REVIEW ARTICLE

Improving Smallholder Farmer Biosecurity in the Mekong Region Through Change Management

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Summary

Transboundary animal diseases including foot-and-mouth disease and haemorrhagic septicemia remain a major constraint for improving smallholder large ruminant productivity in the Mekong region, producing negative impacts on rural livelihoods and compromising efforts to reduce poverty and food insecurity. The traditional husbandry practices of smallholders largely exclude preventive health measures, increasing risks of disease transmission. Although significant efforts have been made to understand the social aspects of change development in agricultural production, attention to improving the adoption of biosecurity has been limited. This study reviews smallholder biosecurity risk factors identified in the peer-reviewed literature and from field research observations conducted in Cambodia and Laos during 2006–2013, considering these in the context of a change management perspective aimed at improving adoption of biosecurity measures. Motivation for change, resistance to change, knowledge management, cultural dimensions, systems theory and leadership are discussed. Due to geographical, physical and resource variability, the implementation of biosecurity interventions suitable for smallholders is not a ‘one size fits all’. Smallholders should be educated in biosecurity principles and empowered to make personal decisions rather than adopt prescribed pre-defined interventions. Biosecurity interventions should be aligned with smallholder farmer motivations, preferably offering clear short-term risk management benefits that elicit interest from smallholders. Linking biosecurity and disease control with improved livestock productivity provides opportunities for sustainable improvements in livelihoods. Participatory research and extension that improves farmer knowledge and practices offers a pathway to elicit sustainable broad-scale social change. However, examples of successes need to be communicated both at the ‘evidence-based level’ to influence regional policy development and at the village or commune level, with ‘champion farmers’ and ‘cross-visits’ used to lead local change. The adoption of applied change management principles to improving regional biosecurity may assist current efforts to control and eradicate transboundary diseases in the Mekong region.

Introduction

The Kingdom of Cambodia and Lao People’s Democratic Republic are two countries in the Mekong region within South-East Asia where a number of transboundary animal diseases (TADs) are endemic, causing a range of negative impacts affecting smallholder farmers through national economies. Cambodia and Laos are two of the poorest countries in South-East Asia, currently equally ranked 138 on the United Nations Human Development Index...
(UNDP, 2012). In both countries, over 70% of the population live in rural areas, with the majority relying on agriculture for their livelihoods. ‘Smallholder’ is a term generally applied to a farm owner of land area <2 ha, with varying productivity that depends on availability of labour, skill, finance and technology resources (Conway, 2011). In a 1990 census, the average farm area for the continents of Asia and Africa was 1.5 ha, with population expansion and the division of land among offspring likely to be driving even smaller plot sizes (Conway, 2011). It is estimated there are 400–500 million smallholder farms worldwide, and of these, nearly 90% are in Asia (Conway, 2011). With this high number of smallholder farms, it is likely that 2 billion people or nearly a third of the world’s population are reliant on smallholdings for their livelihood.

Despite recent improvements in living standards, rural poverty remains a major challenge in Cambodia and Laos with 22.8% and 33.9% of people living below the international poverty line of $1.25 per day, respectively (UNDP 2013). Poverty impacts on children provide alarming statistics, with UNICEF data from 1990 to 1998 reporting 56% and 47% of children having stunted growth in Cambodia and Laos, respectively (UNICEF, 2013). Agricultural development is considered particularly effective in reducing hunger and malnutrition where it involves smallholders and is most effective in reducing extreme poverty and hunger when it increases returns to labour and generates employment for the poor (FAO, WFP and IFAD, 2012).

Smallholder farmers own over 99% of large ruminants in Cambodia, typically owning on average <5 heads each (Young et al., 2013a). Large ruminant production in Laos is also dominated by smallholders, typically owning 6–7 heads per household on 1.1–1.8 ha (Rast et al., 2013). Cambodian cattle in particular are often in poor body condition year round, have low reproductive performance and generally have poor productivity. The primary constraints of large ruminant production are poor nutrition due to inadequate feed quantity and quality and the constant risk of endemic infections and TADs. Development of the national beef industry has been prioritized by both governments due to geopolitical factors, driven by the rising demand for beef in regional advancing economies such as Vietnam, China and Thailand. Meat consumption more than doubled across Asia from 1980 to 2000 (Pingali, 2007), and red meat demand is expected to increase at 3.4% per annum between 1997 and 2020 (Delgado, 2003). Recent research has shown higher farm gate prices (O’Connell et al., 2013) confirming an opportunity for smallholder farmers to increase production and supply this demand as a pathway to help alleviate rural poverty and address food insecurity (Windsor, 2011; Young et al., 2013a).

Smallholder farmers often operate integrated mixed crop-livestock systems with different subsystems, each contributing to the outputs of the enterprise. Large ruminant livestock may provide multiple uses including draught power to cultivate the land, manure for soil fertilizer and/or biogas production, a storage of wealth, sale for beef, and as a sign of social capital or status (Herrero et al., 2010; Young et al., 2013a). These are generally low-input/output systems with use of by-products, where crop residues are used to feed livestock and large ruminants may be used for draught transport. While cropping (predominantly rice) generally provides the primary household staple and income, livestock often provide an important source of secondary income. Of increasing importance, income from healthy livestock may be able to buffer income losses from low crop yields due to climatic events including drought and flooding. Furthermore, as livestock are mobile, they offer some risk mitigation potential cf. crops when climatic catastrophes occur. However, large ruminants are also susceptible to climatic shocks, as documented in northern and central Laos where significant mortality occurred due to hypothermia (Khounsy et al., 2012).

Positively influencing the development of the smallholder farming system through ‘uptake and adoption’ of sustainable interventions or ‘change’ is a major challenge, particularly with respect to improving the management of disease risks. Herein, we review how a ‘change management perspective’ can be applied to improve the uptake and adoption of improved biosecurity in the Mekong region, examining biosecurity risk factors identified from peer-reviewed literature and field observations from our applied field research in Cambodia and Laos during 2006–2013. Change management refers to the understanding of how change is leveraged through strategy, structure and operational processes as well as through informal processes such as power, politics and conflict, culture and leadership (Senior and Fleming, 2010). Topics discussed include motivation for change, resistance to change, knowledge management, cultural dimensions, systems theory and change management leadership. It is suggested that application of applied change management principles to improve biosecurity may assist rural development in the Mekong region through contributions to regional efforts aimed at control and eradication of TADs, thus assisting efforts to alleviate rural poverty.

The Threat of Transboundary Animal Diseases

Foot-and-mouth disease (FMD) and haemorrhagic septicaemia (HS) are two of the most significant TADs impacting smallholder large ruminant farmers in the Mekong region (Young et al., 2013a). In the first half of 2010, the overall incidence of FMD in South-East Asia was at its lowest compared to the previous 3 years (OIE, 2011). Starting in September 2010, increased outbreaks were reported.
in Cambodia, Lao PDR, Thailand and Vietnam with regional epizootic peaks in December 2010 until February 2011 with sporadic outbreaks in the following months (OIE, 2011). This major epizootic highlighted a key failure in international biosecurity in the Mekong region and beyond. The true impact of the 2010–2011 epizootic remains largely unknown due to widespread disease underreporting (Nampanya et al., 2012; Young et al., 2013a) and paucity of socioeconomic studies. In 2010, the Department of Animal Health and Production (DAHP) in Cambodia reported over 60,000 FMD cases in large ruminants although the number of official reports is considered to be a gross underestimation of the actual number. A two-source capture–recapture analysis indicating the official reporting rate of villages in Svay Rieng province experiencing clinical FMD cases to the provincial authorities was only 5% (Vergne et al., 2012). Examination of government reports from Laos indicated there were just fewer than 25,000 large ruminant FMD cases reported in 2010 (Nampanya et al., 2012).

The lack of timely and accurate disease event reporting very likely reflects the limited veterinary service capacities in both countries, particularly at the village level. Although official government veterinary service staff is present at the district level, government veterinary capacity at the commune or village is provided by private para-veterinarians known as village animal health workers (VAHWs) in Cambodia and village veterinary workers (VVWs) in Laos. These para-veterinary workers are important in current disease management, particularly in countries where veterinary educational and regulatory institutions are limited. It has been suggested that the VAHW provision of field animal health services to smallholder farmers has the potential to fill the current gap that exists in FMD control between government services and farmers in Cambodia (Stratton, 2013). However, further research is required to test whether VAHWs can improve vaccine delivery in the face of FMD outbreaks (Stratton, 2013) as well as improve the efficiency and accuracy of disease event reporting. Experience from highly pathogenic avian influenza (HPAI) indicates that training that tends to emphasize disease recognition results in village-level para-veterinarians making diagnostic decisions about disease incidents, leading to filtering of information at the very first step in the reporting process (FAO, 2013). Further filtering can occur at the next step (usually district level) if the outbreak is to be judged to be a common endemic problem rather than a disease incident requiring investigation (FAO, 2013). Capturing disease incident information imposes a financial burden, some of which is borne by the volunteers themselves, thus leading to a decline in their enthusiasm for the process over time (FAO, 2013). Furthermore, this private–public partnership creates significant reliance on the efforts of ‘upstream’ officials and the quality of their engagement with village-level workers (FAO, 2013). While improving disease surveillance will remain an important priority, another proactive approach is systematically addressing smallholder farmer knowledge of animal health and husbandry through participatory research and extension activities. Many smallholder farmers currently practice a range of high-risk practices, with poor biosecurity increasing the risk of transmission of TADs. These practices, combined with poor animal husbandry (nutrition, reproduction) and limited formal market development, are currently major constraints to increasing large ruminant outputs (Stahel et al., 2013).

The South-East Asia and China Foot-and-Mouth Diseases Campaign (SEACFMD), initially established in 1997 by the World Organisation for Animal Health (OIE) and its collaborative partners, is now in its fourth phase of a roadmap to prevent, control and eradicate FMD by 2020. Phase four from 2011 to 2015 incorporates lessons learned from previous phases, recent scientific developments and the changing socio-economic patterns that impact on disease control activities (not limited to FMD), providing directions for disease prevention and management including vaccination and zoning (OIE, 2011). Although reducing TAD incidence and eventual eradication is highly desirable, there is a range of biological, financial, political, geographical and social constraints that threaten the achievement of the 2020 goal.

Recent research projects titled ‘Best practice health and husbandry of cattle, Cambodia’ (BPHHC) and ‘Best practice health and husbandry of cattle and buffalo in Lao PDR’ (BPHHL), have shown that baseline smallholder knowledge and understanding of animal husbandry and health is very low but significant improvements can be made through participatory research and extension programs that address village-level biosecurity and reduce disease risks in northern Laos and southern Cambodia (Nampanya et al., 2010, 2012; Young et al., 2013a). These initiatives are best delivered simultaneously with efforts that enhance large ruminant productivity of smallholder producers and confirm that improving both community level and smallholder farm biosecurity is achievable and potentially important in reducing the impacts of TAD on smallholder households. Improving smallholder knowledge to increase the health and husbandry of cattle and buffalo as a means to enhance large ruminant productivity and profitability will simultaneously help address regional food insecurity and offer a pathway to help alleviate rural poverty (Windsor, 2011).

The impact of aid projects is often high during the life of the project, yet these impacts fade if participant knowledge at project completion is not translated into sustained changes in practice. Governments, donors and communities in general are seeking optimal investment returns on interventions that can lead to sustainable change (Pachico and Fujisaka, 2004; Millar and Connell, 2010). Reducing
the incidence of TADs through improving biosecurity practices by educating smallholder farmers in disease risk management as a strategy to protect improved productivity offers a probable cost-effective and sustainable method of improving smallholder livelihoods.

The Need for Improved Biosecurity

TADs are defined as those diseases that are of significant economic, trade and/or food security importance for a considerable number of countries, which can easily spread across borders and reach epidemic proportions, and where control and management, including exclusion, requires cooperation between several countries (Otte et al., 2004). Both FMD and HS are important TADs and are endemic in Cambodia and Laos as well as neighbouring countries in the Mekong region. These diseases can have a high financial and social impact on smallholder households through animal weight loss or death, leading to a reduction in animal value and high costs for treatment and replacement (Shankar et al., 2012; Young et al., 2013a; Kawasaki et al., 2013). Household members (often women and children) may spend a substantial amount of time and money caring for sick animals that may otherwise be spent in other farm or employment activities or schooling in the case of children (Young et al., 2013c), imposing both financial and social impacts.

Biosecurity can be defined as the implementation of measures or interventions that reduce the risk of the introduction and spread of disease agents on a farm or along a value chain. The details of how biosecurity is applied depend on the individual production system in question, its environmental surroundings, the target disease agent and the available resources, with the three principle elements of biosecurity: segregation, cleaning and disinfection. A practical approach to biosecurity interventions involves consideration for the disease triad: the pathogen, the host and the environment, and how limiting the interactions between the three factors can be achieved to mitigate successful transmission and infection.

It is widely recognized that livestock movement is probably the single most important method of transmission of FMD virus in those countries where FMD is endemic (Rosenberg et al., 1980; Rweyemamu, 1984; Fonnan, 1991; Ferris et al., 1992; Windsor, 2011). Recent research has indicated that smallholder farmers within villages sell 17% of cattle per annum; however, this is considered to be an underestimation (Young et al., 2013b). Considering that 85% of smallholders own three or fewer cattle (Young et al., 2013b), this high annual sale rate, combined with other mobility uses (draught and transport) and communal grazing, would likely provide multiple opportunities for direct contact and opportunity for disease transmission.

Cleland et al. (1996) reported that the greatest impact on reducing the spread of FMD among villages would be through strategies that reduce the likelihood of introductions through livestock purchases, and for villagers taking greater care when livestock is grazed with those from neighbouring villages, particularly when sharing common water supplies. This combined with simple quarantine of early cases during outbreaks and provision of independent water supplies for different villages should also reduce the frequency of FMD outbreaks (Cleland et al., 1996) and supports implementation of biosecurity interventions at the village level. The high volume of inherently variable smallholder farms across multiple administrative layers is in itself a significant constraint to implementing broad-scale biosecurity change (Fig. 1). Researchers have noted that the most appropriate approach to FMD control would be to prevent infected animals from entering the principal trading routes for pigs, cattle and buffalo, plus protection of livestock systems adjacent to these trading routes by vaccination (Perry et al., 2002). One must consider the practicality of such interventions in countries where veterinary capacity and regulation are limited. Furthermore, strategies need to be in place to limit impacts if infection does breach administrative borders.

Part of the BPHHC/L research objectives was to investigate sustainable methods for improved biosecurity activities of smallholder farmers. Smallholder farmers currently undertake risky behaviours and activities undermining biosecurity of which examples are provided (Table 1).

A common theme in the observed constraints is limited smallholder farmer knowledge of both animal health (biosecurity) and methods for improving animal productivity.

Drivers for Change

A change in smallholder farmer practices (behaviour) and attitudes (beliefs) is needed to improve biosecurity practices and reduce the impact of TADs. Changes in husbandry methods, such as reduced communal grazing through increased animal housing and only purchase of animals with a known disease history, have the potential to reduce the incidence of TADs. Achieving a change in behaviour towards improved biosecurity and greater control of TADs is likely to have positive benefits and impacts on the smallholder and greater public good (Young et al., 2013a).

Due to significant scientific advances to date; never before have we had the necessary accumulated knowledge and technological tools to support the control and eradication of TADs including FMD. Therefore, the limiting factor becomes more than the disease itself; rather, it is how to successfully and sustainably deliver and implement the interventions to address these old and sometime
re-emerging problems. As described by Otte et al. (2004), recent years has seen both progress and retreat with regard to controlling TADs. Technical ability to control old problems has advanced with improved information exchange; however, increased movements of people and goods have facilitated TAD spread (Otte et al., 2004).

When considering traditional farming practices, the term ‘traditional’ is at a polar opposite to the term ‘change’. Traditional technologies or methods are approaches to problems that have been used by people for hundreds, if not thousands, of years (Conway, 2011). While smallholder farmers the world over have steadily accumulated local experience and tacit knowledge that will help them to adapt in the future, the rapid rates of change seen in many agricultural systems in developing countries may simply outstrip their capacity (Herrero et al., 2010). There is an urgent need for research and extension that identifies knowledge-based interventions that best assist smallholders to simultaneously improve productivity, health, trade and marketing of large ruminants (Windsor, 2011; Nampanya et al., 2012). In this context, perhaps the greatest opportunity lies in not the delivery of improved technological methods, but in the delivery of knowledge through education to allow smallholder farmers to adopt interventions that are suitable for their individual needs. The scaling out of new activities, technology and practices should enable farmers in different locations identify their problems, trial a range of options and make informed decisions about improving their livelihoods (Millar and Connell, 2010).

**Smallholder Farmer Motivation for Change**

Despite significant efforts of government, research and donor organizations to provide improved biosecurity practices, relative to production-focused initiatives, there has been little emphasis on understanding and gaining insight into smallholder drivers and motivation for change in disease risk-associated activities. Extrinsic (external) motivation involves tangibles such as money, status, and recognition from the ‘powers at be’ (rewards) and can also involve the threat of losing these tangibles (punishment). Intrinsic (internal) motivation comes from within or are intangible factors such as feelings of satisfaction, sense of accomplishment, sense of achievement, pride in one’s work, desire to develop as much as possible and really stretch potential (Evans-Kocinski, 1992). Extrinsic motivation may lead to temporary compliance but only intrinsic motivation leads to internalized changes in attitudes and beliefs and thus sustained behavioural change (Deci, 1996). Wiegers and Curry (2009) discussed factors impacting smallholder uptake of biosecurity related to HPAI influenced by the interrelation of factors including farmers’ risk perception and attitudes, livelihood impacts, knowledge and trust, incentives, and resource endowments. Livelihood factors include loss of income and livelihood, debts, asset sale to repay loan after collapse of poultry business, increased expenditure on alternative protein sources, and the inability to invest in their social networks (Wiegers and Curry, 2009).

An essential component of change is that it is clear who gets rewarded and for what (Kanter, 2001). The expected
The outcomes of the change need to be clearly identified, quantified, and communicated to the smallholder farmers and associated stakeholders including the VAHW/VVW and village chief/headman. The benefits to smallholders may be financial, such as increased income due to avoiding losses from disease, or social, such as increased time for other pursuits that would have otherwise been spent caring for sick animals. The benefits to governments or public good may include increased rural employment and regional and international trade of livestock (and products) to supply growing regional and international demand. The adoption of biosecurity is challenged by the low degree of ‘observability’ meaning that farmers, in the absence of an actual outbreak in their vicinity, cannot easily see the benefits of any prevention measure (Wiegers and Curry, 2009). This presents a major challenge to sustainable uptake and adoption and supports the need that biosecurity be delivered together with production improvements to ensure farmers see tangible benefits. Biosecurity practices that lead to increased household labour without clear benefits are likely

<table>
<thead>
<tr>
<th>Current practices related to poor biosecurity</th>
<th>Observed constraints</th>
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<tr>
<td>Large ruminants in poor body condition and of low immune status</td>
<td>Limited farmer knowledge of modern husbandry methods including nutrition and preventive health</td>
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<tr>
<td>High rate of (direct) animal-to-animal contact between large ruminants, large ruminants sharing common water sources (indirect)</td>
<td>Limited use of fencing (segregation)</td>
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<td>Vaccination for transboundary animal diseases including foot-and-mouth disease (FMD) and haemorrhagic septicaemia (HS) is not routinely practiced by smallholders</td>
<td>Large ruminants are managed in a free-grazing or communal manner</td>
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<td></td>
<td>Mixed use of large ruminants (draught and transport) and potential for high rate of direct contact</td>
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<td>Relative high volume of sale and purchase of large ruminants</td>
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<tr>
<td>Purchase of animals with unknown disease status</td>
<td>Vaccination failure due to inadequate restraint, administration, cold-chain failure and incorrect vaccine matching</td>
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<td></td>
<td>Cost of vaccine relatively high</td>
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<td>Capacity of para-veterinary workers</td>
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<td></td>
<td>Farmer resistance due to effort involved in restraint</td>
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<td></td>
<td>Limited farmer knowledge of disease aetiology</td>
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<td></td>
<td>Belief vaccine causes harm (i.e. abortion)</td>
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<td>Reluctance to use new technology and disease prevention strategies</td>
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<td></td>
<td>Inability of farmers to locate large ruminants when free-grazing during vaccination day/program</td>
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<td></td>
<td>Limited motivation to invest in preventive practice</td>
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<td>Short-term orientation</td>
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<td>Sale of animals with an active disease or as a disease carrier</td>
<td>Farmers lack knowledge of disease and fear animals will die due to illness therefore sell in an attempt to salvage value</td>
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<td>Limited enforcement of animal health laws</td>
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<td>Failure to report disease events and outbreaks and inadequate responses</td>
<td>Currently limited training for village para-veterinary workers</td>
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<td></td>
<td>Limited knowledge of disease risk mitigation activities (biosecurity)</td>
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<td>Animal health agencies have limited resources</td>
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<td>Limited use of cleaning and disinfection in relation to large ruminant equipment, feed and water bins, para-veterinary equipment, potential people and vehicle associated fomites</td>
<td>Limited available running water and adequate cleaning facilities</td>
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<td></td>
<td>Limited use and knowledge of disinfectants</td>
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<td></td>
<td>Limited zoning of clean areas</td>
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<td></td>
<td>Traders visiting farms regularly</td>
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<td>Limited use of quarantine of newly purchased large ruminants</td>
<td>Limited farmer knowledge of quarantine</td>
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<td>Limited suitable segregation facility for two-week quarantine</td>
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<td>Limited use of livestock identification</td>
<td>Belief that ear tags will harm the animal or reduce value</td>
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<td></td>
<td>Lack of adequate and safe restraint facilities</td>
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<td>Low literacy of farmers</td>
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<td>Limited animal health recording of disease events and interventions including vaccination</td>
<td>Limited animal traceability</td>
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<td></td>
<td>Limited farmer knowledge of diseases and appropriate risk management</td>
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<td></td>
<td>Low literacy of farmers</td>
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<tr>
<td>Limited breeding management</td>
<td>Uncontrolled breeding in communal free-grazing management</td>
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</table>
to be rejected by smallholders given that in most systems resources will already be stretched; therefore, strategies where biosecurity can be implemented that will reduce household labour is likely to be more successful. For example, housing cattle and feeding forages has shown to reduce household labour (Maxwell et al., 2012) while also reducing communal grazing and direct animal contact.

Matching participatory research with positive socioeconomic outcomes is likely to raise the probability that interventions become sustainable. Interventions that provide immediate and obvious benefits, or ‘entry point interventions’ or ‘sparks of interest’ (Millar and Connell, 2010), can be used to promote a package suite of interventions including the less obvious interventions providing benefits, which we designate as ‘attachment interventions’. In the example of Cambodia, forage development was quickly identified as an ‘entry point’ intervention, with rapid uptake and adoption by farmers as they immediately saw the time-saving benefit of feeding forages to cattle grown close to the household, nullifying the labour- and time-intensive activity of searching for cattle feeds. A host of ‘attachment interventions’ were then rolled out once farmer attention had been captured and trust developed, including educational- and knowledge-based interventions on animal husbandry, health, biosecurity, reproduction and marketing (Nampanya et al., 2012; Young et al., 2013a).

It is important to note that preconceived ideas on what are or what should be entry and attachment interventions prior to the project commencement may need to remain flexible or even cast aside, and instead the intervention categorization be allowed to be made self-evident through smallholder feedback – which may be reframed from resistance. This became significantly obvious in Cambodia, where forages captured attention, and in Laos, where a single calf treatment of pyrantel between 14 and 21 days of age for Toxocara vitulorum to increase survival received the highest initial attention and smallholder farmer priority. Different communities, and farmers within communities, will have different priorities, and projects should be flexible to adapt to meet current needs throughout the project lifecycle.

Resistance to Change

It would be expected that some smallholder farmers would be resistant to uptake and adoption of new practices, as change can be unpredictable and arouse anxiety. It is important that resistance be examined and reframed as feedback to ensure that intervention implementation can be modified where needed. Factors limiting uptake and adoption should be investigated so that issues are addressed and methods modified to increase success of sustainable change.

Smallholder farmers may be resistant to adoption of practices due to lack of awareness and the perceived high cost of implementing preventive practices such as vaccination. In some cases, there are examples of ‘learned helplessness’ (Seligman, 1975) where smallholder farmers having received a range of assistance from various programs simply wait for assistance from government, donor and research programs to provide interventions such as vaccination, in which case they do not seek it out independently. Change projects can be adapted to ensure this is avoided, that is, through using a gradually implemented user pay system rather than fully subsidized interventions throughout the project life and expecting costs to be suddenly borne by smallholders at project completion, as well as providing cost–benefit evidence for intervention use.

Sources of resistance may vary, and nine potential sources are presented using an adaptation of a recently compiled list (Kanter, 2012) (Table 2). Current social dynamics including low literacy and limited knowledge of new technology may lead to risk of embarrassment, diminished stature or loss of respect (Ford and Ford, 2010). BPHHC project surveys of current smallholder farmers in southern Cambodia indicate that family heads are often around the age of 50, meaning that they would have been young teenagers during the 1975–1979 Khmer Rouge regime, when an estimated two million people were killed. Instead of receiving education, many children and young adults were sent to work in the fields in atrocious conditions (Maxwell et al., 2012). Ford and Ford (2010) report that in an attempt to rectify injury created by broken trust or betrayal, people may lower productivity, reduce work quality and become uncooperative. Sensitivity to cultural and historic practices and events should be considered by foreign experts involved in the implementation of donor-funded projects, highlighting the importance of in-country project partners as discussed by Windsor (2011). Cultural and religious factors may also be of significant importance. Theravada Buddhism, the predominant religion in Cambodia and Laos, may influence practices related to animal husbandry, welfare and management, that is, slaughter practices may be undertaken by a different religious group.

Being aware of possible defence mechanisms may help identify and frame resistance. Often, resistance to change derives from personal anxiety. When we are afraid, we are inclined to become defensive and hide our fear from others and ourselves through ‘rational’ resistance. Defence mechanisms protect one’s self-image from damage and sustain belief in one’s coping ability. Defence mechanisms may include (i) selective perception, that is, where the farmer does not believe the disease presents a significant threat; (ii) scapegoating, that is, where the farmer blames others (such as neighbours) for disease introduction without
taking preventive steps; (iii) regression, that is, where the farmer reverts to previous risky behaviours and low productive practices; (iv) denial, that is, where the farmer does not face the reality of the true risk of disease or the impact of the disease; and (v) displacement, that is, where the farmer considers the disease is caused by spiritual influences rather than biological causes. Farmers may also be affected by cognitive bias (Vedantam, 2008); that is, the weather plays a significant role in farm outcomes, so farmers often blame the weather when production is low and may tout how good their management is when the weather is favourable, when in fact the weather may be only one of a range of factors influencing production outcomes. Where possible, interventions should be implemented during times when farmers are not facing other crises to avoid blaming the interventions for production failure or disease occurrence. In Cambodia, flooding can be a problem that has limited farmer engagement due to lack of time and

**Table 2. Sources of resistance (adapted from Kanter, 2012)**

<table>
<thead>
<tr>
<th>Source of resistance</th>
<th>Leadership and behavioural strategy</th>
<th>Smallholder contextual example</th>
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<tbody>
<tr>
<td>Loss of control impacting self-determination.</td>
<td>Allow participation and incorporate choice in decision-making.</td>
<td>Engagement of smallholder farmers who are willing to improve systems and keeping an open door for non-project participants to be involved where resources permit.</td>
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<tr>
<td>Excess uncertainty where change is rejected simply because it varies too far from the norm.</td>
<td>Provide a clear vision and details of strategy in clear, simple steps with a timetable.</td>
<td>Communicate with stakeholders to foster an open process including visiting sites and engaging smallholders directly about their needs, concerns and triumphs.</td>
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<td>Surprises where decisions are imposed on people suddenly without time to prepare for the consequences.</td>
<td>Share information to minimize surprises; allow time to prepare and reassure; minimize number of differences; leave habits and routines alone.</td>
<td>Use of participatory research to document and communicate expected results and benefits. Plant the seeds of change early with community leaders.</td>
</tr>
<tr>
<td>Loss of face through the acknowledgement that previous animal husbandry practices are not suitable or able to meet current aims.</td>
<td>Integrate and highlight past practices that do work with the new.</td>
<td>Allow sceptical smallholders to observe and participate at own convenient timing; enable people to maintain dignity by celebrating those elements of the past that are worth honoring and making it clear that the world has changed.</td>
</tr>
<tr>
<td>Competence concerns</td>
<td>Use positive reinforcement to ensure participants are not made to feel that their skills are obsolete.</td>
<td>Implement gradual change combining both old and new technologies; repeatedly demonstrate your own commitment; ensure structural reassurance providing abundant information, education, training, mentors and support systems; use a period of overlap, running two systems simultaneously to help ease transitions.</td>
</tr>
<tr>
<td>More work is required</td>
<td>Make requirements, standards and benefits clear. Reward pioneers, innovators and supporters; identify early adopters to serve as champions.</td>
<td>Link biosecurity to livestock production to ensure livelihood gains (income, time saving, children’s schooling) are clear; two champion farmers were supported by the BPHHC project to participate in the ‘National Farmer of the Year’ competition.</td>
</tr>
<tr>
<td>Ripple effects of the changes leading to unexpected outcomes, which may lead to push back from external sources. Past resentments may arise through change implementation.</td>
<td>Identify threats early and be honest about expected impacts.</td>
<td>Identify new opportunities outside initial change boundaries and provide development assistance.</td>
</tr>
<tr>
<td>Real threats from new technologies replacing old ones.</td>
<td>Avoid creating obvious losers but also be candid from the outset.</td>
<td>Recognize sorrows and resentments of the past; letting people air their grievances or they will have trouble moving on.</td>
</tr>
</tbody>
</table>

Offset any employment losses with identification of opportunities such as the creating of the ‘forage economy’ where champion farmers develop forage nursery enterprises.
resources while they manage the climatic event; therefore, the timing and duration of intervention implementation become critical. Farmers also fear that vaccination can lead to abortion and are therefore reluctant to use this practice in animals that are assumed pregnant. Targeted participatory research can help clarify such questions and improve uptake and adoption.

**Knowledge Management and Transfer (Communication)**

Knowledge is among the key determining factors of farmers’ investment decisions related to biosecurity (Wiegers and Curry, 2009). Managing groups to effect broad-scale change requires communication as the central factor. Managing knowledge requires a conscious move from tacit to explicit knowledge (the subconscious to conscious). Tacit knowledge is highly personal, hard to formalize and therefore difficult to communicate (Nonaka, 1991). Tacit knowledge has an important cognitive dimension, consisting of mental models, beliefs and perspectives that we take for granted and therefore cannot easily be articulated. In order for change to reach a broader community, it must become explicit. BPHHC/L research has shown that baseline smallholder knowledge of methods and understanding of animal husbandry and health is low; however, improvements can be made through participatory research and extension programs to address village-level biosecurity and simultaneously enhance large ruminant production capabilities of smallholder producers in northern Laos and southern Cambodia (Nampanya et al., 2010, 2012; Young et al., 2013a). There are also many instances of ‘know-how knowledge’ that should be elicited from the smallholders themselves.

Nonaka (1991) describes four sequences of knowledge transfer: (i) Tacit to tacit – one individual shares tacit knowledge directly with another, that is, champion farmers propagate the use of new technology and practices to other farmers. This ‘socialization’ of the knowledge allows the receiver to become part of the tacit knowledge base. This learning may not be available to the wider community, therefore may be limited in eliciting broad-scale change. (ii) Explicit to explicit – an individual ‘combines’ discrete pieces of explicit knowledge into a new whole, that is, project specialists combine knowledge with experience and observations to find new solutions and innovation. (iii) Tacit to explicit – a specialist ‘articulates’ more of what they know, opening new opportunities for non-specialists, that is, research is undertaken to identify success factors in individuals that can be propagated to larger groups. (iv) Expli-

| Table 3. Structured process improvement for smallholder agricultural development and disease control (adapted from Haigh et al., 2003) |
|---------------------------------|---------------------------------|---------------------------------|
| Levels                          | Description                     | Application to smallholder agricultural development and disease control |
| 1. Initial                      | No key processes and little process focus. Unpredictable and ad hoc – depends on individuals. | Smallholder farmers operating largely independently, using tacit traditional techniques and technologies. Farms have high heterogeneity; disease is endemic and largely uncontrolled. |
| 2. Repeatabe                   | Degree of predictability. Realistic commitments. Good project management processes e.g. project planning, subcontract management, risk management. | Baseline participatory research captures tacit knowledge and practices. Key processes suitable for sustainable uptake and adoption are identified, implemented, trialled and refined. |
| 3. Best Practice Sharing       | Activities are documented, standardised and integrated. Standard processes are used. Teams and units share good practices. Significant visibility of knowledge sharing projects. | Explicit knowledge of best practice techniques and technologies are shared using a range of communication channels and activities. Use of ‘champion farmers’ and ‘cross visits’ to propagate and promote best practice technology. |
| 4. Managed                     | Quality goals for products, processes and supply chain relationships. Variations are narrowed so they fall within acceptable boundaries. | Best practice techniques and technologies are refined to meet market expectations. |
| 5. Optimising                  | Entire supply chain network is focusing on continuous process improvement. Proactive approach to identify and strengthen areas for improvement. Innovations are identified and disseminated throughout the organization. | Best practice techniques and technologies are constantly evolving to further increase productivity and profitability. Disease becomes controlled, and no longer constrains industry. |

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cit to tacit – when new explicit knowledge is ‘internalized’, it becomes tacit, that is, adoption of improved technologies becomes the new process norm.

Haigh et al. (2003) described five stages of knowledge sharing through a process of continuous improvement. While the process model was developed for the construction industry, the concept has been applied to smallholder agricultural development and disease control (Table 3). While Haigh et al. (2003) recognise few organizations reach the ‘optimising’ stage, it is important that it is stated as the primary goal in a cyclical process, with Nonaka’s (1991) knowledge transfer model also involving a cyclical process of socialization, combination, articulation and internalization.

Change needs people who are or become passionate about seeing the change take place (Kanter, 2001). Change champions are the activists and cheerleaders for change (Kanter, 2001). In the BPHHC project, several ‘champion farmers’ were identified as change leaders in their community. These farmers were early adopters often approaching the research team seeking new information and subsequently now promote and facilitate further adoption among their farming peers. Through demonstration of successful implementation of improved interventions, champion farmers may help improve other smallholder farmers through increasing their self-efficacy, boosting their confidence that they too, can implement improved practices leading to increased productivity. In Cambodia, one farmer from a village beyond the project sites approached the project team seeking assistance to improve cattle production. Through working with the project team, he developed stall feeding of forages, leading to improved biosecurity, savings of time and increasing his herd size and income (see ACIAR Blogspot, ACIAR, 2012). Cross-visits involved organizing farmers from one village or commune visiting another village where the interventions had been adopted successfully. Rewards and recognition is an essential component of change (Kanter, 2001), and both champion farmers and cross-visits allowed farmers who had implemented interventions share their success stories with perspective peers. Careful management strategies of this tacit to tacit knowledge transfer have the potential to lead to broad-scale change.

Both these types of tacit knowledge transfer were found to be particularly useful in the BPHHC/L projects and have also been highlighted as important extension techniques by Millar and Connell (2010) in Laos. Wiegens and Curry (2009) consider the importance of interpersonal channels (i.e. direct word of mouth) in the Mekong region. Smallholders seeing successful adaptation to new technologies by other smallholder farmers operating in the same geopolitical and socioeconomic situation can allow farmers considering the technology and interventions to discuss and question their reservations, as well as potential benefits. ‘Seeing is believing’ and seeing what is being done, by others with whom they identify with, can be a powerful extension tool. Factors influencing this supposition may include levels of education including literacy as well as cultural influences.

Cultural Dimensions

Culture is defined as the collective mental programming of the human mind that distinguishes one group of people from another (Hofstede Centre, 2013). A range of factors including historic events, political systems, geography, climate, social values, laws, religion and economic systems may influence culture. Cultural values affect the attitudes and behaviour of people, impacting their actions and performance (Fu and Yukl, 2000). The power distance index (PDI) is the extent to which the less powerful members of organization accept and expect that power be distributed unequally (Hofstede 2001). South-East Asian countries including Malaysia, Indonesia and the Philippines have a much higher PDI than those of the USA, Australia and New Zealand (Hofstede 2001). In countries that are of generally higher power distance countries, those less powerful accept power relations that are more autocratic and paternalistic (Hofstede 2001). In the context of eliciting improved village-level biosecurity, early engagement of the village chief/headman is important to engage larger groups of smallholder farmers and community groups. Individualism versus collectivism, considers the degree to which individuals are integrated into groups, with individualistic societies stressing personal achievements and individual rights, while in collectivist societies individuals act predominately as members of a lifelong and cohesive group (Hofstede 2001). This is often evidenced in Cambodia and Laos with children, parents and grandparents living together within village communities. This community value may also influence the potential impact of champion farmers or change leaders beyond certain geographical and community boundaries. Long-term orientation versus short-term orientation describes societies’ time horizon, with those of long-term-oriented societies attaching more importance to the future whereas in short-term-oriented societies, values promoted are related to the past and the present, including steadiness, respect for tradition, preservation of one’s face, reciprocation and fulfilling social obligations (Hofstede 2001). Short-term orientation may also be partially explained using Abraham Maslow’s pyramidal hierarchy of needs, where first basic needs are to be met, followed by psychological needs followed by self-fulfilment needs. In this context, preventive risk management strategies such as annual vaccination may not be as appealing to short-term oriented groups compared to responsive vaccination in the face of an outbreak, as people react to immediate needs rather than future risk of disease.
**Systems Theory Application**

Too often there is a lack of attention directed at understanding how technology introductions impact people’s lives and how they fit into the whole farm, livelihood and community system (Millar and Connell, 2010). A system is an organized collection of parts that are highly integrated in order to accomplish an overall goal. Each component provides ongoing feedback to other components. A smallholder farm is a system, and a system must be understood as a whole and cannot be comprehended by examining its individual parts in isolation from each other (Fig. 2). Smallholder farm inputs may include labour, money, fertilizer, crop and vegetable seeds, livestock and livestock feeds. These inputs go through a process where they’re aligned, moved along and carefully coordinated to achieve the goals of the system. Outputs are tangible results produced by the system, such as an annual rice crop. The system may also result in outcomes or benefits to the smallholder, for example, quality of life, pride in one’s work and social standing. Subsystems will exist within the larger system, that is, livestock rearing and rice cropping are each subsystems in the smallholder mixed farming enterprise. Each subsystem may require its own inputs, processes, outputs and outcomes. In smallholder systems, each subsystem may provide cross-benefits or inputs to other subsystems, which create overall system efficiency, that is, ruminant manure may be used for biogas fuel and fertilizer for crops. Rice crop by-products such as rice straw may be used as livestock feed. Conversely, failure of one subsystem may impact the others, that is, if a large ruminant becomes diseased, it may not be available for draught work. Rental of a replacement animal may help plug the production gap, yet may also facilitate further disease transmission. The financial cost of replacement of lost livestock to disease may limit other farm inputs. Furthermore, as livestock are completely integrated into the overall farming and livelihood systems of many developing countries (McDermott et al., 2010), innovation in livestock systems cannot be isolated from other economic and social developments (Gray et al., 2012).

As smallholders operate integrated farming systems with livestock, cropping, and household activities highly interconnected and interdependent, implementing any change at one level of the enterprise has the potential to impact other levels or subsystems, and ultimately outcomes and outputs. A systems approach to improving biosecurity should not only be implemented at the farm and village level, as value chains significantly affect the circulation of viruses within countries and into farms in the region (Martin et al., 2011). A number of stakeholders would also be affected with any change. For biosecurity, the immediate obvious stakeholders are the smallholder farmers, VAHWs/VVWs, village chiefs, extension workers, government veterinarians, traders, consumers and government policy makers. Research has shown that farmers spend relatively high amounts on treatment for livestock disease (Young et al., 2013a; Kawasaki et al., 2013), often exceeding the cost of preventive measures such as vaccination. Without income from treating diseased animals, VAHWs/VVWs may be unable to sustain their occupation and seek other employment opportunities. In this context, VAHWs/VVWs’ motivations may be at odds with smallholder farmers’ unless benefits are available to this group.

![Fig. 2. Systems diagram of a smallholder farm indicating the interdependent inputs and outputs between the household, cash crops and large ruminants.](image-url)
As smallholder mixed farming systems are by definition highly variable in their level of inputs, outputs and their geographical, social and political context, interventions will have to be tailored to meet different needs. In terms of change management, viewing smallholder farms as a system will enhance the change agents’ ability to implement interventions with consideration for the whole system. A broader systems view will allow greater understanding of impacts of proposed interventions, which in turn will allow adaptation of implementation to ensure success.

Change Management Leadership

Effective change management leadership will require not only the skills in the aforementioned topics but also the ability to successfully assimilate these skills into practice. In addition to the champion farmers (local change leaders) discussed above, change needs someone at the controls and there needs to be a process for steering it in the right direction (Kanter, 2001). In large-scale research projects, there will usually be a project leader from the donor country and an in-country leader. Change requires even more communication than routine activities (Kanter, 2001); therefore, efforts in advocacy and communication need to be high. Project leaders need to know what’s happening in the field so they can make adjustments to support it or steer it in a different direction (Kanter, 2001). In addition, project leaders and team members need to have strong cross-cultural awareness and know-how to influence people with a different cultural background to be effective and influence their interpersonal networks (Smith and Peterson, 1988; Fu and Yukl, 2000). In a study investigating proactive influence tactics, Fu and Yukl (2000) showed that American managers rated rational persuasion and exchange as effective influence tactics, while Chinese managers rated coalition tactics, upward appeals and gifts higher than their American counterparts.

In the smallholder research project perspective, the roles of the project officer/s and field staff have a unique perspective in having regular exposure at multiple stakeholder levels, often providing a link between project leaders, farmers and students, as well as providing feedback from field staff. The staff need role models to learn from and to see what’s possible, and to be spurred on to new heights (Kanter, 2001).

The role of technical experts (TE) versus process facilitators (PF) should be carefully considered when developing a project team. A PF will treat stated problems as information, focus on relationship building, help in the participatory process of diagnosing and problem solving with the aim of the smallholder having the ultimate responsibility, and help the smallholder develop solutions through development of their own diagnostic and problem solving skills (Schein, 1978). The TE will bring technical expertise, but may accept the statement of problem at face value, spend limited time developing relationships, be focused on increasing the smallholder skill for the stated problem and does it ‘for’ and ‘to’ the smallholder (Schein, 1978). A blend of both PF and TE is very powerful (Margulies and Raia, 1972).

Project site selection must be balanced between practicality, resource limitations and meeting objective outcomes. The need for randomized selection to meet epidemiological internal and external validity may need to be balanced between selecting community groups that are simply ‘willing’ to learn and improve production. In the absence of readily available sampling frames, convenience selection may limit population validity; however, through education-based programmes and the creation of knowledge archipelagos, there is potential for intervention spread beyond the initial sites.

Conclusion

This study examines some of the social aspects of change management that may impact on the sustainability of biosecurity interventions that can assist the eventual eradication of TADs including FMD, an important initiative in reducing the negative impacts of disease on rural families and communities affected by poverty and food insecurity. Changing the attitudes and practices of smallholders to biosecurity does not have to be expensive or complex, but they do need to be implemented in a sustainable manner. Turning knowledge into practice needs examples of successes, documented at both the ‘evidence-based level’ for translation to policy, plus locally, where champion farmers lead local change through cross-visits and other activities. Multiple researchers have noted the importance of tacit to tacit knowledge transfer in the Mekong region through the use of interpersonal channels. Biosecurity interventions should align with smallholder farmer motivations and, without clear short-term oriented benefits, may elicit limited interest and sustainability. Various factors including current disease threats, culture, sources of resistance and existing systems, as well as geopolitical factors will influence the sustainability and success of improved biosecurity. While TADs are often global problems, it is clear that local solutions targeting specific regions need to be identified. Linking biosecurity and disease control with improving livestock productivity provides a pathway for sustainable livelihoods’ improvements. Due to geographical, physical and resource variability, the implementation of biosecurity practices suitable for smallholders is not a ‘one size fits all’. Smallholders being educated in biosecurity principles need to make personal decisions rather than prescribed pre-defined interventions. The engagement of key stakeholders including village para-veterinarians and chieftains is an important community entry point into
developing a village-level biosecurity programme, particularly if linked to a community strategy aimed at taking advantage of marketing opportunities for quality animals.

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