Enhanced Homestead Food Production for Improved Household Food Security and Nutrition in Cambodia: A Critical Analysis of the Fish on Farms program

by

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Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

a. human research ethics approval from the Simon Fraser University Office of Research Ethics

or

b. advance approval of the animal care protocol from the University Animal Care Committee of Simon Fraser University

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Abstract

Background: To rigorously assess the effectiveness of the Enhanced Homestead Food Production (EHFP) program, HKI has partnered with the University of British Columbia (UBC) to conduct a two-phase research and development. The aims of this research were to assess the impact of various EHFP models at improving food security, nutrition outcomes, livelihoods, and women's empowerment in Cambodia (FOF Protocol, 2012). After the completion of the first phase, known as Fish on Farms (FOF), a Gap Analysis was commissioned to better understand key structural, socioeconomic, and behavioural differences between highly successful and highly unsuccessful women farmers that impacted the uptake and continuation of EHFP practices.

Objectives: This study used the Gap Analysis from the FOF project as a case study to examine the tensions between locally focused agriculture development projects and the macroeconomic conditions in which they occur. The sustainability of this project in the long term in light of these tensions was then critically assessed using the Sustainable and Inclusive Agriculture Development (SIAD) analytical framework.

Methods: A secondary data analysis of the Gap Analysis was conducted; a mixed methods study that utilized deviant case sampling to identify highly successful and unsuccessful farmers. Semi-structured interview data was analyzed using NVivo software. Line by line coding was used to examine textual data after which content analysis was undertaken to identify differences between positive and negative deviant farmers. Themes were identified by condensing and refining codes into categories in an iterative process. Quantitative data was analyzed using Microsoft Excel 2013 software and descriptive statistics were generated. Data was then organized into frequency tables and charts to better understand patterns and trends within the sample.

Results: Several key factors were identified that contributed to respondents' success or failure in increasing household (HH) food production and income including: access to primary inputs and irrigation; growing conditions and technical skills; HH demographic and socioeconomic indicators; EHFP harvest and utilization; and marketing and sale of products. Positive impacts of the FOF project were not uniformly distributed within the sample therefore, the intervention was moderately successful in improving access to micronutrient rich foods and improving HH incomes.

Conclusions: While the FOF project contributed positively to HH food production and incomes for some, for others, this was not the case. Without continued financial support and safety nets, negative deviants were more likely to discontinue EHFP all together. In the context of contradictory development policies that prioritize neoliberal free market policies, the possibility for lasting impact is unlikely and threatens the positive gains made by the FOF project. Therefore, it is critical that donor agencies work with LMICs to revise national poverty reduction strategies and allow countries to exercise mercantilist practices where domestic agriculture policy is concerned.

Keywords: Food Security; Sustainable Development, Neoliberal Economic Policies; Cambodia.

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List of Acronyms

CARD	Council for Agriculture and Rural Development
CDRI	Cambodian Resource Development Institute
CIFSRF	Canadian International Food Security Research Fund
ELCs	Economic Land Concessions
FDI	Foreign Direct Investment
FOF	Fish on Farms
FF4F	Family Farms for the Future
EHFP	Enhanced Homestead Food production
HGO	Home Gardens Only
HG+F	Home Gardens plus Fishponds
HH	Household
HIC	High Income Country
HKI	Helen Keller International
IMF	International Monetary Fund
INGO	International Non-Governmental Organization
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoH	Ministry of Health
MPI	Multi-dimensional Poverty Index
NGO	Non-Governmental Organization
LMIC	Low Middle Income Country
ODOV	Organization to Develop our Villages
PDA	Provincial Development Assistance
SAPs	Structural Adjustment Policies
SIAD	Sustainable and Inclusive Agricultural Development
VMF	Village Model Farms
WTO	World Trade Organization

PREFACE

This research was a secondary data analysis of the Gap Analysis study of the Fish on Farms (FOF) project, aimed to evaluate the perceptions of participants. FOF was implemented in collaboration between the University of British Columbia (UBC), Helen Keller International (HKI), Cambodia, Organization to Develop Our Villages (ODOV), Ministry of Agriculture, Forestry and Fisheries (MAFF), World Fish Center, and government of Cambodia. Funding for the project was provided by the International Development Research Centre (IDRC) and the government of Canada. Ethics approval was obtained in both Canada and Cambodia, from UBC's Research Ethics board (Approval number H12-00451), and the Cambodia Medial Ethics Board (approval number 010 NECHR). Ethics for secondary data research was also obtained from Simon Fraser University's Office of Research Ethics (Approval number 2016s0144).

I was involved in the analysis and interpretation of the gap analysis presented in this Capstone. I also was involved in the development of the gap analysis research protocol (Appendix B) and interview questionnaires as part of my practicum in Cambodia from May to August 2015. With the support of the UBC project manager and research assistants, I trained local enumerators on mixed methods research design, with a heavy focus on qualitative research techniques and helped coordinate on-site data collection for the gap analysis. Quantitative data on homestead food production and utilization were compiled by UBC and HKI staff (Table 3&4).

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1. INTRODUCTION

According to The Food and Agriculture Organization (FAO) a state of food security is achieved "when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996, p.2). Where previous conceptual definitions of food security have used the State as the unit of analysis and national self-sufficiency in food production as the mark of success, contemporary literature and discourse employs a more nuanced definition that captures the shrinking role of the State and variability in individual and community livelihoods (Stevens et al., 2003). While it could be that a country is self-sufficient in overall production, disparities may still exist based on the availability, access, quality and safety of food at the individual and household (HH) level (Stevens et al., 2003; WHO, 2015).

Globally, chronic hunger and undernutrition as a result of food insecurity impacts approximately 805 million people, the vast majority of whom are concentrated in developing countries in Southern Asia, Sub-Saharan Africa, and Latin America (FAO, 2014a). Of this 805 million, roughly 75% are the rural poor; typically, smallholder subsistence farmers, agro-pastoralists, and fishing communities, as well as the landless poor (WFP, 2015). The remainder are comprised of slum dwellers on the boundaries of large cities and towns and increasingly include the urban poor (WFP, 2015).

The impact of food insecurity on individuals, families and communities is severe and has deleterious effects on physical, mental, social and economic well-being (Ledrou and Gervais, 2005). Research has shown that chronic undernutrition due to inadequate intake of proteins, fats, and essential nutrients is associated with a multitude of negative health outcomes including: poor cognitive development in children; increased susceptibility to infection and disease; poor pregnancy outcomes, including potential to hemorrhage during childbirth; and increased likelihood of low birthweight infants (FAO, 2014a; WFP, 2015). Moreover, pregnant women and children represent particularly vulnerable sub-groups among the global population of the food insecure as women represent the overwhelming majority of smallholder farmers and the effects of chronic undernutrition are transmitted vertically from mother to baby (WFP, 2015). Taken together, the negative physical and cognitive health outcomes significantly impede the productive capacity of the population, which in turn can negatively impact economic and social development (Gundersen, 2011).

While acute hunger is typically associated with availability of food or, rather, factors affecting food output—adequate rainfall, sufficient quantity of arable land to meet population needs, and nutrient rich soil—chronic hunger is borne out of structural issues of poverty and lack of infrastructures that create barriers to accessing food (Van der Veen and Gebrehiwot, 2011). In the case of low and middle income countries (LMICs), the greatest contributing factor impacting both access and availability (specifically arable land) lies upstream, in the neoliberal economic framework of world trade policies that have eroded the role of the State to invest in and strengthen the agricultural sector (Friedmann, 1993; Margulis, 2014; Pirkle et al., 2014). By critically assessing the impacts of neoliberal market policies and the geopolitical arrangements that characterize the current global agro-food system, this paper seeks to examine the structural factors that have led to the persistence of chronic hunger in LMICs. To illustrate the effects of these particular architectures of relations between LMICs and high income countries (HICs), this paper will draw on a case study, using the Gap Analysis of the Fish on Farms (FOF) project

completed in Prey Veng, Cambodia, to provide a deeper context. Specifically, this paper will explore the tensions that lie at the intersection between locally focused projects and neoliberal macroeconomic policies promoted by the World Bank, International Monetary Fund (IMF), and World Trade Organization (WTO).

1.1 Background: Cambodian Context

Cambodia is a low income country in South East Asia bordering Vietnam, Laos and the gulf of Thailand. Currently, the population is estimated to be 15.3 million with an annual growth rate of 1.6% (CIA Factbook, 2016). Further, with 90% of the population being Khmer, Cambodia is nearly ethnically homogenous with the other 10% of the population comprised of Vietnamese, Chinese, and, local ethnic minority groups (CIA Factbook, 2016; World Bank, 2016). Although Cambodia is rapidly urbanizing, approximately 80% of the population still resides in rural areas (CIA Factbook, 2016).

As is characteristic of countries undergoing modernization, Cambodia's demographic profile is indicative of an epidemiologic transition in which reductions in under five child mortality and declining fertility rates have translated into a shift in age distribution from concentration in the youngest age-groups towards older age groups (Hyder and Morrow, 2006). Currently, children aged 0-14 make up 31.43% of the population followed by the 15-24 age group at 19.71% (CIA Factbook, 2016). The largest segment of the population however, are adults 25-54 in their prime productive years at 39.61% (CIA Factbook, 2015).

Although Cambodia is currently a stable democratic polity, recent histories of genocide and war remain in vivid memory for most Cambodians. During the period known as the Khmer Rouge, the Communist dictator Pol Pot and his party, the Khmer Rouge, systematically murdered more than a quarter of the population, killing roughly two million people between 1975 and 1979 alone. Driven by the desire to create a purely agrarian and self-sufficient society, the Khmer Rouge dismantled 'modern' public institutions and infrastructures and killed all those who opposed the new order (CTM, n.d.). Under their rule, certain groups were exclusively targeted, including educated professionals and intellectuals; urbanites; ethnic minorities of Thai, Vietnamese, or Chinese heritage and; religious minorities (CTM, n.d.). By the end of their reign, the complete collapse of public institutions coupled with the disappearance of the country's educated class left Cambodia perilous and at the mercy of the international community.

After the fall of the Khmer Rouge by Vietnamese forces, a period of civil unrest and guerrilla warfare followed that necessitated the involvement of the international community. By 1991, a peace agreement known as the Paris Peace Accord was struck bringing an end to decades of war and, by 1993, democratic governance was reinstated in Cambodia (Ghit, 2012). Years of war, lack of institutional capacity and the sheer absence of a skilled human resource base, however, sowed the seeds of dependency on aid as Cambodia came to rely on international non-governmental organizations (INGOs) to fill its institutional vacuums and provide basic services to its citizens.

Consequently, like many other developing countries in the early 1990s, Cambodia adopted a series of neoliberal economic reforms promoted by the conglomerate of international donors, International Monetary Fund (IMF) and the World Bank known as Structural Adjustment Policies (SAPs) in order to qualify for donor assistance. As part of a suite of reforms aimed at macroeconomic development, the receipt of development

loans under SAPs hinged upon a number of reforms, including: deregulation of markets and adoption of free market policies; privatization of state-owned resources; significant reductions on tariffs; decentralization of governments; sizable reductions in the number of civil service employees and significant cuts to social expenditures specifically, health and education (IMF, 1999; Pirkle et al., 2014). Thus, during the time in which investments in human development were most crucial for Cambodia's social and economic recovery, development policies put forward by donor countries and lending institutions enforced spending cuts and policy actions that would increase rather than alleviate suffering and poverty.

In recent years, however, Cambodia has enjoyed marked success in annual GDP growth due in large part to vibrant and growing economic sectors, specifically tourism, textiles and footwear, real estate and construction, and agriculture (CIA Factbook, 2016). In fact, in the past decade the country has seen record annual growth rates between 7 and 8% and significant inflows of foreign direct investment (FDI) as a result of favourable economic environments (CIA Factbook, 2016). While FDI has been chiefly responsible for significant GDP growth in these newly developing sectors, this growth has been accompanied by gross inequalities in income and resource distribution (World Bank, n.d). In fact, despite macroeconomic gains Cambodia still remains among the poorest countries in South East Asia with approximately 20% of the population living below the poverty line of less than $1.90 a day, the overwhelming majority of whom are concentrated in rural areas (CIA Factbook, 2016; World Bank, 2016).

Of particular concern, and the focus of this paper, are the effects of neoliberal policies on Cambodia's agriculture sector, which, over the past two decades, has undergone rapid transformation from primarily small scale subsistence agriculture to increasingly specialized large-scale commercial enterprises owned by transnational companies (Guttal, 2011). This transformation, as noted in the Public Expenditure Review commissioned by the World Bank, has been due to the fact that approximately two thirds of total agriculture spending is derived from donor support and private financing, dependence on which has generated numerous problems within the country (World Bank, n.d). Among the challenges cited, the most glaring have been questions of fiscal sustainability; fragmentation of services; poaching of skilled personnel from government posts to donor funded projects; and misalignment of donor priorities and national development goals (World Bank, n.d).

Conversely, while donor funding has steadily increased since the late 1990s, government funding for agricultural infrastructure development, irrigation, and rural road construction has continuously shrunk and in 2009, accounted for less than 1.5% of the national budget (World Bank, n.d). This is particularly concerning as agriculture in Cambodia continues to be the main source of livelihood for 70% of the total labour force and contributes to more than one third of national GDP (FAO, 2014b). Despite the centrality of agriculture as the primary occupation for the majority of Cambodians, government and donor spending patterns appear to favour export commodity crops. This is evident in that as of 2012, 75% of cultivated land was dedicated to rice farming with the other 25% devoted to subsistence agriculture, cash crops such as maize, cassava, and soybeans to fill the rising demand within the livestock feed sector and, industrial crops, namely rubber (FAO, 2014b; World Bank, n.d).

Thus, while market liberalization has been favourable to private firms with the capital to purchase inputs, infrastructures, and source the labour necessary for production at scale,

smallholder producers, possessing neither the capital nor the capacity to absorb the shocks of poor harvests, have failed to keep at pace compromising their accessing to food (FAO, 2014b; Guttal, 2011). In fact, recent reports have shown that the size of land holdings since market liberalization have decreased dramatically to less than two hectares per HH translating into increased food insecurity, reduced biodiversity, landlessness, and outmigration among the rural poor (FAO, 2014b; Guttal, 2011; Mund, 2011).

1.2 State of Food Insecurity in Cambodia

The Multidimensional Poverty Index (MPI) developed by the Oxford Poverty and Human Development Initiative (OPHI) and United Nations Development Programme (UNDP) captures the incidence of poverty and corresponding deprivations that people face across three dimensions: health, education, and living standards (OPHI, 2013). Going beyond the traditional measure of HH income alone, the MPI measures poverty as a function of "the incidence or headcount ratio (H) of poverty – the proportion of the population that is multidimensionally poor – and the average intensity (A) of their poverty – the average proportion of indicators in which poor people are deprived. [Further,] a person is identified as poor if he or she is deprived in at least one third of the weighted indicators" (OPHI, 2013, p. 1). Based on the ten indicators of deprivation (see Figure 3 in Appendix), nearly 50% of Cambodian HHs are multidimensionally poor, and 20% are identified as severely poor with deprivation indices exceeding 50% (OPHI, 2013).

In rural areas, the majority of HHs engage in subsistence agriculture to meet livelihood needs, however, poor land utilization, seasonal droughts and floods, poor storage, and lack of infrastructures result in seasonal food shortages and persistence of food insecurity for most (FAO, 2010; IFPRI, 2012). As such, rice remains the staple food and comprises approximately 70% of daily calories (CARD, 2011) despite lacking essential proteins, fats and micronutrients for optimal development (FAO, 2010). Moreover, poor diets in concert with high prevalence rates of infection have contributed to the persistence of undernutrition such that, approximately 40% of children are stunted and 20% of women in their reproductive years are underweight (NIS, 2011).

In order to combat food insecurity and undernutrition in rural areas, Helen Keller International (HKI) has implemented an Enhanced Homestead Food Production (EHFP) program in Sub-Saharan Africa and Asia (Olney, 2009; Olney, 2013). Specifically, EHFP focuses on vulnerable women farmers and equips them with the education and resources necessary for them to optimize land utilization and, produce nutrient rich foods year round (Talukder, 2005; Weinberger, 2013). Through this, EHFP contributes to improvements in nutrition and food access while also increasing farm incomes. While benefits of EHFP programs have been documented in communities where they have been implemented, the effectiveness of the program has not been assessed. In light of this, HKI has partnered with the University of British Columbia (UBC) to conduct a two-phase research and development study, to assess the impact of EHFP models at improving food security, nutrition outcomes, livelihoods, and women's empowerment in Cambodia (FOF Protocol, 2012).

1.3 Fish on Farms Project Background

The first phase, known as the Fish on Farms (FOF) project, was a cluster-randomized controlled trial of enhanced homestead food production (EHFP) and took place in a poor agrarian rural community in Prey Veng province, Cambodia. This project specifically targeted women farmers and their young children in four districts of Prey Veng, as this is an area of high food insecurity and malnutrition. For 22 months, 900 HHs, with a woman of reproductive age (18 – 45 y) and their youngest child aged 6 – 59 months, were randomly assigned to one of three arms: 1) home gardens only (HGO); 2) home gardens plus aquaculture (fishponds) (HG+F); or 3) control. Participants in the HGO and HG+F arms were given initial farming and infrastructure inputs, training on improved agricultural techniques and/or fish raising, gender equity training, nutrition and hygiene education, including counselling on optimal infant and young child feeding practices. In sum, the FOF project sought to assess the efficacy of EHFP at improving maternal and child nutrition status, food security, HH income, and livelihoods.

For the second phase of the cluster-randomized controlled trial, UBC and HKI designed a follow-up study titled, Family Farms for the Future (FF4F), which expands on lessons learned and best practices of FOF in real world settings. Specifically, during FF4F successful components of FOF will be horizontally scaled out across four agro-ecologically and geographically diverse provinces in Cambodia. Best practices of EHFP in the Cambodian context will be vertically scaled up through capacity building with community, district and provincial level health and agricultural workers; by contributing to national and international food security and nutrition polices through a multi-sectorial and multi-level steering committee; and by sharing 'lessons learned' with key national and international stakeholders, including governments, NGOs/INGOs, UN agencies, academic institutions, and private enterprises.

Prior to participation in the project, intervention groups at both levels, HHs and Village Model Farms (VMFs), had to meet a minimum set of requirements, including presence of a female HH head for the duration of the project and the presence of a child under five years of age. At the HH level, intended beneficiaries were required to have access to land and labour to participate in the program and considered 'poor' according to community wealth rankings (FOF Protocol, 2012). At the VMF level, beneficiaries were required to have 1200 square meters of land available for both EHFP and demonstration plots for technical training. Utilizing a "Train-the-Trainer" model, the VMF owners were each assigned small groups of ten HHs each within their cluster (village) and were expected to demonstrate improved agricultural techniques, provide ongoing technical support and assistance, and produce improved vegetable seed varieties and saplings for distribution within their community (Hillenbrand and Waid, 2014).

Participants in all groups were fairly similar at baseline with respect to certain socioeconomic indicators, specifically, roofing and housing construction materials. Approximately 90% of participants had enhanced roofing, including galvanized metal, asbestos cement sheets, tile or other durable material as opposed to basic roofing comprised of bamboo, thatch, grass or other temporary materials (FOF Endline Survey Report, 2014). Conversely, only 56% of participants had their walls also constructed from enhanced construction materials (FOF Endline Survey Report, 2014). The other 44% on the other hand, had homes constructed from temporary basic materials, including bamboo, thatch, grass, and hay. Additionally, the vast majority of HH (92%) indicated

using wood as their main cooking fuel source and lacked access to electricity (FOF Endline Survey Report, 2014). Lastly, nearly all HH at baseline cited an improved water source, primarily well water, as their water source for cooking, cleaning, laundry and gardening activities; however, only 20% of HHs reported using improved toilet facilities, namely closed latrines, whereas the rest indicated open defecation in fields or bushes (FOF Endline Survey Report, 2014).

In terms of HH possessions, assets reported by HHs at baseline were varied. Nearly half of all respondents possessed a motorcycle or moto scooter, and approximately two thirds owned a bicycle (FOF Endline Survey Report, 2014). With respect to higher end assets such as oxcarts, horse carts and electronics equipment, fewer than 10% of HHs reported owning any (FOF Endline Survey Report, 2014). Lastly, motor vehicles and boats were the least likely possession reported as only few HHs (less than 2%) reported owning them (FOF Endline Survey Report, 2014).

At the HH level, approximately $250 USD per beneficiary was invested by the project on the HGO group and $600 USD per beneficiary was spent on the HG+F group (Lakzadeh, 2016). Conversely, $360 USD per VMF was invested by the project within the HGO only group, whereas $1250 dollars USD per VMF was allocated for the VMF HG+F sites (Lakzadeh, 2016). The differences in spending between intervention groups and, between VMFs and HHs was due to differences in the EHFP model implemented and additional expectations placed on VMF owners respectively. Also, the costs per beneficiary were calculated based on total costs of inputs averaged over all HHs, thus inputs were provided based on HH need. Inputs provided by the project included: water pumps, pond construction and/or renovation, fingerlings, fish feed, nets, tools, seeds, and saplings (Lakzadeh, 2016).

As part of the package of technical training on improved agricultural techniques, all beneficiaries were also taught how to prepare natural fertilizers and maintain compost pits; utilize mulching techniques for gardening during the dry season to minimize water evaporation; prepare bio-pesticides and; use crop rotation techniques for soil conservation and disease prevention. Beneficiaries in the HG+F group were also taught how to prepare fish feed from locally available resources such as rice brans and wasted vegetables, treat pond water using lime and animal dung, and harvest fish using small nets. All training occurred on VMF demonstration plots and was conducted by project staff in collaboration with local development partners specifically Organization for Developing our Villages (ODOV) and Provincial Development Assistance (PDA).

In addition to improved agricultural practices, the project also implemented a nutrition and hygiene education package where beneficiaries received culturally appropriate training based on the World Health Organization's (WHO) 'Essential Nutrition Actions' for improving maternal, newborn, infant and young child health and nutrition (WHO, 2013). Among these, key behaviour changes were promoted through group training sessions, including exclusive breastfeeding for the first six months; complementary feeding after six months; and health seeking behaviours specifically, iron and folic acid supplementation during pregnancy, utilization of skilled birth attendants, and accessing deworming tablets. Moreover, education sessions on nutrient rich foods and impacts of undernutrition as well as water, sanitation and hygiene (WASH) training to communicate the importance of hygienic practices in minimizing the recurrence of infection were conducted.

Lastly, in order to address issues of gender inequity and inequality within the community, gender training was conducted to address local traditional codes of conduct that shape HH activities and women's ability to engage in decision-making. Specifically, the project executed a strategy for gender equality that included two main interventions:

1. Sensitization at HH level of gendered domains which involved a day-long session with men and women together, where they had an opportunity to analyze and discuss each other's activities and responsibilities within the family.

2. Facilitated discussion with women and men during the project's monthly meeting, where participants were encouraged, among other project activities, to discuss on gender based challenges related to intra-HH decision-making processes over nutrition, production, income and marketing.

1.4 Purpose of the Gap Analysis

The Gap Analysis was commissioned to better understand key structural, socioeconomic, and behavioural differences between highly successful and highly unsuccessful women farmers that impacted the uptake and continuation of EHFP practices. Specifically, a mixed methods assessment of selected beneficiaries was conducted to assess the effectiveness of the project in: improving HH food security through year round food production; increasing farm incomes; and contributing to women's empowerment. By identifying gaps in program delivery and best practices for EHFP, this research hopes to inform future EHFP programming and contribute to the development of a robust national food security strategy.

1.4.1 Overview of Gap analysis Methods

The Gap Analysis was conducted in July 2015, one year after the conclusion of the FOF project in Prey Veng province, Cambodia. The sampling strategy used was deviant (extreme) case sampling, a type of purposive sampling, used to select outliers; that is, exceptionally high performers and notable failures. Prior to sample selection, all beneficiaries in the intervention groups (i.e. 600 HH farms and 60 VMF owners in HGO and HG+F groups) were screened to identify positive and negative deviant farmers based on pre-defined selection criteria (**Appendix B**). In total, 40 HH farmers and 10 VMF owners were selected for follow-up interviews, however, only 33 HH interviews were conducted (18 positive and 15 negative deviants) as two positive and five negative deviants were lost to follow up due to family illness and alternative income generating activity taking them away from the home. All 10 deviant VMF owners selected for follow-up interviews participated (six positive and four negative). In total, 28 villages were visited in four districts (**Appendix A**).

Selected farmers (positive and negative deviants) were then interviewed using semi structured on-on-one interviews. Questionnaires were designed using a mixed methods approach, employing both quantitative and qualitative questions to collect numerical data (e.g. income, demographics, agricultural production etc.) and gain in-depth understandings of contextual differences between participants that contributed to or prevented the uptake and/or maintenance of EHFP practices, respectively. Interviews were conducted at two levels: VMF owners and women farmers at the HH level (**Appendix B**).

Data collection was completed within 10 days including travel time. Survey teams were comprised of six Cambodian enumerators who conducted the interviews in Khmer and, the UBC project manager and her research assistants who prepared all materials and oversaw data collection procedures. Written informed consent was obtained prior to data collection and verbal consent with a witness' signature was obtained if respondents' were illiterate.

2. Methodology

2.1. Purpose of the Secondary Data Analysis

The purpose of the current study was to explore the tensions that lie at the nexus between locally focused agricultural development projects and neoliberal macroeconomic policies promoted by the World Bank, International Monetary Fund (IMF), and World Trade Organization (WTO). To illustrate these tensions, data collected during the FOF Gap Analysis was used as a case study. The Sustainable and Inclusive Agriculture Development (SIAD) analytic framework was employed to assess the effectiveness of the FOF program in contributing to food security and gauge its sustainability in the long term.

2.2. Data Analysis

A secondary data analysis of the Gap Analysis was conducted in March, 2016 to fulfill the requirements of the Masters of Public Health program at Simon Fraser University. Raw data from the Gap Analysis was shared with me by the project manager of the FOF project to be used towards this Capstone paper.

According to Boslaugh (2007), secondary data analysis entails the use of data collected by someone else or the use of that data for a purpose other than the one intended for initial research. Although I was involved in the development of the Gap Analysis, I chose to use data from that project to serve as a case study to explore my research question.

Due to the breadth of this project's data, I limited my focus to evaluating the effectiveness of the project in increasing HH food production and income through sale of surplus products. To assess this, I adapted the SIAD analytic framework developed by Tumusiime and Matotay (2014). This framework was chosen as it examines the sustainability of agriculture interventions by using increased productive capacity, ecological sustainability, and contributions to local social and institutional capacity as indicators of success (Tumusiime and Matotay, 2014). An additional indicator, macroeconomic conditions, was included to provide a more holistic assessment of the project and assess the sustainability of the project.

Translated data was provided to me in excel data sets. Data was then imported into my password protected personal computer and analysed using the qualitative software program NVivo 11. NVivo 11 software was chosen as it is designed to help researchers organize, analyze and synthesize information from qualitative data. It allows researchers to code textual data and create categories of information from which emergent themes can be found.

Thematic analysis using line by line coding was used to examine textual data. After all the transcripts were reviewed, codes were then assigned and further condensed and refined using analytic tools such as text searches and matrix coding. Matrix coding, which cross references specific codes with cases in a tabular format, was also used to ascertain differences within and between groups. Once categories were generated, the emergent themes were then identified and reported as the headings in the Results section.

Quantitative data was analyzed using Microsoft Excel 2013 software and descriptive statistics were generated. Data was then organized into frequency tables and charts to better understand patterns and trends within the sample.

2.3 Ethical Considerations

Ethics approvals for primary data collection were obtained prior to data collection from Cambodia's National Ethics Committee for Health Research (NECHR) and from UBC's Behavioural Research Ethics Board in June 2015. Additional ethics approval was granted by Simon Fraser University's Office of Research Ethics for secondary data analysis on March 31st, 2016. Lastly, a letter of permission to access primary data has been granted by the current data steward and Principal Investigator, Tim Green.

3. Results

The findings described in the following section highlight the experiences of women farmers who have participated in the FOF project. Findings were categorized into major themes that impacted the success of small-scale farmers in implementing and maintaining EHFP practices. Key differences between positive and negative deviant farmers were highlighted using the SIAD analytical framework to parse out contextual factors that contributed to success or failure in food production, income generation, and HH food security. The respondents' own words have been presented in italics and labelled as positive or negative deviant.

3.1 Factors limiting expansion of EHFP

3.1.1 Demographic and Socioeconomic Factors

Differences pertaining to HH demographic characteristics stood out between groups (**Table 1**). At the aggregate level, negative deviants appeared to be considerably younger than their positive deviant counterparts with nearly 85% of respondents under the age of 46 compared to approximately 60% of positive deviants. Additionally, negative deviants also reported slightly larger family sizes with more than one third reporting five or more HH members. Alternatively, only positive deviants cited having family sizes of two or fewer individuals.

With respect to the number of children under the age of five in the home, positive deviants accounted for the majority of those with no children under age five and negative deviants accounted for the majority of homes with two or more children under the age of five.

Lastly, positive deviants appear to have given birth to more children with nearly half reporting between three and five children compared to only one third of negative deviants.

Additionally, when asked about the division of labour during busy times of the year, the majority of respondents reported males were busier with physically demanding jobs including: tilling and ploughing soil, splitting firewood and operating harvesting crops. Conversely, women assumed traditionally gendered roles, including cooking, cleaning and child care. Some respondents however, reported women were busier during peak times and stressed the double burden of HH and agriculture duties. For these respondents however, some additional help was available from other family members, including older children and grandmothers but rarely from husbands.

> ***HH Positive Deviant****: I was more busy, throwing fertilizers in rice farm, cleaning grass, reaping rice. When I was busy, my older children were looking after their youngest child such as having a bath, preparing for bed, and feeding rice. Of course it is difficult, busy with rice farm. Living condition also is difficult, everyday coming home late and need to cook.*

> ***HH Positive Deviant****: I, household's wife, have always done works more than other members including looking after children and in agriculture sector. During the busiest period, my mother helps to take care my children as well.*

Table 1. HH and VMF Demographic Factors

	Positive Deviants		**Negative Deviants**	
	n=24	%	n=19	%
Age of Respondent				
25-35	10/24	41.6	10	52.6
36-46	5/24	20.8	6	31.6
47-57	6/24	25	2	10.5
>58	3/24	12.5	0	0
Number of HH members				
≤2	2/24	8.3	0/19	0
3-5	15/24	62.5	12/19	63.16
>5	7/24	29.3	7/19	36.8
Number of children < 5 in HH				
0	10/24	41.7	7/19	36.8
1	12/24	50	8/19	42.1
≥2	2/24	8.3	4/19	21
Number of children birthed				
0-2	11/24	45.8	9/19	47.4
3-5	11/24	45.8	8/19	33.3
>5	2/24	8.3	2/19	10.5

Aside from poor growing conditions due to external factors beyond farmers' control, group differences were observed across certain socioeconomic factors, resulting in poorly productive homestead farms for some farms and not others. In particular, diversity of sources of income beyond EHFP, including seasonal labour in construction and factory work; remittances from family members; rice production; sale of livestock and poultry products; and small businesses, including mobile food services rental income were notably higher among positive deviants (**Table 2**). Further, sales from livestock and poultry products and cash crops such as rice, grain and sugar cane were more commonly cited among positive deviants, exceeding their negative deviant counterparts by twofold or more.

With respect to wage labour, there were notable differences between the groups; nearly half of all HHs reported engaging in wage labour to supplement family incomes with the vast majority belonging to the HH G+F group. Additionally, supplementary HH income from remittances from family members working outside the home was higher among positive deviants, exceeding negative deviants by four fold. Monthly transfers from children were also almost unanimously cited by positive deviants, with only one negative deviant reporting remittances from her son. Interestingly, no remittances were reported from the HH GO group (**Table 2**).

Table 2. Diversity of income sources (HH and VMFs)

	Positive Deviants		**Negative Deviants**	
	n=24	%	n=19	%
Livestock and Poultry products	6/24	25	2/19	10.53
Money Lending Business	1/24	4.17	0/19	0
Rental Income	1/24	4.17	0/19	0
Rice, grain, sugar cane sales	10/24	41.67	4/19	21.05
Sale of Assets	0/24	0	1/19	5.26
Small business	6/24	25	3/19	15.79
Seasonal Labour	14/24	58.33	9/19	47.37
Remittances	5/24	20.83	1/19	5.26

3.1.2 Access to Resources

Differences between farmers were observed stemming from differential access to land, labour and capital. In fact, of those citing lack of access to farm labour, all but one of the respondents were negative deviants. Additionally, negative deviants also reported illness in the family and lack of critical inputs as additional barriers to increasing production.

> ***HH Negative Deviant**: I have no ability to plant more fruit trees/crops because I have small homestead area and I don't have growing technique as well.*
>
> ***HH Negative Deviant**: I cannot raise more fish production as lack of labor force and have illness in family.*
>
> ***HH Negative Deviant**: I myself meet a difficulty with pest outbreak on vegs in the dry season, especially worms and ants. I and other families meet a big challenge to grow vegs in rainy season due to the high soil moisture. The medium/rich*

famer household have capacity to install higher bed to grow veg to avoid the floods, but the poor household like my family can't do it as it needs much costs to buy materials...

When asked about their willingness to access microcredit loans to improve their EHFP yields, both positive and negative deviants alike expressed hesitation in accessing these services for fear they would be unable to pay back the interest rate on the loans. Interestingly however, of those that opposed, one third were positive deviants compared to only one fifth of negative deviants.

Moreover, when asked about HH finances in the past two months nearly half of all respondents mentioned having to repay a debt either to a family member or a microfinance institution. Of these respondents however, 60% were negative deviants.

3.2 Factors impacting production

3.2.1 Access to inputs and infrastructure

The primary inputs required for agriculture and fish production for EHFP are vegetable seeds, fruit saplings, fish feed, and fingerlings. When asked about the source of their inputs, the vast majority of respondents, both negative and positive deviants alike, reported vegetable seeds and fingerlings were derived externally from the project, project partners, or purchased from the market. With respect to fruit saplings and fish feed, however, between-group differences were observed with a greater percentage of positive deviants expressing self-sufficiency in producing their own saplings and fingerlings (60% and 70% respectively). In contrast, only 20% of negative deviants reportedly produced their own saplings and 50% produced their own fingerlings.

In addition to primary inputs, respondents also cited the need for fertilizers and pesticides as necessary inputs to increase yields. The majority of negative deviants, however, reported cost as a major barrier to accessing these inputs whereas few positive deviants mentioned need for these additional inputs. Interestingly, respondents associated the use of natural fertilizers and bio-pesticides, techniques taught to all farmers throughout FOF project, with being a poor farmer. In fact numerous respondents noted these to be major contributors to success.

***HH Negative Deviant**: I and other women famers faced animals eating crops. The issue is effect all families in community. The rich families bought chemical fertilizers, but the poor famers use natural fertilizers. Men and women are effected" HH Negative deviant.*

***HH Negative Deviant**: The only challenge is pest. Every household faces the same problem. For those who are rich, they buy pesticide.*

3.2.2 Year-round access to irrigation

Lack of access to water year round was a major impeding factor to the success of farmers. For VMF owners, differences were observed between the GO and G+F groups. Interestingly, all the VMF owners in the G+F group reported year round access to water from a nearby pond/canal or ring-well on the homestead whereas only one VMF GO

reported year round access to water. However, when all farmers were asked about water loss prevention techniques, only the VMFs in the G+F group reported using techniques taught to them in the FOF project, including mulched rice straws and pond storage.

> ***VMF Negative Deviant****:…mulched rice straws on veg bed to reduce water evaporation, and keep soil humidity.*
>
> ***VMF Positive Deviant****: Pump water from other ponds into the nearest pond for growing veg.*
>
> At the HH level, access to a reliable source of water was a major barrier to production by all groups.
>
> ***HH Positive Deviant****: The main challenge for famers is lack of water. The rich family could get water from pumping machine, while poor family depends upon the raining.*

3.3 Factors Impacting Productivity

3.3.1 Seasonality of Production

Seasonality of production was a common theme that HHs cited as a major factor impacting their outputs with the lowest yields in all three areas of production (vegetable, fruit, and fish) occurring during the rainy season between May and October for all groups **(Table 1).** Out of all three areas of production, vegetable production was highest across all groups, followed by fruit and fish production respectively. Although vegetable yields were lowest during the rainy season, positive deviants exceeded their negative deviant counterparts by four fold in surplus production. Excess fish production beyond HH consumption needs however, was low for all groups and surprisingly highest during the dry season (November to April).

Table 3. Surplus Food Production by Season (HH level)

	Positive Deviants		**Negative Deviants**	
	n=18	%	n=15	%
Vegetables				
Dry Season (November –April)	14/18	77.8	8/15	53.3
Rainy Season (May-October)	10/18	55.6	2/15	13.3
Fruits				
Dry Season (November –April)	9/18	50	4/15	26.7
Rainy Season (May-October)	3/18	16.7	1/15	6.7
Fish				
Dry Season (November –April)	2/9	22.2	1/7	14.3
Rainy Season (May-October)	1/9	11.1	0/7	0

Source*: Adapted from Gap Analysis Report, 2015.*

3.3.2 Poor growing conditions

In addition to seasonality of EHFP outputs, respondents across both groups reported poor environmental conditions, including nutrient poor soil, frequent droughts and floods, insects, pests and diseases as major factors impacting their yields of fruit, vegetable, and fish.

> ***HH Negative Deviant****: The challenge, our village is old and land is barren, we even could not grow something. Our land has termite, drought, even if we put fertilizers, some crops still dying.*

> ***HH Negative Deviant****: There are few challenges in the community such as pest and disease outbreak, roots of most crops are rotted due to the heavy rains during the rainy season, no water during the dry season and cause some crops dry and died.*

3.3.3 Technical skills

When asked about the possibility of expanding production in the future without increasing the size of gardens or fishponds in spite of these negative environmental conditions however, there were notable differences among respondents. For respondents that expressed it would not be possible to expand production, positive deviants were on average more likely to attribute their failures to inefficient agricultural techniques, suggesting these negative externalities could be mitigated in part through improved knowledge and technical skills.

> ***HH Positive Deviant****: I has no ability because I did not attend the training skill to grow mango…*

In contrast, negative deviants were more likely to ascribe their inability to do so to limiting environmental factors alone, some even expressing sentiments of defeat and helplessness.

> ***HH Negative Deviant****: I has no ability to increase because land is not good, cow and buffalo always eat, and no water in the dry season.*

> ***HH Negative Deviant****: I think that I do not have abilities as I cannot raise the fish well and also some fish died without any reason.*

Although more than half of the respondents reported it was possible to increase production without expanding the size of gardens or fishponds, this belief was not predicated by current performance status. Additionally, when asked how they might accomplish this, both negative and positive deviants alike mentioned increasing time spent on agriculture and aquaculture activities, applying natural pesticides to manage pests, and employing agricultural techniques taught to them in the FOF project, including: row planting, intensive planting, and crop rotation to maintain soil health.

> ***HH Positive Deviant****: It is possible to expand the growing as I do rotation growing of leafy vegetable and root vegetable.*

> ***HH Negative Deviant**: It is possible to increase the veg production by increasing the diversification of veg, plant control, fertilizing, spraying bio-pesticide to prevent insects and diseases as well.*

In regard to expanding production of specific EHFP outputs, differences were observed among respondents with increasing fish production most favoured among 57% of respondents, followed by vegetables (46.6%) and fruits (33.3%). Interestingly, in the VMF GO group, none of the respondents favoured expanding fruit production and only positive deviants stated the possibility of expanding vegetable production. For all respondents, lack of agricultural techniques for growing fruit trees, pests, lack of sufficient water, and casting of shade over vegetables were the main reasons reported for the decision not to expand fruit production.

> ***HH Positive Deviant**: …if we grow more fruit trees, there will have shadow, which could not grow veg.*

> ***HH Positive Deviant**: Recently, I have no ability to produce more fruits because it had a lot of insects especially the sucked insects, worms and slugs perforated the fruits, and I need natural fruits without [pesticides].*

3.4 EHFP Harvest and Utilization

Differences were observed between positive and negative deviants on all measures, including varieties of vegetables and fruits grown in the last 12 months; amount of vegetable, fruit, and fish harvested in the last 2 months (in kilograms); income earned (in USD) from sales of EHFP products; and size of home garden (in square meters) under cultivation in the last 2 months (**Table 4**). Differences in vegetable, fruit, and fish production between the two groups were substantial with the median outputs for positive deviants reported to be 100 kgs, 200 kgs, and 70 kgs respectively compared to median outputs of 0 kgs for negative deviants on all three measures. Lastly, when comparing intervention groups, differences were staggering with the gardens only group outperforming the gardens plus fishponds arm with median outputs for vegetables and fruit of the former reportedly 50 and 150 kgs respectively compared to 29 and 30 kgs for the latter (**Table 4**).

In addition to differences in production, the utilization of vegetable, fruit and fish products was also notably different between positive and negative deviants with positive deviants reporting greater proportions of harvested products sold for income and consumed by the HH. Despite the wide range, the median proportions for vegetable, fruit and fish products consumed were reportedly 60%, 50%, and 90% respectively for positive deviants compared to 0% on all three counts for negative deviants (**Table 4**).

Although these differences in harvest and utilization arose due to deviant case selection criteria, changes in yields and consumption from baseline to end line were marked among intervention groups in comparison to the control groups at the aggregate level (**Appendix D**). Intervention groups grew more varietals, consumed more proportions of harvested products, and reported greater incomes from sale of surplus products.

3.5 Market Challenges

For respondents that mentioned generating surplus vegetable, fruit, and fish products for sale, follow up questions regarding market challenges and transport of products were asked. The most common responses among positive and negative deviants alike was selling products at the village market and directly at the farm gate to neighbours. Additionally, a few respondents mentioned using a middleman to sell surplus products, with the most common product sold to them being fruits due to the tendency to spoil faster.

When asked about pricing of products, respondents resoundingly expressed their anger towards middlemen with all but one respondent reported losing profits by selling to them.

> ***VMF Positive Deviant**: Couldn't sell veg with fair price because the middlemen usually buy with cheaper price as they need highest profit from their veg collection business up to around 50%. For example, they buy in costing 3,000 riel per 1 kg at farm gate, and they would sell out 6,000 riel at the market.*
>
> ***VMF Positive Deviant**: There are around 30 people selling the same products and price as well. So that is why the middlemen always cheapen the price as they have [multiple] alternatives whether they buy veg from farmers or not.*

Interestingly, the respondent that mentioned generating more income by selling to middlemen reasoned that fuel and transport costs would diminish profits if taken to market.

> ***VMF Positive Deviant**: Received fair price. If we went to the market by [ourselves], we would need to pay for the petrol. So we would get less profits than selling to the middlemen at home.*

In addition to negotiations with middlemen, respondents also stated that competition from other sellers was a major challenge in the sale of their EHFP outputs. In fact, almost all respondents mentioned that there were many other vendors who sold similar products and at the same price. As a result, in order to generate income, respondents mentioned they would often have to sell at a similar or lower price. When asked about how prices were determined, it was unanimously reported that prices were set commonly amongst all vendors; deviating from which would be met with negative criticism and loss of customers.

> ***HH Positive Deviant**: There are around 10 sellers. I sell the same price as other. If not, they might angry me. And the price is not expensive during the veg session.*
>
> ***HH Positive Deviant**: There are about 20people, which sell fruits. If we sell at different price, customers will find the cheapest.*
>
> ***VMF Negative Deviant**: There are so many people selling similar veg since this village is big. Veg are sold with the same price. If they are sold with higher price, no one will buy.*

When asked about the fate of unsold and unconsumed EHFP products, losses due to waste was surprisingly not a common response with only two positive deviants reporting food waste.

> ***HH Negative Deviant****: The extra veg gave to relatives, but sponge guord [was too] ripe.*
>
> ***HH Positive Deviant****: The extra fruits were sold and gave to relatives for cooking. Some were [too ripe].*

Post-harvest processing on the other hand was reported by all groups. A strong majority of farmers in the GO group mentioned the preservation of both vegetables and fruit. When asked about specific techniques, respondents mentioned preserving vegetables mainly through pickling, and preserving fruit by making jelly and jams. In regard to fish preservation, those in the G+F group reported drying and fermentation as commonly used techniques. Interestingly, however, the decision to preserve fish or produce appeared to be almost mutually exclusive with only one respondent reporting both.

> ***HH Negative Deviant****: Extra mango fruits were processed as mango jelly.*
>
> ***HH Positive Deviant****: Excess fish was sold and processing to Khmer Prahok [and] dried fish…*
>
> ***HH Positive Deviant****: The excess cabbages were pickled to sell*

3.6 Perceptions of Fish on Farms

3.6.1 Participation in the project

When respondents were asked why they initially participated in the project, the vast majority reported receipt of free inputs and technical assistance as the main drivers for their willingness to participate. Moreover, several respondents indicated the need for continued support specifically, with primary inputs, including vegetable seeds and fingerlings.

> ***HH Positive Deviant****: Because the project supported both, production technique and inputs for veg growing and fish raising. Through the cooperation with the project, my family could increase the agricultural production for own consumption and sale. I want to continue my participation.*
>
> ***HH Positive Deviant****: Because I received the initial support from HKI like fishpond, fingerlings, seeds and pumping machine to improve agricultural productivity in order to generate family income and living condition as well. Through this involvement, I feel that I and other farmers rather work hard than before the project implementing. It is because of the project would respond the required demands of rural farmers to improve their livelihood.*

3.6.2 Willingness to continue EHFP

Overall, the project was well received by respondents; all but two respondents, both of whom were negative deviants, indicated they would continue EHFP activities in the future. When asked about how participation in the project impacted their wellbeing, nearly all respondents mentioned improved health and well-being as a result of their organically grown vegetables, fruits and fish products.

> ***HH Negative Deviant**: During participating with the project, the family member's health was good, and had veg for cooking. The project impact family and community's health because of organic veg (no chemicals), we growed ourselves. This project has no negative impact because we used organic veg, which no affect our health, and consumers.*
>
> ***HH Negative Deviant**: Through the positive result of the Fish on Farm Project, our well-being are increased because we don't meet diseases like before the project implementing because all family members have organic vegs and good fishes to consume. Not only that other family members have had good well-being as well as they could access to the organic vegs and good fishes in the community directly.*
>
> ***HH Positive Deviant**: Before my health was not good and I often got sick, but my health is now better. Also, my family members have improved their wellbeing because we all have consumed the organic products which grown by ourselves.*

The opportunity to grow organic food for HH consumption appeared to be a strong motivator for continuing EHFP beyond the lifespan of the project for both positive and negative deviants alike. Moreover, respondents also mentioned additional income from the sale of surplus EHFP products and savings due to decreased food purchases as additional incentives to continue EHFP. Notably, income from EHFP sales was more commonly cited as a motivator by positive deviants whereas reduced expenses on food items were cited equally by positive and negative deviants.

3.6.3 Positive aspects of the project

When asked about their attitudes towards EHFP, a strong majority of respondents mentioned the physical aspects of gardening and aquaculture with a positive affect; specifically, digging soil, tending the garden and, feeding fish.

> ***HH Positive Deviant**: I like feeding fish as I enjoy seeing the fish eating and growing.*
>
> ***HH Negative Deviant**: Growing veg, watering vegetables, looking after, because I got benefit, and have enough veg for cooking, and they looked beautiful.*
>
> ***VMF Positive Deviant**: "I like seeing veg growing well, weeding and taking care of the garden. I like growing because I can get money from it every day.*

In addition to this, respondents also mentioned the social aspect of sharing wholesome natural food with family members and relatives.

> ***HH Positive Deviant**: Fish raising is easy to raise and not difficult at all. My family would get fishes for own consumption, selling and distributing to relatives, as well as can be improved the livelihood.*
>
> ***HH Positive Deviant**: I like growing yard long bean because this crop is easy to grow and sell. No need to find job far from the village and I could get veg to eat and share with the relatives.*

When asked about the utility of the gender training component, all but one of the respondents reported their appreciation for it and its usefulness in improving relations between men and women in the home and the community at large. Respondents also mentioned the need to conduct training with more men in the community in order to reduce gender based violence and transform rigid gender roles.

> ***HH Negative Deviant**: It is good training. As we can know the equal value of men and women. After training, I also had informed to my husband about the equal rights of men and women regardless those who do paid work or unpaid work. Mostly, participants have common understanding. I recommend to have more training for new and old participants.*
>
> ***VMF Positive Deviant**: The training on gender is very essential because it will lead to no discrimination between gender and less domestic violence. Still I think it is not enough. I would suggest for the refresher training on gender happen more often.*

3.6.4 Negative aspects of the project

When asked about the negative aspects of the FOF program, respondents mainly cited poor environmental conditions, including droughts and floods, pests and diseases as well as intensive manual labour required to maintain gardens and fishponds. Additionally, some respondents mentioned that they lacked the time to appropriately care for gardens and fishponds due to other jobs.

> ***HH Positive Deviant**: Some farmers are busy with their own jobs and have exciting important occupation. But for my household, I have to merge time to take part in the project activity even though we are busy with other jobs.*
>
> ***HH Positive Deviant**: Some people were not free, after finishing rice farm, they went to work at the construction in Phnom Penh. They don't have time to look after crops, and difficult to look after. Could not solve, because they don't stay at home, there were only young children at home, who could do nothing.*

Table 4. Household HFP Harvest and Utilization

	Gardens + fishponds (n=16)	Gardens only (n=17)	Positive Deviants (n=18)	Negative Deviants (n=15)
# of vegetable varieties grown in garden in last 12 mos, *median (range)*	6(0-16)	14(0-17)	15(4-17)	3(0-5)
# of fruit varieties grown in garden in last 12 mos, *median (range)*	2(0-6)	2(0-4)	3(0-5)	1(0-6)
Kg(s) of vegetables produced in garden in last 2 mos, *median (range)*	29(0-500)	50(0-200)	100(20-500)	0(0-5)
Utilization of vegetables produced in last 2 mos				
% sold, *median (range)*	0(0-92)	0(0-30)	25(0-92)	0(0)
% gifted, *median (range)*	1(0-60)	5(0-30)	12(0-60)	0(0)
% consumed, *median (range)*	30(0-100)	50(0-90)	60(5-90)	0(0-100)
Kg(s) of fruit *median (range)*	30(0-700)	150(0-550)	200(0-700)	0(0-200)
Utilization of fruit produced in last growing season				
% sold, *median (range)*	0(0-50)	0(0-50)	20(0-50)	0-(0-10)
% gifted, *median (range)*	3(0-50)	10(0-50)	15(0-40)	0(0-50)
% consumed, *median (range)*	50(0-100)	40(0-80)	50(0-100)	0(0-100)
Kg(s) of fish harvested from fishpond in last rainy season, *median (range)*	13(0-210)	n/a	70(0-210)	0(0-10)
Utilization of fish harvested in last rainy season				
% sold, *median (range)*	5(0-90)	n/a	50(0-90)	0(0)
% gifted, *median (range)*	0(0-20)	n/a	3(0-20)	0(0)
% consumed, *median (range)*	14(0-100)	n/a	90(0-90)	0(0-100)
Income earned in USD from fruit, vegetable, fish sales in last 2 mos, *median (range)*	69(0-300)	25(0-125)	75(25-300)	0(0)
Size of home garden under cultivation in the last 2 mos, m^2, *median (range)*	40 (0-150)	60(0-200)	100(25-200)	0(0-40)

Source: *FOF Gap Analysis Report, 2015.*

4. DISCUSSION

The experiences highlighted by farmers in the FOF project are reminiscent of trends observed by smallholder farmers the world over in LMICs. Challenges pertaining to seasonality of agricultural production, soil degradation, erratic rainfall and inadequate access to reliable water sources as well as; rising costs of energy and primary inputs for production continue to present major barriers to year round food production. Consequently, food insecurity and by extension malnutrition disproportionately impact subsistence farmers in low resource settings. To help mitigate these challenges, HKI and UBC implemented a multi-pronged agriculture and nutrition intervention to foster year round food production through the provision of primary inputs and infrastructure for horticulture and/or aquaculture. Thus, it was theorized that increasing year-round HH access to nutritious food through an improved EHFP model, coupled with training that incorporated education for improved maternal and child care, nutrition counselling, and WASH messaging would result in a reduction in undernutrition (**Figure 1**).

Based on results from the gap analysis, the FOF project has been moderately successful in achieving phase one project goals and objectives which aimed to:

1. Increase the availability of micronutrient rich foods through increased HH production;
2. Generate income through the sale of surplus production; and
3. Increase knowledge and adoption of optimal health and nutrition related practices, including the consumption of micronutrient foods.

Though the results were mixed among participants, the broad success of the project is due partly to employment of key principles of sustainable and inclusive agriculture development (SIAD). According to development theorists, SIAD is a holistic approach to development that maximizes aid effectiveness through the creation of supportive social and institutional environments and strengthens the suite of interconnected factors that impact smallholder farmers namely, productive capacity, ecological sustainability, and socioeconomic factors (Pretty et al., 2011; Tumusiime and Matotay, 2014). Specifically, SIAD works to improve productive capacity by promoting efficient land utilization using environmentally friendly practices, including minimal chemical inputs; efficient use of water and; diversification of crop rotations to replenish organic matter in soil, and increase both yields and incomes (Pretty et al., 2011). Additionally, SIAD works to extend the reach of development efforts to include marginalized segments of the population and facilitates the development of critical social infrastructures to help farmers organize and create economies of scale. By increasing human capital through skills based training and increasing social cohesion, solidarity and cooperation through the creation of strong social networks, farmers become better positioned to harness collective resources, influence policy, access markets and raise farm incomes broadly (Pretty et al., 2011). Therefore, by using SIAD as an analytic framework, the sustainability of the FOF project can be assessed (**Figure 2**).

Inclusiveness

A key strength of the FOF project was the level of integration within national health and agriculture departments and alignment with national development priorities. Specifically, core intervention strategies explicitly focused on addressing basic causes of undernutrition, that is, conditions of poverty, lack of resources, gender inequity and

limiting environmental conditions as prioritized within the National Nutrition Strategy (MoH, 2009). Project activities therefore directly echoed strategic priorities, namely: "reduction in protein-energy malnutrition and micronutrient deficiencies in young children; reduction in protein-energy malnutrition and micronutrient deficiencies in women and; strengthened national leadership, cross-sectoral collaboration and increased allocation of resources in the area of food security and nutrition" (MoH, 2009, p. VI). Additionally, a multi-sectoral and multi-level steering committee with government representatives, including Ministry of Agriculture, Forestry, and Fisheries (MAFF), Council for Agricultural and Rural Development (CARD), and Ministry of Health (MoH) was struck to guide the project and ensure coordination of activities with broader development goals. This was particularly encouraging as it embraced principles of the Paris Declaration for Aid Effectiveness which, among other points of action, stressed the importance of alignment of donor and developing country objectives and the use of local systems (OECD, n.d.). By employing this principle, the FOF project was able to contribute to building institutional capacity through shared knowledge and expertise and, utilize donor dollars in a manner that was consistent with national policy goals.

At the local level however, partnerships did not appear to be equal as district and local staff were not involved in the decision making process; rather, they were seen as instruments in program delivery rather than agents of change. In fact, with HKI supervision, local NGO staff conducted orientations for District Health Officers, Commune Councils, Village Health Volunteers, and Chiefs ex-post to *describe* the project and their respective roles in mobilization rather than involving them in identifying locally defined needs in the first place. This is particularly problematic as this is one of the major pitfalls of development aid, where externally funded projects may produce unintended consequences that actually reduce local institutional capacity due to the multiple demands placed on them by donors and governments alike (Tumusiime and Matotay, 2014; IEG, 2007; Riddell, 2013; Zoomers, 2005). Thus, while the intent was to increase local institutional capacity through knowledge and skills development in EHFP best practices, nutrition and health messaging, the lack of local ownership of the project among agriculture and health extension workers may jeopardize continuation of uptake in the medium to long term.

Despite, the top-down approach taken with partners at the district and community level, communities were sensitized to the project prior to rollout and women farmers (intended beneficiaries) were active participants in a series of community forums that encouraged dialogue. Moreover, although beneficiaries were randomized in the treatment arms, they were given the opportunity to decline or participate if they met selection criteria. Thus, partnership for HHs and VMFs was meaningful and mutually beneficial as they received free inputs, technical support and skills training that was resoundingly welcomed, increasing both human and social capital.

In terms of inclusivity however, the nature of the project was an agriculture-based nutrition intervention and thus required sufficient access to land as a criterion for participation; excluding the most vulnerable segments of the population, the landless poor. Additionally, although they had access to land, a number of negative deviants reported that their land was depleted of nutrients and that they lacked the capital to purchase fertilizers. Furthermore, the majority of these respondents lamented over existing debt burdens and were therefore not receptive to accessing microcredit to purchase inputs which, consequently lead to poor yields and/or fallow fields. In contrast, positive deviants had the advantage of access to productive resources, specifically

suitable land and capital to purchase necessary inputs which, in turn lead to favourable results. Similar trends have been observed in USAID funded agriculture projects in Tanzania in which beneficiaries, though in need of support, possessed productive assets and financial capital to thrive whereas those most on in need were left out (Tumusiime and Matotay, 2014).

Productive Capacity and Ecological Sustainability

A key indicator of success in the FOF project was the increase in total yields of fruit, vegetable and fish production, through employment of conservation farming practices, specifically, crop intensification and diversification. Grounded within the sustainable agriculture model, beneficiaries learned techniques that minimized carbon footprints including: how to prepare natural fertilizers and maintain compost pits; utilize mulching techniques during the dry season to minimize water evaporation; prepare bio-pesticides; and use crop rotation techniques for soil conservation and disease prevention. Beneficiaries in the EHFP plus aquaculture arms were also taught how to prepare fish feed from locally available resources, raise fish, and maintain fishponds. While most respondents reported utilizing some combination of these eco-friendly methods with modest increases in yields, pest management using bio-pesticides and soil conservation using natural fertilizers appeared to be ineffective against harsh growing conditions in the region and, was frequently supplemented by chemical pesticides and inorganic fertilizers respectively.

Further, despite the overwhelming preference for organic produce, farmers with the means to do so applied chemical inputs and reported greater yields for both consumption and sale, suggesting a lack of confidence in green farming practices. This was further solidified by farmers explicitly stating their willingness to access microcredit despite the high interest rates to purchase fertilizers, insecticides, and pesticides in order to improve their yields and, their association of organic farming practices with poor status. While application of pesticides and inorganic fertilizers are justifiable, the potential for misuse and soil degradation from over-farming are glaring in contexts without strong social safety nets to help farmers maintain rural livelihoods (Pretty et al., 2011). Moreover, Cambodia's lack of stringent regulatory mechanisms on chemical inputs throughout the supply chain puts smallholders at even greater risk in the long-term. In fact, it has been suggested by the Cambodian Development Resource Institute (CDRI) that over the last decade, as much as 30% of fertilizers on the market have been counterfeit due to tampering with product labels and mixing of low and high quality fertilizer (CDRI, 2014). Thus, although the immediate likelihood of chemically intensive farming is low, it is possible that a spillover effect may occur jeopardizing both the continuation of conservation farming in the future and ecological sustainability through indiscriminate use of low quality inputs (Tumusiime and Matotay, 2014).

Additionally, severe water shortages most notably in the dry season were experienced by most respondents, reducing both productivity and desire to continue EHFP. The reduced effectiveness of sustainable EHFP practices during dry season however, may be attributed to effects of climate change which, in the past two years have brought about unprecedented seasonal temperatures in the country and elsewhere in the region (CNN, 2016). As a result of El Niño effects in 2015/2016, Cambodia has experienced the worst droughts in over 50 years directly impacting 2.6 million people and placing all but seven provinces, including Prey Veng, in critical water shortage (Save the Children, 2016). Longer hotter dry seasons and shorter monsoon rains have had immediate and negative consequences for agriculture and human health have therefore ensued,

including low crop yields and/or total failures, loss of aquaculture, water scarcity, and increased illness, including dehydration, diarrhea, fever, and upper respiratory infections (Save the Children, 2016). Additionally, when the labour intensive nature of sustainable farming is taken into account within contexts such as these, the external constraints preventing continued uptake of agriculture interventions become clear.

Socioeconomic Factors

According to Tumusiime and Matotay (2014), the success of agricultural interventions is contingent upon the diffusion of economic and social benefits between and within groups. The FOF project has been moderately successful in demonstrating improved access to food year round, increases in income from sale of surplus EHFP outputs, and increased savings from reductions in food purchases. These benefits however, have been unequally distributed. HHs with diverse income streams, including sales from high value livestock and poultry products, small businesses, remittances from family members, and access to credit were more likely to adopt EHFP practices and report substantial improvements in yields and farm incomes. Additionally, these respondents were on average older, had no young children in the home, and were therefore able to commit time and energy to EHFP. In contrast, those without diverse income sources and productive assets had reduced ability to absorb shocks from poor harvests and were more likely to discontinue EHFP year round. Additionally, these respondents were on average younger, had low availability of HH farm labour, and expressed the dual burden of child rearing and maintaining family farms as reasons for failure to increase production beyond HH consumption. Thus, when differences in socioeconomic and HH demographic factors are taken into account, it is unsurprising that negative deviants would discontinue EHFP and seek out seasonal employment opportunities off-farm to earn immediate income in order to make ends meet. Sustainability of EHFP for these vulnerable HHs is therefore bleak without continued financial support and adequate investment in the social safety net.

Macroeconomic factors

While the FOF project was able to demonstrate improvements in livelihoods for beneficiaries and tangible benefits for investments in smallholder agriculture, its contributions to long term rural development are constrained in light of macroeconomic trends in the country that are contributing to rural outmigration. As Guttal (2011) writes, these patterns of rural out-migration are driven in large part by national development strategies that prioritize trade liberalization, most notably within the agriculture sector through provision of largescale economic land concessions (ELCs). In hopes of attracting FDI, Cambodia has granted numerous ELCs to private firms, both foreign and domestic over the past involving the sale or lease of approximately 300,000 hectares of land to private companies (Guttal, 2011; Mund, 2011). This resulted in the conversion of vast expanses of arable farmland and forests into cash crop plantations of rubber, sugarcane, tobacco, and jute intended for export markets. It has also corresponded with the gradual decrease in production of staple crops destined for national food markets (FAO, 2014b; Guttal, 2011; Mund, 2011). Considering the most recent global food crises in 2008 and 2011 which placed numerous net food importing countries at the mercy of volatile international markets, national food self-sufficiency has never been more important; a possibility which Cambodia is gradually losing (Cohen and Smale, 2011).

Moreover, as part of its Agriculture Sector Strategic Development Plan 2014-2018, Cambodia has also actively promoted contract farming as a means to increase

productivity, diversification and commercialization of the sector while simultaneously providing income generating opportunities for the rural poor (MAFF, 2015). Although this sounds promising in theory, in practice the strategy has shown to be quite damaging to agricultural production. While seasonal farm labour has contributed positively to HH incomes in the short term; this livelihood strategy among Fish on Farms respondents has had deleterious impacts on EHFP in the long term as engagement in seasonal labour away from the home significantly reduces available farm labour, time and attention spent on EHFP. Together, the twin issues of shrinking arable farmland for subsistence agriculture and loss of human resource capital on family farms are sounding the death knell on small scale agriculture.

Furthermore, while agricultural trade liberalization has increased flows of FDI into the country for large scale investments in cash crops heavily integrated within the global food economy, smallholder producers struggle to meaningfully engage with sub-national and national food economies due to the lack of sufficient manufacturing and food processing infrastructures available to them as well as the high costs of transport associated with accessing large urban markets. Lack of infrastructures proved to be particularly detrimental as few HHs engaged in post-harvest processing beyond traditional pickling and drying methods. Moreover, competition from other vendors selling similar goods in small village markets coupled with a small consumer base without significant purchasing power created environments in which smallholder producers felt demoralized and unmotivated to expand production. These trends are in line with other similar studies found in development literature that stress the importance of diversified market linkages beyond village boundaries to incentivize producers to maximize production (FAO 2007; FAO 2014b; Hillenbrand and Waid, 2014; Lentz and Barrett, 2013).

Additionally, shifting land tenure patterns present significant challenges to rural communities who depend on common lands for grazing cattle, sourcing building materials for housing and farming infrastructures and foraging wild foods (Guttal, 2011). While respondents in this project did not comment on this directly, elsewhere in the country outright land grabbing and sale of common lands to investors from wealthy Gulf States and elites in the country alike has occurred resulting in complete losses of rural livelihoods for affected communities (Guttal, 2011; Saturnino et al., 2012). This is due in large part to the fact that approximately 80% of total land in Cambodia is owned by the State and farmers are essentially stewards of the land, meaning they have access to use the lands however, the government reserves the right to appropriate them at any time for the sake of the development (USAID, nd). Furthermore, although farmers can apply for land titles, the vast majority of Indigenous farmers do not have formally recognized land titles and common lands have historically been informally negotiated through a system of reciprocity (USAID, nd). Therefore, smallholders not only have to contend with possibilities of displacement at any moment but often do so with little or no compensation (Ghit, 2012; Saturnino et al., 2012; USAID, nd).

Encroachment of private wealth on common lands is further compounded by current bilateral aid structures from donor countries with conditions that facilitate increased trade and investment prospects for their firms at the expense of Cambodian firms (Guttal, 2011). It is entirely unsurprising that Cambodia's largest export partners are also its largest development partners with the United States, Canadian, and European markets accounting for the lion's share of Cambodia's apparel, textiles, and footwear exports (CIA Factbook, 2016). Similarly, China which in recent years has taken the lead as

Cambodia's largest development partner and investor, shelling out concessional loans totalling 11.2 billion USD, has also reaped benefits at the expense of the domestic economy (CSIS, 2013). Despite the fact that garment factories account for 30% of total FDI, less than 5% of them are owned by domestic firms, with firms based in Hong Kong and China accounting for the largest share (Asuyama and Neou, 2012). Thus, while outward economic orientation has been good for FDI flows, these economic trends have undermined the development of a robust domestic economy. Initiatives such as the FOF project are therefore likely to fail in policy environments that hinder progressive local initiatives.

5. Recommendations

5.1 Upstream Level Changes

In order to improve rural HH food security and strengthen national self-sufficiency in food production, it is essential that Cambodia reverses its trend towards commercial cash cropping and injects significant investments into diversified production. This can be further supported within the international trade policy arena by reducing demands on LMICs to lower tariffs on imports as tariffs are an important revenue source for most governments that lack a sufficient tax base and can generate the necessary funding for investment in agriculture (ICTSD, 2012).

Secondly, agro-business corporations have considerable power as intermediaries between the food manufacturing industry and farmers and wield considerable power in changing production and consumption patterns. Furthermore, because they have solidified their presence in the international trade arena as transnational agro-business conglomerates, it is essential that their activities through foreign direct investment within Cambodia are heavily regulated so as to protect smallholder subsistence farmers from land grabs (Pirkle et al., 2014).

Lastly, in order to incentivize smallholder producers to expand and intensify production, it is essential that they have access to diverse market linkages where they can receive fair prices for their agricultural products (FAO, 2007). This can be facilitated by implementing a price support mechanism in which farmers are guaranteed a competitive price for their agricultural products. Local agribusiness growth can also be supported through earmarked loans and grants for initial capital, research and training support. Thus creating local institutional capacity can alleviate challenges expressed by farmers, specifically, abuses of middle men and constraints of village markets.

5.2 Local Level Recommendations

In order to maintain the positive impacts of the FOF program, it is essential that future EHFP programming in coordination with local farmers and development partners work to create robust community seed banks and tree nurseries so farmers can continue to grow diverse micronutrient rich vegetables and fruits year round. This will not only contribute to farmers' self-sufficiency, reducing their reliance on costly purchased inputs but will also serve as safety nets during emergencies such as floods or crop failures from pest infestation—challenges cited by nearly all respondents (FAO, 2014b). Community seed banks have the potential to improve agriculture production and community resiliency as

varieties most adapted to local environmental conditions would be conserved thus reducing risk of crop failure writ large (FAO, 2014b).

Secondly, diversifying market linkages should be accompanied by investments in rural development, specifically, local level agro-processing infrastructures through a mix of public and private financing (FAO, 2007). Greater availability of local agro-processing facilities at the local level would increase the value add of agricultural products increasing their marketability and durability, minimize losses from food waste and spoilage and, increase the opportunities for non-farming jobs in rural areas (World Bank, 2015). Likewise EHFP programming could incorporate HH level food processing and preservation techniques in formal training. Further inquiries into local knowledge and practices of food processing could be explored and possibly developed into potential microenterprise opportunities.

Thirdly, in order to curb the tide of displacement and rural outmigration, Cambodia needs to reform its land titling and land tenure policies especially for common and Indigenous lands. This can be accomplished through formal recognition of Indigenous land use rights and registration of land titles through local governments (USAID, n.d). Furthermore, increased technical assistance and capacity building efforts from development partners are needed to help local communities act in self-interest and negotiate with external parties effectively on matters pertaining to their Indigenous lands (USAID, n.d).

6. Study Limitations

One key limitation that may have impacted the validity of this research is the fact that there was no second coder to ensure inter-rater reliability and establish rigor within the findings. Due to limited time and budget constraints, I was unable to hire a second researcher to code the data.

Secondly, the data was gathered in July of 2015, back translated to English in October of 2015 and analyzed March 2016. Despite efforts taken to consult with enumerators to ensure faithfulness of translation and integrity of the data, it is possible some meanings and subtle nuances may have been lost in translation.

Thirdly, it is worth noting that during data collection, the presence of outsiders namely myself, the project manager and the other research assistant may have impacted the integrity of the interview and generated social desirability bias. This was evident in some of the interview transcripts where respondents exaggerated positive aspects of the project and downplayed the negative aspects. For example, some respondents refused to elaborate on things they didn't like about farming or things they wished to change about the project but went into extensive detail when citing positive aspects.

Although only the Cambodian enumerators directly interacted with the participants during data collection, our presence could have also generated the Hawthorne Effect; a threat to validity that emerges when participants know they are being observed and change their responses or behaviour as a result (Neuman, 2006). Observation (interviewer) bias may have also occurred as different interviewers may have interacted with respondents or asked questions differently (Neuman, 2006).

Lastly, the research presented only captures a snapshot of the intervention and therefore cannot fully illustrate the sustainability of the project in the long term. Moreover, because this was a randomized controlled trial, spillover effects of EHFP in non-intervention HHs was not captured limiting understanding of broad changes within communities.

7. Conclusion

In light of recent global food crises and persistence of chronic hunger in LMICs, agriculture based interventions directed at strengthening small-scale subsistence farming have made a resurgence. To avoid failures of patchwork development interventions from previous decades however, recent agriculture initiatives have sought to contribute to sustainable and inclusive development by addressing structural issues of poverty and lack of infrastructures that serve as barriers to food access. Using a mixed methods research design, this paper explored the effectiveness of one such intervention in improving food security, nutrition, and livelihoods of the rural poor in Prey Veng, Cambodia.

Based on findings, the research and development study known as the FOF project implemented by HKI and UBC provides a useful model through which EHFP can be promoted year round as a viable tool in combatting HH food insecurity and malnutrition in rural Cambodia. Its investments in primary inputs and infrastructures for farming and technical skills training contributed to greater yields, higher incomes and savings for participants. Insights gleaned from the gap analysis however, identified a number of factors which may have limited the success of some women farmers and not others in maintaining EHFP practices after the project concluded. These included: seasonality of production; access to productive resources; alternative livelihood strategies beyond EHFP; and barriers to uptake of EHFP, including seasonal migration and inadequate HH labour. Thus, for a number of respondents, without continued injections of financial resources and expansion of social safety nets, the positive impact of FOF is likely unsustainable.

Additionally, the possibility for lasting impact is further complicated by contradictory national development strategies that embrace neoliberal free-market policies and prioritize large-scale commercial farming at the expense of small-scale producers and rural livelihoods. Therefore, it is critical that donor agencies work with LMICs to revise national poverty reduction strategies and allow countries to exercise mercantilist practices where domestic agriculture policy is concerned. This also needs to be accompanied by revisions to SAPs still promoted by the IMF, World Bank, and WTO so LMICs, like Cambodia, can strengthen local agriculture and meaningfully reduce rural poverty.

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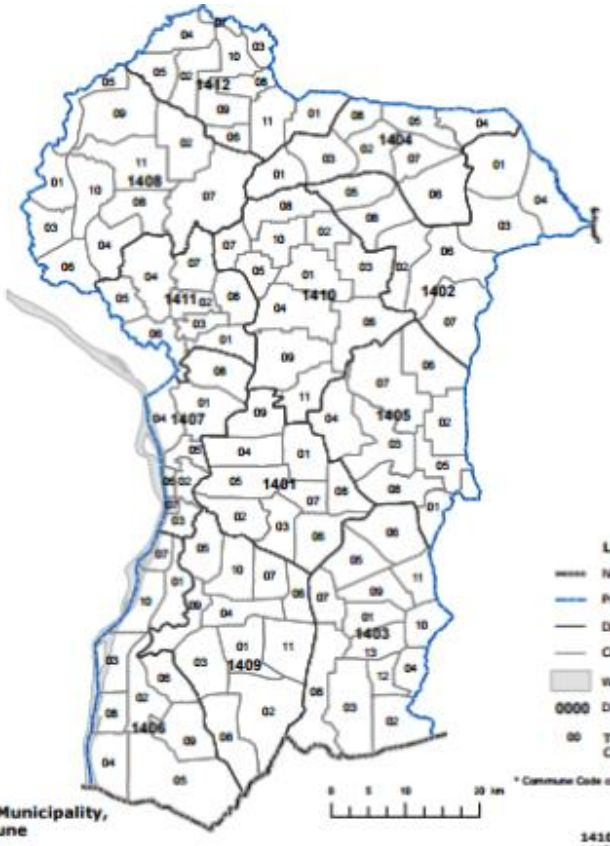
APPENDICES

APPENDIX A: MAP OF PREY VENG



Code of Province / Municipality, District, and Commune

14 PREY VENG

1401 Ba Phnum
140101 Boeng Preah
140102 Cheung Phnum
140103 Chheu Kach
140104 Reaks Chey
140105 Roung Damrei
140106 Sdau Kaong
140107 Spueu Ka
140108 Spueu Kha
140109 Theay

1402 Kamchay Mear
140201 Cheach
140202 Doun Koeng
140203 Kranhung
140204 Krabau
140205 Seang Khveang
140206 Smaong Khang Cheung
140207 Smaong Khang Tboung
140208 Trabaek

1403 Kampong Trabaek
140301 Ansaong
140302 Charn
140303 Cheang Daek
140304 Chrey
140305 Kansoam Ak
140306 Kou Khchak
140307 Kampong Trabaek
140308 Peam Montear
140309 Prasat
140310 Pratheat
140311 Prey Chhor
140312 Prey Poun
140313 Thkov

1404 Kanhchriech
140401 Chong Ampil
140402 Kanhchriech
140403 Kdoeang Reay
140404 Kouk Kong Kaeut
140405 Kouk Kong Lech
140406 Preal
140407 Thma Pun
140408 Tnaot

1405 Me Sang
140501 Angkor Sar
140502 Chres
140503 Chi Phoch
140504 Prey Khnes
140505 Prey Rumdeng
140506 Prey Totueng
140507 Svay Chrum
140508 Trapeang Srae

1406 Peam Chor
140601 Angkor Angk
140602 Kampong Prasat
140603 Kaoh Chek
140604 Kaoh Roka
140605 Kaoh Sampov
140606 Krang Ta Yang
140607 Preaek Krabau
140608 Preaek Sambuor
140609 Ruessei Srok
140610 Svay Phluoh

1407 Peam Ro
140701 Ba Baong
140702 Banlich Prasat
140703 Neak Loeang
140704 Peam Hean Chey
140705 Peam Ro
140706 Preaek Khsay Ka
140707 Preaek Khsay Kha
140708 Prey Kandieng

1408 Pea Reang
140801 Kampong Popil
140802 Kanhcham
140803 Kampong Prang
140804 Kampong Ruessei
140805 Mesa Prachan
140806 Preaek Ta Sar
140807 Prey Pnov
140808 Prey Sniet
140809 Prey Sralet
140810 Reab
140811 Roka

1409 Preah Sdach
140901 Angkor Reach
140902 Banteay Chakrei
140903 Boeng Daol
140904 Chey Kampok
140905 Kampong Soeng
140906 Krang Svay
140907 Lvea
140908 Preah Sdach
140909 Reathor
140910 Rumchek
140911 Sena Reach Otdam

1410 Prey Veaeng
141001 Angkor Trat
141002 Chea Khlang
141003 Chrey
141004 Damrei Puon
141005 Me Bon
141006 Pean Roung
141007 Popueus
141008 Prey Khla
141009 Samraong
141010 Svay Antor
141011 Tuek Thla

1411 Kampong Leav
141101 Baray
141102 Cheung Tuek
141103 Kampong Leav
141104 Pou Rieng
141105 Preaek Anteah
141106 Preaek Chrey
141107 Prey Kanlaong
141108 Ta Kao

1412 Sithor Kandal
141201 Ampil Krau
141202 Chrey Khmum
141203 Lve
141204 Pnov Ti Huoy
141205 Pnov Ti Pir
141206 Pou Ti
141207 Preaek Changkran
141208 Prey Daeum Thnoeng
141209 Prey Tueng
141210 Rumlech
141211 Ruessei Sanh

* Codes and boundaries are as of February 9, 2009.

APPENDIX B: GAP ANALYSIS PROTOCOL

Fish on Farms Follow Up: Protocol for Gap Analysis

July 2015

Scale up of Homestead Food Production for Improved Household Food Security and Nutrition in Cambodia:

"FAMILY FARMS FOR THE FUTURE"

IDRC Grant Agreement No. 107982-002
Helen Keller International and the University of British Columbia

Foreign Affairs, Trade and Development Canada
Affaires étrangères, Commerce et Développement Canada
IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international
Canada
UBC
Helen Keller INTERNATIONAL

1. Background

Almost 50% of Cambodian households experience multi-dimensional poverty, and 20% severe poverty[1]. Household food insecurity and seasonal food shortages remain high, particularly in rural areas where the rice-based diet may provide sufficient energy, but lacks adequate protein, essential fats and micronutrients[2]. Many of the poor, food insecure, and nutritionally vulnerable live in rural areas and make their livelihood from subsistence farming; however, these farmers often use inefficient traditional agricultural practices and fail to optimize land for year-round food production and income generation[2,3].

In order to address poor land utilization, under-nutrition and food insecurity, Helen Keller International (HKI) has implemented an Enhanced Homestead Food Production (EHFP) model in Cambodia and elsewhere[4,5]. EHFP focuses on women farmers and fosters year-round environmentally sustainable production of micronutrient-rich fruits, vegetables and animal source foods [6,7]. However, to date there is a lack of rigorously designed studies assessing the effectiveness of EHFP at improving food security and nutrition outcomes. To address this, HKI and the University of British Columbia (UBC), through CIFSRF funding, are conducting a two-phase research and development study assessing the impact of sustainable models of integrated EHFP at improving food security, nutrition outcomes, livelihoods, and women's empowerment in Cambodia. During the first phase, known as 'Fish on Farms', 900 women farmers were randomly assigned for 24 months to three arms: 1) home gardens only; 2) home gardens plus aquaculture (fishponds); and 3) control. Findings from Fish on Farms identified a number of factors that may have limited the success of some women farmers, including issues with seasonality of aquaculture; limited business training, including limited financial literacy and opportunities for income generation; and barriers to uptake and continuation of EHFP technologies (e.g. agricultural and aquaculture practices), such as seasonal migration.

2. Purpose

A mixed-methods assessment of deviant cases (successful and unsuccessful women farmers) from Fish on Farms will be conducted to better understand socio-economic factors, behavioral, familial, cultural, and structural factors that may have affected decision-making, motivation, willingness to continue EHFP activities, and the success of Village Model Farm owners (VMF) and household (HH) farmers. Data collected from this research will be used to inform the second phase of the study, which aims to identify evidence-based scalable and environmentally sustainable models of EHFP that are suitable for replication in different agro-ecological areas in Cambodia and in the long term, in the Asia-Pacific region. Successful components of Fish on Farms, as well as additional EHFP options will be horizontally (geographically) scaled out to ~4500 new HHs in three additional districts in Prey Veng province and in three new provinces: Kampot, Kompong Cham and Khan Meanchey, an urban poor of Phnom Penh. Simultaneously, best practices of EHFP in the Cambodian context will be vertically scaled up through capacity building with community, district and provincial level health and agricultural workers; by contributing to national and international food security and nutrition polices through a multi-sectorial and multi-level steering committee; sharing 'lessons learned' with key national and international stakeholders, including

governments, NGOs/INGOs, UN agencies, academic institutions, and private enterprises.

2.1 Study objectives

1. Identify key factors contributing to greater or lesser fruit, vegetable, and fish production at the HH and VMF level.
2. Identify key factors contributing to motivation and willingness to continue EHFP technologies and agricultural practices.
3. Identify socio-economic factors that led to improved livelihoods and greater income generation in some HHs and VMFs but not others.
4. Identify key factors (behavioral, familial, cultural, and structural) contributing to successful women farmers.
5. Investigate the availability of formal and informal credit services and farmers willingness to access these services.
6. Map supply chain of fruit, vegetable and fish products at different levels (HH, VMF and community) for participating HHs and VMFs, including identifying service providers that impact marketing and distribution of EHFP products.
7. Define gaps and opportunities to improve existing EHFP agriculture and aquaculture protocols, Information, Education, Communication (IEC) and Behaviour Change Communication (BCC) materials.

3. Methods

A purposive sampling method will be used to select deviant farmers from Fish on Farms in order to learn from women who had outstanding successes and notable failures. Initially, a screening exercise of all intervention HHs and VMFs (600 HHs and 60 VMFs) that participated in Fish on Farms project will be conducted in order to identify deviant cases. Once the deviant cases have been selected, semi-structured one-on-one interviews will be conducted using a mixed-methods approach. Key informant interview (KII) guides will consist of quantitative and qualitative questions. Quantitative questions will be used to assess HH characteristics, income, and agricultural production. Open-ended qualitative questions will be used to better understand social-economic, behavioral, familial, cultural, and structural factors that may have affected women farmers' motivation and willingness to continue EHFP practices or adoption of EHFP technologies and their perceptions of the Fish on Farms project.

Two types of KIIs will be conducted:

I. **KIIs with VMF owners** to investigate their motivation and willingness to provide technical assistance and inputs to HH; explore farmers' perceptions of Fish on Farms, including their perceived risks and benefits to project participation; understand current knowledge, attitudes and practices with regard to agricultural and aquaculture practices; explore barriers to project participation and suggestions for potential improvement; examine VMFs' experiences and challenges related to the adoption of EHFP technologies and year-round fruit, vegetable and fish production; identify service providers that impact marketing and distribution of EHFP products.

II. **KIIs with deviant HH women farmers'** to explore farmers' perceptions of Fish on Farms, including their perceived risks and benefits to project participation; understand current knowledge, attitudes and practices with regard to agricultural and aquaculture practices; explore barriers to project participation and suggestions for potential improvement; examine farmers' experiences and challenges related to the adoption of EHFP technologies and year-round fruit, vegetable and fish production; identify key actors across the value chain and supply chain; identify service providers that impact marketing and distribution of EHFP products.

3.1 Selection Criteria

HKI program staff, in collaboration with local NGO partners, will conduct an initial screening exercise with all 600 HH in both intervention arms of Fish on Farms (300 HHs with gardens only and 300 HHs with gardens + aquaculture) and 60 VMFs (30 VMFs with gardens only and 30 VMFs with gardens + aquaculture) to identify 'positive' (successful) and 'negative' (unsuccessful) deviant farmers. Farmers will be evaluated on current agricultural and aquaculture practices and the amount of income generated from the sale of fruit, vegetables and fish. In total, six VMFs and 20 HHs will be selected as 'positive' deviants and four VMFs and 20 HHs will be selected as 'negative' deviants based on the following criteria:

3.1.1 VMF selection

- Number of fruit and vegetable varieties grown in the last 12 months;
- Number of fruit sapling and vegetable seedling varieties produced in the last 12 months;
- Kilograms of vegetables produced in the last two months;
- Kilograms of fruit produced in the last growing season;
- Kilograms of fish produced in the last rainy season;
- Per cent of harvested vegetables, fruit, and/or fish that was sold, gifted or consumed;
- Amount of money earned from the sale of vegetables, fruit, and/or fish in the last two months; and
- Size of VMF (in square meters) under cultivation in the last two months;
- Year-round access to irrigation facilities for gardening;
- Maintained compost heap/pit;
- Use of green manuring (decomposed cultivated crops and ploughed soil and/or leguminous crops); and
- Use of the following improved soil conservation and disease prevention techniques: crop rotation, mulching, crop diversification, and intensive planting.

3.1.2 HH selection

- Number of fruit and vegetable varieties grown in the last 12-months;
- Kilograms of vegetables produced in the last two months;
- Kilograms of fruit produced in the last growing season;
- Kilograms of fish produced in the last rainy season;

- Per cent of harvested vegetables, fruit, and/or fish that was sold, gifted or consumed;
- Amount of money earned from the sale of vegetables, fruit, and/or fish in the last 2 months; and
- Size of garden (in square meters) under cultivation in the last two months.

3.2 Location and sample size

In total, 50 KIIs will be conducted in four districts in the Prey Veng province: 40 KIIs with deviant HH farmers and 10 KIIs with deviant VMF owners. As already mentioned, deviant VMFs and HHs will be identified during the initial screening exercise. Based on these findings, three successful and two unsuccessful VMFs and 10 successful and 10 unsuccessful HHs from both arms (gardens only and gardens + fish ponds) will be selected according to best and worst practices and based on the data collected during the screening exercise. The number of KIIs conducted with VMFs and HHs will be evenly split between both intervention arms: five VMFs and 20 HHs in the gardens only arm, and five VMFs and 20 HHs in the gardens + aquaculture arm.

3.3 Survey team

The survey team will consist of eight enumerators with previous experience conducting qualitative research, two HKI staff members, and two UBC research assistants. The enumerators (6) will be divided into three research teams of two: one member of the qualitative research team will be responsible for facilitating the KIIs and taking shorthand notes; a second member of the team will be responsible for operating the tape recorder and for taking supplemental notes.

As research supervisors, HKI staff members will be present to help facilitate data collection, ensure accuracy and completion of consent forms and questionnaires, and to collect all completed survey tools and audio recordings at the end of each day. In addition, two UBC research assistants will be in the field to help oversee data collection and assist with answering any questions that may arise.

Each pair of enumerators will be responsible for completing four interviews each day. Therefore, including travel time, it should take four research teams a total of six days to complete data collection.

3.4 Training and pre-testing of survey materials

The survey training will be a minimum of three days in duration. On the first day, all enumerators will be trained to have a thorough understanding of the survey objectives, research methodology, interview guides, and quantitative and qualitative interview techniques. On the second day of training, the team will practice interviewing in pairs to make sure the question guides are clear. The survey tools will then be pre-tested in a community where the study will not take place. The third day of training will be devoted to recapping lessons learned, making necessary revisions to the survey instruments, and finalizing the composition of the research teams.

3.5 Data Collection

Each research team will be responsible for preparing all necessary materials (e.g. interview guides, clipboards, paper, pens, tape recorders etc.) before leaving Phnom Penh for the field and the evening before each day of field work. Upon arrival at the

village, the team will explain the objective of the gap analysis, review the specific purpose of the KIIs with local village authorities and VMF owners and ask for their assistance in identifying deviant farmers. All KIIs will be facilitated using a semi-structured interview guides. All materials for data collection will be translated into Khmer from English prior to the data collection and back translation from Khmer to English to ensure the integrity of the questions.

3.5.1 Screening Exercise

HKI staff (both field staff and M&E staff from the Phnom Penh head office) will screen all 600 HHs and 60 VMFs in Prey Veng two weeks prior to the qualitative assessment. All data will be collected using an electronic checklist. Farmers will be asked a series of questions on EHFP production and techniques, utilization of EHFP products, and income generated from the sale of EHFP. These data will then used to score each farmer out of 100 based on their peers. The top three and bottom two VMFs and top 10 and bottom 10 HHs within will be selected for a follow up qualitative survey (deviant cases).

3.5.2 In-depth Interviews

At the end of each day of data collection during the follow up interviews, the research teams will be responsible for reviewing all field notes and adding additional supplementary notes, as necessary. All interview notes, including audio recordings will be submitted to the survey team leads upon completion of field work. Data will be transcribed and translated from Khmer to English by the HKI program staff in Phnom Penh using both the expanded interview field notes and by reviewing the audio recording and supplementing the notes as necessary. Participant characteristics will be summarized as the number of participants and percentage for categorical variables and means and standard deviation for continuous variables.

3.5.3 Consent

Prior to conducting interviews, written informed consent will be obtained from all participants. Where participants are not able to read, a thumbprint, along with a witness' signature will be obtained. All consent forms will be translated into Khmer. Confidentiality will be maintained throughout the study. All respondents will be informed that participation in the survey is completely voluntary. Respondents will given the opportunity to refuse participation in the study or refrain from answering any question at any time throughout an interview.

3.6 Data Analysis

Data collected during the initial screening exercise will be used to identify deviant cases using the following steps:

3.6.1 VMF Selection

Step 1: First, VMFs will be down selected if they are not following specific techniques taught to them during Fish on Farms. The 'successful' criteria will be applied to specific questions to determine which VMFs move forward. These questions include: Q111, Q112, Q113, Q114 in the VMF gardens + fish checklist; and questions Q109, Q110, Q111, Q112 in the VMF gardens only checklist (**Appendix A).**

Step 2: Each question in the checklist is categorized as either ‘Critical’ or ‘High Impact’. ‘Critical’ questions are fundamental for determining which HH will be selected for follow up in-depth interviews. If the farmer does not meet the success criteria for these questions, they cannot be considered successful. ‘High Impact’ questions play a large role towards the success of the farmer, but are not considered as critical. These questions include:

VMF gardens + fish checklist:
Critical Questions: Q101, Q102, Q103, Q104, Q107, Q108, Q109
High Impact Questions: Q105, Q106, Q110

VMF gardens only checklist:
Critical Questions: Q101, Q102, Q103, Q104, Q107
High Impact Questions: Q105, Q106, Q108

The ‘Critical’ and ‘High Impact’ questions are weighted as follows:

Critical	High Impact
80%	20%

Using all the questions together will generate a score out of 100 for each VMF. The top six and bottom four scores will be selected for key informant interviews.

Step 3: In the case of ties between deviant cases, the final question in the checklist will be used as a tie-breaker. That is, during the screening exercise all interviewers will be asked to rate the success of the VMFs using a 5-point Likert Scale; one corresponds to “strongly agree” and five corresponds to “strongly disagree”.

3.6.2 HH Selection

Step 1: Each question in the checklist is categorized as either ‘Critical’ or ‘High Impact’. ‘Critical’ questions are fundamental for determining which HH will be selected for follow up in-depth interviews. If the farmer does not meet the success criteria for these questions, they cannot be considered successful. ‘High Impact’ questions play a large role towards the success of the farmer, but are not considered as critical. These questions include:

HH gardens + fish checklist:
Critical Questions: Q101, Q102, Q103, Q106, Q107, Q108
High Impact Questions: Q104, Q105, Q109

HH gardens only checklist:
Critical Questions: Q101, Q102, Q103, Q106
High Impact Questions: Q104, Q105, Q107

The ‘Critical’ and ‘High Impact’ questions are weighted as follows:

Critical	**High Impact**
80%	20%

Farmers are then given a score out of 100 based on their peers. A detailed list of the 'Critical' and 'High Impact' questions for HHs are included in **Appendix B.**

Step 2: In the case of ties between deviant cases, the final question in the checklist will be used as a tie-breaker. That is, during the screening exercise all interviewers will be asked to rate the success of the farmers using a 5-point Likert Scale; one corresponds to "strongly agree" and five corresponds to "strongly disagree".

3.6.2 Qualitative data analysis

Textual data collected during the qualitative assessment (in-depth interviews) will be imported, managed and analysed using the qualitative software program NVivo 10. NVivo as a computer program helps the investigator attach codes to segments of text such as a word, phrase, sentence, or paragraph. The coding of qualitative data entails assigning unique labels to text passages that contain references to specific categories of information. Further, the textual data will be explored both deductively through framing and inductively using content analysis to generate lists, categories and explanations. Data will be systematically examined through multiple iterative processes including using analytic tools such as word frequency, text searches, and visualizing the data (e.g., tables, matrices, word clouds) to identify dominant themes. We will use standard qualitative coding techniques including chunking the data, assignment of attributes and relationships, and memoing. Data will also be explored through queries and cross-case analyses in order to understand between-group differences that may have impacted the program delivery.

4. Timeline

Data collection will take place between July and August 2015. The main research activities include: developing the study protocol and research tools; reviewing, translating, pre-testing and finalizing the question guides; conducting research team training; conducting data collection and transcription; data translation; data analysis and reporting.

5. Ethical considerations

Necessary steps will be taken to ensure participant confidentiality and privacy through the use of a unique identification number on questionnaires and in the electronic database. Prior to data collection, approval of the study protocol and research tools will be obtained from Cambodia's National Ethics Committee for Health Research (NECHR) and from UBC's Behavioural Research Ethics Board.

5.1 Data storage

All electronic data files will be stored on password-protected computers and/or secure servers accessible only to members of the research team. Archived electronic data files and any hard copies of data, consent forms, questionnaires or other papers containing data will be stored in locked filing cabinets in locked storage rooms at HKI, Cambodia.

De-identified data will be sent from Cambodia to UBC, Canada. Data will be sent by email over a password-protected spreadsheet. All co-investigators and research assistants working on the project will have access to the data. Responsibilities concerning privacy and confidentiality will be discussed with the research assistants.

Paper and archived electronic data will be stored in locked filing cabinets in locked research rooms at UBC for at least 5 years following publication of research findings. After this time, they will be physically destroyed (e.g., paper copies will be shredded).

6. References

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Appendix A: VMF Selection Criteria

Gap Analysis – VMF Deviant Selection – Gardens + Fish

Deviant Selection Criteria	
In the last 12 months, how many different fruit and vegetable varieties did you grown in your garden? *Criteria* Successful: Higher variety of vegetables – ranked against peers (top) Unsuccessful: Lower variety of vegetables – ranked against peers (bottom)	□□Vegetables □□ Fruits
In the last 12 months, how many different fruit saplings and vegetable seedlings did you produce in your garden? *Criteria* Successful: Higher variety of vegetable seedlings – ranked against peers (top) Unsuccessful: Lower variety of vegetable seedlings – ranked against peers (bottom) *Note – Fruit is not in season and therefore not considered in the farmers evaluation of success for this question	□□ Vegetables seedling □□ Fruits sapling
In the last 2 months, what was the amount of vegetables produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of vegetables
In the last 2 months, what percentage of the vegetables grown in your garden did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of sell – greater than 50% and ranked against peers (top)** **Unsuccessful: Lower percentage of sell – greater than 50% and ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption
In the last growing season, what was the amount of fruit produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□□□ kg of fruits
In the last growing season, what percentage of the fruit grown in your garden did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of sell –** greater than 50% and **ranked against peers (top)** **Unsuccessful: Lower percentage of sell –** greater than 50% and **ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption

In the last rainy season, what amount of fish (both large and small) did you harvest (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□□□ kg of fish	
In the last rainy season, what percentage of the fish harvested from your fishpond did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of sell –** greater than 50% and **ranked against peers (top)** **Unsuccessful: Lower percentage of sell –** greater than 50% and **ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption	
In the last 2 months, how much money did you earn from the sale of fruit, vegetables and/or fish? *Criteria* Successful: Higher riel amount – ranked against peers (top) Unsuccessful: Lower riel amount – ranked against peers (bottom)	□□□□□□□□(in riel)	
In the last 2 months, what was the size of your land (in square meters) under cultivation? *Criteria* Successful: Higher kg/m^2 output – ranked against peers (top) Unsuccessful: Lower kg/m^2 output – ranked against peers (bottom)	□□□□□(square meters)	
Do you have year-round access to irrigation facilities for gardening and/or fish farming? *Criteria* Successful: Yes Unsuccessful: No	□Yes □No	
Do you have a maintained compost heap/pit? *Criteria* Successful: Yes Unsuccessful: No	□Yes □No	
Do you use green manuring (decomposed cultivated crops and ploughed soil and/or leguminous crops) in your garden? *Criteria* Successful: Yes Unsuccessful: No	□Yes □No	
What types of improved soil conservation and disease prevention techniques do you use? NOTE: check **ALL** that apply *Criteria* Successful: All four techniques used Unsuccessful: None of the techniques are used	1=crop rotation 2=mulching 3=crop diversification 4=intensive planting	☐ ☐ ☐ ☐

(Aka “interviewer assessment”) INTERVIEWER ONLY DO NOT ASK RESPONDENT: **Circle the response that most** closely reflects the extent to which you agree or disagree with the following statement:

The farmer appears to be very successful at gardening and/or aquaculture.

Strongly agree
Agree
Neither agree nor disagree
Disagree
Strongly disagree

Criteria
Successful: Strongly Agree
Unsuccessful: Strongly Disagree

Gap Analysis – VMF Deviant Selection – Gardens Only

Deviant Selection Criteria	
In the last 12 months, how many different fruit and vegetable varieties did you grow in your garden? *Criteria* Successful: Higher variety of vegetables – ranked against peers (top) Unsuccessful: Lower variety of vegetables – ranked against peers (bottom)	□□Vegetables □□ Fruits
In the last 12 months, how many different vegetable seedling and fruit saplings did you produce in your garden? *Criteria* Successful: Higher variety of vegetable seedlings – ranked against peers (top) Unsuccessful: Lower variety of vegetable seedlings – ranked against peers (bottom) *Note – Fruit is not in season and therefore not considered in the farmers evaluation of success for this question	□□ Vegetables seedling □□ Fruits sapling
In the last 2 months, what was the amount of vegetables produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of vegetables
In the last 2 months, what percentage of the vegetables grown in your garden did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of sell – greater than 50% and ranked against peers (top)** **Unsuccessful: Lower percentage of sell – greater than 50% and ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption

In the last growing season, what was the amount of fruit produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□□□ kg of fruits	
In the last growing season, what percentage of the fruit grown in your garden did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of sell –** greater than 50% and **ranked against peers (top)** **Unsuccessful: Lower percentage of sell –** greater than 50% and **ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption	
In the last 2 months, how much money did you earn from the sale of fruit and vegetables? *Criteria* Successful: Higher riel amount – ranked against peers (top) Unsuccessful: Lower riel amount – ranked against peers (bottom)	□□□□□□□□(in riel)	
In the last 2 months, what was the size of your land (in square meters) under cultivation? *Criteria* Successful: Higher kg/m^2 output – ranked against peers (top) Unsuccessful: Lower kg/m^2 output – ranked against peers (bottom)	□□□□□(square meters)	
Do you have year-round access to irrigation facilities for gardening and/or fish farming? *Criteria* Successful: Yes Unsuccessful: No	□Yes □No	
Do you have a maintained compost heap/pit? *Criteria* Successful: Yes Unsuccessful: No	□Yes □No	
Do you use green manuring (decomposed cultivated crops and ploughed soil and/or leguminous crops) in your garden? *Criteria* Successful: Yes Unsuccessful: No	□Yes □No	
What types of improved soil conservation and disease prevention techniques do you use? NOTE: Record **ALL** that apply *Criteria* Successful: All four techniques used Unsuccessful: None of the techniques are used	1=crop rotation 2=mulching 3=crop diversification 4=intensive planting	☐ ☐ ☐ ☐

(Aka “interviewer assessment”) INTERVIEWER ONLY DO NOT ASK RESPONDENT: **Circle the response that most** closely reflects the extent to which you agree or disagree with the following statement:

The farmer appears to be very successful at gardening and/or aquaculture.

Strongly agree
Agree
Neither agree nor disagree
Disagree
Strongly disagree

Criteria
Successful: Strongly Agree
Unsuccessful: Strongly Disagree

Appendix B: HH Selection Criteria

Gap Analysis – HH Deviant Selection – Gardens + Fish

DEVIANT SELECTION CRITERIA	
In the last 12 months, how many different fruit and vegetable varieties did you grow in your garden? *Criteria* Successful: Higher variety of vegetables – ranked against peers (top) Unsuccessful: Lower variety of vegetables – ranked against peers (bottom)	□□□□ Vegetables □□□□ Fruits
In the last 2 months, what was the amount of vegetables produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of vegetables
In the last 2 months, what percentage of the vegetables grown in your garden did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of home consumption –** greater than 50% and **ranked against peers (top)** **Unsuccessful: Lower percentage of home consumption –** greater than 50% and **ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption
In the last growing season, what was the amount of fruit produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of fruits
In the last growing season, what percentage of the fruit grown in your garden did you sell, gift, and keep for home consumption? *Criteria* Successful: Higher percentage of home consumption – greater than 50% and ***ranked against peers (top)*** Unsuccessful: Lower percentage of home consumption – less than 50% and ***ranked against peers (bottom)***	□□□ % sell □□□ % gift □□□ % home consumption
In the last rainy season, what amount of fish (both large and small) did you harvest (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of fish
In the last rainy season, what percentage of the fish harvested from your fishpond did you sell, gift, and keep for home consumption? *Criteria* Successful: Higher percentage of home consumption – greater than 50% and ***ranked against peers (top)*** Unsuccessful: Lower percentage of home consumption – less than 50% and ***ranked against peers (bottom)***	□□□ % sell □□□ % gift □□□ % home consumption

In the last 2 months, how much money did you earn from the sale of fruit, vegetables and/or fish? *Criteria* Successful: Higher riel amount – ranked against peers (top) Unsuccessful: Lower riel amount – ranked against peers (bottom)	□□□□□□□□(in riel)
In the last 2 months, what was the size of your land (in square meters) under cultivation? *Criteria* Successful: Higher kg/m^2 output – ranked against peers (top) Unsuccessful: Lower kg/m^2 output – ranked against peers (bottom)	□□□□□□ (square meters)
(Aka "interviewer assessment") INTERVIEWER ONLY DO NOT ASK RESPONDENT: **Circle the response that most** closely reflects the extent to which you agree or disagree with the following statement: The farmer appears to be very successful at gardening and/or aquaculture. Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree *Criteria* Successful: Strongly Agree Unsuccessful: Strongly Disagree	

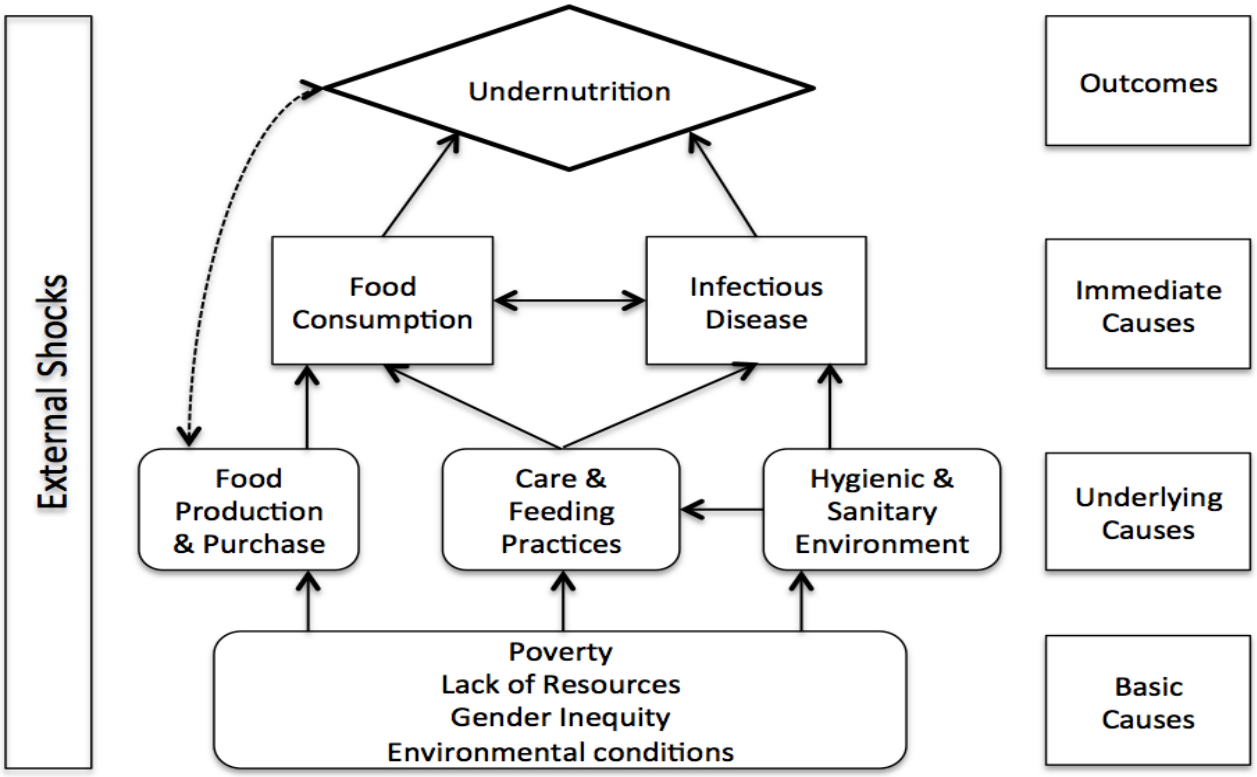
Gap Analysis – HH Deviant Selection – Gardens Only

DEVIANT SELECTION CRITERIA	
In the last 12 months, how many different fruit and vegetable varieties did you grow in your garden? *Criteria* Successful: Higher variety of vegetables – ranked against peers (top) Unsuccessful: Lower variety of vegetables – ranked against peers (bottom)	□□□□ Vegetables □□□□ Fruits
In the last 2 months, what was the amount of vegetables produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of vegetables
In the last 2 months, what percentage of the vegetables grown in your garden did you sell, gift, and keep for home consumption? *Criteria* **Successful: Higher percentage of home consumption –** greater than 50% and **ranked against peers (top)** **Unsuccessful: Lower percentage of home consumption –** greater than 50% and **ranked against peers (bottom)**	□□□ % sell □□□ % gift □□□ % home consumption

In the last growing season, what was the amount of fruit produced in your garden (in kg)? *Criteria* Successful: Higher kg amount – ranked against peers (top) Unsuccessful: Lower kg amount – ranked against peers (bottom)	□□□□ kg of fruits
In the last growing season, what percentage of the fruit grown in your garden did you sell, gift, and keep for home consumption? *Criteria* Successful: Higher percentage of home consumption – greater than 50% and ***ranked against peers (top)*** Unsuccessful: Lower percentage of home consumption – less than 50% and ***ranked against peers (bottom)***	□□□ % sell □□□ % gift □□□ % home consumption
In the last 2 months, how much money did you earn from the sale of fruit, vegetables and/or fish? *Criteria* Successful: Higher riel amount – ranked against peers (top) Unsuccessful: Lower riel amount – ranked against peers (bottom)	□□□□□□□□(in riel)
In the last 2 months, what was the size of your land (in square meters) under cultivation? *Criteria* Successful: Higher kg/m^2 output – ranked against peers (top) Unsuccessful: Lower kg/m^2 output – ranked against peers (bottom)	□□□□□□ (square meters)
(Aka "interviewer assessment") INTERVIEWER ONLY DO NOT ASK RESPONDENT: **Circle the response that most** closely reflects the extent to which you agree or disagree with the following statement: The farmer appears to be very successful at gardening and/or aquaculture. Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree *Criteria* Successful: Strongly Agree Unsuccessful: Strongly Disagree	

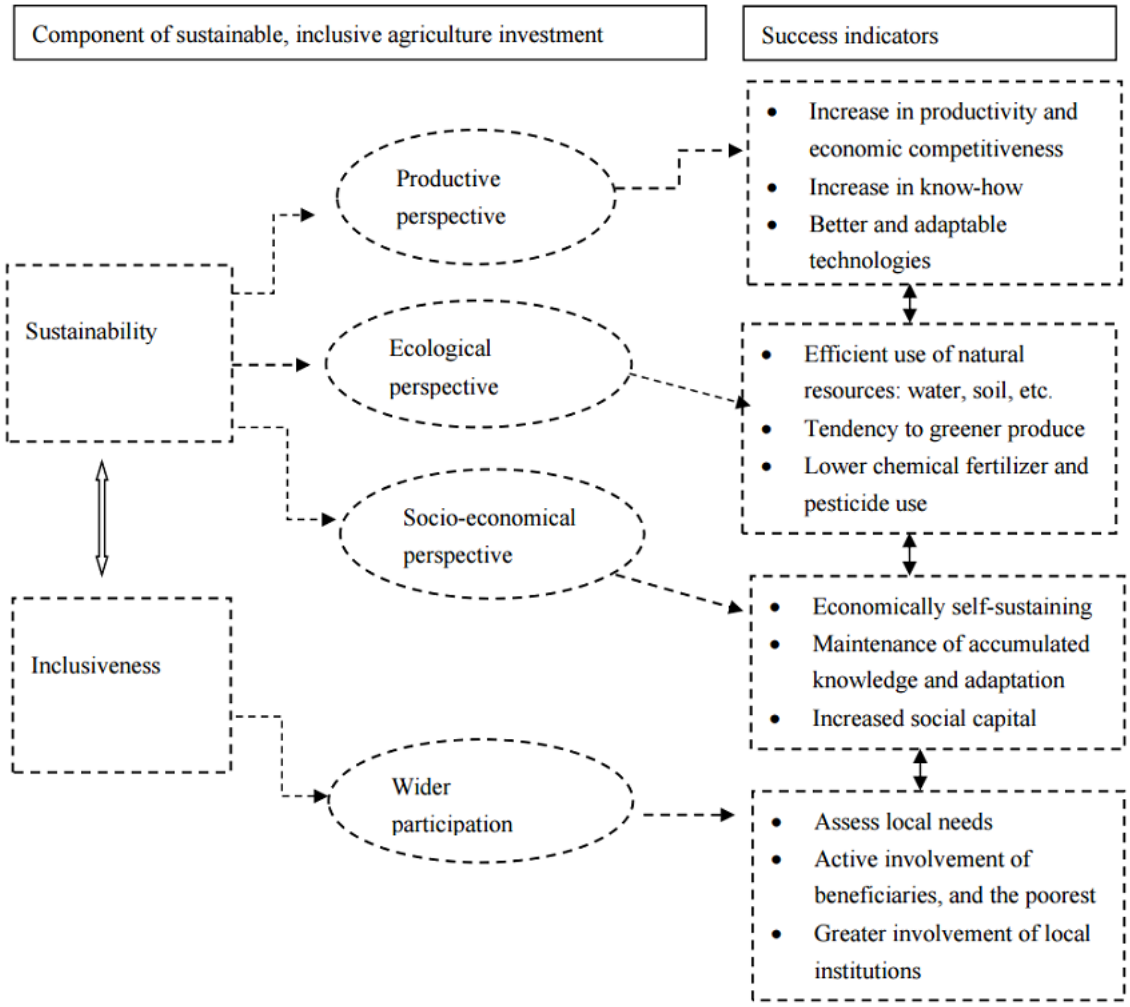
APPENDIX C: FIGURES

Figure 1: Fish on Farms Conceptual/Theoretical Framework for Food Security and Nutrition



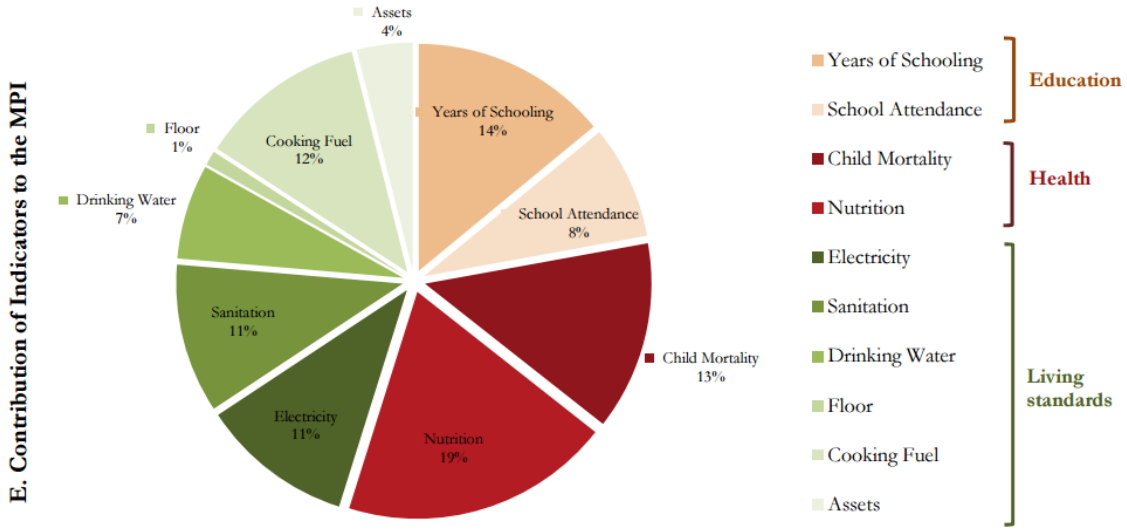
***Source**:* FOF Project Proposal, 2014, p. 14

Figure 2: Empirical model for Sustainable, inclusive agricultural development at the farm level



Source: Tumusiime and Matotay, 2014, p. 185.

Figure 3: Deprivation Indicators for Multi-dimensional Poverty Index



Source: OPHI Country Briefing Cambodia, p. 3

APPENDIX D: TABLES

Table 1: Household Vegetable production

	Control	HFP[1]	HFP+F[2]	Total
Number of varieties of vegetables currently grown in garden [Median (Range)]	4 (1—17)[a]	6 (1—21)[b]	6 (1—21)[b]	6 (1—21)
Mass of vegetables produced in last 2 months (kg) [$\bar{x}$±SD]	15.22 ±23.80[a]	49.74 ±50.88[b]	61.56 ±75.85[b]	45.71 ±60.07
Use of vegetables produced in last 2 months [n(%)]:				
Home consumption	111 (62.0)	162 (87.6)	158 (84.0)	431 (78.1)
Sell	1 (0.6)	16 (8.6)	19 (10.1)	36 (6.5)
Give to others	2 (1.1)	0	2 (1.1)	4 (0.7)
No produce yet	3 (1.7)	0	1 (0.5)	4 (0.7)
N/A (no home garden)	62 (34.6)	7 (3.8)	8 (4.3)	77 (13.9)

[1]HFP=Homestead Food Production
[2]HFP+F=Homestead Food Production plus fish
[a,b] means differ significantly between values in rows not sharing a common superscript (by one-way ANOAV and Tukey's multiple comparisons)

Source: FOF Endline Survey Report, 2014

Table 2: Homestead Fruit Production

	Control	HFP[1]	HFP+F[2]	Total
Varieties of fruit plants grown [Median (Range)]	2 (0—8)	3 (0—7)	2 (0—7)	3 (0—8)
Mass of vegetables produced in last 2 months (kg) [$\bar{x}$±SD]	44.94±67.10	88.72 ±202.24	67.67±117.12	70.36 ±148.83
Main use of fruit produced [n(%)]**:**				
Home consumption	95 (53.1)	150 (81.1)	153 (81.4)	398 (72.1)
Sell	3 (1.7)	6 (3.2)	5 (2.7)	14 (2.5)
Give to other	0	0	0	0
No produce yet	5 (2.8)	11 (5.9)	8 (4.3)	24 (4.3)
N/A (No fruit plants)	76 (42.5)	18 (9.7)	22 (11.7)	116 (21.0)

[1]HFP=Homestead Food Production
[2]HFP+F=Homestead Food Production plus fish

Source: FOF Endline Survey Report, 2014

Table 3: Household Fish Production

	Control	HFP[1]	HFP+F[2]	Total
Currently have fish pond [n(%)]:				
Yes	40 (22.3)	61 (33.0)	185 (98.4)	286 (51.8)
If yes, number of species of small fish [Median (Range)]	0 (0—5)	0 (0—4)	1 (0—6)	0 (0—6)
If yes, number of species of large fish [Median (Range)]	0 (0—5)	0 (0—5)	1 (0—7)	0 (0—7)
Small fish harvested in last 2 months (in kg) [$\bar{x}$±SD]	0.2±1.04	0.6±2.83	2.2±3.81	1±2.96
Large fish harvested in last 2 months (in kg) [$\bar{x}$±SD]	1±3.34	2.94±8.49	12.9±16.43	5.7±12.11
Proportion (%) of small fish consumed by household [mean (range)]:				
(%) Consumed by HH	100 (50—100)	76 (10—100)	88 (0—100)	87 (0—100)
Proportion (%) of large fish consumed by household [mean (range)]:				
(%) Consumed by HH	80 (0—100)	80 (10—100)	74 (10—100)	76 (0—100)
Money earned from sale of fish in past 2 months				
Yes	6 (3.4)	8 (4.2)	55 (29.3)	69 (12.5)
No	173 (96.6)	177 (95.7)	133 (70.7)	483 (87.5)
If yes, amount (US$) [$\bar{x}$ (Range)]	0.46[a] (0-25)	1.37[a] (0-75)	13.02[b] (0-750)	5.05 (0-750)

[1]HFP=Homestead Food Production
[2]HFP+F=Homestead Food Production plus fish
[a,b] means differ significantly between values in rows not sharing a common superscript (by one-way ANOVA and Tukey's multiple comparisons)

Source: FOF Endline Survey Report, 2014