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## Agricultural change, increasing salinisation and migration in the Mekong Delta: insights for potential future climate change impacts?

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## Agricultural change, increasing salinisation and migration in the Mekong Delta: insights for potential future climate change impacts?

### Abstract

This chapter focuses on the situation of some households from Nha Phan hamlet in Cai Nuoc District that have become more financially vulnerable as a result of the agricultural and environmental shift and thus have turned to migration as a means of coping. It reveals the complex pathways that link migration choices with changing environmental conditions. It explores how those impacts and choices are linked to human security and how the lessons learned from this study can shed light on climate change-induced migration. The chapter begins with a brief overview of sea-level rise projection for the Vietnamese portion of the Mekong Delta before discussing the switch to shrimp aquaculture in Cai Nuoc District and factors that affected whole-household migration decisions that were discovered during a study of households from that district.

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# AGRICULTURAL CHANGE, INCREASING SALINISATION AND MIGRATION IN THE MEKONG DELTA INSIGHTS FOR POTENTIAL FUTURE CLIMATE CHANGE IMPACTS?

Olivia Dun

## INTRODUCTION

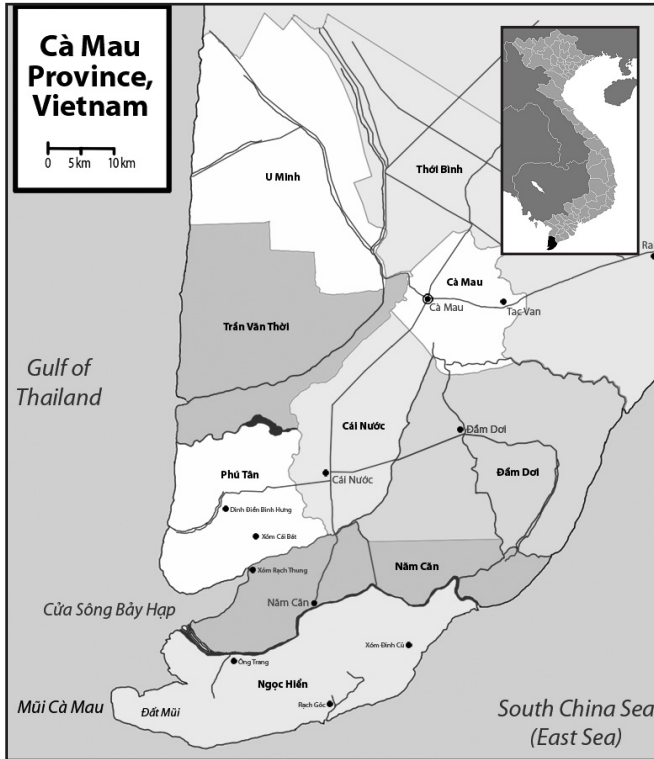
The propensity for human insecurity is greater in developing countries, where people are often highly dependent directly on their surrounding natural environment for their immediate livelihood activities, and governments are less able to afford prevention of potential harm caused by environmental changes than in developed countries. Recent studies comparing potential impacts of future sea-level rise on the world's developing countries identified Viet Nam as one of the countries that would be most severely affected, noting in particular, the risks to the Mekong Delta in the south of the country.<sup>1</sup>

Cai Nuoc District, in Ca Mau Province of the Mekong Delta, is naturally prone to salinity intrusion (see Figure 7.1). Since 2000, increasing salinisation of surface water and soils in the district has occurred, largely

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1 S. Dasgupta et al., "The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis", *Climatic Change*, Vol. 93, No. 3 (2009), pp. 379–388; Ministry of Natural Resources and Environment (MONRE), *Climate Change, Sea Level Rise Scenarios for Viet Nam* (Hanoi: Ministry of Natural Resources and Environment, 2009).

FIGURE 7.1  
Map of Ca Mau Province. Cai Nuoc District is located in the centre of the province.



Source: C. Baer, “Map of Ca Mau Province”, Wikipedia (2008), [http://en.wikipedia.org/wiki/File:Ca\\_mau\\_province\\_map\\_-\\_sm.png](http://en.wikipedia.org/wiki/File:Ca_mau_province_map_-_sm.png) (accessed 13 January 2012).

caused by the transformation of coastal area rice fields into salt-water based monoculture shrimp farms. At the household level, these changes have had mixed outcomes on human security, generating some benefits and creating new vulnerabilities.

This chapter focuses on the situation of some households from Nha Phan hamlet in Cai Nuoc District that have become more financially vulnerable as a result of the agricultural and environmental shift and thus have turned to migration as a means of coping. It reveals the complex pathways that link migration choices with changing environmental

conditions. It explores how those impacts and choices are linked to human security and how the lessons learned from this study can shed light on climate change-induced migration. The chapter begins with a brief overview of sea-level rise projection for the Vietnamese portion of the Mekong Delta before discussing the switch to shrimp aquaculture in Cai Nuoc District and factors that affected whole-household migration decisions that were discovered during a study of households from that district.<sup>2</sup>

### SEA-LEVEL RISE AND THE MEKONG DELTA

The Vietnamese Ministry of Natural Resources and Environment (MONRE), with support from the United Nations Country Team (which includes all the United Nations agencies, funds and programmes in Viet Nam), have applied the Intergovernmental Panel on Climate Change's (IPCC's) global climate change scenarios to the national context and identified the potential climate change impacts for Viet Nam.<sup>3</sup> Most relevant for the Mekong Delta is the possibility of a 75-centimetre (cm) rise in sea level by 2100.

A 2007 study<sup>4</sup> found that Viet Nam would be one of the five developing countries most affected by a one-metre rise in sea level,<sup>5</sup> with the deltas of the Mekong and Red rivers facing the most severe threat. As such, in its National Target Programme to Respond to Climate Change,<sup>6</sup> the Vietnamese government's planning is focusing on the possibility for

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2 Information about outcomes for households presented in this chapter is based on interviews conducted between May and December 2010 with just over 90 households from Cai Nuoc District (mostly from Nha Phan hamlet).

3 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)* (Cambridge: Cambridge University Press, 2007); United Nations Viet Nam, "Climate Change Fact Sheet: The Effects of Climate Change in Viet Nam and the UN's Responses", [http://www.un.org.vn/en/publications/publications-by-agency/doc\\_details/217-climate-change-fact-sheet-the-effects-of-climate-change-in-viet-nam-and-the-uns-responses.html](http://www.un.org.vn/en/publications/publications-by-agency/doc_details/217-climate-change-fact-sheet-the-effects-of-climate-change-in-viet-nam-and-the-uns-responses.html) (accessed 25 November 2011).

4 Dasgupta et al., "The Impact of Sea Level Rise on Developing Countries".

5 Based on a comparison of population, gross domestic product, urban extent, agricultural extent, wetlands impacted and land area inundated.

6 The programme was approved by the Vietnamese prime minister in December 2008.

such a rise by 2100.<sup>7</sup> Experts suggest that roughly five per cent of the land area (17,423 square kilometres) in Viet Nam would be inundated by a one-metre rise in sea level if significant measures are not taken in terms of dyke construction and reinforcement or improved drainage.<sup>8</sup> Of this, 82 per cent would be in the Mekong Delta alone,<sup>9</sup> where 37.8 per cent of the land would be inundated.<sup>10</sup> The provinces of Ca Mau, Kien Giang, Hau Giang and Soc Trang would be the most affected areas of both the Mekong Delta and the country as a whole (see Figure 7.1).<sup>11</sup> In Ca Mau, which is the basis of study in this chapter, around 52 per cent of the province would flood, including the districts of Tran Van Thoi, Cai Nuoc, U Minh and Ca Mau City.<sup>12</sup>

## RECENT AGRICULTURAL AND ENVIRONMENTAL CHANGE IN CA MAU PROVINCE

Increasing salinisation in Ca Mau Province has thus far been a function of increased shrimp aquaculture production. Such aquaculture-driven salinisation has facilitated the movement of seawater inland, rather than climate change leading to rising sea levels. Yet in the face of likely future increases in salt-water intrusion in the Mekong Delta provinces as a result of climate change, an exploration of recent increases in salinisation activities in Ca Mau Province provides a useful case study of potential human insecurities and the ways in which communities might respond to these changing environmental conditions.

### The Change Towards a Year-Round Saline Water Environment

There was a large-scale change in the land use of Cai Nuoc District, Ca Mau Province in 2000, with an unprecedented shift in the amount of land dedicated to saline-water shrimp monoculture. This reflected a broader trend in Ca Mau Province. From 2000 to 2001, the area dedicated to

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7 MONRE, *Climate Change, Sea Level Rise Scenarios for Viet Nam*.

8 United Nations Viet Nam, "Climate Change Fact Sheet".

9 Ibid.

10 MONRE, *Climate Change, Sea Level Rise Scenarios for Viet Nam*.

11 United Nations Viet Nam, "Climate Change Fact Sheet".

12 Ibid.; MONRE, "Global Warming Threatens Ca Mau Province", *Natural Resources and Environment Newspaper*, 2010, <http://www.monre.gov.vn/v35/default.aspx?tabid=675&CateID=59&ID=83468&Code=N3LXY83468> (accessed 3 May 2010).

shrimp monoculture in the province doubled, amounting to 42 per cent of all land in Viet Nam dedicated to shrimp aquaculture production.<sup>13</sup> For Cai Nuoc District, this represented a 10-fold increase over the same period. This sudden switch in land use is largely attributed to Vietnamese government Resolution 09/NQ-CP of 2000 which permitted farmers to transform coastal saline rice fields into shrimp farms in order to maintain national target levels for shrimp production.<sup>14</sup> This switch to shrimp monoculture has limited fresh surface-water availability in fields and ponds, which in turn has created more saline soils, mobilised acid-sulphate soils and altered soil and water organisms in shrimp farming areas.<sup>15</sup>

There were mixed feelings among locals about this change towards shrimp monoculture, with some households wanting to raise shrimp while others wished to continue growing rice. The switch to shrimp aquaculture meant that farmers had to convert their rice fields into ponds and allow saline water from common village canals to fill those converted ponds. Farmers keen to raise shrimp broke down sluice gates and dykes that had prevented saline water in rivers from entering common canals, paving the way for increased saline intrusion. They did so despite opposition from other farmers who had not yet harvested their rice and who anticipated crop destruction if saline water came to their fields. Some rice farmers rebuilt gates and dykes but, in the end, were unsuccessful

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13 T. N. K. D. Binh et al., "Land Cover Changes Between 1968 and 2003 in Cai Nuoc, Ca Mau Peninsula, Vietnam", *Environment, Development and Sustainability*, Vol. 7, No. 4 (2005), pp. 519–536.

14 Ngo Thi Phuong Lan, "From Rice to Shrimp: Ecological Change and Human Adaptation in the Mekong Delta of Vietnam", in M. A. Stewart & P. A. Coclanis (Eds.), *Environmental Change and Agricultural Sustainability in the Mekong Delta* (New York: Springer, 2011); T. V. Nhuong et al., "Vietnam Shrimp Farming Review", Individual Partner Report for the Project, Policy Research for Sustainable Shrimp Farming in Asia, European Commission INCO-DEV Project PORESSFA No. IC4-200110042, Bac Ninh, Vietnam, CEMARE University of Portsmouth (October 2002).

15 For more details on the changes experienced by Cai Nuoc District in terms of switching to increased shrimp aquaculture, see Binh et al., "Land Cover Changes"; Nguyen T., N. Vromant & L. Hens, "Organic Pollution and Salt Intrusion in Cai Nuoc District, Ca Mau Province, Vietnam", *Water Environment Research*, Vol. 78, No. 7 (2006), pp. 716–723; Nguyen T. et al., "Soil Salinity and Sodicity in a Shrimp Farming Coastal Area of the Mekong Delta, Vietnam", *Environmental Geology*, Vol. 54, No. 8 (2008), pp. 1739–1746.

in preventing saline waters from affecting their land and destroying unharvested crops.

### **Household Outcomes from Changes: Impact on Livelihoods and Income**

The switch to shrimp monoculture in Cai Nuoc District produced mixed human security outcomes. On the one hand, several households benefited from the switch to shrimp because one hectare of shrimp generates an income up to 160 times higher than one hectare of rice.<sup>16</sup> In Nha Phan hamlet, many households were able to upgrade their homes and build new concrete houses whereas primarily subsistence (rice-based) living enabled only basic housing made with plant fibres, leaves and wood. As more money flowed into the hamlet, electricity was introduced and a concrete road was built. Households were able to invest money in modern technologies such as television sets and video compact disc players. Raising shrimp is far less labour-intensive than growing rice. Household members often spoke of this benefit because their work became physically easier and this freed up their ability to seek extra work elsewhere. In this sense, conditions of human security<sup>17</sup> were enhanced, with households able to improve their economic circumstances with flow-on benefits such as securing more robust shelter.

On the other hand, some households became more vulnerable as a result of both the change to shrimp farming and the consequent increasing salinisation of their land. They became more vulnerable overall as their financial debt level increased, which contributed to growing human insecurity. The initial switch to shrimp aquaculture required financial investment to implement the conversion of rice fields to shrimp ponds (machinery, fuel and labour were required to dig up the fields). Government loans became available through state-run banks specifically for this purpose and uptake was widespread. First yields of shrimp commonly

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16 Binh et al., "Land Cover Changes".

17 A broad view of human security is taken here, interpreting human security as including dimensions such as security from poverty, food security, and adequate shelter. See Human Security Report Project, "What is Human Security?" (Burnaby, Canada: School for International Studies, Simon Fraser University, 2010), [http://www.hsrgroup.org/docs/Publications/miniAtlas/miniAtlas\\_en\\_human\\_security.pdf](http://www.hsrgroup.org/docs/Publications/miniAtlas/miniAtlas_en_human_security.pdf) (accessed 25 November 2011).



resulted in a good harvest and financial success because the pond environment, having recently been converted from a rice field, contained good levels of nutrients and plankton for shrimp to feed on. This initial flush of money and income prompted further conversion of land into shrimp ponds.

However, many households began to experience failure following this initial success. Shrimp disease and attempts to maintain correct pond conditions resulted in households borrowing increasing amounts of money through informal and formal channels.<sup>18</sup> Continued failure to harvest shrimp and consequent inability to repay debt resulted in further financial insecurity for households and informal money-lending groups that relied on loan repayments.<sup>19</sup> Indeed, case studies from Thailand and Indonesia demonstrate that shrimp aquaculture is unsustainable and leads to local poverty and food insecurity.<sup>20</sup>

Human insecurities of the kind described here were then exacerbated through limitations on further changes. This anticipates the kinds of constraints that might also apply in conditions of salt-water intrusion associated with climate change. Few other agriculture or aquaculture options were possible once the change to brackish-water aquaculture and saline conditions had occurred. Higher salinity levels meant that rice could not be grown even for household consumption, unless the entire community agreed to grow rice simultaneously. Previously abundant fruit trees (mangoes, coconuts or bananas) had been reduced in number and were no longer able to yield fruit of suitable quality or substantial quantity because of saline-affected soils. It was possible to raise salt-water crabs or fish, but often these also required high levels of financial investment.

Moreover, shrimp farming itself is vulnerable to climate change effects. A recent study among small-scale shrimp farmers in Ca Mau and Bac Lieu Provinces in the Mekong Delta showed that farmers perceived

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18 Shrimp is very sensitive to the pond environment and without the correct conditions (salinity levels, light, oxygen, nutrients and stocking density) can easily die. The risk of disease outbreaks among shrimp populations commonly increases after five to 10 years of operation. See Binh et al., "Land Cover Changes".

19 In some cases, household members fled from the shame or fear of not being able to repay their debts.

20 Environmental Justice Foundation, *Smash and Grab: Conflict, Corruption and Human Rights Abuses in the Shrimp Farming Industry* (London: Environmental Justice Foundation, 2003).

too much rain, high temperatures, canal/river/sea-level rise, as well as irregular weather and storms, as the most serious climate change threats to their shrimp farming activities.<sup>21</sup> These threats, combined with fluctuating international food market prices, indicate further global concerns for already vulnerable local shrimp farmers in Cai Nuoc District. As this discussion shows, environmental change including climate change is not isolated from systems of agriculture and aquaculture nor from the livelihoods dependent upon them.

### **New Vulnerabilities/Threats to Human Security for Whole Migrating Households**

In Nha Phan hamlet, household members with more diverse income sources, such as from a small business (e.g. a grocery shop or motorbike repair workshop), government employment (e.g. work as a teacher or local official) or the service sector (e.g. waitressing), were slightly more resilient than those households dependent solely upon aquaculture and/or agriculture. For others, high household debt levels and a need to find alternative income sources (linked to both changing environmental and economic conditions) were key to household decisions to migrate. Generally, poorer households with small plots of land or landless households struggled to gain or maintain enough financial capital to invest in their shrimp ponds. Mounting debt, an inability to repay that debt from either agricultural or aquaculture activities on their land, and the lack of alternative work in the surrounding rural area prompted some of these households to decide to move to other locations where work was available. The trends of the poor becoming poorer on the one hand and income diversification on the other are not unique to Cai Nuoc District. They reflect a broader trend in Southeast Asia as economic development and investment in agricultural (or aquaculture) intensification are identified as possible pathways out of poverty.<sup>22</sup>

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21 N. W. Abery et al., "Vulnerability and Adaptation to Climate Change and Extreme Climatic Events: The Case of Improved Extensive Shrimp Farming in Ca Mau and Bac Lieu Provinces, Vietnam: Analysis of Stakeholder Perceptions", *Aquaclimate Technical Brief*, No. 3 (2011), [http://library.enaca.org/emerging\\_issues/climate\\_change/vietnam\\_shrimp\\_tech\\_brief\\_1.pdf](http://library.enaca.org/emerging_issues/climate_change/vietnam_shrimp_tech_brief_1.pdf) (accessed 10 April 2012).

22 J. Rigg, "Land, Farming, Livelihoods, and Poverty: Rethinking the Links in the Rural South", *World Development*, Vol. 34, No. 1 (2006), pp. 180–202.

Two categories of migration were observed in this study: households that only had some members elsewhere, and households where all members moved as a group. This latter group of whole household migrants were among the most vulnerable, facing significant human security challenges. Those challenges are framed here using the five “capitals” that underpin a livelihoods approach analysis.<sup>23</sup> This discussion also outlines a framework that has potential utility for anticipating the human security impacts of environmental change (understood in terms of “capital” losses) and the links between climate change and migration, particularly in situations of likely saline intrusion or progressive (as opposed to sudden) environmental change in rural areas. It also shows how human insecurities become cumulative, and demonstrates the challenges that face communities as well as policymakers in identifying and implementing adaptive and supportive (safety net) human security strategies.

### *Loss of Natural Capital*

The loss of natural assets affected all members of the research hamlet in Cai Nuoc District. For whole migrating households, however, the important consequences of this reduction in natural capital arose primarily through changes in the availability of fresh water and in the composition of soils. Before the switch to shrimp aquaculture, households were able to access fresh (non-saline) water from the canals as well as ponds located in land right next to their houses. They could dig an isolated pond in their land and it would fill with rainwater in the wet season. This water, and that from canals, was used for domestic activities including washing clothes and dishes, and bathing. As canals were filled with saline water and as ponds in household plots (even if filled with rainwater) became saline because of salt seepage from adjacent soils, freshwater resources became rarer and households became highly dependent on groundwater resources, particularly in the dry season. Accessing freshwater therefore came to involve higher costs.

Financial investment in hand-operated groundwater pumps required a loan or support from local religious charities. Ten years after the initial

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23 For further discussion about the sustainable livelihoods approach, see I. Scoones, *Sustainable Rural Livelihoods: A Framework for Analysis* (Sussex: Institute of Development Studies, 1998); I. Scoones, “Livelihoods Perspectives and Rural Development”, *Journal of Peasant Studies*, Vol. 36, No. 1 (2009), pp. 171–196.

move to shrimp aquaculture, many households were increasingly unable to obtain water using their hand-operated pumps because of the large number of people extracting from shared aquifers. Motorised pumps enabling easier extraction of groundwater were then required. This not only generated additional costs (purchase of fuel and motorised pumps) but also resulted in larger volumes of groundwater use as extraction rates were quicker and more convenient. Those who could not afford to upgrade to a motor pump either spent lengthy amounts of time in the evenings pumping water by hand when neighbours had generally ceased pumping groundwater, or purchased groundwater from wealthier neighbours who had motorised pumps (often at prices higher than the costs incurred by the pump owners in extraction). Households with the ability to purchase several rainwater pots fared better because they were able to store rainwater well into the dry season, but many households could not afford the cost of such large numbers of rainwater pots.

As noted above, soil degradation caused by increasing salinity affected household ability to grow those crops, fruit and vegetables that were intolerant of high salt levels. Some short-cycle vegetables could be grown as their roots only extended into the shallow layers of soil which were not as greatly affected by salt. Soils were further degraded as extracted waste and effluents from shrimp ponds were pumped onto soils bordering the ponds.

### *Loss of Physical Capital*

Prior to a whole household making a decision to migrate, households would often lease out or contract out their land to others in return for a regular income or lump sum respectively. In Viet Nam, contracting out is a common arrangement known as “co”.<sup>24</sup> Households often prefer this arrangement as the initial lump sum provides a large amount of money that can be used to pay off some or all of their debt, and then allows them

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24 Under a “co” arrangement, one party allows another party to use their land for a fixed period of time, e.g. three years, in exchange for a large lump sum (more than could generally be earned from renting out the land). Once the fixed period of time has lapsed, the original landowner is able to “buy” their land so long as they return the initial lump sum paid. If the fixed time period passes and the original landowner cannot afford to re-purchase their land, the other party can continue using the land until the original owner is able to return the amount owed.

to move elsewhere, work, and re-purchase their land. However, a major problem arises when units of gold instead of cash are exchanged for “co”. As the value of gold sometimes more than triples in the period following the initial “co”, households have to earn far more money to purchase sufficient gold to buy their land.

Whole-household migrants also faced physical capital losses because of potential damage to their houses and belongings which were locked up and abandoned in their home town. Members of those households worried about damage to property from heavy rain or theft, but they could not return home frequently to check on their property (in many cases houses were made of leaf material) because it was too expensive. Some asked their neighbours to check their houses but knew that generally people did not take as good care of other people’s property as their own. Thus, damage increased the amount of money required for any return to their home town.

### *Loss of Financial Capital*

As previously discussed, environmental and agricultural change meant that some households faced such high debt levels that they eventually moved with their whole household to find work. These moves were often perceived as temporary, with households intending to move just for the period of time<sup>25</sup> necessary to earn enough money to pay off their debt with some additional money to return and re-invest in their land (usually to continue raising shrimp). The strategy of moving with all household members was the result of a combination of practical reasons (such as not having other family members available to take care of children) and economic logic (having more members of the household working in the migration destination meant a chance to earn more income).

The movement of whole households has emerged as a new phenomenon in Nha Phan hamlet since around 2005 and is the closest to what might be considered a form of distress migration. Many households had not wanted to move but were grateful for the opportunities to find work and earn an income in the booming manufacturing sector of Viet Nam. Such temporary labour movements were neither forced,

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25 Two to four years was common among households interviewed.

nor entirely voluntary, with households often working long hours under risky and unhealthy conditions, compelled to do so by their economic circumstances, lack of alternative livelihood options, inequalities, and environmental limitations in their home location. Such movements of entire households (in addition to the more common partial household migration) under conditions of increasing human insecurity may be an indicator of the type of migration which might emerge as a growing trend in the future as climate change impacts become more pronounced.

### *Loss of Human Capital*

One of the more alarming trends in relation to whole-household migration was the removal of children from a school environment, which contributed to a decline in human capital of the household unit and thereby affected longer term prospects of reaching a state of human security. Households had either removed their children from school because they could not afford the education costs, or needed to take their children out of school because they were migrating. Once at their destination, and depending on the age of the children, the children would either work or stay in the family's rented boarding house room alone or with siblings during the day while their parents worked. Although the children could attend school in their destination area, there was no safe way for them to travel to and from school as parents often worked very long hours and could not collect their children after school. Parents feared for the safety of their children in such unfamiliar destinations as the busy, industrial zones where the majority of migrants from Cai Nuoc District were able to find work, but where they did not know those living around them. Lack of affordable post-school child care arrangements meant that parents were choosing to keep their children out of school.

Whole-household migrants based their decision about where to move primarily on whether they knew someone who had worked, or who was able to help them find work, in a particular destination. In Viet Nam's current stage of development, most unskilled work is in the manufacturing, processing and construction sectors which are clumped in various industrial zones around the country. These are where the majority of whole-household migrants interviewed ended up. Social networks were extremely important in this regard (an issue also addressed in Graeme Hugo's chapter in this monograph); most households did not pick indus-

trial zones randomly. They always went to an industrial zone where they knew at least one other person.

Working in the manufacturing, processing and construction sectors raised new human capital and human security challenges for households. Working household members often worked 12-hour days (with some breaks) for at least six days a week. Income was often based on amount of output, e.g. kilogrammes of cashew nuts shelled or numbers of soft toy parts sewn (which is why household members worked long hours or sought overtime). While households gained new skills, they also faced new health risks, either from exhaustion and dangerous work environments, or living in cramped, poorly ventilated boarding houses with poor hygiene and sanitation conditions. When household members became ill or seriously injured, this affected the ability of the household to earn an income.<sup>26</sup>

### *Loss of Social Capital*

In some cases, a household would move elsewhere for work but would leave the youngest child(ren) with grandparents (if available). Consequently, parents were only able to see their offspring once a year when they had saved enough money to return to their home town for annual celebrations. This has an important effect of changing the composition of rural households, with the more vulnerable elderly and very young living together in the absence of adults of working age, while also taking an emotional toll on parents and children, with parents living away from home for at least three years or, in some cases, even longer. This means that many children grow up not really knowing their parents or forming close bonds with them. This can weaken one of the most significant forms of social capital that exists in a society—the relationship between a parent and a child. In the future, the lack of close bonds between the two could have unforeseen impacts, perhaps in terms of a child's willingness to care and provide financial support for ageing parents. The government may have to play a greater role in the future care of its elderly population than has traditionally been the case.

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26 One household reported that all family members often had diarrhoea and this limited their ability to work. In another case, a woman working in the construction sector fell from the first floor of a building and damaged her spine. All the money the household had earned during the previous two years was spent on her treatment in hospital and returning her by taxi to her home town.

Looking at the social structure on a broader scale, growing rice required labour in the rice fields. This generated a significant amount of work between households and particularly for the landless. Less labour required to raise shrimp meant that less work was available in the local area. Additionally, as households faced mounting debt, they were more inclined to rely on their own household members rather than seek external labour. The initial shrimp boom created labour opportunities for pond and house construction. However, increasing debt meant that employment opportunities for labourers declined once the boom was over.

Furthermore, the problem of theft arose during the shrimp harvest period. Household members slept in makeshift shelters next to their ponds to keep watch for thieves. Households that were more successful in raising shrimp were often reluctant to share their secrets with neighbouring households. The overall effect of the switch to shrimp farming has perhaps been increased individualisation, competition and even conflict between neighbours in local areas and less social cohesion.

## CONCLUSION

Agricultural and environmental change in Cai Nuoc District, Ca Mau Province, Viet Nam, has led to greater saline-water intrusion in the area, an issue that anticipates problems associated with climate change. As a result, some households have become more vulnerable in terms of their ability to obtain food and earn a living from their land and surrounding natural environment, as well as in terms of their financial situation, household education level, exposure to health risks, loss of physical assets and general overall ability to escape the traps of poverty. For some of the most vulnerable households, the migration of whole households was perceived as a solution to mounting debt problems arising from their failure to raise shrimp successfully. However, this migration was not a direct consequence of environmental change; rather, environmental change is best understood as a systemic rather than proximate cause.

Migrating to areas of employment potential in the manufacturing, processing and construction sectors, often using connections available through social networks, enabled some of these households to earn a more stable income and pay off some of their debt and entertain the idea of returning home. Other households continued to live under unstable



financial conditions in their migration destination while some others move back and forth between their home and migration destination, preferring to try to survive in their home town, but having to return to their migration destinations when they fail to earn sufficient income. The migration of whole households has also exposed families to new types of vulnerability, particularly in relation to health and education issues. The long-term success of such household migration measures is unclear, as even after returning home, migrants will have to deal with the increased salinity of local water and soils. This will limit opportunities for agricultural and aquaculture production without significant financial investment.

This analysis of migration of entire households using a human security lens has highlighted some of the challenges households face in responding to agricultural and ecological change. It serves to show the cascade of changes that can lead to financial distress and trigger an eventual migration decision following a slower process of environmental change, namely increasing salinisation in the particular agrarian context of the Mekong Delta. Ongoing internal migration, and possibly distress migration, may increasingly emerge in the Mekong Delta as threats and impacts of climate change continue to evolve alongside a plethora of other locally, nationally and regionally induced changes to the Mekong River Delta's water flow regime, salinity levels and agricultural/aquaculture production context.

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