quintile. Clearly, the lower average incomes, the more important are household consumption and sales of birds, eggs, and other poultry products.

Finally, the quartet in Figure 11 reinforces the importance of livestock to securing wealth and saving for the poor. Distilling the many perspectives cited in this section, it is clear that household poultry will remain important to Viet Nam's rural population as long as the smallholder production remains the majority farm enterprise model.

Figure 11 Buffalo (top) and pig (bottom) asset value as a multiple of annual household income



lny = logarith of household income
Source: VHLSS 2002, 300 nationally representative households

5. Producer Risk and Adjustment to External Shocks

Because uncertainty is endemic to agriculture, farmers exhibit a variety of strategies for dealing with the risk of adverse shocks to their livelihoods. For smallholders, these are associated first with food security and second with income, and take two generic forms, *ex ante* risk management and *ex post* risk coping. Risk management is generally incorporated into long term production practices, while risk coping is a short term response to adversity. The two are linked, however, since risk management can offset the need for risk coping and coping strategies can induce adoption of new management practices. HPAI provides examples of both kinds of linkage. Lack of (private as well as public) risk management experience has led to unprecedented culling operations and complex risk coping reactions among farmers (including non-reporting, stock concealment, illicit marketing).

In the smallholder context, the food security and income objectives interact because risk strategies for the two are highly correlated. To secure their own food supply, farmers diversify across agricultural products in terms of variety and seasonality. This can reduce risks to income if diversification also occurs between marketable commodities, but can increase risk, as in the case of cash crop monoculture, when farmers reduce product diversity to increase potential

income. In this note, we consider a specific type of risk, i.e. outbreaks of HPAI, but the behavioural context is relevant to a wider spectrum of smallholder uncertainty. An outbreak of HPAI threatens farm income in two major ways:

1. stock loss from mortality, from voluntary liquidation, or from control measures
2. price reductions resulting from the need to liquidate distressed inventory (infected animals, animals associated with an outbreak and even animals at a distance from outbreaks)

In either case, a farmer's chickens can be infected or healthy, but uncertainty regarding animal health status imposes costs across the producer sector. Table 1 summarizes a constellation of factors that can influence how farmers cope with disease risk such as HPAI. Several of these are coping strategies with potential for longer term use in risk management, including product diversification and development of non-farm income. Some strategies are purely private and others entail public-private cooperation. In either category, there are opportunities for the government to play an enabling role.

Table 1: Coping strategies for smallholder livestock producers

Endogenous	**Exogenous**

• Gains through price increases of substitute products
• Intensification of other farming activities (e.g. pig production)
• Engagement in 'new' farming activities (e.g. fruit)
• 'Release' family labour for labour market (e.g. construction)
• Draw on savings and social networks
	• Compensation, but
	  • partial (20% of value of culled bird)
	  • late (several months delay is not uncommon)
	  • none for revenue foregone
	• Restocking assistance, but
	  • delayed
	  • perhaps inopportune
	• Diversification assistance
	• Product quality improvement with 'supply-chain certification'

To better understand motives and mechanisms for risk management and coping, consider the formal uncertainty problem facing an individual farm. In the HPAI context, expected income

$$(1) \quad E[Y] = P_C Q_C + P_A Q_A + wL - \pi_S S$$

can be thought to arise from three sources poultry: (C), other agricultural products (A), and non-farm income (e.g. labour L at wage w), the components of which we assume are known to the farmer. Finally, income could be affected by some external shock (S), such as HPAI, which is thought to occur with a given probability.

In this relatively simple framework, farmer's expected income can change for many reasons, i.e.

$$(2)\quad dE[Y] = dP_C Q_C + P_C dQ_C + dP_A Q_A + P_A dQ_A + dwL + wdL - d\pi_S S - \pi_S dS$$

For the present, however, we assume farmers cannot influence either the market price of other agricultural products (P_A) or the non-farm wage (L). Then expression (2) simplifies to

$$(3)\quad dE[Y] = dP_C Q_C + P_C dQ_C + P_A dQ_A + wdL - d\pi_S S - \pi_S dS$$

If we now visualize risk management and coping as an insurance problem, farmers' behavioural objectives becomes to minimize the variability of expected income change, i.e. $dE[Y] = 0$. This can be expressed as

$$(4)\quad \pi_S dS = [dP_C Q_C - d\pi_S S] + [P_C dQ_C + P_A dQ_A + wdL]$$

$$= \textit{Quality Effect} + \textit{Diversification Effect}$$

The first term above indicates how improvements in product quality can command higher prices ($dP_C > 0$) and also reduce disease risk ($d\pi_S < 0$). Both of these are primary objectives of PPLPI's approach to HPAI risk management because they contribute directly to long term producer viability. The diversification effect includes income effects of net output changes ($dQ_A > 0$, but production constraints could mean $dQ_C < 0$) and new off/non-farm activity (dL).

In practical terms, two decision variables are of special importance to the poultry farmer's insurance problem,

$$(5)\quad Exposure = E = \frac{P_C Q_C}{Y}$$

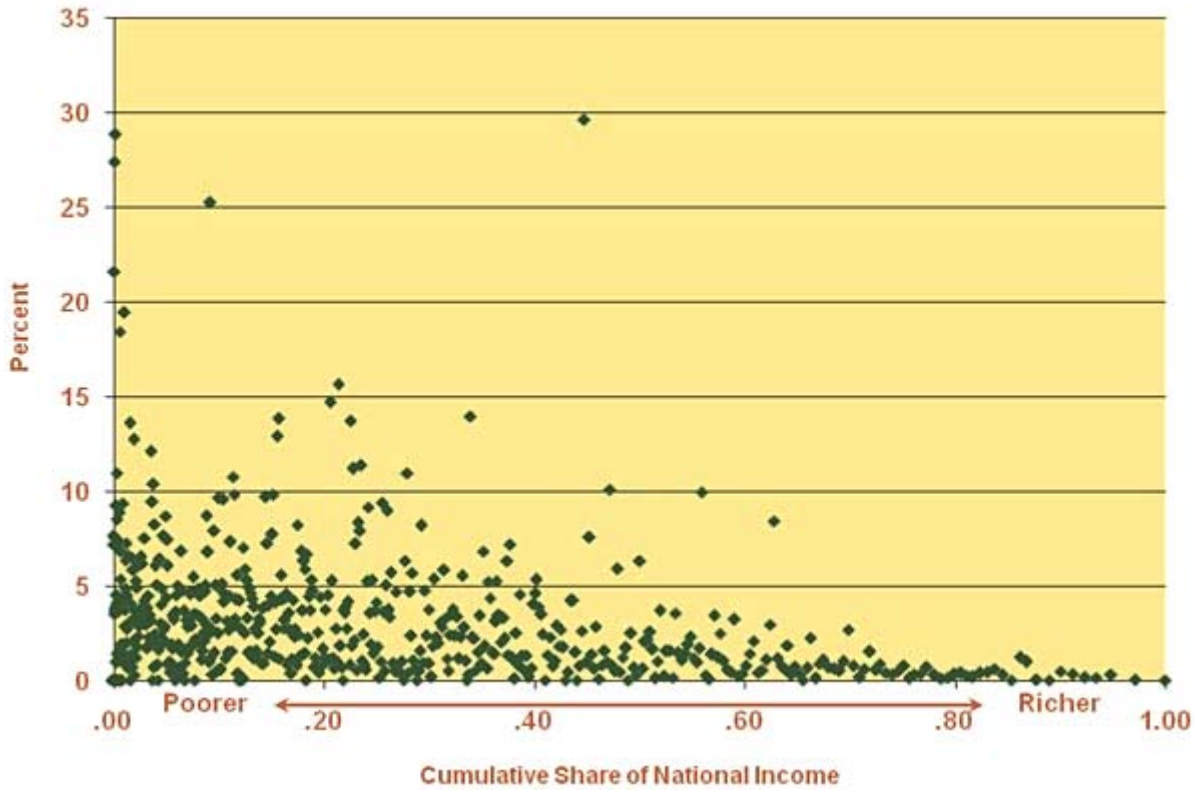
which measures the share of poultry revenue in total farm income, and

$$(6)\quad Coverage = K = \frac{p_A Q_A + wL}{p_C Q_C}$$

which measures the multiple of poultry income coming from other sources. This index is essentially a metric for the diversification effect in expression (4).

In the case of Viet Nam, Figure 12[1] shows that exposure through poultry keeping is significantly skewed toward smallholders. These national survey results support the geographic inference from Figure 10, that poultry dependence is inversely correlated with income and concentrated in regions with high provincial poverty headcounts. Not only are the poor more common (if not more numerous) in remote rural areas, but poultry is more important to their incomes. Figure 12 indicates that the latter is true regardless of whether the poor are in remote or semi-urban areas (where they are in fact much more numerous).

Figure 12 Exposure (percent) through poultry keeping by income level

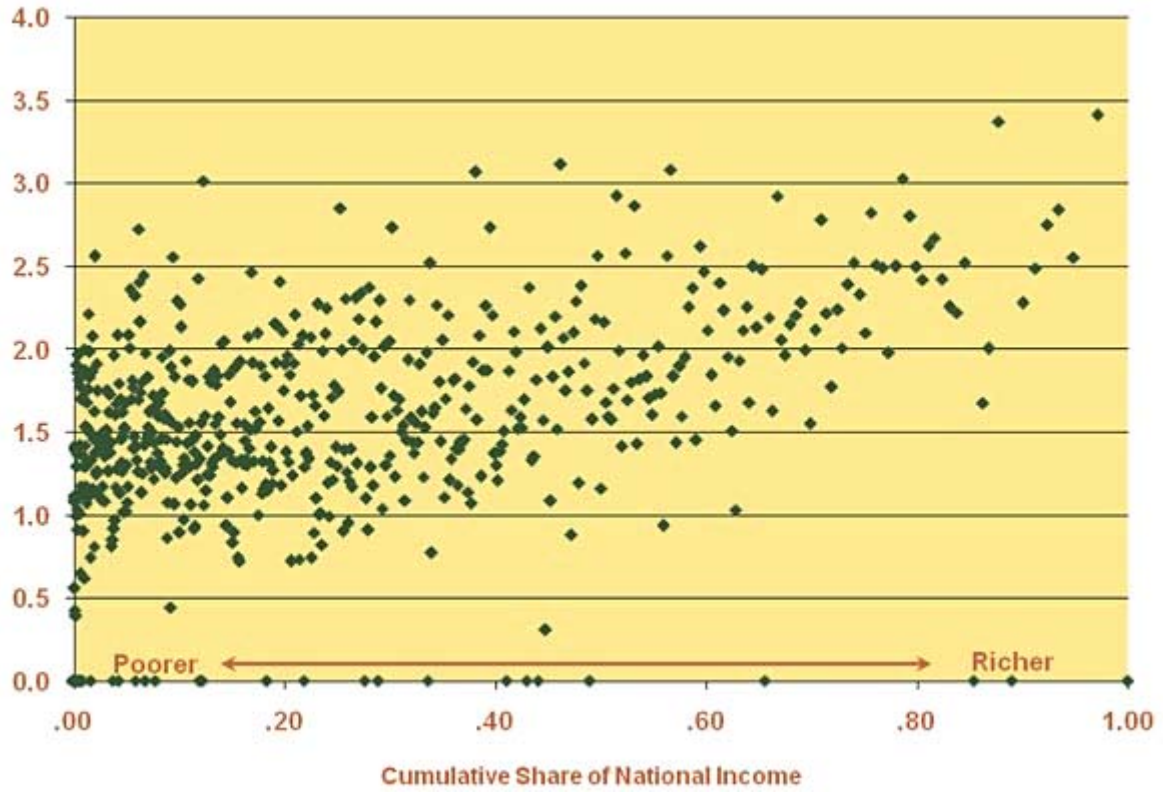


Source: Authors calculations

Although exposure is higher for low income groups, coverage rates are relatively high across the agricultural sector. Figure 13 depicts the base-10 logarithm of K with respect to household incomes, and coverage rates exceed 10 (log=1) for most of the population. Coverage rates vary significantly (two orders of magnitude are required to encompass 90 percent of this distribution), but most poor households have coverage rates between 10 and 100 (1 and 2 on the scale) and, as expected, coverage generally rises with income. This implies that a total stock loss would represent less than a 10 percent income shock for most households.

[1] The nationally representative sample of 65,000 households is aggregated here into rural and urban quintiles for each of Viet Nam's thirty provinces, yielding 300 observations of representative households.

Figure 13 Coverage (percent $\log_{10}$) of poultry-income shocks by household income level



Source: Authors calculations

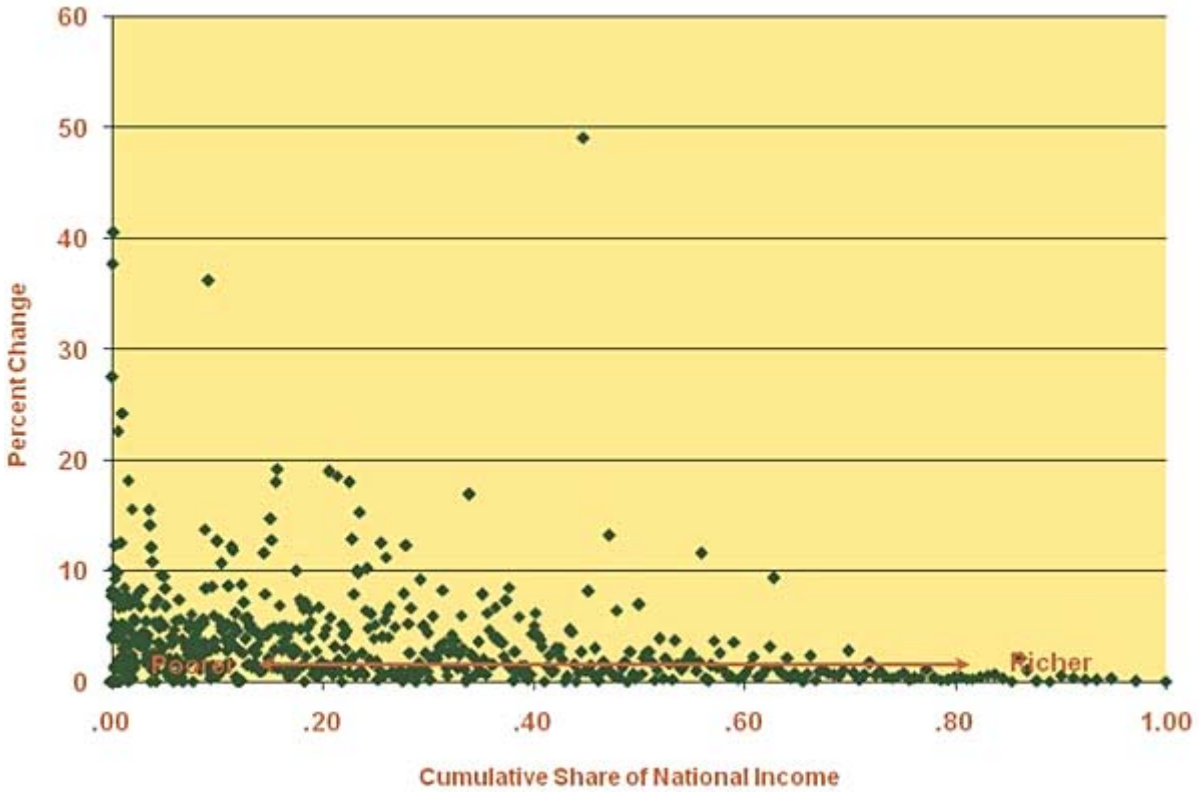
6. Diversification

'Coverage' implies the ability to offset poultry production risks/losses by expanding other income opportunities. On an average basis, Figure 13 implies that significant scope exists for this in Viet Nam, but individual adjustment capacity is more varied. To assess the latter, using the IPALP facility, we simulated an income-neutral loss of poultry stock, assuming individual households expanded other agricultural capacity/marketing to make up the income shortfall while 'diversifying' away from poultry in response to an economic risk level for this activity that has increased with the advent of HPAI. Recalling that we assume prices remain constant, the results are given in Figure 14. The results obtained indicate that most farmers could cope with a one-time poultry stock loss by increasing other agricultural production/marketing by 5 percent or less, although a significant minority would need increases in the 5 to 10 percent range. This is a relatively modest increase, indicating that 'diversification' with respect to poultry production should be a high priority for adjustment assistance programs. Such policies are generally more transparent than direct compensation schemes. Rather than creating potentially adverse coping incentives (e.g. disease concealment, illicit trading, etc.), they sustain the farmer's long term risk management capacity. Finally, note the linkage in this policy experiment between risk coping and risk management. The coping strategy increases farmer's coverage rates by

$$(7)\ \Delta K = \frac{p_A \Delta Q_A (>0) + wL}{p_C Q_C + p_C \Delta Q_C (\leq 0)} > 0$$

improving their long term risk position through diversification toward other farm and non-farm activities.

Figure 14 Risk coping by increasing other agricultural income



Source: Authors calculations

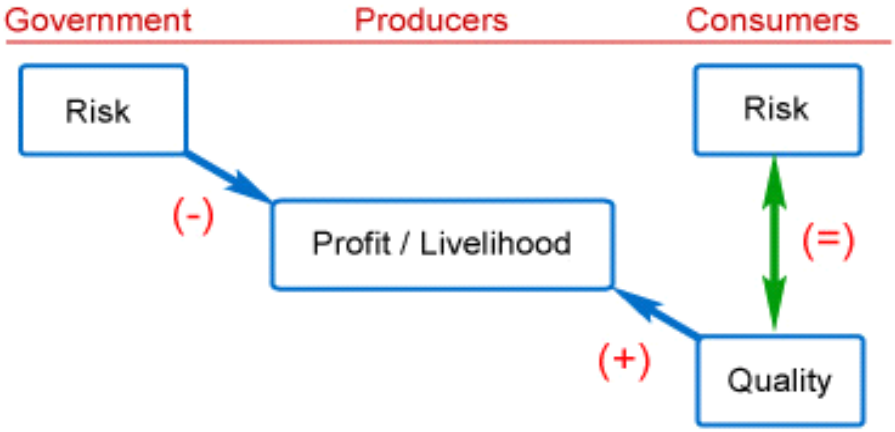
Analogous simulation with non-farm income as a source of coverage yields unsatisfactory results because a large proportion of rural households are in a 'corner solution' with zero initial non-farm income. This renders the counterfactual (percent change needed to offset poultry income losses) vacuous. Certainly development of non-farm income is an important component of the risk management agenda, but policy resources in this context are better targeted at urban and peri-urban populations with ready access to urban labour markets. For the rural poor majority, agricultural 'diversification', promoting a broader array of / increases in farm income sources, is a higher priority and a more appropriate focus of livestock policy.

7. Product Quality, Value Chains, and Certification

The second component of the farm insurance problem relates to product quality. Official perception of and action against animal disease such as HPAI is perceived by farmers as

negatively impacting their balance sheets, while product quality improvements in the form of animal health upgrading confers a positive effect (Figure 15).

Figure 15 Quality recognition in the supply chain



Recalling expression (4), farm insurance has two components

$$(8)\quad dP_C Q_C - d\pi_S S$$

denoting the farm revenue benefits of higher prices ($dP>0$) and reduced risk of adverse shocks ($d\pi_S<0$). In the HPAI context, the price effect can be attributed to improved product quality and/or stronger bargaining power, both of which have significant scope for improvement among smallholder livestock producers in Viet Nam and many other developing countries. Linkage between these causes and price effects are an empirical question, but it is worth noting from the simple table below that even modest price premia can add up to important financial buffers against adverse revenue shocks in a few years. Preliminary results of poultry price surveys in Viet Nam indicate that type/breed and quality differentials of more than 20 percent are common. This would pay back lost income from a 100 percent stock loss in five years, which provides a solid basis for micro-credit to restore stocks as an alternative to full compensation.

Table 2 Additive compounding of price premia

(all figures in percent)

Price	Additive Payback	
Premium	3-Year	5-Year
5	15	25
10	30	50
15	45	75
20	60	100

The second quality effect component arises from reductions in animal disease risks of any kind, since these are highly correlated with the probability of stock losses from either mortality or culling. In this context, it is important to recognize the link between control measures and farm balance sheets. These are alternative approaches to the same disease risk with very different incentive properties.

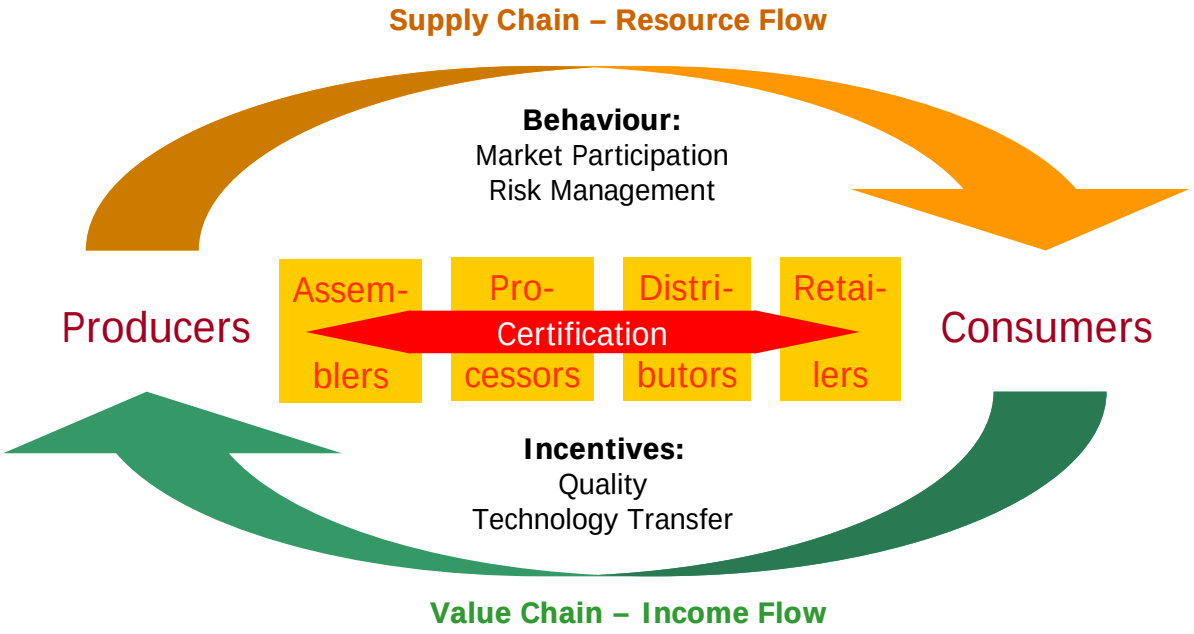
Returning to the first term in the quality effect (expression 8 above), it should be noted that price improvement can arise from two sources, (i) improved product quality and (ii) stronger bargaining power in marketing/value chains. Either can improve the returns for producers, and the two are closely linked by behavioural characteristics in markets. Smallholder producers are doubly disadvantaged in this context. Their remoteness increases their reliance on third party distributors, and this in turn undermines the market access they need to be more fully informed participants.

For smallholder livestock producers, higher market transactions costs and weaker bargaining power undermine their incentives to join the virtuous cycle of quality improvement and price appreciation. Both factors reduce their financial incentive to participate in value chains or make needed investments in expanded/upgraded production, while the latter poses a host of moral hazard and adverse selection problems. Smallholders are more likely to be 'screened' from final buyers by traders, consolidators, and other intermediaries, reducing the reputation incentive for product quality. As depicted in Figure 16, this situation can transform livestock markets into a classic 'lemons market' like that for used automobiles, where sellers cannot get a fair price for quality because of systemic uncertainty. Adverse selection then ensues, with lower quality producers driving others out of the market. Under the impetus of loss aversion, the consequences are even more severe when health standards are compromised in such a market. Producers with sub-standard animals have an incentive to increase supply, driving prices further down, and accelerating the decline in average product quality (including health/safety).

Adverse incentives in control measures can lead to a variety of unintended and undesirable outcomes. For any given sector regulatory regime, loss aversion may lead some producers to misrepresent animal health status. There are many strategies to circumvent health standards, including counterfeit certification, illicit marketing, inventory/invoice misrepresentation, stock swapping, etc., all of which increase the cost of public surveillance. Meanwhile, traders can actually profit in these circumstances by purchasing animals known to be sub-standard and reselling them without this information. In other words, uncertainty regarding product quality creates a wealth transfer from producers to traders (this is one of the main incentives for producer marketing cooperatives). Finally, buyers with low levels of risk aversion can also facilitate trade in sub-standard animals by ignoring minimum sanitary requirements to save money (this includes an important retail category of surrogate buyers, restaurants and butchers).

At all three levels, incentives exist for behaviour that will increase surveillance costs, undermine animal health standards, and transfer disease risk down the supply chain. Meanwhile, blending of animals from different producer and trader stocks can magnify the biocontainment problem.

Figure 16 Market flow of resources, value generation, and incomes



Practically speaking, the empirical properties of the ($d\pi_S$) term combine regulatory behaviour (probability of a cull), with epidemiology (infection risk). Indeed, this term is the only one in the farmer's HPAI risk management problem that directly addresses the animal health side of the problem. The initial probability of a shock may be exogenous, but ($d\pi_S$) can be affected by individual and collective strategies for disease risk management. In this context again, it is important to recognize that each farmer's action affects the adjustment risk faced by all others, and by extension anyone affected by HPAI now and in the future. These facts make it even more important that positive incentives take precedence in HPAI control policy. Finally, where control measures are necessary, it is essential they be transparent and credible. To make the financial commitments needed to mitigate risk, farmers need to accurately assess ($d\pi_S$) and its linkage to their own behaviour.

Compounding the challenge for smallholders are lack of financial capital and market access, both of which limit capacity for technology adoption. Livestock production on the part of the world's rural poor majority has evolved as an extension of subsistence activity, and thus relies heavily on customary practices and natural resources. Any new production standards must be coherent with these two characteristics if they are to be adopted beneficially. For example, medication of animals may require training or even social mediation to be accepted / adopted, while animal

confinement may deny access to common property (foraging) resources. These issues rarely arise with industrial scale producers, whose processes are more modular and easily re-configured.

From an investment perspective, two factors limit smallholder adoption of sanitary measures. Chronic illiquidity makes private transition from the traditional production model difficult. Moreover, R&D for biosecurity technologies appropriate to their scale of production is probably under-funded, narrowing the spectrum of technology choice for smallholders. As is the case in most low level investment traps, uncertainty and limited choice make smallholders require a higher rate of return per animal than large scale producers to justify an equal investment. Meanwhile, small scale imposes higher per animal costs for a given (fixed cost) technology.

8. Conclusions

Risks and uncertainty are endemic to agricultural activities, and poor farmers have limited means to deal with the many economic risks presented by nature, imperfect markets, and weak institutions. This paper examines an important risk in the global livestock sector, Highly Pathogenic Avian Influenza (HPAI), and assesses its significance for poor farmers in Viet Nam, one of the epicentre countries for this disease. After appraising the role of poultry in the national economy and among smallholder agricultural households, we evaluate how smallholder livelihoods can be affected by HPAI risk and adjustments arising from disease outbreaks and control measures.

Viet Nam is typical of lower income Southeast Asian economies in that poultry production is ubiquitous in both rural and peri-urban areas. Intensive production systems, although rapidly expanding, are the exception, with an overwhelming majority of birds and people engaged in smallholder production. Poultry are geographically concentrated near urban centres, but density of bird populations within households is low across the nation. Chickens are the dominant bird species across the country, and commercial operations are nearly all located in the periphery of a single large urban area, HCMC.

In addition to contributions it makes to food security and agricultural pest management, household poultry is an important source of income, and more so the poorer the household. Farmers themselves consider income from livestock as second only to crop yields as a contributor to their livelihoods. Our review of the evidence on poultry and livelihoods indicates that household poultry will remain important to Viet Nam's rural population as long as the smallholder production remains the majority farm enterprise model.

Given its economic importance across farms, the risk of poultry losses from disease or disease control measures can strongly influence farmers' decisions and welfare. We develop a conceptual framework to elucidate this behaviour and its implications for smallholder adjustment to adverse disease shocks, identifying two essential areas for deeper policy consideration. The first of these is diversification. Measuring HPAI risk exposure by the percent of income coming from poultry, we see this is low for the majority of Vietnamese households but can be significantly higher for poorer households. For these groups, policies targeted at increasing income shares from other agriculture and non-farm sources could reduce risk while increasing income. In the nationally representative sample we use, we find that only modest percent increases in other agricultural income can hedge the poultry 'exposure' of most poor households. Diversification with respect to poultry is also a more systemic approach to risk reduction than simple support payments for stock losses.

Another essential insight from this risk and adjustment analysis concerns product quality. Commitments to improving quality can contribute to expected income in two ways: (i) by reducing disease risk and (ii) by increasing producer prices. In the first case, farmers that improve the sanitary status of their birds reduce the risk of an adverse HPAI shock, directly from infection and indirectly if the government recognizes their effort and exempts them from culling. To increase prices is a much more complex problem, because it requires that individual farmers be recognized by buyers willing to pay a premium for product quality characteristics. Currently, most smallholders are 'shielded' from downstream contacts by distribution systems that consolidate birds and bird products, pooling disease risk and other qualitative uncertainties. This system undermines both consumer confidence (price) and the incentive for individual farmers to invest in higher quality. The report concludes that product certification systems could provide an essential remedy for these market failures. Adoption of credible and individualized certification systems can increase product quality and producer incomes while providing a more cost-effective disease surveillance and trace-back system.

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David Roland-Holst
Department of Agricultural and Resource Economics
207 Giannini Hall, University of California Berkeley, CA 94720 - 3310 USA
E-mail: dwrh@are.berkeley.edu

Michael Epprecht
Independent Consultant, ex-IFPRI
IPO Box 74 GPO, Hanoi, Viet Nam
E-mail: michael@epprecht.org

Joachim Otte
Food and Agriculture Organization - Animal Production and Health Division
Viale delle Terme di Caracalla, 00153 Rome, Italy
E-mail: joachim.otte@fao.org
PPLPI website at: http://www.fao.org/ag/pplpi.html