Field Building Leadership Initiative

Advancing Ecohealth in Southeast Asia and China

Completion report




December 2016

What is in this report?

This is the completion report for the Field Building Leadership Initiative: Advancing Ecohealth in Southeast Asia (FBLI). This report covers the period from October 1st 2011 to September 30th 2016. The purposes of this report are: to describe the key activities supported by the projects, focusing in the outputs, achievements, outcomes and lessons learned from the five-year implementation of the project components including research, capacity building, and knowledge translation as well as the whole project.

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Abbreviation:

AI	Avian Influenza
APEIR	Asia Partnership for Emerging Infectious Diseases Research
CENPHER	Center for Public Health and Ecosystem Research
CU	Coordinating Unit
ECOMORE	Economic Development, Ecosystem Changes, and Emerging Infectious Diseases Risks Evaluation project
FBLI	Field Building Leadership Initiative
FL	Future Leader
GHTL	Global Health True Leaders
HSPH	Hanoi School of Public Health
HSRI	Health System Research Institute, Thai land
INDOHUN	Indonesia One Health University Network
IDRC	International Development Research Centre, Canada
KT	Knowledge Translation
KMU	Kunming Medical University
MU	Mahidol University
PA	Program Assistant
PO	Program Officer
PR	Public Relationship
OH	Outcome Harvesting
RCG	Regional Core Group
SEA	South East Asia
TOT	Training of Trainers
VOHUN	Vietnam One Health University Network
UI	University of Indonesia
VPHA	Vietnam Public Health Association
VWB/VSF	Veterinarians without Borders / Vétérinaires sans Frontières

Executive summary

This completion report synthesizes the key activities supported by the projects, focusing on key research findings and outputs, significant outcomes and lessons learned from the five-year implementation of the project components including research, capacity building, and knowledge translation. These topics are all addressed in greater details in the country technical reports which are available on request.

The ecohealth approach promoted by IDRC is largely accepted by the ecohealth community. While ecohealth has been promoted for a relatively long time in Latin America and Africa, it has only been more recently introduced in South East Asia (SEA) for the last 15 years. Ecohealth is useful for addressing complex health and environmental issues in developing countries, in particular in SEA where agricultural intensification processes have profound implications for ecosystems and health. Agriculture intensification can be beneficial for human health in terms of increased food security and socioeconomic development; there are also negative impacts on people and environmental health.

This project concentrated on the building the field of ecohealth in the region by integrating research, capacity building, policy and networking that can solve human health problems associated with agricultural intensification in SEA countries.

Specifically, the project had four interlinked objectives: (i) Conduct transdisciplinary, multi-country, multi-institutional, gender-sensitive and participatory ecohealth research to address human health problems related to agricultural intensification; (ii) Strengthen the capacity within SEA for ecohealth research and practice by developing institutional capabilities to deliver ecohealth training, provide a range of training materials and course offerings, and mentor early-career professionals to build leadership and expertise in the ecohealth field; (iii) Engage key policy makers – at local and national levels – to interact with the ecohealth research teams, sites and communities to ensure that the emerging research findings will inform and positively influence policy and practice in the field and (iv) Facilitate networking-of-networks and knowledge sharing at national and regional levels, linking with key events in the region to mainstream ecohealth approaches and foster the development of the ecohealth field in the region.

These were achieved through carrying out three interlinked components namely research, capacity building and knowledge translation. Working predominantly with local villagers and authorities in four countries, the project engaged policy makers at different levels at the beginning to the end of the project.

The project methodology was based on ecohealth approach (Charon et al, 2010) in which various research methods derived from different disciplines were used, including qualitative and quantitative methods, such as literature reviews or desk studies, cross-sectional surveys, participatory rural appraisal, laboratory testing, action research and on-farm intervention.

The research component was achieved through carrying out a two-stage study involving (a) situational studies to determine the current status of health and identified some constraints to the health and (b) intervention or action study.

The findings of this program have demonstrated that i) agricultural intensification increases risks to human, animal, and environmental health; ii) application of Ecohealth approach can address some of the negative effects of agricultural intensification; iii) Increasing the capacity and involvement of farmers and other relevant stakeholders to apply Ecohealth principles and practices contributes to improved agricultural practices and health; iv) Capacity building activities – such as training for future leaders – improve the leadership skills and capabilities of current and future Ecohealth practitioners and v) Building up and sustaining the Ecohealth field in the region requires concerted efforts in research, capacity building and knowledge translation, underpinned by appropriate support from policy makers.

The research component played as a backbone for the other components and contributed important knowledge. Results from research undertaken by the FBLI country teams provided overall pictures of the impact of pesticides, rubber plantation, dairy cattle production and animal and human waste management on the health of people, crops, animal and the environment. Overall, the findings from the four country research projects show that:

China: Results from laboratory analysis showed pesticide residues were detected not only in samples of vegetables and fruits, but also in local soil and water, and in urine samples of farmers and children in Yuanmou, a key vegetable-growing region in China. It was found that 65 percent of the samples contained traces of at least one pesticide, even though the region switched to “low toxic” pesticides in the early 2000s. The team distributed informational calendars and performed street theatre in villages to educate the farmers about how to reduce pesticides and use them safely. Thanks to this education, the farmers knew the health risks of overusing pesticides in agricultural production, started using self-protective measures. The overuse of pesticides in agricultural production is one issue of pesticide production and distribution, and therefore involving many different stakeholders.

Indonesia: In the project “Measuring the impact of smallholder dairy farming on health using an ecohealth approach: A case study in the highlands of West Java”, river samples were analyzed to measure its BOD, COD, pH, and TSS levels and were compared to Indonesian standard protocols. The research showed that farming management in Pangalengan did not fully implement the ecohealth approach, and the contamination in the river in relation with human health risks was found. The contamination was mainly by animal waste from local dairy farms. The researchers developed ways to convert cow waste into fertilizer and other products for recycling and reuse purposes. This not only created a new source of income for farmers, it also proved effective in increasing crop yields.

Thailand: The country study illustrated that there was a direct correlation between rubber plantation expansion and increased risk of vector-borne diseases, i.e., dengue and chikungunya around the rubber plantation areas in eastern Thailand while the rubber workers had limited knowledge of these vector-borne diseases. Water contamination with heavy metals, the bacteria *E. coli* and *Salmonella* were reported.

Inappropriate disposal and handling of chemicals including poor self-protection and sanitation were observed. Proper self-protection was proposed and awareness among rubber workers was improved through providing health education, the research team promoted the use of DEET-impregnated screen jackets as one of self-protection measures. A pilot vector control intervention, using innovative super-sterile male mosquitoes, was conducted in order to reduce vector populations and risk to the diseases they transmit.

Vietnam: The study on livestock and human waste management in Hanam province showed that livestock wastewater management has become a challenge in Vietnam as livestock related infrastructure and regulations have not kept pace with livestock population growth. The use of biogas to treat livestock waste provides gas for cooking and effluent for crop irrigation was a common practice. However, the concentrations of pathogens in biogas effluent at the smallholder farms were high. The biogas effluent exceeded standards for the bacteria *E. coli* and *Salmonella,* the parasite *Giardia*, and other harmful contaminants. Biogas effluent used as fertilizer also put farmers at high risk of diarrhea. The intervention program focusing on proper practices of biogas management at household level has contributed to the changing knowledge and practice of farmer in using household biogas. The rate of proper knowledge and practices on biogas management has actually been increasing after intervention. The biogas effluent quality as a result of the intervention was also improved.

Based on study results, all four teams prepared communication materials for policy and practice changes such as booklets, policy briefs, flyers, poster and news for loudspeakers.

The FBLI has increased clearer awareness and better understanding of linkage between agricultural intensification and health in general, as well as documented the factors affecting health of farmers and environmental health in study sites in China, Indonesia, Thailand and Vietnam. Furthermore, it has contributed to identifying the main constraints to health improvement of the community members.

Capacity building component comprised Training of Trainers (TOT), Future Leader (FL), and Degree Training (DT) sub-component, being led and managed by VWB, UI, and MU respectively. (i) Training of trainers: we developed a manual of ecohealth, tested and run several ToT. The ToT manual was translated and adapted in local languages. A survey of the TOT manual users was conducted to assess use, and to inform decisions around TOT manual translation. The translation of the Ecohealth TOT manual into local languages (Bahasa, Thai and Mandarin) is in progress. The Vietnam published an Ecohealth textbook in Vietnamese which is based on different sources including the TOT manual and research and policy results of FBLI Vietnam. This textbook was released during the final research workshop in Kunming and launched in 29 September 2016 in Hue city, Vietnam and launched at various ecohealth conference including Ecohealth conference in Melbourne 2016.

(ii) Degree Training: The MSc and PhD degree training program “One Health and Ecosystem Management” proposal at Mahidol University was approved by the faculty committee and was officially approved by the University Council on 20 August 2014. The degree program course descriptions are developed and revised by 9 faculties of the Mahidol and the completed degree program curriculum was submitted to the Faculty

of Graduate Studies and the University Council. The final degree programs are expected to launch after obtaining an approval from the Ministry of Education, hopefully in 2017. In addition, ecohealth curricula have been integrated into four FBLI consortium member universities (Mahidol University, Thailand, Hanoi School of Public Health, Kunming Medical University and Indonesia University).

(iii) Future Leader: Led by FBLI Indonesia, a series of trainings for future leaders in global health was successfully conducted in Indonesia, Thailand, Vietnam and China, 218 participants of students and young professionals from medicine, public health, veterinary medicine, and other discipline from 10 countries namely Indonesia, Malaysia, Vietnam, Thailand, Philippines, Lao PDR, Cambodia, China, Nepal, and Myanmar were trained, of which 79 participants were funded by the FBLI future leader sub-component and the remainder in partnership with One Health program funded by USAID. A total of 20 small seed research grants were approved and awarded in four countries. These funds provided opportunities for young researchers to develop a novel idea to employ ecohealth approach in solving real problems in communities.

The knowledge translations (KT) although the component was delayed and faced some challenges, some important results were gained:

At regional level: Regional synthesis booklet and regional policy brief were published and disseminated. In addition, the project information as well as results was shared through international conferences and workshops, websites, Facebook and Twitter.

The knowledge translation process at the country level was initiated by forming policy alliance groups in four countries. Common dissemination techniques were used including policy briefs, website publications, newsletters, and international professional conference presentations, presentations to community meetings and policy makers, and international peer-reviewed journal publications. Articles, national and international peer-reviewed journals, local newspapers, loudspeakers, calendars and street theaters were also used. This increased understanding on ecohealth and agricultural intensification will contribute to enable decision makers to appreciate the importance of agricultural activities to the health as well as target their interventions to mitigate the negative impact of agricultural activities on the health.

The Coordinating Unit (CU) has provided the substantive and administrative support to the activities of the FBLI, as well as assisted the regional core group members and managed the day-to-day organization of the FBLI network. Specifically, providing logistical arrangements for the FBLI's workshops, meetings during the 5 years, i.e. setting the agenda, arranging facilitation if necessary, managing travel arrangements etc. CU also participated actively in communication and advocacy for the work of the FBLI through different channels (workshops, meeting, regional policy briefs, website, bulletins, newsletters, etc.).

The FBLI has strengthened collaboration among the project participating institutions as well as linkages between academic communities and national and local authorities and increased capacity to carry out ecohealth/integrated-based projects.

Outputs

During the 5-year period, the following outputs were produced by the FBLI: 9 international papers; 7 national papers; 4 policy briefs (one regional and 3 national policy briefs); (iv) 3 books, project briefs and bulletins, 10 degree student trained, 218 trainees for future leader program, several media publications, 47 presentations at international and national workshops and conferences; 8 workshops/meeting reports in addition, 1 website and several blogposts.

Outcomes

Three most common and important outcomes generated by the FBLI in four countries are: (i) *Local community people changed their behavior* from the FBLI. Changes adopted in personal protection when vegetable producers spraying pesticides in China; in Thailand more rubber workers and owners of rubber plantations are more aware of their health and more cautious about how the environment may affect their health and in Vietnam, more pig farmers adopted proper animal waste management practices. By working with FBLI teams through farm visits, focus group discussions, on-site interviews, and soils, sample testing, the local communities get better understanding of impact of pesticide, animal waste management, and rubber expansion on the health of human and environment; (ii) *Integration of Ecohealth concept into the existing curriculums* and courses of KMU, HSPH, MU and UI and *institutionalization of Ecohealth teaching*. EcoHealth approaches are gradually known by research institutions and universities in four FBLI participating countries through our project activities, including research result dissemination, teaching and training in the last four years. An EcoHealth elective course becomes a routine course in the elected course list for undergraduate and post graduate students in these universities. In addition, some country-specific outcomes could be drawn from the FBLI program. (iii) Researcher integrated more Ecohealth spirit in designing and conducting research. Indeed researchers from national team but also our research partners have taken more ecohealth principles in doing there research

Policy Implications and Recommendations for Action

Based on the evidence and lessons emerging from five years of FBLI research, capacity building and knowledge translation work, there needs to be concerted efforts to convince governments and global/regional bodies in SEA – such as GHSA, ASEAN, FAO, WHO and USAID – to enable changes in agricultural policies and practices that are more Ecohealth friendly.

- Increased investment in agricultural intensification research is warranted to further demonstrate the impacts of agricultural intensification on human, animal and environmental health, and to show that Ecohealth can be an appropriate approach to address agriculture intensification problems and solutions.
- Health risks can be managed through improving the knowledge, attitudes and practices of farmers and other concerned stakeholders, and involving them throughout the project/activity cycle.
- There is a strong need to continue training and education activities to groom future leaders and the next generation to better understand and apply Ecohealth principles and approach.
- Policy makers should support the institutionalization of the Ecohealth field – including mainstreaming these approaches in regional and national agricultural plans – and commit to scale-up best practices throughout the region.

1. The research problem

In Southeast Asia and China, rapid population and economic growth have fueled agricultural intensification, which is defined as the increase in the productivity of crops and livestock per unit of input. Driven by population growth, globalization and advance in agricultural techniques, agricultural intensification including staple crops, cash crops, tree plantation and livestock rearing has been widely practiced in Southeast Asia countries and China in the last five decades that, on the one hand, produce food to feed the growing population and contribute to food security as well as increase farmers' income, and on the other hand, have negative implications for ecosystems and human health. While agricultural intensification is widely practiced in Southeast Asia and China, its implications for human health and the ecosystems have not yet well documented and understood. A better understanding of this impact is essential for addressing the negative impact and achieving the goal of sustainable development.

Using an Ecohealth approach to comprehensively tackle complex issues requires individual, institutional and country capacity development in understanding and applying this approach within the regional context. The FBLI program was developed by research centers in China, Indonesia, Thailand and Vietnam to carry out research, capacity building, policy advocacy and networking on the links between changing agricultural practices and human health in South East Asian countries and China.

In order to promote the application of ecosystem-based approach, particularly in Asia, there is an urgent need for regional networking, capacity-building, knowledge generation, and leadership development in the field of ecohealth. Supported by IDRC, a five-year regional collaborative project was conducted that employed EcoHealth research to understand and address issues caused by agricultural intensification n Southeast Asia and China. The project consisted of four multidisciplinary research teams from four countries in this region, namely China, Indonesia, Thailand and Vietnam, and had three major components, namely research, capacity building, and knowledge translation.

Research was the backbone of the project. Guided by the six principles of EcoHealth research, a multi-disciplinary research team was organized in each of the four countries and the teams adopted a site-based, participatory action research approach. The site-based approach is unique because it works in specific place/location with strategic purpose rather than focusing on single disease or specific health problem.

After research inception workshop in October 2012, final research topics, detailed research plans were improved and finalized. These topics were identified based on the quick situation studies with the community to re-define research topic and research questions, others (Thailand, China) improved research plan by developing tools as their research topic was clear at the end of Y1.

To address the health risks caused by agricultural intensification, FBLI country teams identified by the country teams as follows:

- China: Using ecosystem approach to reduce pesticide use and its health and environment impacts in Yuanmou County, Yunnan Province, China

- Indonesia: Ecohealth and Dairy Production: Connecting Issues and Finding Interventions for Small-Scale Farming in as Southeast Asian Context

- Thailand: Study on potential impacts and proposed best practices in agricultural development: A case study of rubber plantation expansion and increased risk of vector-borne diseases in eastern Thailand

- Vietnam: Using Ecohealth Approach for Better Management of Livestock and Human Waste in Hanam Province, Vietnam

By understanding and adapting ecohealth concepts through better inter-sectoral, institutional and transdisciplinary collaboration, innovative and practical solutions are developed through participatory action research with local communities and stakeholders. Mechanisms to bridge people and bring different types of actors together enable changes in thinking, behavior and action.

By building capacity and leadership in ecohealth, systems thinking are recognized in university teaching and ecohealth becomes a well-respected field of study and practice. Field research and various training and exchange opportunities help foster a new generation of leaders and brokers in ecohealth. Knowledge translation processes and products inform and influence both policy and practice. The voice of SEA becomes more prominent in international forums and debates.

2. Progress towards achieving objectives

2.1 Research

Overall, the research component had two stages/phases. The first phase focused on the situation analysis and the second phase was the intervention or action research, which was envisaged and developed as a successor to the situation analysis phase. It would seek to actively engage local communities in implementing intervention packages. In this phase, efforts have also been made to consolidate and disseminate the research findings. Brief summaries of research progress in each FBLI country project are given below. More information is included in Annex 1.

China: Using ecosystem approach to reduce pesticide use and its health and environment impacts in Yuanmou County, Yunnan Province, China.

The overall objective of this study was (i) to explore the impact of pesticide use on the health of human being and the ecosystem; (ii) to reduce pesticide use by developing community-based interventions, and; (iii) to promote more sustainable agricultural development.

(i) Situation analysis

Some key points from the situation analysis are summarized below:

Yuanmou County, Yunnan Province, China is a winter-seasonal vegetable production base in China, where both farming systems exist, including family-based smallholder and large scale vegetable farming systems. Both systems highly reply on pesticides and other modern agricultural production inputs such as chemical fertilizers, new variety of seeds and irrigation that increase productivity and farmers' income, but also pose health risks to farmers, agricultural workers, local residents and consumers and cause the pollution of environment.

The farmers know the health risks of overusing pesticides in agricultural production but they take little self-protective measures and they also have no choices. The overuse of pesticides in agricultural production is just one link in the complex web of pesticide production and selling that involve many different stakeholders. Local farmers know some of the harmful effectiveness of pesticides and they reduce the risk by consuming self-grown vegetables that do not use or use little pesticides.

A total of 766 vegetable samples were collected respectively from farming field, home gardens/private plots and local markets and 230 urine samples of local people including adults (men and women) and children and tested for pesticide residues and 23 local water samples and 25 local soil samples were tested for assessing the impact of pesticide use on human health and the environment. Results from laboratory analysis showed that those pesticide residues were detected not only in samples of vegetables and fruits, but also local soil and water, and urine samples of adults and children. The research findings show that local water and soil are widely polluted by pesticides. 46.5% of the soil sample collected from farming land and 33.33% soil samples collected from private plot/home gardens were tested positive for at least one pesticide residue, and the total positive rate of soil samples is 40%. 33.33% of the irrigation water samples and 9.09% of the drinking water samples locally collected were tested positive for at least one pesticide residue, and the total positive rate for water samples is 21.7%.

Although there is no strong evidence gained from this research that shows the serious harmful impact of pesticide on health, the pesticide internal exposure rate of local people is high: more than 60% of urine samples of local people tested positive for at least one kind of pesticide, including persons above 60 years old and infants of one year old.

The excessive use of chemical pesticides in agricultural production in Yuanmou is caused by the complex interaction of different actors with diverse interests that are deeply embedded in the institutional arrangements and agricultural development policy that creates structural incentive.

Based on the situation analysis, an intervention packages were collectively designed by researchers and community farmers, depending on the agro-ecosystems, which community members operate and their circumstances.

(ii) Interventions

The purposes of these interventions were three-fold: to disseminate the research findings to local communities and other stakeholders, particular the lab test results of pesticide residues in local vegetable samples; to raise awareness of the harmful effects of pesticide using and educate local farmers about the

importance of using self-protection techniques when using pesticides; and to discuss with local farmers to discover ways to reduce the use of chemical pesticides. A street theater and role play have been used to do health education on pesticides in the six project villages in Yuanmou. Locally designed media such as calendar and posters on knowledge of pesticide have been designed, produced and distributed to the project villages.

There were positive changes after interventions: more farmers took self-protection when using pesticides and those who took more self-protection had lower positive rate of urine pesticide residues. This suggests that self-protection taken by local farmers is effective although it looks simple and unprofessional.

Indonesia: Ecohealth and Dairy Production: Connecting Issues and Finding Interventions for Small-Scale Farming in a Southeast Asian Context.

(i) Situation analysis

Situation/observational studies consisted of three surveys, including a preliminary and two graduate research studies. The preliminary survey was carried out to obtain contextual information on dairy farming in Pangalengan and on the dairy farms taking part in the research, with total respondents of 74 farmers. This survey was conducted to seek information based on farmer's knowledge and behavior. The result showed that most farmers had poor dairy management practice which caused lower quality of dairy products.

The research involved two mater students from Environmental Science faculty, Universitas Indonesia. The research studied the dairy farm management practice in Pangalengan, West Java.

(i) The first study title is measuring the Impact of Smallholder Dairy Farming on Health. This research aimed to identify problems for which feasible and effective intervention can be found to address the environmental damage, and human and animal health problems. The results showed that farm activities with Ecohealth Approach had not been fully applied to the management of dairy cattle business in Pangalengan, which therefore caused several health problems. Livestock activities affected water quality criteria which was lightly polluted river turned into a heavily polluted with the value of 10.39 Pollution Index. The feed management activity had a significant relationship with human health, while dairy cow maintenance activity had a significant relationship with animal health.

(ii) The second study title is an Ecohealth Study of Smallholder Dairy Farmers in Indonesia. This research aimed to obtain information on characteristics about the farms to provide a baseline set of descriptor and category of farm management practice to identify which categories are being done in a sustainable, healthy, and eco-friendly way and which are not. The result showed that economic status of the farmers are connected to environmental of health status, and these in turn may be driven by psychosocial ones. The researcher proposed an organization which will run cow waste processing plant as a solution to reduce negative impact on health and environment.

(ii) Interventions

The agricultural waste in Pangalengan caused water contamination in river and affected human and animal health, based on graduate student's research finding. The FBLI- Indonesia team then initiated conversion process of farm waste into valuable products to address this problem, which resulted in four products (Biofertilizer; Kascing (Earthworm Feces); Solid and Liquid Organic Fertilizer; and Animal Herbal Feed Supplement). The conversion of farm waste into these products had not only solved environmental problems, but also gave additional income for the local farmers who produced it.

- Biofertilizer: It is a product made from urine of rabbit mixed with fruits and other organic materials were being processed used decomposer microbes. The bio-fertilizer has benefit to accelerate production of solid fertilizer, and enrich its ingredients with useful nutrients for soil. This product will be used as additional material to produce solid and liquid organic fertilizer.

- Kascing (Earthworm Feces): It can be used as material to produce compost, because it contains high nutrients which needed by the plants. The earthworms' feces, which had been processed before, will be used as additional material to produce solid and liquid organic fertilizer.

- Solid and Liquid Organic Fertilizer: They were made from cow manure, decomposer, vermicompost, Mikoriza, and Trichoderma. These ingredients then were processed through biotechnological method. Several laboratory tests were being conducted to analyze the quality and effectiveness of these fertilizers. The liquid organic fertilizer was tested with 8 parameters, namely: the followed materials (plastic, glass, and gravel), C-Organic, Heavy Metal Extraction, pH, Hara Macro Extraction, Microbial Contaminants, Micro Nutrient Extraction and other elements. While solid organic fertilizer was tested with 11 parameters are: Preparation, C-Organic Materials Follow up, Water content, Heavy Metal Extraction, pH, Hara Micro Extraction, Microbial Contaminants, Microbial Functional, Hara Micro Extraction and Other Elements. The result is disseminated in the form of a laboratory certificate, which then be used to fulfill requirement regarding product marketing. The field trial of the product had been conducted in several farms in Pangalengan, some positive results were found.

- Animal Herbal Feed Supplement: It was made from molasses, probiotic, curcuma, katuk leaf, and Lumbricus rubellus earthworm, which were being processed through biotechnological method. This product increased performance of the animal by giving enough nutrients needed. There were several laboratory analysis conducted to analysis the quality of this product.

By applying an ecohealth approach, researchers and farmers worked together to implement an intervention that converts farm waste into herbal feed supplements, casting, earthworm extract, and bio-fertilizers, all of which to improve human, animal, and environmental health. A business incubator has been formed to facilitate product commercialization. These products have improved the economic prosperity of over 230 farmers, and discussions are ongoing with government officials to promote eco-friendly agricultural products, which will enhance the sustainability of benefits associated with these interventions.

Thailand: Study on potential impacts and proposed best practices in agricultural development: A case study of rubber plantation expansion and increased risk of vector-borne diseases in eastern Thailand.

(i) Situation analysis

A cross-sectional study was applied for collecting baseline information including ecological, biological and sociological factors. The results show that risk for dengue chikungunya and malaria appeared to be higher in areas with rubber plantations in comparison to those without rubber plantations.

Spatial maps created by using GIS, overlaid with characterized rubber plantations from Thaichote Satellite and Google images, showed that dengue was highly concentrated in the central areas in the districts without rubber plantations while dengue were scattered in the districts with rubber plantations. The average numbers of dengue incidence per 1,000 people in the districts without rubber plantations and the districts with rubber plantations were 0.43±0.45 and 0.76±0.76 respectively. There was a trend of dengue spread and cluster in the areas of rubber plantations and dengue risk seems to be higher in the districts with rubber plantations. The study also showed that chikungunya cases in 6 villages were high and clustered in the central and north areas of Wang Chan District where rubber plantations were concentrated. There were positive containers with the presence of mosquito larvae and pupae in rubber plantations. Many of them were freely discarded throughout the area; and when the rain fell, it made them suitable breeding sites for mosquitoes. The practice of not turning the rubber latex cups upside down created more breeding sites and made rubber workers who lived and stayed all day and night in rubber areas be more vulnerable for mosquito-borne diseases. In six provinces with high rubber plantation areas, there was a trend in increasing *Aedes* vector populations (4.35±0.39) and also dengue cases (107.35±24.72). Therefore, rubber plantation was one of the environment factors that enhanced dengue risk.

A series of sample collection and preliminary analysis activities were implemented. A total of 82 water samples collected from rubber plantations in Chachoengsao Province were screened for chemical residues (lead, cadmium, manganese, nickel). It revealed that both drinking and utility water were not appropriated for direct usage, but the concentration of heavy metal (Pb, Ni, Mn, Cd) in water did not exceed the limit value.

A total of 107 soil samples were collected from 109 visited houses in rubber plantations in Chachoengsao Province. Result shows that concentration of selected heavy metal in soils did not exceed the limit value (Pb<400 mg/kg, Cd<37 mg/kg, Mn<1,800 mg/kg, Ni<1,600 mg/kg) but biological contamination found in soils exceeded the limit value (total bacterial count = 50,000 cfu/ml; Coliform bacteria = 1,000 cfu/ml; Salmonella spp. = 1,000 cfu/ml), i.e., Coliform bacteria (97%), Salmonella spp. (25%) and E. coli (1%).

A total numbers of 170 domestic dog serum samples in Wang Chan District, Rayong Province were investigated for dengue virus infection by using RT-PCR and virus isolation. The results confirmed that dengue virus type 3 had circulated in domestic dog populations. Partial gene phylogeny revealed that it was closely related to those strains circulated in human populations.

A comparative study of the socio-economic impacts on health care among different groups involved in rubber cultivation industries in Thailand was conducted. Results revealed that displacement of migrants forces them to face new environment and could expose to potential hazards. Most of migrants have low skills and often work in sectors with high level of occupational health risk and with low payment. Inequalities of income make migrants face with poverty, which limit them to access education and health service, rendering them to be vulnerable to health problems.

(ii) ***Interventions***

By collating research findings and working with migrant workers, crop owners, health care providers, and other government officials, the research team developed acceptable and effective integrated interventions which include health education tools and strategies and innovative vector control to mitigate health risks that are associated with rubber plantations in Chachoengsao province.

- *Community and public engagement* were initiated through media, community meetings in order to educate the communities and the public on an innovative birth control of mosquito vectors of dengue, chikungunya, yellow fever and Zika disease.

- *Reducing risk of mosquito-borne diseases among workers associated with rubber plantations using DEET-impregnated screen jackets.* Self-protection strategies from mosquito bites among workers have been very limited. Thai team developed DEET-impregnated screen jackets and then conducted the experiments to test their efficiency in a real situation. A total number of 30 rubber plantations in Chachoengsao, eastern Thailand were selected. Trials of these jackets among workers indicated significant reduction in the mean numbers of mosquitoes attracted within five minutes when compared between treatment and control. This type of jacket could be used as one of the self-protection measures.

- *Suppression of vectors of dengue, chikungunya and Zika diseases using super-sterile Aedes males.* The primary results showed low egg hatching rate in control village when compared to treatment villages. Releasing of super-sterile male mosquitoes could be considered as an alternative eco-friendly strategy for vector control.

Vietnam: Using Ecohealth Approach for Better Management of Livestock and Human Waste in Hanam Province, Vietnam.

(i) ***Situation analysis***

PRA results showed that cleaning animal housings were not good. Some households have used animal waste without or not properly treatments. For most households who treated animal and human waste by biogas, waste water often did not reach the required standards. Therefore, animal waste management becomes one of the main concerns of local communities.

Qualitative research showed that the local regulation documents (Huong Uoc) proposed by the community should focus on vaccination for livestock (78.5%), protection of public building (49.6%), monthly cleaning the streets (39.5%), and garbage classification (33.3%). Most of respondents would like to be communicated about "Huong Uoc" via loud speakers of each village and via local meetings in each village. This is crucial information for designing intervention.

A baseline surveys of 461 households was implemented in 2012, the results revealed that 78% of households kept livestock. About 60% of the surveyed households increased their flock sizes during the five-year period between 2008 and 2013. 24% of the livestock keeping households owned biogas tanks. Ninety three percent of pig housing for breeding did not meet the livestock hygiene standards of Vietnam. Over the past 6 months of monitoring, sows often acquired diarrhea, cough, fever, sudden death and paralytic (14.1%; 6.6%; 6.6%; 1.5% and 0.5%, respectively). Diarrhea and cough were the most common symptoms in sows, fattening pigs and piglets. Over 60% of households called the vet when pigs became sick, and 1/3 of the households surveyed applied self-treatment when pigs became sick.

In 2014, an investigation was conducted in 451 smallholder biogas in Ha Nam province. The investigation focused on current situation of operating biogas system; using biogas wastewater in agricultural production; and assessment of exposure to biogas wastewater by farmers. The results showed that average biogas age was 5 years, ranging from 1 year to 28 years. The average volume of a biogas tanks is quite small, around 11 m^3. Most of input waste is pig excreta (90.0%); poultry excreta (29.7%). Very high percentage of households also has toilets which directly linked to the biogas (50.8%). Using biogas waste water in agriculture was very common in the study sites. Wastewater, solid waste of the biogas did not fully treat that usually using for irrigation, fish feeding in our study sites. For example, the percentage of farmers using biogas wastewater to irrigate for cucumber and corn was 27.9%; fruit trees (24.4%) and vegetables. Most of farmers did not understand the way of processing and maintaining the biogas, only 1.8% of the interviewed farmers had right understanding on the retention time of waste in the biogas tank, and 11% had right knowledge on the safety management. Moreover, the properly handling practice of cleaning pig pen was low (74.4%); and the relevant time for cleaning the pig cages (73.8%). These are direct and indirect factors which make the amount of total waste exceed the capacity of the biogas.

In addition, a total of 150 samples of biogas wastewater (included 75 samples of outlet tanks and 75 samples of drains) were taken to analyse for some specific pathogens and chemical indicators. Results showed that all wastewater samples exceeded industry standards for *E. coli*, BOD5, and COD indicators. Average of E. coli concentration was over 11x103 CFU/ml. 34%, 31% and 57% wastewater samples were positive with *G. lambila, C. parvum*, and *Salmonella*, respectively. The average concentrations of *Salmonella, G. lambila, C. parvum* were 5 CFU/ml, 6 Cys/100 ml and 8 Cys/100 ml, respectively. These findings suggest that further measures are needed to reduce risk by either improving the microbial quality of biogas effluent or by ensuring the use of personal protective measures when exposing to biogas wastewater.

Health risk assessment related to biogas-wastewater was also conducted; the results demonstrated that concentrations of pathogens in biogas wastewater at the smallholder farms are high. Microbial quality of biogas waste water did not meet the Vietnamese standard for agricultural wastewater quality. Some pathogens found in biogas wastewater were exceeded the National Standard QCVN 01-79: 2011), in particular *E. coli* ($1.4*10^6$ /100 ml), *Giardia (44.0%),* and *Cryptosporidium (34.7%).*

(ii) ***Interventions***

An intervention package was introduced to promote good hygienic practices in the study area, which include: (i) Collaboration with a highly committed involvement of local authorities and community members with the research team to develop relevant booklets, flyers, poster to provide with information on how to best use the biogas, keep environmental sanitation management and animal health management; (ii) Development of specific village regulations in relation to environmental sanitation, in particular animal waste management to encourage healthy habits in Hoang Tay commune.

Intervention evaluation was conducted before-after and compared with a control group to assess the effectiveness of intervention program. The results showed that the intervention program has contributed to the changing knowledge and practice of farmer in using household biogas. The rate of proper knowledge and practices on biogas management has actually been increasing after intervention. The biogas wastewater quality as result of the intervention also increased. Average reduction of COD index before and after intervention were 451.6 mg/L and 3137.7 mg/L respectively and average decrease BOD before and after intervention ware 313.4 mg per litter and 967.5 mg per litter respectively.

2.2 Capacity building

Capacity building component comprises Training of Trainers (TOT), Future Leader (FL), and Degree Training (DT) sub-components, being led and managed by VWB, UI, and MU respectively.

TOT

The Training of Trainer (TOT) sub-component was kicked-off in 2011 with the main purpose of supporting the production of training material and building human resources for research & training activities from countries and components. The TOT consisted of 2 phases, the first phase is TOT manual preparation and the second one is dissemination and translation into local languages.

The first phase was marked with two events:

- *Review of Ecohealth Trainer Manual' Writeshop, 29-31 March 2012, Bangkok, Thailand;*
- *Ecohealth ToT Workshop for Ecohealth lecturers/trainers, 30 June – 4 July 2012, Pattaya, Thailand*

The second phase featured 2 activities:

- *The Manual was first launched at the first Ecohealth course co-organized by EcoZD-ILRI and FBLI in Hanoi in May, 2013.* In the RCG meeting in December 2013 in Jakarta Indonesia, the issue of translating the Ecohealth TOT manual, followed by the dissemination and planning for further use of the Manual in the future were raised. This prompted a survey to assess the use of the TOT manual by relevant users. The assessment was done by VWB, CU and an independent consultant in July and August 2014. The results of the assessment showed that there were a high demand of understanding Ecohealth concepts and principles in local languages and contexts. The plan for translation of the Ecohealth TOT manual was then finalized among all teams and with Veterinarians Without Borders (VWB).
- *Translation of Ecohealth TOT Manual in local languages*
- With the support from VWB, three teams (Indonesia, Thailand and China) decided to translate the Ecohealth TOT Manual in local languages (Bahasa, Thai and Mandarin). Vietnam team decided to write a new book in Vietnamese based on the available materials on Ecohealth and their own FBLI research case studies. Up to September 2016, the Vietnam team has completed its work with the book titled "Ecosystem Approach to Health-Theories and Practices in Environmental Health Research in Vietnam". This textbook was launched on 29 September 2016 in Hue city, Vietnam. The translation in Bahasa, Thai and Mandarin is in progress. For more details please see Annex 3.

Degree training

The degree program was developed for Master and Ph.D. degree by 9 Faculties/Institutions of Mahidol University. The Degree Program was approved on 486th Mahidol Meeting on 16 July 2014 by Mahidol University Council. Degree Program's committees was nominated and appointed on 4 November 2015, consisting of 13 members from 9 Faculties/Institutions. Currently, the degree program specification and curriculum is developing and revising by the degree program committees.

The completed Degree Programme curricula are expected to submit to the Faculty of Graduate Studies and the Mahidol University Council and the final version of the Degree Program are expected to submit to the Education Commissions, Ministry of Education. The new curricula of the Doctor of Philosophy and the Master Program in "One Health and Ecosystem Management" (International Programme) are expected to announce to the public in 2017 and begin to recruit students in the academic year 2017.

A number of post graduate students were trained via the FBLI project and gained valuable practical experiences that would not have been possible if the project had not been undertaken. For instance, two researchers from Indonesian team used data from FBLI research project and earned Master's degree from the UI in 2015. Seven from Vietnam team, three from China teams and one from Thai team obtained Master degrees. In addition, two bachelor degrees of natural resources and environment; and one bachelor's degree of social science and humanity graduated in 2014 and 2015 in Vietnam.

Future leaders

This program aimed to nurture and supports the development of early-career professionals to become future leaders in the field, literate in ecohealth, and to provide opportunities for them to exercise problem-solving skills at strategic study sites as well as through regional networking.

This future Leader subcomponent was led by FBLI Indonesia, a series of trainings for future leaders was successfully conducted in Indonesia, Thailand, Vietnam and China, 218 Participants of students and young professionals from medicine, public health, veterinary medicine, and other discipline from 10 Countries from Indonesia, Malaysia, Vietnam, Thailand, Philippines, Lao PDR, Cambodia, China, Nepal, and Myanmar was trained, of which 79 participants were funded by the FBLI future leader sub-component. A total of 24 small seed research grants were approved and awarded in four countries. These funds provided opportunities for young researchers to develop a novel idea to employ ecohealth approach in solving real problems in communities.

After the successful organization of Future Leader Trainings in all four countries, the Seed Funding activity was followed to provide young scholars with opportunities to apply Ecohealth in their own research. A total of 20 small seed research grants were approved and awarded in four countries. In China, four of trainees who participated in the future leader training received seed funding for ecohealth practices. In Indonesia, the seed funding was given to nurture and support the development of 6 young professionals to become future leaders, become more knowledgeable in Ecohealth, and provide opportunities for them to improve leadership and problem-solving skills. In Thailand, four proposals from Thai applicants were selected and announced for financially support through the FBLI-SEED Funding for leadership project on ecosystem approach to health and contracts will be signed before December 2015. For Vietnam, six seed funding were awarded to six selected young researchers for the studies of application of ecohealth approach in communities.

2.3. Knowledge Translation

2.3.1. Activities at regional level

The key purpose of the knowledge translation component is to disseminate the FBLI research findings on health risks associated with agricultural intensification to various audiences.

This is the most challenging component of FBLI due to difficulties in the arrangement of hosting institutions for KT. However, some important outputs and outcomes were produced.

- FBLI synthesis booklet

This first synthesis booklet of the FBLI describes how the FBLI has contributed to developing the field of Ecohealth by drawing on research and practical experiences from Southeast Asia (Indonesia, Thailand, Vietnam) and China. The case studies showed how local communities addressed and learned from challenges in managing agricultural intensification through joint efforts with researchers and other actors.

This booklet aims to synthesize and present activities since program launch in October 2011 to December 2015.

- Regional policy brief:

The FBLI Regional KT Workshop was held in Ho Chi Minh City, Vietnam by the FBLI-Coordinating Unit from 23-24 May 2016. The objectives of the workshop were: (i) to share and consolidate policy-relevant findings and key messages from ecohealth research and capacity building conducted in four FBLI countries; (ii) to synthesize the major results and lessons learned from KT, capacity building, and M&E activities, highlighting those that have regional importance and implications and (iii) to develop a format for producing one FBLI regional policy brief and three country briefs. Main outcomes from the workshop are: (a) Participants have enriched their knowledge on how to formulate a good policy brief based on research findings and lesson learned during the FBLI program implementation; (b) Specific suggestions for the further revision of country policy briefs were provided and (c) Key messages for the regional policy brief were formulated. Based on that, the CU has formulated a FBLI regional policy brief with assistance of an international consultant.

- Media Briefing

A media briefing session was organized right after the FBLI final research workshop in Kunming in September 2016, where representatives from 8 news agencies and websites in China joined the session, including Xin Hua News Agency and Xin Hua Website, the two biggest official news agencies in China. The context of agricultural intensification and health in the region was presented. Four lead researchers from each of the country project teams presented their work to the media and there were opportunities for questions and answers. Findings from these studies are crucial to the development of national and regional agricultural development strategies in each country as well as joint strategy of region as a whole. After the workshop, six news agency originally reported the FBLI project and 12 other news agencies reproduced the original reports, which made the knowledge generated by the FBLI project had a wide media coverage in China.

Several tools haven been used by FBLI for dissemination of FBLI at regional level as follows:

FBLI newsletters: The FBLI has produced a newsletter every six month. This highlighted key results and activities. These newsletters were distributed through the FBLI website and to the mailing list of FBLI member contacts, and may be forwarded to others.
FBLI website: It is one the main sources of information about FBLI available to most stakeholders (www.ecohealthasia.net). The website is divided into seven sections: About us (with information about FBLI, visions, organization structure); Research (research proposals); News and Events (FBLI events and other FBLI relevant topic events); Knowledge translations (proposals); Capacity building; M&E (reports) and publications (FBLI reports, and FBLI relevant papers/articles). In addition, the FBLI Facebook was designed to be informative to ensure wide communication with diverse audience.
International conference presentations: The FBLI RCG members have collectively prepared some conference presentations. They contain brief descriptions of FBLI including FBLI's objectives and partners. They were distributed at events attended by FBLI partners in order to increase visibility of FBLI and expand the FBLI

network. International conferences included; FBLI Mid-term Research Workshop in Da Nang, February 2-4, 2015; the 14th World Congress on Public Health hosted in Kolkata, India from 11-15 February *2015;* The 4th Food Safety and Zoonoses Symposium for Asia Pacific held in Chiang Mai in August 2015; the 9th European Congress on Tropical Medicine and International Health (ECTMIH), Basel, Switzerland, during 6-10 September 2015, One Health Ecohealth congress in December 2016 in Melbourne.

2.3.2. Activities at country level

The FBLI was quite well positioned to work with local communities in the participating countries to mitigate impacts of agricultural intensification on health of humans, animals and ecosystems. Policy Alliance Groups were formed in Indonesia and Vietnam, and is being formed in Thailand, to act as a vehicle for conveying research findings for use by local communities and public audience.

At country level, researchers reported that they used common dissemination techniques, including: policy briefs (Indonesia, Vietnam); website publications (China, Indonesia, Thailand and Vietnam); newsletters; international professional conference presentations (China, Indonesia, Thailand and Vietnam), presentations to community meetings and policy makers (Vietnam), international peer-reviewed journals and media news, especially, a total number of 64 news articles, 20 TV programs and 3 radio interviews were released in Thailand to inform and educate the public on super-sterile male mosquitoes.

2.4 Networking

During the five year period, FBLI members had joined a number of international and national conferences and workshops. The most important international events for FBLI were: The 4th Biennial **Conference** of. International Association for Ecology & Health. 15–18 October **2012**, Kunming, P.R. China; the 5th Ecohealth Biennial Conference, 11-15 August, 2014, Montreal, Canada. One Health Ecohealth congress in 3-7 December 2016 in Melbourne. FBLI had established the networking with other networks in the region such as EcoZD, APEIR, EcoEID, SEAOHUN, Ecomore, and PMAC etc.

The country teams had the linkages with other network in their own countries. For example, FBLI-China team has the linkage with *Forehead*, a forum that promote interdisciplinary research and action on environment and health in China. Through this forum, the team established wide links with researchers and institutions in China that work on environment and health.

2.5. The Coordinating Unit (CU)

2.5.1. Monitoring and Evaluation:

M&E Framework has been drafted, circulated among the RCG members and finalized. The first draft of the M&E framework was prepared by the CU and circulated among the RCG members on 7 March 2013 and finalized in August 2013 in the M&E training with Mr. Bob Williams-consultant.

The CU collaborated with the FBLI Indonesia, China and Vietnam teams to conduct the internal assessments by using Outcome Harvesting as an approach.

In Indonesia, the first M&E exercise using OH as the key tool was conducted with the FBLI Indonesia team on 14th and 15th November and on the from 15th and 21st December 2013. The tool, the framework as well as the guideline for M&E activity has been developed by the Coordinating Unit and Mr. Bob Williams – M&E freelance consultant. The trial was very useful in providing information for the M&E activity. A number of adjustments were made by the M&E team after December meeting in Jakarta. These adjustments were included in the M&E exercise with the FBLI Vietnam in September 2014

In Vietnam, the assessment started in October 2014 with various in-depth interviews and focus group discussions. The evaluation report covered the period from July 2012 to September 2015. The aim of the activity was to share the outcomes, challenges as well as lessons learnt of the FBLI Vietnam over the last three years. Also, the CU was hoping that this report will serve as an example for further replication in other teams. Five outcomes in three categories have been identified. The enhancement of team members' knowledge and skills in doing Ecohealth research by practical experiences, the changes in recognition of the local authority, and adjustment of Ecohealth approach in new curriculum for master training at the HSPH are the three outcome areas. Outcomes are supported by the detailed stories, evidences and proper analysis. They reflected the participatory evaluation process in identifying achievements, challenges, and lessons learnt. The team found the exercise very helpful in reflection and finding way forward for the upcoming phase. The full report is in the annex.

In China, to capture FBLI China's progress towards Ecohealth field building outcomes, along with challenges and lessons learned, the program's Coordinating Unit (CU) at the regional level facilitated a session with the FBLI China team in October 2015 to reflect on outcomes. The process of change from this project can be seen in three main groups of outcomes: 1) the FBLI changed the way researchers do research by integrating knowledge from local community; 2) local partners were actively engaged in the research process; and 3) Ecohealth has been recognized by local academic peers through FBLI-China's networking activities.

2.5.2. Technical arrangement and supports to the activities of FBLI

The Coordinating Unit (CU) has provided the substantive and administrative support to the activities of the FBLI, as well as assisted the regional core group members and managed the day-to-day organization of the FBLI network. Specifically, providing logistical arrangements for the FBLI's workshops, meetings during the 5 years, i.e. setting the agenda, managing travel arrangements and reporting, etc.

Four RCG meetings were organized: *The first RCG meeting was held in Jakarta, Indonesia 17th to 20th December 2013.* The meeting marked the milestone of signing the Consortium Agreement (CA) among eight partner institutions which affirms their commitments in partnership and collaboration. Besides, the progress of two year implementation of each country teams as well as other components of the program was reported. *The second RCG meeting was organized in Da Nang Vietnam, which was a spin-off of the mid-term research workshop on 5 February 2015*. All the components' activities were updated. During this meeting all the components of FBLI was updated but a special focus was on M&E and KT planning and implementation. The meeting could address the way forward for staffing of KT and strategic discussion on field building related to actual work of FBLI. *The third annual FBLI RCG meeting took place in Bangkok,*

Thailand in February 2016 and was followed the FBLI networking meeting (see below). The participants discussed FBLI progress, future plans, and plans post-FBLI at the 3rd annual FBLI regional core group meeting. *The final RCG meeting was held in Kunming, China in September 2016*, followed by the final research and KT workshops (21 September 2016). Only half of the RCG members were able to participate (Jang Jing, Pat, Hung, Tung) to discuss the up-coming final FBLI technical report, including the overview of main messages of each FBLI component and scientific highlights. Some reflections and next steps were also discussed and shared.

The FBLI Mid-term Research Workshop, held in Da Nang city, Vietnam, 2-4 February 2015, brought together a pool of four country research team members, together with invited guests from donor organization and collaborating institutions. At the workshop, four country team leaders were able to provide an up to date overview of research, including research progress activities, most interesting and innovative results, outputs, outcomes for policy implication and how the results are steadily beginning to influence attitudes, practice and policy change in significant ways for the country members' contributions. In addition, thirteen (13) short papers were presented. This composites evidences a substantial research effort being made and indicates the significant level of knowledge being generated as a direct result of the FBLI project. The Mid-term workshop provided a valuable setting for discussion of the next steps (intervention and knowledge translations) for the FBLI in general and each country team in particular.

FBLI Networking workshop was held from 15-19 February 2016, Bangkok, Thailand. The networking and dialogue event brought together 23 participants, mainly researchers, to discuss integrative approaches to addressing developmental challenges in Asia (in particular on health, agriculture, food systems, and the environment); and to explore future collaborations. Participants had affiliations with FBLI, APEIR, ECOMORE, EHNA, SEAOHUN, INDOHUN, MBDS, and VWB. Participants represented a variety of academic and professional disciplines, including public health, environment, agriculture, economics, and human and veterinary medicine; and have extensive experience in using integrative approaches in Asia. Each network reported activities of their network or organization, and shared perspectives for regional collaboration.

FBLI Knowledge Translation Workshop, held in Ho Chi Minh City, Vietnam, from 23-24 May 2016. The objectives of the workshop were: (i) to share and consolidate policy-relevant findings and key messages from ecohealth research and capacity building conducted in four FBLI countries; (ii) to synthesize the major results and lessons learned from KT, capacity building, and M&E activities, highlighting those that have regional importance and implications and (iii) to develop a format for producing one FBLI regional policy brief and three country briefs. During the workshop, the group work used discussions of country policy briefs and regional policy brief as a vehicle for exchanging ideas and comments about how to improve pre-prepared policy brief by distilling research results and key messages that have regional relevance for ecohealth policy makers. The workshop provided an opportunity for researchers to synthesize their key findings and articulate policy implications and recommendations, which will be used to communicating key messages to policy audiences.

Media Event to introduce the regional FBLI research to the Vietnamese audience and Ecohealth book in Vietnamese, Hue city, Vietnam

Being inspired by the media event introducing the regional FBLI program in Kunming China, the same format has been replicated in Vietnam in 29 September 2016. The event was hosted by FBLI-CU and gathered participants from academic institutions, government agencies and media including Hanoi School of Public Health; Hue University of Agriculture and Forestry; Hue University of Medicine and Pharmacy; Department of Health under the Provincial People Committee of Hue city, Preventive Medicine Center of Hue city, Hue Provincial Broadcasting and Television Station (RTV), and some local newspapers (Tuoitre and Thanh Nien). During this workshop, the Ecohealth book in Vietnamese was also launched. The regional FBLI program and the workshop was disseminated through the website of RTV and the Institute for Community Health Research, Hue University of Medicine and Pharmacy

http://www.trt.com.vn/TintứcSựkiện/tabid/57/itemid/30262/categoryId/1/type/1/Default.aspx

http://iccchr-hue.org.vn/vn/our-works/vien-ncskcd-tham-du-hoi-thao-gioi-thieu-du-an-“sang-kien-xay-dung-va-phat-trien-suc-khoe-sinh-thai-tai-dong-nam-a?key=301

The CU also took over from Sonia Ferve in following up with the TOT training activities. The task includes following up progress from country teams and coordinating administrative and financial procedure with VWB in Canada.

2.5.3. Communication activities:

CU also participated actively in communication and advocacy for the work of the FBLI through different channels (workshops, meeting, regional policy briefs, website, bulletins, newsletters, etc.).

- Website (http://www.ecohealasia.net) and social platforms were created

Web pages to support the project were prepared and were updated throughout the duration of the project for the FBLI website (http://www.ecohealasia.net). We encourage other teams’ contributions to enrich this digital platform. Besides, Facebook and Twitter pages are used to better update audiences with FBLI and other related Ecohealth activities. Twitter https://twitter.com/EcoHealthSEA; FB page https://www.facebook.com/Field-Building-Leadership-Initiative-FBLI-514382155383636/timeline/

- Video: A five-minute video on the regional FBLI has been made by the CU. The video was made of video footages from country teams and component: https://www.youtube.com/watch?v=axOOQshLkXk

- Policy brief/Newsletter/Bulletin: One regional policy brief, two short briefs, and 3 bulletins were produced by the CU

3. Synthesis of research results and development outcomes

3.1 Research results

Each of the FBLI studies generated a considerable new knowledge on pesticide use and it impact on human and environmental health; smallholder dairy cattle farming and environmental health; linkage between rubber plantation expansion and increased risk of vector-borne diseases and the impact of animal and human waste management on human and environmental health.

In the case of vegetable and fruit plantation in Yuanmou, Yunnan, China, both smallholders and large plantations, highly rely on pesticides and other modern agricultural production inputs such as chemical fertilizers, new variety of seeds and irrigation that increase productivity and farmers' income, but also pose health risks to farmers, agricultural workers, local residents and consumers and cause the pollution of environment. Results from laboratory analysis showed that pesticide residues were detected not only in samples of vegetables and fruits, but also in local soil and water, and in urine samples of farmers and children in Yuanmou, a key vegetable-growing region in China. It was found that 65 percent of the samples contained traces of at least one pesticide, even though the region switched to "low toxic" pesticides in the early 2000s. The team distributed informational calendars and performed street theatre in villages to educate the farmers about how to reduce pesticides and use them safely. Thank to this education, the farmers know the health risks of overusing pesticides in agricultural production, start taking care of self-protective measures. The overuse of pesticides in agricultural production is just one issue of pesticide production and distribution, involving many different stakeholders.

In the project "Measuring the impact of smallholder dairy farming on health using an ecohealth approach in the highlands of West Java, Indonesia, the research results showed that farming management in Pangalengan had not fully implemented the ecohealth approach and contamination in the river with human health risks was found. The contamination was mainly from by animal waste from local dairy farms. The researchers developed ways to convert cow waste into fertilizer and other products. This not only created a new source of income for farmers, it also proved effective in increasing crop yields.

In the case of the rubber plantation expansion and vector-borne diseases, in Chachoengsao province, Thailand, The study illustrated that there was a direct correlation between rubber plantation expansion and increased risk of vector-borne diseases, i.e., dengue and chikungunya around the rubber plantation areas in eastern Thailand while the rubber workers had limited knowledge of these vector-borne diseases. Water contamination with heavy metals, the bacteria *E. coli* and *Salmonella* were reported. Inappropriate disposal and handling of chemicals including poor self-protection and sanitation were observed. Proper self-protection was proposed and awareness among rubber workers was improved through providing health education, the research team promoted the use of DEET-impregnated screen jackets as one of self-protection measures. A pilot vector control intervention, using innovative super-sterile male mosquitoes, was conducted in order to reduce vector populations and risk to the diseases they transmit.

The study on livestock and Human Waste management in Hanam Province, Vietnam showed that livestock wastewater management has become a challenge in Vietnam as livestock related infrastructure and regulations have not kept pace with livestock population growth. The use of biogas waste water in agriculture was very common practice; however, the concentrations of pathogens in biogas wastewater at the smallholder farms are high. The biogas effluent was tested and found that the biogas effluent exceeded standards for the bacteria *E. coli* and *Salmonella,* the parasite *Giardia*, and other harmful contaminants. Biogas wastewater used as fertilizer also put farmers at high risk of diarrhea. Farmers have adopted better biogas management practice, which lead to improved after-biogas effluent quality.

3.2 Main outcomes

The most common and important outcomes generated by the FBLI in four countries can be summarized as bellows:

- (i) *Local community people changed their behavior* from the FBLI. Changes adopted in personal protection when vegetable producers spraying pesticides in China; in Thailand more rubber workers and owners of rubber plantations are more aware of their health and more cautious about how the environment may affect their health and in Vietnam, more pig farmers adopted proper animal waste management practices. By working with FBLI teams through farm visits, focus group discussions, on-site interviews, and soils, sample testing, the local communities get better understanding of impact of pesticide, animal waste management, and rubber expansion on the health of human and environment;
- (ii) *Integration of Ecohealth concept into the existing curriculums* and courses of KMU, HSPH, MU and UI and *institutionalization of Ecohealth teaching*. EcoHealth approaches are gradually known by research institutions and universities in four FBLI participating countries through our project activities, including research result dissemination, teaching and training in the last four years. An EcoHealth elective course becomes a routine course in the elected course list for undergraduate and post graduate students in these universities. In addition, some country-specific outcomes could be drawn from the FBLI program.
- (iii) Researcher integrated more Ecohealth spirit in designing and conducting research. Indeed researchers from national team but also our research partners have taken more ecohealth principles in doing there research

Some country-specific outcomes could be drawn from the project:

China

Seven major outcomes generated in this project. First is the better understanding and the insights of the use of pesticides in agricultural production and the underlying drivers in China. Second are some innovative interventions to address the negative impact of pesticide use. Third is the behavior change of local farmers, after the interventions, more farmers taking personal protection when using pesticides. Five is the enhanced capacity of the research teams and students who participated in the project. Six is the integration of Ecohealth concept into the existing curriculums and courses of Kunming Medical University. Seven is the implication of this project has for the pesticide control policy in China.

Indonesia

Community production, consisting of bio-fertilizer, casting, *Lumbricus rubellus* earthworm, solid and liquid organic fertilizer, and animal herbal feed supplement, was initiated by the FBLI Indonesia team. The idea was based on the results of a survey on characteristics of farms and farm management practice conducted in dairy farms in Pangalengan area of West Java. These products helped address socio-economic conditions and farming methods, helped reduce the practice of disposing of cow waste into local streams and rivers, and proposed to policy makers to consider socio-economics aspects and other farming characteristics in implementing the Ecohealth approach.

The initiative involves teaming up with an established producer of fertilizer in Pangalengan to convert cow waste into a compost for worm production (medicinal vermiculture) and bio-fertilizer that is more environmentally friendly than current alternatives. The fertilizer is currently being commercialized and widely accepted by local farmers in several provinces in Java.

The animal feed supplement that was being tested on several farms supports the substitution of feed and antibiotics on poultries, supports increasing profit and protection of poultry from virus. FBLI Indonesia helped promote the production of this product to farming households. As such, it created job opportunities; improved the profit of ten farms and delivered safe food in the community. All of these activities brought evidences for the discussion between FBLI Indonesia and the Ministry of Agricultural Production on regulation of animal health.

Thailand

The FBLI project has an impact on raising awareness among labour workers and owners of rubber plantations on the vulnerable living and working conditions which might eventually affect their health and well-being. The labour workers and owners of the rubber plantation enhanced their awareness on health and vector-borne diseases i.e., mosquito vectors, self-protection, and appropriated use of chemical products. The FBLI Thailand contributed to this change thanks to a number of activities including focus group discussions, on-site interviews, and soils, water, human sero-samples and dog blood samples were collected and screened for heavy metals, pathogens and biological contamination.

Vietnam

One of the important outcomes of Ecohealth capacity building component of FBLI in Vietnam was the publishing of the 1st Ecohealth textbook in Vietnamese in 2016. The book aims to introduce to the readers in Vietnam about the Ecohealth approach, its six core principles and application in practices. The opportunities and challenges of applying Ecohealth approach in research in Southeast Asia and in Vietnam are also discussed. The book features 12 modules, which describe and analyze theory and practices of Ecohealth approach in Vietnam and internationally. The content of these modules was based on the international experiences, a book titled *Ecohealth Research in Practice - Innovative Applications of an Ecosystem Approach to Health* by Dominique F. Charron (2012), as well as research and training experiences of the authors in the Vietnamese context. This is the first ever book in Ecohealth published in Vietnamese

and can serve as an useful reference for undergraduate and postgraduate students in the field of Public Health, Environmental Health, Preventive Medicine, Veterinary Medicine, Aquaculture, Animal Sciences, and Social Sciences as well as researchers who are interested in Ecohealth research.

In addition, two members of RCG received an award for Outstanding Contributions to Ecohealth (Fang Jing, 2014) and for Exceptional Early Career Award (Hung Nguyen, 2016) of the International Association for Ecology and Health (IAEH). This is great achievement of FBLI for its contribution to the field of Ecohealth.

4. Methodologies

4.1 For research

The project methodology was based on ecohealth approach (Charon et al, 2010) in which various research methods derived from different disciplines were used, including qualitative and quantitative methods, such as literature reviews or desk studies, cross-sectional surveys, participatory rural appraisal, on-farm intervention, laboratory testing.

4.1.1. Situation analysis phase

A desk study was conducted to review of the literature (publications) associated with the linkage between agricultural intensification and health. Secondary data was collected and analyzed. The data was used to describe situation before the project and used to compare with the results of the project to find out changes, and identify factors affecting these changes.

The participatory approaches used, based on methodologies developed in participatory rural appraisal (PRA) context, included site visit and observation; semi-structured and informal interviews, focus group discussion, problem tree, seasonal calendar, Spider diagram and Venn diagram.

Quantitative approach was also applied during this phase, such as laboratory tests, and risk assessment framework to assess collected sample situation and identify hazard, dose-response assessment, exposure assessment, and risk characterization.

4.1.2. Intervention phase

The research teams have worked with local communities and stakeholders to explore and pilot innovative solutions to address the identified health and ecosystem issues. The methods used in this phase included (i) On-farm trials and farmers to farmers extension; (ii) Community-based engagement and (iii) Laboratory testing. Although almost the whole community had participated in the situation analysis stage, a much smaller proportion wished to become involved in action research. The inclusive earlier stages of the project ensured that the community knew the trails and the farmers involved and actively observed the outcome. Farmers managed the trials, which were also monitored by themselves with assistance from researchers. No material incentives were provided.

Specifically, the team of China used “street threat” and role play to raise farmers’ awareness of the health and environment impact of pesticide using. The team gave feedback of the urine lab test results to farmers to raise their awareness of the harmful effect of pesticide use. The Indonesian team has implemented an intervention that converts farm waste into herbal feed supplements, casting, earthworm extract, and bio-fertilizers, all of which improve to human, animal, and environmental health. The Thai team developed DEET-impregnated screen jackets and then conducted the experiments to test their efficiency in a real situation and using super-sterile *Aedes* males for suppression of vectors of dengue, chikungunya and Zika diseases and integrating health education to mitigate health risks associated with vector-borne diseases. The Vietnam team has conducted an intervention package to promote good sanitation practices in the study area, which include: (i) Collaboration with a highly committed team of local authorities and community members to develop relevant booklets, flyers, poster and loudspeakers with information on how to best use the biogas and health checks for animals, and; (ii) Development of specific village regulations in relation to environmental sanitation, in particular animal waste management to encourage safe management practices.

4.2 Capacity building

Two main methods were used for capacity building component: (i) In class Training and (ii) Field Visitation and Community Engagement. The main objective of the in class-training was to provide basic theories to participants. The field visitation and community engagement were used to introduce participants to real situation.

The future leaders training and development process was based on an adult-learning methodology that is learner-centered, participatory and dynamic. Learning is achieved by practice, exchange and collaboration through seminars, lectures, case analysis, and placement at strategic study sites, exercises, and self-guided works.

4.3. Knowledge translation

The first activity was the formation of policy alliance groups of senior researchers and middle-level policy makers in China, Indonesia, Thailand and Vietnam. A series of national and regional policy workshops and seminars were organized, bringing together the policy alliance groups to help them develop effective solutions and knowledge products based on research findings. Methods included: Literature reviews policy synthesis; and knowledge dissemination events. Synthesis reports and policy briefs targeted at policy makers were produced through a sequence of steps: searching for appropriate research publications; identifying and assembling main research findings from FBLI and other relevant projects; and synthesizing and communicating findings and implications for ecohealth policy and practice.

A media briefing session was organized right after the FBLI final research workshop in Kunming in September 2016, where representatives from 8 news agency and websites in China joined the session, including Xin Hua News Agency and Xin Hua Website, the two biggest official news agencies in China.

5. Project outputs

During the 5-year period, the following outputs were produced by the FBLI: 9 international papers; 7 national papers; 4 policy briefs (one regional and 3 national policy briefs); 3 books, project briefs and bulletins, 10 degree student trained, 218 trainees for future leader program, several media publications, 47 presentations at international and national workshops and conferences; 8 workshops/meeting reports in addition, 1 website and several blogposts.

A list of completed outputs is in Annex 2. After the end of the project, country teams had plans to publish several outputs, including in-country, cross-country, and regional synthesis publications.

6. Problems and challenges

The project management during the 5-year period has maintained the initial structure with the CU working closely with the RCG members in exchanging and updating any progress of the whole project. However, the frequency of discussion among RCG members could not be maintained as we wished and discussed.

It is worthy emphasized again that the contact of RCG members significantly reduced during the Y3, Y4 and Y5. This can be explained by the busy schedule of the members and everyone has to focus on delivery of the country team. However, after 5 years of working together, there was a tendency that RCG members did not have the same level of responsiveness and interaction among the group as they did before during the proposal development phase and during the beginning of the programme implementation phase, which leads sometime to the communication disconnection. In addition, we had difficulties with HSRI to move the KT ahead but fortunately it worked out with effort of the RCG, VPHA and intervention of IDRC.

Conducting EcoHealth project is highly demanding for researchers who are required not only to act as researchers but also take on the roles of facilitators, coordinators, leader and advocates, which will cause uncomforting and challenge for some researchers.

Community and public engagement on intervention packages in all participating countries was difficult in the early stage because it is a new approach. However, after working closely with communities, people were understood and were supported and help expanding new practices into other farms and communities.

The existing vertical institutional and administrative arrangements also make it difficult for cross-institutional collaboration. This FBLI project is a multi-country collaboration that needs research team in each country going aboard to attend meetings and workshops, which is hard in some situation because going aboard is often restricted by regulation and administrative rules

7. Administration reflections and recommendations

IDRC program officers and financial officials have been always very supportive and helpful in proving needed assistance. They also gave flexibility and allowed making change when it was needed and reasonable, which are really the merits of IDRC and we strongly recommend that IDRC keeps this in future project

administration. Although undertaking Ecohealth research is very challenging, transdisciplinarity and collaboration across different disciplines and institutions are really needed to better understand and solve problems that involve complexity. Therefore, we strongly recommend IDRC to continue supporting transdisciplinary research. Knowledge translation is one of the six principles of EcoHealth and is also one component of this FBLI initiative. However, how to do knowledge translation in the context of a multi-country project needs further research. IDRC may take a lead in exploring the best practices of knowledge translation.

The project faced the problem of budget loss according to the change in the exchange rate. Exchange rate should be corrected according to current exchange rate on the day of money transfer not the day of agreement.

Annexes

All the annexes can be found here: http://www.ecohealthasia.net/, publication section

Annex 1: Country final technical reports (available on request).

- Annex 1.1: China
- Annex 1.2: Indonesia
- Annex 1.3: Thailand
- Annex 1.4: Vietnam

Annex 2: List of of outputs

Annex 3: TOT sub-component

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