# Capital, Livelihoods, and Resilience

A Study of Farming Households in the Dry Zone of Sri Lanka

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# Preface

As my undergraduate education comes to an end, I find myself reflecting on what I have learned and wondering about next steps for my professional career. I decided to defend an Honor's Thesis because graduate school is in my future and I wanted the opportunity to pursue an independent research project before graduating college. I am proud of the outcomes of my project and I look forward to applying what I have learned during this process in future research.

Throughout my time at the University of Colorado Boulder, I developed an interest in global aid and development efforts. I am particularly interested in learning more about how people in developing countries adapt to climate variability to protect their livelihoods and to build resilient social systems. Overall, my research interests were a decisive factor when choosing a topic for my Honor's Thesis.

Through this project, I furthered my research interests by studying and applying them to a single country, Sri Lanka. Although the scope of my project was narrow, I believe my conclusions are applicable to a broader audience. Statistical analysis and interpretation, scientific writing, and GIS map-making are just some of the skills I explored during this project. My overall takeaway is the importance of surveys in informing appropriate decision making at both national and international levels.

Now that my research has been completed, I would like to acknowledge my thesis committee – Amanda Carrico, Dale Miller, and Stephanie Renfrow – for their guidance and support throughout this process. Amanda, thank you for trusting me with your personal research data and for your patience in introducing me to statistics and the art of research. The work you do is inspirational and I have become a better researcher through your mentorship. Dale, thank you for helping me stay on track with university requirements and deadlines. Stephanie, thank you for providing me with your expertise in scientific writing; your feedback was vital for the completion of this project. I would also like to extend my thanks to Phillip White for his help navigating GIS.

# **Executive Summary**

Anthropogenic climate change is transforming the natural environment, directly undermining the wellbeing of global populations and placing considerable stress on livelihood systems. In developing countries, the prominence of climate-sensitive sectors, primarily subsistence farming, promotes the conditional relationship between individual livelihoods and climate variability.

ADAPT – Sri Lanka carried out a survey (SEADS) encompassing responses from 25 different communities and 1148 households in the dry zone of Sri Lanka. The goal was to understand how farmers adjust their farming practices when they encounter challenges attributed to climate change.

Utilizing data collected from SEADS, I analyzed and interpreted the relationship between the five types of capital, adaptive behavior, and sustainable livelihood outcomes in the context of farming households located within the dry zone of Sri Lanka. I associate adaptive behavior and sustainable livelihood outcomes as components of climate resilience. Climate resilience is the end goal for Sri Lankan farmers.

My statistical analysis concluded that the prevalence of adaptive behavior and sustainable livelihood outcomes is significantly dependent on a farmer having access to diversified capital. Based on my analysis, I identified financial and social capital as key players in promoting climate resilience.

Identifying valuable forms of capital is crucial in guiding both national and international efforts to build resilient systems in the face of climate change. Based on my research, I determined that financial capital receives the majority of attention. In turn, I argue that more attention needs to be devoted to providing the conditions favorable for the creation of social capital. Social capital creates the bonds of values, norms, and institutions that are a catalyst for development. Furthermore, development will facilitate the achievement of climate resilience.

Based on my analysis and research, I recommend Sri Lankan organizations to devote more resources towards Farmer Organizations and to invest in bringing people together. According to my analysis, a farmer that is part of a Farmer Organization, is more likely to pursue adaptive behavior and in turn achieve sustainable livelihood outcomes. A greater flux of information and the creation of trust among farmers is a necessity to address the effects of climate change.

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### **1. Introduction**

Climate change is stressing global agricultural systems by reducing the availability and reliability of water. In the dry zone of Sri Lanka, monsoonal rains drive agricultural production and thus define a farmer's livelihood potential. Recent shifts in monsoon seasons and lengthened periods of drought expose the growing need of resilience to environmental changes. Furthermore, capital in all its diverse forms, plays a key role in creating climate resilience.

My research project, presented here as an Honor's Thesis for fellow Environmental Studies students at the University of Colorado Boulder, aimed to shed light on the extent to which capital promotes adaptive behavior and sustainable livelihood outcomes among Sri Lankan farming households. I view adaptive behavior and sustainable livelihood outcomes as defining characteristics of climate resilience. Using data collected during the *ADAPT – Sri Lanka* project (2015-2016), I completed a statistical analysis to address the following two research questions:

- 1. How does capital facilitate and constrain a farmer's adaptive response to climate change in the dry zone of Sri Lanka?
- 2. How do vulnerabilities in capital affect a household's ability to achieve sustainable livelihood outcomes in the face of climate change?

I divided this report into four primary sections. As a way of introduction, the Background section is comprised of key terminology, general information on Sri Lanka, and a brief description of *Adapt – Sri Lanka*. Next, Methods details the steps I took to complete my statistical analysis. Following, the Results section presents the outcome of my statistical analysis

with key findings identified. Lastly, the Discussion section contains my interpretation of what the statistical relationships mean in the context of Sri Lankan farming households.

### 2. Background

Anthropogenic climate change is transforming the natural environment, directly undermining the wellbeing of global populations and placing considerable stress on livelihood systems. Among the most notable indicators of climate change are temperature and precipitation anomalies. Current trends show that dry regions are becoming drier and wet regions are becoming wetter (Chou et al., 2013; Trenberth, 2011). Inhabitants of the dry zone, that are struggling to fulfill their basic water needs, face an imminent challenge. Because of this trend, social scientists are interested in understanding how changes in precipitation and temperature are altering livelihood outcomes.

In developing countries, the prominence of climate-sensitive sectors, primarily subsistence farming, guarantees a dependent relationship between livelihood potential and environmental conditions (Truelove, Carrico, & Thabrew, 2015). This relationship is identified in Sri Lanka. Recent records indicate that Sri Lanka experiences delayed onset and shorter rainy seasons, reduced number of rainy days per year, increased frequency of heavy rainfall events, and prolonged dry spells during rainy seasons (Ampitiyawatta & Guo, 2010). Climatic variability is of particular concern for the dry zone of Sri Lanka. While the wet zone receives rainfall from both the Maha and the Yala monsoons, the dry zone depends solely on the Maha monsoon. Significant variation can damage agricultural yields for an entire season and diminish livelihood potential. Farmers who have access to different types of capital can better adapt their farming

technique and maintain a standard of cultivation regardless of climate variation, thus creating climate resilience.

Diversity in capital provides the goods and services that define quality of life as well as vulnerability and resilience to climate change. Between the developed and developing world there is a pronounced disparity in capital (Adger et al., 2003). Additionally, geographic distribution of climate change effects disproportionately affects many low and middle income nations. As a result, people in the developing world, like Sri Lankans, bear the highest costs of climate change (Mendelsohn, Dinar, & Williams, 2006).

In this section, I define capital and sustainable livelihoods, provide background on my research site, offer a brief review of climate, agriculture, and food security in Sri Lanka, and outline the goals of *ADAPT – Sri Lanka*.

### 2.1 Capital and Sustainable Livelihoods

A livelihood is defined as having access to the "capabilities, assets, and activities necessary to attain a means of living" (Chambers & Conway, 1992). Economic welfare, nutrition, health, and happiness are just some examples of such needs. Chambers & Conway take this definition a bit further by distinguishing between a livelihood and a sustainable livelihood. Someone who has achieved a sustainable livelihood can cope and recover from shocks and stressors while maintaining and/or enhancing access to their current capabilities, assets, and activities (1992). In this report, when livelihood is discussed, I am referring to a sustainable livelihood. Furthermore, I identify a sustainable livelihood as a determinant factor of climate resilience.

For my analysis, I drew from Harvard's Humanitarian Initiative's Sustainable Livelihoods Framework to further refine the concept of a sustainable livelihood (2014). The Sustainable Livelihoods Framework identifies five components to a sustainable livelihood and illustrates their significance and the nature of their interaction. The five components are: vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies, and livelihood outcomes.

Figure 1: Fiv	e Types of Capital						
Capital	Definition						
Human	Health, nutrition, education, knowledge and skills, capacity to work, and capacity to adapt						
	Ex. A farmer's level of education and their willingness to experiment with adaptive farming measures						
Physical	Infrastructure, tools, and technology. Ex. Status of home, access to irrigation tanks, and cultivation equipment like a tractor or a water buffalo.						
Financial	Currency and Investment Ex. Wages earned from selling surplus crops or from working another job, outside farming.						
Natural	Land produce, water & aquatic resources, trees and forest products, and environmental services Ex. Rainfall or access to trees and other natural resources on a farmer's land						
Social	Networks and social connections Ex. How cohesive a community is and their willingness to support one another.						

The vulnerability context encompasses external uncontrollable factors that influence people's assets and livelihood opportunities. In Sri Lanka, natural disasters and climate trends are relevant examples. The second component, livelihood assets, refers to capital. The different types of capital are outlined in **Figure 1**. In my analysis, I categorized financial and physical capital as one because of their interdependence. The third component, transforming structures and processes, is comprised of diverse stakeholders that hold weight in decision making. Government officials, community leaders, and cultural traditions represent stakeholders in Sri Lanka. The fourth component, livelihood strategies, concerns an individual's options to pursue livelihood goals. In Sri Lanka, a farmer's willingness to experiment with adaptive measures would be considered a livelihood strategy. The fifth and final component, livelihood outcomes, addresses the attainment of a sustainable livelihood.

Overall, the Sustainable Livelihoods Framework is a great way to study Sri Lanka because it focuses solely on Sri Lankans and what they can do to attain a livelihood strategy. Currently, Sri Lankans are vulnerable to water scarcity. My research focused on how access to capital encourages adaptive behavior and secures sustainable livelihood outcomes. By understanding these relationships, I can make recommendations towards creating climate resilience.

### 2.2 Research Area – Sri Lanka

Sri Lanka is an island nation situated in the Indian Ocean, off the coast of India, with a total land area of 6.5 million hectares and a population of 21 million (World Bank, 2016). Located between 6 °- 9° latitude, the island experiences a tropical climate - hot and humid year-round with distinct wet and dry seasons. Based on annual rainfall, the island is categorized into distinct agro-ecological zones. **Figure 2** visually illustrates the three distinct zones. Locally termed, they are the dry, intermediate, and wet zones.



Figure 2: Agro-Ecological Zones in Sri Lanka

Altogether, Sri Lanka's climate is characterized by two monsoons: the Yala and the Maha. The Yala monsoon lasts from May to August and brings heavy rains to the southwestern region of the island as well as the central highlands. In this region, the monsoon period is followed by a dry season that lasts from December to March. The Maha monsoon lasts from

October to February and brings heavy rains from the Bay of Bengal to the northeast side of the island; a dry season from May to September follows this monsoon (De Silva et al., 2007). Overall, The Yala and Maha monsoons play a crucial role in Sri Lankan agriculture, as 96% of water collected during monsoons is diverted to agriculture (De Silva et al., 2007).

Agriculture places the largest stress on Sri Lanka's water resources. Rice is the staple food and more than 700,000 hectares are devoted to paddy cultivation (De Silva et al., 2007). However, the entirety of this land is not always cultivated due in large part to water shortages. This holds true primarily in the dry region, where the Maha monsoon accounts for most of the yearly average rainfall. According to a report published by the Sri Lankan government, approximately 800,000 farmers and their families depend directly on paddy (MPDI, 2003). Low precipitation and high temperature events lead to an increase in evapotranspiration, overall diminishing the water supply available for agriculture. As the prevalence of water scarcity increases, agricultural yield will become more vulnerable, thus resulting in a stressed livelihood.

Although studies tend to focus primarily on Sri Lanka's paddy production (Colombo, 1975; Herath & Ratnayake, 2004; Suppiah, 1997), there are other crops produced that constitute Sri Lanka's agricultural potential. Sri Lankan farmers cultivate coconut, tea, rubber, and a wide variety of minor crops grown specifically for export (Crop Diversification in the Asia-Pacific Region, 2001). Diversity of crop cultivation promotes resilience to climate change and is a form of adaptive behavior, but it is not widely practiced throughout the island.

### 2.2.1 Past and Present Struggles

Sri Lanka's past has not been free of struggle and with the challenges climate change is posing, the future remains uncertain. The people of Sri Lanka were at war with themselves for twenty-six years beginning July 23, 1983 and ending in May of 2009. The Sri Lankan Civil War, a military campaign was initiated by the Liberation Tigers of Tamil Eelam (LTTE) who launched an intermittent insurgency against the government. For decades, the Tamil Tigers fought to create an independent state along the dry zone in the north and east of the island – my study area. The lengthy civil war created significant challenges for the population, economy, and environment of Sri Lanka. Since the end of the war, Sri Lankans have worked towards developing sustainable livelihoods and rebuilding their country. However, climate uncertainty has made this difficult.

A prime example of the effects climatic change can have on local populations are the 2016 floods. Beginning on May 14, 2016, a low-pressure area over the Bay of Bengal carried heavy rains across the island. In a matter of days, heavy rains caused fatal floods and landslides that displaced millions of people. Locals lost their homes, crop yields, and as a result saw their livelihoods threatened.

Sri Lanka was the site selected for my research, but my conclusions are applicable to other developing nations that struggle with the effects of climate change.

# 2.3 Climate, Agriculture, and Food Security

In Sri Lanka, the principal threat to sustainable livelihood outcomes is climate change because of its conditional relationship with food security. Over a period of several decades, research conducted in Sri Lanka captured a gradual decline in average yearly precipitation and an increase in temperatures (Fernando & Chandrapala, 1992; Chandrapala, 1996; Chandrapala, 1997; Domroes, 1996). Together, these conditions pave the way for multiple monthlong droughts per year (De Silva et al., 2007; Droogers, 2004). This pattern is only expected to become more pronounced if anthropogenic climate change is not mitigated.

Sri Lankan livelihoods are closely tied to fluctuations in precipitation and temperature because of their dependence on subsistence agriculture. Climatic variation influences agriculture, in some cases restricting potential and average agricultural yields. For example, if sufficient water and nutrients are not available and if temperature exceeds a crop's optimal level, agricultural yields will decline. Because of the variability in Sri Lanka's monsoonal rains, growing seasons are shifting and in some cases cut short (Lal, 2011; Sivakumar et al., 2010). Such alterations to food cultivation create food security instability. While the term "food security" does not have a universal definition, I am defining food security based on the definition provided by the United Nations' Committee on World Food Security. Furthermore,

Food security is the condition in which all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (2012).

The relationship between climate change and food security is clearly manifested in the northern and eastern parts of the island (dry zone) where the largest percentage of the population is malnourished (Korf, 2004; Kurukulasuriya & Ajwad, 2007). Overall, food security is a determinant factor of climate resilience.

#### 2.3.1 Precipitation and Food Security

Droughts and floods are frequent hazards that influence agriculture (Eriyagama et al., 2010; Fedoroff et al., 2010; Sivakumar et al., 2005). The dry zone is the most vulnerable because it already struggles with a limited water supply.

The staple crop in Sri Lanka is paddy. Rice cultivation requires constant soil moisture and large amounts of water for a successful yield. Although traditionally grown in flooded fields, rice has been modified to grow with less than ideal amounts of water. For the dry zone, rice cultivation is only possible because of irrigation canals. Water is collected in large canals during the wet season and during the dry season the water is irrigated to different crop lands. Currently, these irrigation canals are only partially successful because of the inconsistency of precipitation levels.

At the opposite end of drought is flooding. Although a good amount of research states that an increase in rainfall will be harmful for agriculture because of flooding potential, other research concludes that increases in rainfall will be beneficial for agricultural output (Seo et al., 2005). For example, rice can withstand being submerged in water for long periods of time and still grow successfully. In the case of rice, it may even be better to have more water than less water, but current research is vague. However, it is important to mention that floods pose danger

not just to yields, but to local livelihoods because such events are fatal and can physically destroy supportive infrastructure already in place, as was the case with the 2016 floods.

The variability and unpredictability of rainfall creates large fluctuations in agricultural yields, particularly for crops that have a defined growing season, such as rice. Droughts and increased soil erosion, caused by heavy rainfall events, are likely to reduce storage capacity in irrigation canals, putting current irrigation systems at risk. Although precipitation variation is largely considered the prominent factor altering food security, temperature changes can be just as harmful.

#### 2.3.2 Temperature and Food Security

Temperature variations work along precipitation fluctuations to make the effect of climate change on food security more pronounced. First of all, higher temperatures are directly associated with higher  $CO_2$  levels. Studies suggest that elevated  $CO_2$  levels in the atmosphere will increase yields of agricultural crops, such as paddy, due to increased photosynthesis (Waggoner, 1983; Watson et al., 1998). However, more  $CO_2$  only has a positive impact to a certain level; at some point, too much  $CO_2$  creates more harm than good. Similarly, in some areas, warming may benefit the types of crops that are typically cultivated there, or allow a shift to crops that are currently grown in warmer areas. However, if higher temperatures exceed a crop's optimum temperature, yields will decline, particularly in areas where rising temperatures cause soils to become drier. For example, the maximum temperature paddy can withstand is 43° - 48° C (Sanchez et al., 2014). Any temperature higher than this will destroy the crop. Overall, as temperatures continue to increase, the benefits will be far outweighed by its limitations.

Currently, the combination of both low precipitation and high temperatures patterns is creating a climatic variation that has a negative effect on agriculture production (Caesar et al., 2011; Droogers, 2004; Seo et al., 2005). If these trends continue in the same direction, Sri Lanka's food security may be in grave danger and national livelihoods will be threatened.

#### 2.3.3 Vulnerability, Adaptation and Resilience

Climate vulnerability is the degree to which geophysical, biological, and socio-economic systems are susceptible to, or unable to cope with, adverse effects of climate change, including climate variabilities and extremes (IPCC, 2007). A key climate vulnerability is found in food supply and thus sustainable livelihoods.

When looking at the correlation between climate change and sustainable livelihood outcomes, scientists are proposing insight into what can be done to adapt and properly address it. Some proposals include raising awareness through education and outreach activities, enhancing irrigation efficiency, promoting conservation farming techniques, diversifying crop cultivation, developing drought-resistance rice, and promoting water harvesting techniques (Canziani et al., 2007; Esham & Garforth, 2013; Jayawardane, 2006). All these adaptations are meant to make Sri Lanka more climate resilient.

However, some scientists are taking a different approach. Instead of focusing on what needs to change, they focus their research on what has already been successful. For example, they are looking at the ancient small-tank irrigation system (Meinzen-Dick & Bakker, 2001; Shah et al., 2013) and trying to determine how it can be further improved to meet the growing demands of the 21<sup>st</sup> century. This irrigation system collected rainfall during each monsoon

season and diverted it to a dam via irrigation channels. From this collection site, water was then irrigated to local farms, based on need, for agriculture. This adaptation proved especially beneficial for the dry zone. Although this is an adaptation that was developed in ancient times, it may still have the potential to meet present needs.

When looking at how climate affects people's livelihood, scientists tend to focus only on food security, but there is so much more to a sustainable livelihood and although food security is important, it is not an ultimate indicator. For my study, I will delve into the different variables that influence climate resilience. Climate resilience is the ability of a system or community to survive disruption and to anticipate, adapt, and thrive in the face of environmental changes (Nelson et al., 2007). Key characteristics of resilience include flexibility, inclusiveness, learning, prevention, and management.

My study analyzes climate resilience by focusing on capital, adaptive behavior, and sustainable livelihood outcomes. Only when farmers are actively adapting to their climate vulnerability through their behavior while also managing to secure and maintain a sustainable livelihood, will they create climate resilience.

# 2.4 ADAPT - Sri Lanka

Agricultural Decision Making and Adaptation to Precipitation Trends in Sri Lanka (*ADAPT – Sri Lanka*) made my research possible by allowing me to utilize its data for my statistical analysis. *ADAPT – Sri Lanka* carried out interviews with farmers to learn about farming decisions, gather existing data on climate conditions, and establish a rich contextual understanding of the institutional processes that influence farming. Specifically, a survey

collected information about demographics, agricultural production, perceptions of environmental change, agricultural innovation, access to irrigation infrastructure, farmer training programs, and agricultural support within different communities in the dry zone of Sri Lanka. The goal of this project was to compile old and new data from multiple sources to better understand the factors that affect farming practices in the dry zone of Sri Lanka. The project was launched by researchers at Vanderbilt University, University of North Florida, and University of Colorado - Boulder (ADAPT, 2017).

#### 2.4.1 Survey Instrument

A primary component of *ADAPT – Sri Lanka* is Sri Lankan Environmental and Agricultural Decision-making Survey (SEADS). SEADS is composed of three individual surveys. The first two were conducted on the head farmer. In most cases, the head farmer was male. The third survey was carried out on the female head. Each survey took about 1.5 hours to complete. According to the project website, the goals of the survey were to:

- Document adaptive responses adopted by farmers to cope with water scarcity and examine their potential for more widespread diffusion.
- Examine individual, household, and community level factors that contribute to vulnerability or resilience in the face of water stress.
- Identify opportunities for developing or improving services that can assist farmers to cope with water stress.

 Assess the impacts of new irrigation infrastructure, policies, interventions, land use changes, and climate change on household and community agricultural productivity and socioeconomic outcomes over time (2017).

#### 2.4.2 Data Collection

SEADS data collection took place in two cohorts. Cohort 1 conducted surveys from April – May 2015. Cohort 2 from June – July 2016. Ideally, both cohorts were supposed to carry out the survey during the same months in separate years. However, during Cohort 2's scheduled time, farmers were still cultivating. Drought pushed the growing season further out into the year. This decision to change the time of the survey was made because farmers would be unable to participate during times of cultivation.

In total, 25 communities situated along the dry zone were selected to participate in the survey. Communities were represented by 30-40 households. The criteria for participation was simple. Households had to cultivate paddy and be located in the desired geographic region. **Figure 3** displays the locality of each community included in my analysis.

Figure 3: Study Sites



*SEADS* partnered with a research survey firm in Sri Lanka. Trained local interviewers – enumerators – administered surveys at each household in the respondent's primary language.

Enumerators were recruited from within 100 miles of each site. They went through extensive training, both on and off site. The final team consisted of approximately 25 people, including supervisors. Although there were both female and male enumerators, the majority were female. Females allowed more flexibility as they were widely perceived as less threatening and demonstrated skill at connection.

Upon approaching a household, enumerators asked to speak to the individual who made the majority of farming decisions (head farmer). In most cases, this individual was male; however, in a minority of households a female identified as the head farmer. The enumerator also collected select household-level information from the head female in all households.

# 3. Methods

Based on the magnitude of my dataset, responses from 1148 households, a statistical analysis was the ideal approach to interpret my data in the context of my two research questions. For organizational purposes, I divided my project into two main phases: analysis and interpretation. This section will highlight the steps I took to complete my statistical analysis.

#### 3.1 Analysis

I began the analysis phase by reviewing introductory-level terminology and concepts of statistics. *Statistics in Plain English* (Urban, 2010) proved to be a valuable resource to develop the skills necessary to proceed with my analysis. Simultaneously, I learned to use *SPSS Statistics*. My primary advisor, Amanda, recommended this software as the appropriate analytical tool for its distinction in the social sciences. At the beginning of my project, I did not

have a strong background in statistics, nor in using *SPSS Statistics*. I addressed these weaknesses by relying on the guidance offered by my advisors and online resources.

I began my analysis by studying the survey, both its content and structure. As a first step, I categorized questions based on what information they aimed to answer. Several questions seemed to regard the same aspect of the respondent's life, and so I tended to group those questions together. During this phase, I also developed categories of inputs and outputs for a series of regression models. I declared my inputs to be livelihood assets (i.e. different forms of capital) and the outputs to be livelihood outcomes (i.e. adaptive behavior, food security, economic wellbeing, health, and happiness). Through this process, I created a list of potential variables I could analyze. Livelihood assets were my independent and input variables (**Figure 4**). Sustainable livelihood outcomes were my dependent and outcome variables (**Figure 5**). At the beginning, I had too many variables selected and I was advised to be more selective. Figures 4 and 5 specify descriptive statistics from my final selections of input and outcome variables.

#### Figure 4: Descriptive Statistics of Input Variables

Figure 4: Descriptive Statistics of Input Variables					
	N	Min.	Max.	Mean	Std.
					Deviation
below secondary degree (head farmer)	1148	0.00	1.00	0.29	0.46
achieved above a secondary degree (head farmer)	1148	0.00	1.00	0.24	0.43
First generation farmer	1148	0.00	1.00	0.02	0.14
Farmer only stated occupation is farming	1148	0.00	1.00	0.47	0.50
Age_U40	1148	0.00	1.00	0.22	0.42
Age_O60	1148	0.00	1.00	0.20	0.40
Gender of head farmer	1148	0.00	1.00	0.90	0.29
Farmer's level of reliance on agricultural machinery; sum of HAC2A1-8	1148	0.00	8.00	4.74	1.08
Total paddy land holding of household (owned or rented)	1104	0.00	34.00	3.43	3.32
4.In a typical season, how many people outside of your family	1144	0.00	306.00	21.56	24.79
would you hire to work on your cultivation (paddy only FAR1B_4					
wealth index score	1148	-3.91	1.42	0.00	1.00
Environmental Vulnerability: Farmer's perception of the vulnerability of	1148	1.14	4.00	3.20	0.45
his/her yield to environmental threats (average of ENV3A1-ENV3A7)					
% of seasons in last 5 years with lower harvest due to insufficient water,	915	0.00	1.00	0.17	0.21
weighted average by plot size					
Farmer's level of participation in FO (SAT1_2; if not a FO member coded	1148	1.00	3.00	2.56	0.65
as no participation)					
Farmer's level of satisfaction with FO (avg. of SAT1_3, SAT1_4)	1057	1.00	4.00	3.34	0.65
Mean of NDP 9 2,3,4	1148	1.00	3.00	1.62	0.50
Village cohesion: average of CAP1_1, CAP1_2, CAP2_1, CAP2_2, CAP2_3	1148	1.00	4.00	3.04	0.54

# Figure 5: Descriptive Statistics of Outcome Variables

Figure 5: Descriptive Statistics of Outcome Variables					
	Ν	Min.	Max.	Mean	Std.
					Deviation
Adaptive Efficacy: Farmer's perceived ability to overcome	1148	1.40	4.00	2.95	0.46
problems in cultivation (avg of CAP5_2, CAP5_3, CAP5_4,					
CAP3_2, CAP3_4)					
Risk Taking Propensity: Farmer's willingness to take risks.	1148	0.00	4.00	1.19	0.84
(recoded items PID2A_1 - PID2A_4 as risky choice (=1) or not					
(=0). Summed all items.)					
Awareness of adaptations score. Sum of ADP_[x]_A.	1148	2.00	9.00	6.59	1.42
Innovation Adoption; The number of adaptations that the farmer	1148	0.00	7.00	3.41	1.48
has ever adopted in the past; Sum of item B; Ranges from $0 - 9$ .					
Last maha farmer cultivated OFCs in paddy land	1148	0.00	1.00	0.05	0.23
Last maha season yield (mt/ha)	1137	0.00	51.29	4.53	2.60
Health Treatment: 3.Have you or anyone in your family not	1148	0.00	1.00	0.15	0.36
received medical facilities while being ill in the last 3 years?					
1.On which step of the ladder do you feel you personally stand at	1119	1.00	10.00	5.32	1.86
this time? - head farmer					
Dietary Diversity - food groups consumed per week, weighted by	1148	21.75	104.00	59.61	16.49
nutritional value					
Farmer has some outstanding debt	1148	0.00	1.00	0.50	0.50

Narrowing my variable list was a challenging, but necessary stage of my project. I managed to successfully narrow my list of variables by running correlations and eliminating variables that were too statistically similar and/ or explained the same thing. I relied on the Pearson Correlation Coefficient to identify correlations. Once I had a smaller set of variables I started running multi-variable regressions. Running regressions allowed me to examine the nature and strength of the relationships between variables, the relative predictive power of several independent variables on a dependent variable, and the unique contribution of one or more independent variables when controlling for one or more covariates. Regression models from my analysis will be further discussed in the Results section of this report.

In this phase I also dedicated time to making my analysis more accessible. I did this by either designing tables in excel or creating maps with *GIS*. My primary advisor shared the infographics I created with Sri Lankan stakeholders during the ADAPT – Sri Lanka Symposium. Overall, the analysis phase took approximately 7 months to complete and paved the way nicely for my interpretation phase.

### 3.2 Interpretation

At the conclusion of my analysis phase, I had a list of ten outcome variables that aimed to address my two research questions. I also had an established idea of the statistical relationships between my output and input variables. As such, I started looking at the literature to determine what each statistical relationship meant for Sri Lanka. My interpretation process involved reading peer-reviewed literature as well as reports published by humanitarian and environmental organizations over the course of many years. Based on my findings, I brainstormed recommendations for Sri Lanka's efforts towards developing climate resilience. Overall, the interpretation phase is where I went back to my research questions to see if they could be answered and if so, to what degree.

# 4. Results

The results of my statistical analysis are laid out in the following two Multivariate Regression Models. After each model, I delve into a short analysis of key takeaways. In this section, looking at the appendix will be necessary to better understand the results. Following, the Discussion section will analyze and interpret the statistical relationships identified in this section.

# 4.1 Multivariate Regression Model 1

	Adaptive Efficacy		Risk Taking Propensity		Adaptation Awareness		Innovation Adoption		OFCs <sup>1</sup>	
	Beta	p	Beta	p	Beta	p	Beta	p	OR	<u>сз</u> р
Human Capital										1
Education										
Below Secondary	-0.05	0.14	0.14	0.00	-0.12	0.00	-0.12	0.00	1.13	0.74
Above Secondary	-0.06	0.13	0.07	0.08	0.01	0.88	-0.12	0.00	1.03	0.95
First Generation Farmer	0.03	0.46	0.02	0.61	0.02	0.49	0.04	0.23	0.96	0.97
Farming Only Occupation	-0.02	0.52	-0.04	0.29	0.06	0.08	0.02	0.58	1.00	1.00
Age										
Under 40	-0.03	0.48	-0.04	0.32	-0.06	0.08	-0.05	0.15	0.22	0.04
Over 60	-0.06	0.12	-0.04	0.30	0.03	0.39	0.08	0.02	1.42	0.34
Gender Male	0.07	0.06	0.10	0.00	0.05	0.13	0.04	0.19	1.89	0.40
Financial/ Physical Capital										
Reliance on Machinery	0.10	0.00	-0.09	0.02	0.04	0.28	0.14	0.00	0.96	0.80
Paddy Land Holding	0.05	0.22	-0.12	0.00	-0.10	0.01	0.08	0.05	1.07	0.13
Hired Help	0.01	0.76	0.02	0.58	0.21	0.00	0.09	0.02	1.00	0.70
Wealth Index Score	0.06	0.07	0.06	0.07	0.15	0.00	0.01	0.73	0.98	0.93
Natural Capital										
Perceived Enviro. Vulnerability	0.22	0.00	-0.12	0.00	-0.11	0.00	0.20	0.00	1.63	0.19
Insufficient Water	-0.02	0.65	0.06	0.06	0.00	0.98	0.05	0.14	3.04	0.11
Social Capital										
FO Participation	-0.06	0.09	0.05	0.17	0.06	0.07	-0.03	0.37	1.55	0.29
FO Satisfaction	0.03	0.38	0.00	0.98	0.12	0.00	0.09	0.01	1.53	0.17
Source of Expected Assistance	0.09	0.01	-0.01	0.69	0.04	0.29	0.11	0.00	0.61	0.14
Village Cohesion	-0.01	0.71	0.07	0.06	-0.03	0.39	-0.01	0.73	1.54	0.21
F/Chi-square	5.396**		4.622**		8.480**		8.104**		29.75	j
R-Squared / Nagelkerke R-squared	0.10		0.09		0.15		0.14		0.10	
Ν	1148		1148		1148		1148		1148	
a. Robust standard errors ^p<.10, *p<.05, **p<.01										

<sup>1</sup>Logistic regression model

# 4.1.1 Model 1 Key Takeaways

Model 1 is a regression table that outlines the statistical relationship between Adaptive

Efficacy, Risk Taking Propensity, Adaptation Awareness, Innovation Adoption, and OFC's in

relation to independent variables that represent the different forms of capital.

The first dependent variable I looked at was Adaptive Efficacy. This variable was measured in a scale of 1 to 4 with a mean of 2.95. This variable had a significant (p-value<.01) relationship with *Perceived Environmental Vulnerability, Reliance on Machinery*, and *Community Disaster Assistance*. For these variables, the Beta coefficients were positive, signifying a positive relationship between them and adaptive efficacy. Together, all independent variables statistically explained 10% of a farmer's adaptive efficacy (R-squared = 0.10).

The second dependent variable I looked at was Risk Taking Propensity. This variable was measured on a scale from 1 to 4 with a mean of 1.19. It had a significant (p-value <.05) and positive (Beta > 0) relationship with *Below Secondary Education* and *Gender Male*. Additionally, it had a significant, yet negative (Beta < 0) relationship with *Reliance on Machinery*, *Paddy Land Holding*, and *Perceived Environmental Vulnerability*. Statistically, the independent variables explained 9% of a farmer's risk taking propensity (R-squared = 0.09).

The third dependent variable I looked at to study a farmer's ability to adapt was Adaptation Awareness. This variable ranged from 2 - 9 with a mean of 6.6. Adaptation awareness had a significant (p-value <.05) and positive (Beta > 0) relationship with *Hired Help*, *Wealth Index Score*, and *FO satisfaction*. Additionally, it had a significant (p-value <.05) and negative (Beta < 0) relationship with *Below Secondary Education*, *Perceived Environmental Vulnerability*, and *Paddy Land Holding*. Statistically speaking, independent variables explained 15% of a farmer's adaptation awareness (R-squared = 0.15).

The fourth variable I looked at was Innovation Adoption. This variable ranged from 0 - 9 with a mean of 3.41. Innovation adoption had a significant (p-value <.05) and positive (Beta > 0)

relationship with Perceived Environmental Vulnerability, Reliance on Machinery, Source of Expected Assistance, FO Satisfaction, Hired Help, and Paddy Land Holding. Yet, it had a significant (p-value <.05), but negative (Beta < 0) relationship with any level of education. Overall, all independent variables explained 14% of innovation adoption by farmers (R-squared = 0.14).

The fifth and final dependent variable I looked at was *OFCs*. The only variable that it had a significant (p-value <.05) relationship with was *Age* and it was positive (Beta > 0). Independent variables explained 10% of OFCs utilization (R-squared = 0.10).

# 4.2 Multivariate Regression Model 2

	Maha Vield		No Medical		Position on		Dietary		Daht	
	Reta n		Beta n		Beta n		Beta n		Beta n	
Human Capital	Deta	P	Deta	<u>P</u>	Deta	<u>P</u>	Deta	<u>P</u>	Deta	P
Education										
Below Secondary	-0.03	0.49	-0.09	0.02	-0.08	0.04	-0.04	0.27	-0.15	0.00
Above Secondary	-0.05	0.23	-0.05	0.15	0.00	0.94	0.00	0.92	0.03	0.42
First Generation Farmer	0.01	0.88	-0.04	0.27	0.02	0.50	0.08	0.02	0.03	0.43
Farming Only Occupation	-0.01	0.85	0.02	0.64	0.05	0.16	-0.10	0.00	-0.07	0.04
Age										
Under 40	0.04	0.28	-0.02	0.55	0.01	0.76	-0.01	0.70	-0.01	0.87
Over 60	-0.03	0.36	0.01	0.89	0.01	0.76	-0.04	0.23	-0.15	0.00
Gender Male	0.03	0.39	-0.03	0.46	0.05	0.18	-0.05	0.17	0.01	0.71
Financial/ Physical Capital										
Reliance on Machinery	0.14	0.00	-0.01	0.88	0.02	0.67	0.00	0.97	0.09	0.01
Paddy Land Holding	-0.12	0.00	0.08	0.03	0.12	0.00	0.09	0.01	0.01	0.82
Hired Help	0.13	0.00	-0.06	0.14	0.00	0.99	0.10	0.01	0.07	0.09
Wealth Index Score	0.09	0.02	-0.20	0.00	0.20	0.00	0.21	0.00	-0.01	0.85
Natural Capital										
Perceived Enviro. Vulnerability	0.06	0.10	0.21	0.00	0.10	0.01	0.11	0.00	-0.07	0.05
Insufficient Water	-0.02	0.51	0.14	0.00	0.06	0.08	0.10	0.00	0.10	0.01
Social Capital										
FO Participation	0.09	0.02	-0.01	0.89	-0.06	0.10	0.09	0.01	0.00	0.99
FO Satisfaction	0.03	0.41	-0.04	0.23	0.07	0.05	0.03	0.39	0.00	0.96
Community Disaster Assistance	0.02	0.50	-0.08	0.02	0.02	0.66	-0.10	0.00	-0.08	0.03
Village Cohesion	0.07	0.05	-0.03	0.35	0.03	0.38	0.04	0.27	-0.05	0.18
	2 0.02	)**	7.02(**		C 11C**		0.412**		5 222**	
F/Cni-square	5.964	2	0.14	/.936**		5.115**		8.413**		
R-Squared / Nagelkerke R-squared	0.08		0.14		0.10		0.15		0.10	
N	1137		1148		1119		1148		1148	
a. Robust standard errors										
^p<.10, *p<.05, **p<.01										
<sup>1</sup> Logistic regression model										

# 4.2.1 Model 2 Key Takeaways

Model 2 is a regression table that outlines the statistical relationship between Maha Yield, No Medical Attention, Position on Ladder, Dietary Diversity, and Debt in relation to independent variables that represent the different forms of appital

variables that represent the different forms of capital.

In this model, the first outcome variable I looked at was Maha Yield. This variable was measured in metric tons per hectare and ranged from 0 to 52 with a mean of 4.53. Higher Maha yields were significantly (p-value <.05) and positively (Beta > 0) correlated with *Reliance on Machinery*, *Hired Help*, *Wealth Index Score*, *FO Participation*. On the other hand, higher Maha yields were significantly (p-value <.05), and negatively (Beta < 0) correlated with *Paddy Land Holding*. Independent variables statistically explained 8% of Maha Yields (R-squared = 0.08).

The second outcome variable I looked at was No Medical Attention. This variable ranged from 0 to 1 (Yes or No) and had a mean of 0.15. It was significantly (p-value <.05) and positively (Beta < 0) correlated with *Perceived Environmental Vulnerability, Insufficient Water*, and *Paddy Land Holding*. Contrary to this, not receiving medical attention was significantly (p-value <.05), but negatively (Beta < 0) correlated with *Wealth Index Score*, *Secondary Education*, and *Community Disaster Assistance*. Overall, independent variables statistically explained 14% of No Medical Attention (R-squared = 0.14).

Another outcome variable I looked at was Position on Ladder. This variable ranged from 1 to 10 with a mean of 5.32. Where a farmer stood on the ladder was significantly (p-value <.05) and positively (Beta > 0) correlated with *Wealth Index Score*, *Paddy Land Holding*, *Perceived Environmental Vulnerability*, and *FO Satisfaction*. Yet, it was significantly (p-value <.05) and negatively (Beta < 0) correlated to having a *Below Secondary Education*. Statistically speaking, the independent variables selected explained 10% of Position on Ladder (R-squared = 0.10)

The fourth outcome variable I looked at was Dietary Diversity. This variable ranged from 21 to 104 with a mean of 60. It had a significant (p-value <.05), and positive (Beta > 0)

relationship with *Wealth Index Score*, *Perceived Environmental Vulnerability*, *Hired Help*, *Insufficient Water*, *Paddy Land Holding*, *FO Participation*, and being a *First-Generation Farmer*. However, it is significantly (p-value <.05) and negatively (Beta < 0) related to *Farming Being Only Occupation* and *Community Disaster Assistance*. Statistically, the independent variables in this model explained 15% of Dietary Diversity (R-squared = 0.15).

The fifth and final outcome variable I looked at in this model was Debt. This variable ranged from 0 - 1 (Yes or No) and had a mean of .50. Debt was significantly (p-value <.05), and positively (Beta > 0) correlated with *Reliance on Machinery* and *Insufficient Water*. However, it was significantly (p-value <.05) yet negatively (Beta < 0) correlated with *Below Secondary Education*, *Farming Only Stated Occupation*, *Older than 60*, *Perceived Environmental Vulnerability*, and *Community Disaster Assistance*. Overall, independent variables explained 10% of Debt (R-squared = 0.10).

# 5. Discussion

Access to diverse forms of capital influences adaptive behavior and sustainable livelihood outcomes among Sri Lankan farming households. In this section, I interpret the statistical relationships identified in my Multivariate Regression Models and offer possible explanations for each relationship. Furthermore, I place my analysis in the context of climate resilience throughout the dry zone of Sri Lanka.

### 5.1 Participant Demographics

My interpretation of the data was guided primarily by participant demographics. In social research, it is important to acknowledge demographics of a sample in order to make findings

relevant and useful. SEADS collected data on participant's (head farmer and head female) age, gender, religion, ethnicity, farming background, and on their seasons of cultivation. The breakdown of these demographics is visually represented in **Figure 6**. Overall, considering demographics in my analysis allowed me to better relate my findings to Sri Lankan farming households located in the dry zone of the country.





# 5.2 Research Question 1: Capital and Adaptation

The first goal of my statistical analysis was to shed light on the relationship between capital and adaptation. Specifically, I wanted to identify how having access to the different types of capital influenced adaptive behavior among farmers. Five dependent variables, discussed in the following subsections, were analyzed to represent a farmer's adaptability to climate change. This section breaks down my analysis from Multivariate Regression Model 1.

#### 5.2.1 Adaptive Efficacy

The first outcome variable I looked at was Adaptive Efficacy. Adaptive Efficacy refers to a farmer's perceived ability to overcome problems in cultivation. Overall, the data is showing that an increase in natural, financial/ physical, and social capital increases a farmer's adaptive efficacy. On the other hand, human capital does not seem to have an influence.

The predictor variable used to represent natural capital is *Perceived Environmental Vulnerability*. Perceived Environmental Vulnerability refers to a farmer's perception of their yield's vulnerability to environmental threats. This variable was categorized as part of natural capital because a farmer's environmental vulnerability is closely tied to the availability of natural resources. For example, as actual rainfall conflicts with expected rainfall, a farmer may feel that his yield is threatened by a lack of water and will seek an alternative way to secure enough water for his cultivation. As a farmer becomes more aware of changing environmental conditions, his natural capital increases. Data from my analysis shows that as a farmer feels more vulnerable, their adaptive efficacy increases. An explanation for this relationship can be that a farmer who feels especially vulnerable is more likely to seek help or information to decrease his or her

vulnerability. By becoming more informed, and therefore more prepared, a farmer can foresee challenges and address them early on, thus building his adaptive efficacy.

*Reliance on Machinery* is indicative of financial/ physical capital and refers to the diversity of equipment a farmer held. Potential examples include a tractor, sprayer, water pump, combine harvester, and water buffalo. In Sri Lanka, having access to such equipment is a symbol of economic wealth. Farmers that have access to a diverse range of machinery and infrastructure are better able to adapt to climate challenges. For example, a water pump can be especially helpful when there is little rainfall and water must be irrigated from a far distance. In this scenario, farmers with access to established irrigation infrastructure would be better able to adapt to drought than those who do not. As such, adaptive efficacy will be higher for farmers with irrigation, since they know they can address the challenges of a water shortage with their financial/physical capital.

Social capital is measured by the strength of social institutions and community dynamics that increase reciprocity, trust, and cooperation within a society. In this model, the predictor variable representing social capital is *Community Disaster Assistance*. This variable is indicative of farmers who when disaster strikes, expect assistance from community-level stakeholders. When farmers expect assistance from fellow community members during times of extreme vulnerability, insight is provided as to how strong social bonds are. With this variable, I assume that farmers who have received aid in the past from community stakeholders, have positively benefited from such aid. An increase in a farmer's reliance on community stakeholders to offer support during disasters, increases their adaptive efficacy, because it assures farmers that they are not alone in dealing with challenges thrown their way. Aid provided at the community level

is more appropriate because it better understands the needs of locals and is overall better suited to handle local challenges. Overall, it can be said, that social capital creates hope.

Human capital seemed to have no statistically significant relationship with Adaptive Efficacy. This may be because regardless of education, farming background, age, and/or gender, a head-farmer could still find resources that allow them to feel less vulnerable and better prepared to address the challenges climate change creates.

#### 5.2.2 Risk Taking Propensity

To address adaptive behavior, I also analyzed Risk Taking Propensity. Risk Taking Propensity refers to a farmer's willingness to take risks. Overall, the data is showing that Risk Taking Propensity increases with human capital, but decreases when financial/ physical and natural capital increases.

First, let's look at the positive relationships. Based on the findings from Model 1, if the head-farmer is male and has a below-secondary education, then they are more willing to take risks in farming. Both gender and education represent a farmer's human capital, leading me to conclude that the willingness to take risks is overall highly dependent on human capital. A broader explanation for this relationship can be that a lower education allows farmers to be more open-minded and employ riskier adaptations. This is almost counter-intuitive to what we would assume. My original thought was that more education would encourage a farmer to try new and often riskier adaptations because they would be introduced to a wider range of possibilities through formal education. However, based on the data, a higher education prevents riskier adaptation measures which are sometimes necessary to address climate change. This may be
attributed to the fact that educated farmers have a larger scope of what can go wrong. On the other hand, farmers with little to no education execute riskier adaptations. For example, if an NGO tells an uneducated farmer that a risky adaptation is going to benefit them, the farmer may take the information at face value and make the change because they have little access to contradictory information.

When it comes to gender, male farmers dominate the industry in Sri Lanka. Thus, they are empowered by numbers and have less judgement posed upon them when they go against the traditional norms or when risks backfire. My statistical analysis does not delve into gender, but predefined gender roles may be highly influential in determining a head farmer's ability to pursue adaptive behavior.

On the other hand, as Reliance on Machinery, Paddy Land Holding, and Perceived Environmental Vulnerability increases, Risk Taking Propensity decreases. High reliance on machinery and large paddy land holdings are both examples of financial/physical capital. A hypothesis for this relationship can be that if a farmer has good equipment and a large cultivation, they simply do not have the need to make risky choices, since they have a substantial buffer. Additionally, as Perceived Environmental Vulnerability increases, risk taking propensity seems to move in the opposite direction and decrease. An explanation for this may be that a farmer that already feels vulnerable may not be willing to risk much if there is a small chance of becoming even more vulnerable.

Lastly, Risk Taking Propensity did not have any statistically significant relationship with social capital. An explanation for this may be that social relationships both encourage and

prevent risky cultivation practices. This variable may also be more applicable at the community level. For example, in some communities, the average Risk Taking Propensity may be higher, while in others it may be low or nonexistent. In this case, culture may be a more accurate determinant.

### 5.2.3 Adaptation Awareness

The third variable I looked at to study a farmer's ability and willingness to seek adaptive behavior was *Adaptation Awareness*. Adaptation Awareness refers to how aware a farmer is of adaptive cultivation practices. Overall, the data is showing that Adaptation Awareness increases with financial and social capital, but also decreases with human, natural, and to an extent financial capital.

First let's address financial capital since it creates a tricky scenario for analyzing this outcome variable. *Hired Help*, *Wealth Index Score*, and *Paddy Land Holding* are all indicative of financial capital. The latter variable is statistically less significant than the first two. Adaptation Awareness increases with a higher number of employees and a higher wealth index score. However, it decreases when a farmer has more acres of land. A reason for this may be that a farmer, who is wealthy, is exposed to a larger range of adaptations. This may be due to the diverse background of farming technique among employees that expose the head farmer to new adaptations. Additionally, a farmer may actively seek to learn more about adaptation practices that make his farming more resilient. Regarding land holding, if a farmer has a vast expanse of land, it might just be too hard or even impossible to try and apply adaptive behavior so the farmer will stop seeking information on different farming adaptations.

Adaptation Awareness also increases with social capital. The variable used to look at social capital was *FO Satisfaction*. "FO" stands for farmer organizations meetings. Through FOs, farmers remain informed of diverse adaptations that they can employ in their farming and participate in many FO activities that aim to increase climate resilience. Those satisfied with FOs were likely more involved and thus received more from their participation. In conclusion, it can be assumed that participating in FOs proves beneficial for promoting adaption to climate change among Sri Lankan farmers.

On the contrary, Adaptation Awareness decreased with increases in human and natural capital. A variable suggestive of human capital was *Below Secondary Education*. Farmers with a minimal education were less likely than their counterparts with a higher education to be aware of adaptations. The variable representative of natural capital was *Perceived Environmental Vulnerability*. A farmer who is not aware of many adaptations, may feel that his individual vulnerability is high.

Overall, being aware of adaptations is extremely important in order to encourage adaptive behavior among farmers. Financial/physical and social capital were the largest determinants.

### 5.2.4 Innovation Adoption

The fourth outcome variable I looked at was Innovation Adoption. Innovation Adoption refers to the number of adaptations that a farmer has adopted in the past. On average, a farmer attempted 3 - 4 adaptations. This is not great, but it is a definite starting point. Innovation Adoption increased with access to financial, natural, and social capital.

Variables indicative of financial capital were *Reliance on Machinery*, *Hired Help*, and *Paddy Land Holding*. Financial capital encourages the adoption of innovations by creating buffers that allow the farmer to not bear heavy costs if things do not go as planned. The adoption of infrastructure, particularly farming equipment, makes it easier for farmers to implement innovations with very few changes to farming technique. Similarly, having many employees allows a farmer to disperse work necessary for innovation, so changes are implemented more effectively by completely utilizing the skill of each individual employee. Additionally, a large land holding may allow a farmer the flexibility to adopt innovations on a portion of his land. If for some reason an innovation does not work well, the farmer does not lose too much since it is a small percentage of their entire cultivation.

Natural and social capital also influenced innovation adoption, but to a lesser degree. Natural capital was represented by *Perceived Environmental Vulnerability*. As a farmer's perception of their vulnerability increases, he or she might adopt innovations as a coping mechanism. Variables indicative of social capital were *Source of Expected Assistance* and *FO Satisfaction*. Through FOs, farmers learn about innovations. Thus, FO satisfaction may regard a farmer's success in learning and adopting innovations they were exposed to through their participation. Additionally, a farmer that participates in FOs, feels a greater sense of community, in which they can depend on in times of need.

Overall, for innovation adoption, the most indicative resource was financial capital. In Sri Lanka, wealthier farmers are adopting more innovations because they have buffers in place to shield them from problems, should they arise.

### 5.2.5 OFCs

The fifth and final outcome variable I looked at to gain a better understanding of adaptation was *OFCs*. OFCs stands for "other field crops." A goal of OFCs is to increase economic efficiency of water through crop diversification. This can be an adaptation in itself when water availability is particularly low as it is during the Yala season.

The usage of OFCs was dependent on human capital. Younger farmers, under 40, tended to utilize OFCs in comparison to their counterparts who were over 60. The reason behind this pattern may be that older farmers are more set in their ways and are not likely to derail from them. On the other hand, younger farmers may be more open-minded and willing to experiment and learn from different NGO's and research groups.

### 5.2.6 Conclusions of Research Question 1

Based on Model 1, financial/ physical and social capital seem to be the largest contributors to promoting adaptive behavior among Sri Lankan farmers. Both financial and social capital create buffers that prevent a farmer from experiencing the shortcomings associated with trying something new or different from the established norm. Thus, a farmer that has large quantities of financial/ physical and social capital will be better able to develop climate resilience and address the challenges associated with climate change.

### 5.3 Research Question 2: Capital and Sustainable Livelihood Outcomes

The second goal of my statistical analysis was to shed light on the relationship between capital and sustainable livelihood outcomes. Through my analysis, I wanted to understand how capital contributed to a farmer securing outcomes that promoted a sustainable livelihood. My

analysis draws from Multivariate Regression Model 2, displayed in the Results section of this document. The four sustainable livelihood outcomes I studied are economic welfare, nutrition, health, and happiness.

### 5.3.1 Economic Welfare

An important outcome of a sustainable livelihood is economic welfare. To analyze economic welfare, I looked at two outcome variables: Maha Yields and Debt. Higher Maha yields supports economic welfare, but debt completely deteriorates it. In Sri Lanka, yields are the largest contributor to financial capital and allow for the purchase or exchange of goods necessary to ensure a sustainable livelihood. However, when a farmer has large amounts of debt, he or she becomes trapped in a poverty trap. A poverty trap is simply an economic system that makes it exceedingly hard for people to escape poverty. By making payments towards his pervious debt, a farmer is not fulfilling his basic needs of the present and thus the likelihood of him borrowing even more in the future increases significantly. Through this cycle, a farmer's economic welfare will always be at risk. For the best economic welfare, a farmer should have higher Maha yields and very little debt. During the Maha season is when farmers in the dry zone of Sri Lanka receive the most rainfall and thus cultivate the most. For this study, it is important to note that having a Maha cultivation was a requirement for participating in SEADS.

Overall, Maha yields were dependent on financial and social capital. *Reliance on Machinery*, *Hired Help*, *Wealth Index Score*, and *FO Participation* were all important determinates of how great a growing season would be. Financial capital encompasses machinery and farming hands. Large dependence on farming equipment and a large pool of helpers allows a farmer to use resources efficiently and maximize output per hectare of cultivated land.

Additionally, participating in farmer organizations provides farmers with information on what to do or not to do to maximize yields.

A second output variable looked at to provide insight into economic welfare was *Debt*. Debt was dependent on financial and natural capital. Farmers that relied heavily on machinery incurred the most debt. This may be due to the fact that farmers are willing to accrue debt to purchase machinery with the purpose or hope that such choice will increase overall yields, allowing them to pay back the debt. Additionally, natural capital was also a factor into how much debt a farmer had. Model 2 illustrates that a farmer who saw his cultivation fail because of insufficient water had debt. Since the farmer in this scenario lost a portion of his livelihood, he had no choice but to accrue debt in order to continue meeting his basic human needs.

Additionally, it is interesting to note that Maha yields decreased in larger farms. This explains a key problem for many farmers. In Sri Lanka, most farmers do not cultivate all available land because it is either impossible or economically unviable.

To ensure economic welfare, farmers must be vigilant on to how much debt they take on, since too much may trap them in a poverty trap and completely decimate any chance of attaining a sustainable livelihood.

### 5.3.2 Nutrition

Equally important to economic welfare is nutrition. In Sri Lanka, most farmers are subsistence farmers. This means that the entirety of their nutrition depends mainly on what they cultivate or what they can get in exchange for their cultivated goods. The outcome variable used to provide insight into nutrition was Dietary Diversity. This variable was created by calculating food groups produced per week, weighted by nutritional value. The food groups asked about are as follows: rice, grains, bread and starchy staples, tubers, vegetables, fruits, cooking oils/ fats, dairy, and meat protein.

Generally speaking, Dietary Diversity was dependent on all forms of capital. Input variables indicative of financial capital were *Wealth Index Score*, *Hired Help*, and *Paddy Land Holding*. If a farmer has a high yield, they will have enough food to consume as well as a surplus to trade for more luxuries foods, thus increasing their dietary diversity. On the other hand, farmers with poor yields will sustain themselves on what they grow and/ or cheap alternatives that they can afford. This does not contribute to a lot of diversity in diet, thus leading to malnutrition. Like discussed previously, these same input variables also contribute to economic welfare. As such, I can conclude that economic welfare is a big determinant of a farmer's nutrition.

Next, let's take a look at natural capital. *Perceived Environmental Vulnerability* and *Insufficient Water* were indicative of natural capital. A farmer who was aware of his vulnerability to climatic variations and/ or had lost a harvest in the last four years to lack of water seemed to have a higher Dietary Diversity. A potential explanation for this is that the farmer may have sought assistance and adapted to address his growing limitation of natural capital.

Additional, participating in farmer organizations was shown to increase a farmer's Dietary Diversity. *FO Participation* was indicative of social capital. An explanation for this may be that individual farmers participating in FOs have a greater likelihood of helping each other in times of need. Aid can come in the form of trading goods or even sharing effective techniques

for maximizing yield. When there is social capital, specifically *FO Participation*, economic welfare also seems to increase.

Finally, human capital also seemed to influence Dietary Diversity. The variable indicative of human capital was being a *First-Generation Farmer*. First-generation farmers are new to the farming field, so they do not have much background in traditional farming techniques. As such, they may adopt new techniques that maximize yields, thus increasing their overall diet diversity.

Overall, the relationship between economic welfare and nutrition is obvious. To ensure the proper nutrition, a farmer needs good economic welfare. As established earlier, economic welfare is dependent on financial and social capital. As such, I reach the same conclusion with nutrition. Financial and social capital are the most important types of capital to ensure proper nutrition among households in the dry zone of Sri Lanka.

### 5.3.3 Health

Health is a major component of a sustainable livelihood. The outcome variable used to delve into this was *No Medical Attention*. Households were asked if anyone in the past three years had not received medical attention while being ill. 15% of the sample reported that this was indeed the case. Model 2 indicates that not receiving necessary medical attention was influenced by natural and financial capital.

Conclusively, farmers that felt especially vulnerable due to environmental change or who had lost a harvest due to insufficient water in the last five years were the ones more likely not to seek medical aid. This is probably due to the high costs associated with health care in Sri Lanka. A minimal percentage of farmers who participated in this survey had health insurance. Farmers who are struggling to feed their families, will not prioritize their health during times of hardship.

Generally, households with a high *Wealth Index Score* did not face this struggle. However, an interesting relationship did come up when looking at financial capital. The data is showing that as a farmer's paddy land holding increases (financial capital), they or a member of their family is less likely to receive medical attention when they need it. This is counterintuitive since thus far we have categorized land ownership as financial wealth. A possible explanation may be due to culture. A farmer may resort to more traditional medicine like spiritual healers or herbal medications that can be found/ grown in their land.

Overall, health among Sri Lankan farming households was highly dependent on natural and financial capital.

### 5.3.4 Happiness

Along with health, happiness is an equally important outcome when insuring a sustainable livelihood outcome. Happiness may even be considered an extension of health since a person's happiness contributes largely to their mental health. Farmers in the study were asked to place themselves on a happiness ladder. Placing themselves at the bottom step (1) meant a farmer was unhappy with their life. Placing oneself at the top-most step (10) meant that the farmer was the happiest imaginable. The majority of famers placed themselves around the middle (5). Since a large portion of the sample was Buddhist, faith can be a reason for this explanation. Part of Buddhist doctrine is acknowledging that no one's life is or will be perfect.

Where a farmer stood on the ladder was dependent on financial, natural, and social capital. Financial capital was analyzed by looking at *Wealth Index Score* and *Paddy Land Holding*. Farmers who were financially stable and had large expanses of land tended to be on the higher step of the ladder. Natural capital was measured by looking at *Perceived Environmental Vulnerability*. This is an interesting relationship. The data is showing that farmers who feel more vulnerable tend to be happier. This too is counterintuitive. An explanation for this relationship can also be religion. A prime doctrine of Buddhist religion is that all life is suffering. Perhaps farmer that feel the most vulnerable are more in tune with their religion.

Finally, social capital also showed an influence on happiness. Social capital was studied by looking at *FO Satisfaction*. Farmers who were socially active, be that through farmer organizations, tended to be happy/ live happier lives. This may be due to general human nature which craves emotional relationships.

Overall, happiness was dependent on financial, natural, and social capital. As such, it can be concluded that in order to ensure happiness a farmer must have access to a diversity of capital.

### 5.3.5 Conclusions for Research Question 2

Based on the significance of relationships outlined in Multivariate Regression Model 2, sustainable livelihood outcomes are largely dependent on financial/ physical capital. Additionally, it seems that the livelihood outcomes of nutrition, health, and happiness are dependent on each other. I reach this conclusion based on each outcome variable sharing significance with the same input variables representing the different types of capital.

### 6. Recommendations

Financial/ physical and social capital were the most significant determinants of adaptive behavior and sustainable livelihood outcomes among farming households in the dry zone of Sri Lanka. Financial capital is an observable conclusion. However, the role of social capital often goes unnoticed. Research is finding that social capital gives rise to financial capital and economic development (Woolcock & Narayan, 2000). Additionally, it plays a prominent role in promoting sustainable livelihoods. A recent study found that the factors that best prescribe people's perceptions of livelihood recovery are formal networks in the community as well as leadership and trust of community-based organizations (Minamoto, 2010). Most national and international aid groups focus on creating financial capital by trying to increase yields and savings, but the creation of social capital may require even less resources and be just as valuable.

Sri Lanka is still recovering from the impacts of its recent civil war, so social capital may not be at its peak simply because the legacy war leaves behind tends to be extensive. Also, those impacted the most by the war were people in the dry zone, my study group. As such, a different approach to social capital may be necessary. Research indicates that rather than focusing on engineering social capital, external agencies need to focus on better understanding the preconditions for social capital formation and how they can contribute to the creation of an enabling environment (Uphoff & Wijayaratna, 2000). Through my study, I reach a similar conclusion. Organizations should focus on creating conditions that contribute to the formation of social capital, rather than focusing on creating social capital itself.

In Sri Lanka, some ways to create conditions for social capital growth may be through the creation of weekly communal events and/ or large celebrations for national holidays. Social

events like these recommended do have costs associated with them, but it would be a worthwhile investment by aid organizations, governments, and community leaders hoping to increase social capital. Something that seems to already work very well is participation in Farmer Organizations. To increase participation, community leaders need to devise ways that further incentivize diverse participation in FOs. Organizations should seek members from different demographics in order to create a greater sense of community engagement. The creation of social capital will create bonds of shared values, norms, and institutions that are a catalyst for development. Overall, the level of development a country experiences is the best indicator of climate resilience that will be achieved.

### 7. Limitations

An identified limitation of this project regards SEADS. SEADS was not specifically designed to address or collect information on all forms of capital equally and thoroughly. As a result, some types of capital were better represented by questions asked than others. Such discrepancy, prevented me from executing a more holistic and extensive analysis of how capital manifests in Sri Lankan farming households and communities.

### 8. Significance and Further Research

Throughout this research project, a primary focus was the simplification and visualization of my dataset. My dataset is large and extensive. As such, the only way to make it meaningful and useful is by simplifying and increasing accessibility. The infographics I created during this project were distributed to Sri Lankan stakeholders in August of 2017 and will be used to aid

climate resilience efforts throughout the island. Furthermore, I am beginning the process of publishing the findings of my statistical analysis.

Although my research was extensive, I did not accomplish everything I set out to accomplish. This project included data collected from 25 communities in the dry zone of Sri Lanka. Due to time constraints of my project, community-level adaptive behavior and sustainable livelihood outcomes were not studied. For future research, it would be interesting to study how these aspects of climate resilience manifest and vary among communities.

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### Appendices

Appendix 1: SEADS Surveys

### SRI LANKA ENVIRONMENTAL AND AGRICULTURAL DECISION-MAKING SURVEY—HOUSEHOLD QUESTIONNAIRE (SEADS-HH)

### Head Farmer, Day 1 Module

The SEADS survey project include household (SEADS-HH) and community (SEADS-C) questionnaires. The SEADS is a component of the ADAPT-SL project (<u>https://my.vanderbilt.edu/srilankaproject/</u>), a collaboration between Vanderbilt University (USA) and the National Building Research Organization (Sri Lanka) (affiliated to the Ministry of Disaster Management). The ADAPT-SL project is funded by the US National Science Foundation.

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### Please direct all questions about the use or development of SEADS-HH instrument to: Heather Barnes Truelove, PhD, Department of Psychology, University of North Florida, <u>h.truelove@unf.edu</u>. Formatting

1.	District						
2.	DS division						
3.	GN Name and code	a) Nam	ne			b) ID	
4.	Village Name and ID #	a) Nam	ne			b) ID	
5.	Sampling Frame List ID (1 – 400)						
6.	Selected Farmer's ID (1 – 35, 40, 60, 80)						
7.	Person name in the sample list						
8.	Name of head farmer of the household interviewed	<b>1 = Same</b> If diffe	e as pers rent the	<b>on on list</b> name	2 = Other fa	mily member	
9.	1 <sup>st</sup> session : Date and time:	MM:	DD	From	То	1 AC	2 BC
10.	2 <sup>nd</sup> session : Date and time:	MM:	DD	From	То	1 AC	2 BC
11.	3 <sup>rd</sup> session : Date and time:	MM:	DD	From	То	1 AC	2 BC
12.	Interviewer Name & Code						
13.	Supervisor Name & Code						

Table Concerns 1: Major challenges         What do you consider to be biggest challenges to your family's well-being? Please consider the farming challenge s well as other family challenges.         Instructions: Record up to 5 major challenges as in the same order that the farmer claimed.	Rate after the first day's interview in order of their importance 1= most important 5= least important
1.	
2.	
3.	
4.	
5.	

I am going to read out some farming equipment which are used in farming. Can you please tell me if they are used in the farming activities of your family?

Tabl	e HAC2: Farm Assets and Equipme	ent	
Insti	ructions: Record whether the hous	ehold use each item, for agricultural p	urposes only. If yes,
indi	cate whether the item is owned, rer	nted, borrowed (used at no cost), or ot	her.
	Equipment	Is used by famer?	How?
		(a)	(b)
1	Tractor (Hand Tractor/Two wheel)	Yes1	Owns1
	<h></h>	No2 -> next row	Rents2
			Borrows3
			Other4
2	Tractor (Four wheel) <h></h>	Yes1	Owns1
		No2 -> next row	Rents2
			Borrows3
			Other4
3	Sprayer <h></h>	Yes1	Owns1
		No2 -> next row	Rents2
			Borrows3
			Other4
4	Water Pump (for farm use) <h></h>	Yes1	Owns1
		No2 -> next row	Rents2
			Borrows3
			Other4
5	Combine harvester- Ghost	Yes1	Owns1
		No2 -> next row	Rents2
			Borrows
_	<u> </u>		Other4
6	Combine harvester- I sunami	Yes1	Owns1
		No2 -> next row	Rents2
			Borrows
7		Mar A	Otner4
1	Thresher (AgroTec) <h></h>	Yes1	Owns1
		NO2 -> next row	Rents2
			Dollows
0	Combine hervester Other	Voc 1	Ourier4
0	Combine harvester- Other		Dwils
		NO	Refits2
			Othor 4
۵	Buffalo	Ves 1	
3	Bullaio	No $2 \rightarrow \text{next row}$	Rents 2
		NOZ -> NEXTION	Rorrows 3
			Other 4
10	Do you use traditional equipment	Yes 1	
10	(e.g. scythe tiller hoe)	No 2	
11	Do you have a space to store	Yes, inside house. 1 -> Next table	Owns 1
	vour harvest?	Yes, outside house $2 \rightarrow (b)$	Rents 2
	,	No	Borrows
			Other

SEADS-HH

Table LAN 1: Agricultural Land Tenure Ask about any agricultural land held by the household. Land that is 'held' includes any land that is owned, rented, borrowed, or informally occupied, including Bethma lands cultivated in the last seasons or more frequent basis, and put the name as "Bethma land".

Shara Co Co <b>Ta</b>	ъ	4	ა	2	-																						
<b>nancy (d)</b> /n (Including S v't owned/rent nt/Lease- Priv ared: "Thattu/																									(a)	land	Name of
innakara,/Mahaveli) ( Swanboomi/Jaya/ Ba ately owned/ Anda"/Poi kattu maaru"															Others6	Tank5	4	Chena	plot3	House	land2	High	land1	Paddy/low		(d)	Type of land
																									(ଚ	[acres]	Area
00)																						codes)	(see		(d)	<b>×</b>	Tenanc
Major Major Major											(E)	years)	(# OI	30 #/		(e)	ions ?	interrupt	ss of	regardle	this land	farming	been	you	have	long	How
How do y Reservoir- Mahaw Reservoir- Irrigatic Scheme (MASL)- I Scheme (ID)- Minc	1234	1234	1234	1234	1234													(F)	(MA)		4=Others	crop	3=Perennial	crops	2= Seasonal	1= Paddy	Type of crop
ou irrigate this lan eli Authority on Dep't Minor Storage/Drain or Storage/Drainad							land)5	Bethma/ part of	In Yala only (as	(part or lariu)4	In Mana only	area)	(IUIAI 2roa) 2	/total	n Yala only	(total area)2	In Maha only	(total area)1	Both seasons		MA	(G)	Yala ?	Maha and/or	land in typical	cultivate this	Do you
<b>d during (h)</b> 1 2 nage tank3 e tank													uiat appiy)	that apply!	codes: all	(see			MA	(H	go to U	if only 5/6	this land?	irrigate	generally	you	How do
0.7													U		Ð	6=Udawalaw	Tank	5=Giant's	4=Kantale	3=Galoya	۵	Pimburattew	2=	1= Padaviya	(Major only)	Reservoir	Main Tank/
<sup>9</sup> umping/divert fror Other (specify															(L)		farmers)	Rain-only	used and for	where it is not	(Not applicable		Name	Tank	Tank/ Minor	Drainage	Storage Tank/
n canals/stre						K1	K2)	sidein colum	from the left	name or the	8= Other (En	7= Centre	6=1 ower	5- Hopor	Minor	K2)	sidein colum	from the left	4= Uther (En	3= Centre Ba	2= Right Bar	1= Left Bank	<u>Major</u>	( <b>K</b> )	Main cana	sluice ga	Name of t
ams etc						K2				HF (	ter			c	. در	Tail	ר 2	* Middl		Head				cana	al? fiel	te/ no	he Loca
10													NION	Know	Don't	-99	s	systen	major	ask fo	Only		(M)	1? canal	d P	n of the	tio Name
									Know		Don't	3 v	system	evetom	maior	ask for	Only		(Z	r canal	t/field-	turnou	the	? er of	numb	or	Name

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																								(a)	land	Name of
						Maha	2	(eg 14, 21 o	, of		from the ma	days water i	field. Not the	is taken to th	(Number of		6	intermit	(Continuc	applica	herbicides/	the tin	preparation	water dur	do you take	Total Numb
						Yala	02	r 30 days)	days		ajor tank)	s released	number of	ie farmer's	days water		<u> </u>	tently)	ously or	tion?	veedicide	ne of	(Including	ing field	irrigation	er of days
					മ	Mah	<u> </u>	satistied 4 = NA	3 = Very	satisfied	2 = Some	satisfied	1 = Not		(P)	herbici	applicat	during	prepara	fiel	receiv	water	irrigat	the amo	are you	How sat
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R. Н.	R. H.	R. H.	R. H.	R.H.		Maha	õ											(eg. Every		Hhours p	R. Rotation .			during the u	irrigation wa	How freque
R.	R.	R.	R.	R.		Yala	Q2											7 days, 6 hou		er rotation	Days		Q	growing stac	ater to your I	ntly do you t
Ŧ	Ŧ	÷	Η.	H.											ω	s	N	1 (s			_			ge?	land a	take
						Maha	R								s = Very sa	atisfied	? = Somew	= Not sat	(R)	stage	during gr	you rec	irrigation	amoun	are you w	How sati
						Yala	R2								atisfied		vhat	tisfied		." ."	owing	eive	water	tof	ith the	sfied
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	R	R	R	R														Every 9 days, 6		er rotation	Days			(S)	luring the latt	ently do you t
	H.	H.	H.	 Н.		Yala	S2											3 hours)							er stage?	ake irrigation
						Maha	Γ											3 = Very satis	2 = Somewha	1 = Not satisf.	() ()	stag	receive du	irrigation v	with the a	How satisfi
			<u> </u>			Yala	T2											sfied	at satisfied	fied	5	ge?	ring latter	water you	Imount of	ied are you

## Table LAN 1: Agricultural Land Tenure (Cont..)

5	4	3	2	1	Name of land (a)
					In the past 5 years, how many seasons have you cultivated this land? (U)
					[if U <10] Why did you not cultivate those seasons? (V) 1=Insufficient water 2=Flooding 3=Elephants/animals 4=Worked outside 5=Sick 6=Other
					Of the seasons you cultivated (# in U), how many seasons did you have a less than expected harvest due to <u>not</u> enough water/rain? (W)
					Of the seasons you cultivated (# in U), how many seasons did other problems (e.g., flood, elephants, epidemic) cause a lower than expected harvest? (X) (X)

## Table LAN 3: Agro-well or pond Irrigation

З	2	1	Collect t Well/ pond #
-	-		he tollowing in Well or p (a) Agro-well Pond
2	2	2	ond? 
			about each agro-well tr When was installed? (b) Year:
			rat is held by the house? If How deepis? (c) Feet:
1	1	1	there are no agro-w V (d) Household Privately owned by Collectively/Comm Other (Specify)
2	2	2	rells, 'x' or Vho owns someone unity owne
သ	З	ယ	ut the tabl
4	4	4	s, 
			Cost to household (material + labour) to establish/"buy-in"? 99 =Don't know/can't say SLR:

Coh	
orts 1	
& 2	

SEADS-HH

Table FAR1: Last Seasons (Maha 2014-15 & Yala 2014) Paddy Land Usage, Harvest, & Seed varieties used with OFC deatils

This table refers only to paddy land. Record the number of acres of paddy land that were used in Last Maha (harvested in 2015) & Last Yala (Harvested in 2014). If land was not used in the way specified, enter 0 as the number of acres.

20	19	18	17	16	15	14	
Do you normally cultivate Other Field Crops (OFC) in your paddy land?	. How much extent of seed/ variety 2 do you usually plant in a typical season?	Why did you choose to cultivate this seed/ variety 2? (All that apply; spontaneous)	Seed/ variety 2 planted	Seed/ variety 2 time duration	Seed/ variety 2 used	. How much extent of seed/ variety 1 do you usually plant in a typical season?	(All that apply; spontaneous)
1=Yes 2=No (Move Q25)) 997=Yes, annual crops	Acres: 9997 = Depends season to season	Cost of seed	Acres	(e.g., 2.5, 3.0.3.5, 4.0 etc)	(e.g., BG 300, AT308; Samba; Ponni; Heenati).	Acres: 9997 = Depends season to season	Availability of seed

SEADS-HH

Cohorts 1 & 2

April 17, 2015

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26.	25.	24.	23.	22.	21.	
Did you use your paddy land in some other way that I have not mentioned? If so, please explain.	How much of your paddy land did you leave fallow or not cultivated in?	Estimated total earning from OFC altogether in paddy land by selling (per season)?	Total cost of cultivating OFC in paddy land (per season)?	What other field crops did you plant in your paddy land? (use OFC codes, enter all that apply) (enter '99' if no OFCs cultivated)	How many acres you cultivate with other field crops last season?	
Use:Acres:	Acres:	Rs per season	Rs. per season		Acres:	9997=Depends on the season
Use Acres						
Use Acres						

Crop Code: 1= Paddy; 2= Kurakkan; 3= Maize; 4= Other Cereals; 5= Yams; 6= Sesame; 7= Finger Millets; 8= Cowpea; 9 = Soya Bean; 10= Moong Beans/Green Gram 11= Other Pulses; 12= Leafy Vegetables; 13= Vegetables; 14= Cinnamon; 15= Chili; 16= Pepper; 17= Other Condiments;; 19= Papaw; ; 20= Melon 21= Pincapple; 22= Mangoes; 23= Oranges; 24= Other Fruit; 25= Coconut; 26= Dhall (Mysoor, Thora, Kadala, etc); 27= Okra; 28= Onion; 29= Banana; 30= Potato; 31= Bitter Gourd; 32= Pumpkin;;33=tomato 34= Other Specify

Table FAR 2: Non-Paddy Farmland (Chena or High land) Cultivation

					1 10		·····
	(Write dc	un answer and pu) wn answer and pu	it the codes later)		Write down	مارین answer and	l put the codes later)
	al)	Maha (a2)	Annual (e.g. Ban pineapple etc.,) (a3)	anas, Yala (b1) 99=don't know/car	nt tell kng	ha ) =don't >w/cant	Annual (e.g. Bananas pineapple, etc.) (b3) 99=don't know/cant t
. Crop codes							
. Approx. total cost							
. Approx. total income							
ble FIN 2: Head farmers - I	lon-farm Income & F	emittances/ Socia	al Safetv Nets etc.				
he answer is yes, indicate	and any other moo			i is ilo, ship to u.o.			
courage the respondent to	arris any construction the wage earned by are entered should <i>l</i> give an approximat	the household us e recorded only o e value if he/she i	ing one of the four un nce. All the figures th s unsure	ts (e.g., daily, mont at are entered shou	hly, season Id be releva	ally). Leave nt. Do not e	any cells blank that nter irrelevant
ormation or total figures. courage the respondent to Does this household have ome other than farming?	arry curry correct income the wage earned by are entered should I give an approximat any other sources c	the household us recorded only o e value if he/she i f Yes No	ing one of the four un nce. All the figures th <u>s unsure</u> 1 2 skip t <u>o</u> next table	at are entered show	hly, season Id be releva	ally). Leave nt. Do not (	any cells blank that nter irrelevant
ormation or total figures. courage the respondent to Does this household have ome other than farming?	arro arry ourse incode the wage earned by are entered should I give an approximation any other sources c	the household us re recorded only o e value if he/she i f Yes f No	ing one of the four un nce. All the figures th <u>s unsure</u> 2 skip to next table 2 Respondent clain	at are entered shou ed amounts	hly, season Id be releva	ally). Leave nt. Do not (	any cells blank that nter irrelevant
ormation or total figures. courage the respondent to Does this household have come other than farming?	arro arro corro inco are entered should I <u>give an approxima</u> any other sources c	the household us re recorded only o re value if he/she i f Yes No Daily (a)	ing one of the four un ince. All the figures th s unsure 1 2 skip to next table 2 skip to next table 2 skip to next table Monthly (b)	at are entered shou ed amounts (c)	hly, season Id be releva Annual (d)	nt. Do not after after	any cells blank that nter irrelevant ad annual amounts, verification from respondent (e)
ormation or total figures. courage the respondent to Does this household have come other than farming? Daily wages/ labour	arro arro corro mod are entered should I give an approximat any other sources c	the household us re recorded only o re value if he/she i f Yes No Daily (a)	ing one of the four un ince. All the figures th s unsure 2 skip to next table Respondent clain Monthly (b)	ed amounts (c) (c)	hly, season Id be releva Annual (d)	nt. Do not nt. Convert after	any cells blank that nter irrelevant ad annual amounts, verification from respondent (e)
ormation or total figures. courage the respondent to Does this household have come other than farming? Daily wages/ labour Daily wages/ labour	arro arry concerned by are entered should I <u>give an approxima</u> any other sources c	the household us re recorded only o re value if he/she i f Yes No Daily (a)	ing one of the four un ince. All the figures th s unsure 2 skip to next table 2 skip to next table Monthly (b) (b)	at are entered shou ed amounts Seasonally (c)	hly, season Id be releva Annual (d)	nt. Do not after	any cells blank that nter irrelevant ad annual amounts, verification from respondent (e)
ormation or total figures. courage the respondent to Does this household have come other than farming? Daily wages/ labour Daily wages/ labour Animal husbandry Government service/priva	arro any other model are entered should I o give an approximation any other sources c e salaried employee	the household us re recorded only o e value if he/she i. f Yes No Daily (a)	ing one of the four un ince. All the figures th s unsure 2 skip to next table Respondent clain Monthly (b) (b)	ed amounts (c) (c)	hly, season Annual (d)	nt. Do not after after	any cells blank that inter irrelevant ad annual amounts, espondent (e)
ormation or total figures. courage the respondent to Does this household have come other than farming? Daily wages/ labour Daily wages/ labour Government service/privation Self-employment/own eco	arro arry corror model are entered should I o give an approximation any other sources c any other sources c e salaried employee nomic activity	the household us re recorded only o e value if he/she i. f Yes No Daily (a)	nce. All the figures th s unsure Respondent clain Monthly (b)	its (e.g., daily, mont at are entered show seasonally (c)	hly, season Annual (d)	nt. Do not after	any cells blank that inter irrelevant ad annual amounts, ad respondent (e) (e)
ormation or total figures. courage the respondent to Does this household have come other than farming? Daily wages/ labour Daily wages/ labour Daily wages/ labour Self-employment/own eco Self-employment/own eco	arre entered should I <u>give an approxima</u> any other sources c e salaried employee nomic activity	the household us e recorded only o f Yes No Daily (a)	nce. All the figures th nce. All the figures th s unsure Respondent clain Monthly (b)	ed amounts Seasonally (c)	Annual (d)	nt. Do not after	any cells blank that inter irrelevant ad annual amounts, verification from respondent (e)
ormation or total figures. courage the respondent to Does this household have come other than farming? Daily wages/ labour Daily wages/ labour Government service/privatorice/ Government service/privatorice/ Self-employment/own eco Self-employment/own eco All other non-farm income	are entered should it o give an approximation any other sources c e salaried employee nomic activity nomic activity	the household us re recorded only o e value if he/she i. f Yes No Daily (a) (a)	nce. All the figures th sunsure Respondent clain Monthly (b)	its (e.g., daily, mont at are entered shounds Seasonally (c)	Annual (d)	nt. Do not after	any cells blank that inter irrelevant ad annual amounts, verification from respondent (e)

SEADS-HH

Cohorts 1 & 2

April 17, 2015

	2 No (Skip to question 3)	1 Yes	<ol> <li>Have you used 1920 agriculture advisory service last 5 years?</li> </ol>
			Table CAES: Agricultural Advisory Services Usage
	Somewhat Very much		
	A little	al amount of irrigation water per acre of land	7. Would you say that farmers in this community get an equ SHOW CARD 3/Readout all answers options
	Very much		
2	A little		SHOW CARD 3/Readout all answers options
1	Not at all	erally well managed in your community?	6. Would you say that water in your tanks and canals is gen
ω	Good quality .		
od quality	oles, gates etc)in Poor quality	astructure (i.e. canals, tanks, anicuts, bunds, p	<ol> <li>What do you think about the condition of the irrigation infi this village?</li> </ol>
	Very much		
3	Somewhat		-
	A little		SHOW CARD 3/Readout all answers options
1	Not at all		4. Are you generally satisfied with your FO?
	Very much		
2	A Ilue		
۲		ual problems?	3. Can you cooperate with other FO members to tackle mut
	Always		
2	Sometimes		
4	Nover		3 Low offen de vou participate in mostinge?
2 skip to item 5 D here	No There is no FC		
1	Yes		1. Are you a member of the farmer organization (FO)?
	ate response for each question.	following statements. Circle the appropri	Instructions: Ask participants to answer each of the
	April 17, 2015	Cohorts 1 & 2	SEADS-HH

<ol> <li>Have you used 1920 agriculture advisory service last 5 years?</li> </ol>	1 Yes		(Ski	2 No p to question 3)
2. Was their advice useful in rectifying your	1	2		3
problem?	Very useful	Somewhat	useful	Not useful
3 Will you use the service again?	1			2
J. WIII you use the service again:	Yes			No

1 2 Moderately good 3		2. Do you consider farming a good profession?       Bad       A little good         1       2	1. Are you happy being a farmer?     Yes       No     No	Table CAP 9. Occupational Attachment         Now I am going to ask about how you feel it is to be a farmer.
	job2 3	Moderately good 3		

### Table Concerns 1: Major challenges

Rate the concerns in the order of their importance

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# SRI LANKA ENVIRONMENTAL AND AGRICULTURAL DECISION-MAKING SURVEY— HOUSEHOLD QUESTIONNAIRE

(SEADS-HH)

## Head Farmer, Day 2 Module

ч	4.	ω.	2.	<u>+</u>
Supervisor Name & Code	Interviewer Name & Code	3 <sup>rd</sup> session	2 <sup>nd</sup> session	1 <sup>st</sup> session
		MM:	MM:	MM:
		DD	DD	DD
		From	From	From
		То	To	To
		1 AC	1 AC	1 AC
		2 BC	2 BC	2 BC

Cultivation Practice	1. Bethma	2. Kakulan/Kakulama	<ol> <li>Planted other field crops in low land</li> </ol>	<ol> <li>Recycling irrigation drainage water; capturing and re-using drainage water</li> </ol>
Have you heard of? (a) Yes 1 (go to b) No2 (skip to next row)	1 2	1 2	1 2	4
Have you ever practiced? (b) Yes1 No2 (skip to f)	1 2	1 2	1 2	1 2
Did you practice during the last Maha (2014/15) seasons? (c) 1=Maha 3=Both 4=Neither (skip to f)	Ask only			
For what purpose? (d) All that apply; Spontaneous 1=Increase income 2=Due to 2=Due to 2=Due to 2=Due to 2=Due to 2=Due to 2=Due to 2=Due to 2=Cueton 3=Advised by expert(eg:agri cultural extension officers) 4=Common in area/ 5=Custom/tra dition	if ever practiced -			
Was it (e) SHOW CARD 4 1=Not at all 2=A little 3=Moderately 4=Very				
Do you intend to practice in the (f) 2=No	1 2	1 2	1 2	1 2
(g) (g) All that apply; spontaneous [Ask only if never practiced] 1=Too much time 2=Too expensive 3=Insufficient labor 4=Not effective 5=Reduction in yield 6=Insufficient knowledge 7=Other (specify) 8=No barriers				
Do you consider this practice risky? (h) SHOW CARD 4 1=Not at all 2=A little 3=Moderately 4=Very 4=Very				

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 Table ADP1: Farm Practices

 Today we would like to start the conversation on a number of cultivation practices that are used in some communities throughout Sri Lanka. Start by asking the farmer if he has heard of this

 Today we would like to start the conversation on a number of cultivation practices that are used in some communities throughout Sri Lanka. Start by asking the farmer if he has heard of this

 practice. If the farmer has not heard of the practice, you may skip to the next row. Please note the 'skip' and 'spontaneous' instructions. This table extends across multiple pages.

			1					
SEADS-HH Cultivation Practice	Cultivation Practice			5. Short-duration seed variety (early yielding varieties; short duration means less than 3.5 months)	6. Parachute Method (using trays)	<ol> <li>Transplanted Seedlings (vs. broadcast method, other than parachute method; by hand or by machine)</li> </ol>	8. Alternate Wetting and Drying Irrigation; Saturation irrigation	9. Low flood depth irrigation (< 3 inches deep)
Have you heard of?	Have you neard or? (a) Yes 1 (go to b) No2 (skip to next	No2 (skip to next row)		1 2	1 2	1 2	1 2	1 2
Have you ever	Have you ever practiced? (b) Yes1 No2 (skip to	f) f)		1 2	1 2	1 2	1 2	1 2
Cohorts 1 & 2 Did you practice during	Did you practice during the last Maha (2014/15) or Yala (2014) seasons? (c)	1=Maha 2=Yala 3=Both 4=Neither (skip to f)	Ask only i					
April 17, For what	For what purpose? (d) All that apply; Spontaneous	Spontaneous 1=Increase income 2=Due to 2=Advised by expert(eg:agri cultural extension officers) 4=Common in area/ 5=Custom/tra dition 6=Other	f ever practiced -					
2015 Was it	Was It effective? (e) SHOW CARD 4	<b>4</b> 1=Not at all 2=A little 3=Moderately 4=Very 4=Very						
Do you intend to	Do you intend to practice in the future? (f) 1=Yes 2=No	1=Yes 2=No		1 2	1 2	1 2	1 2	1 2
Why haven't you tried this?	Why naven't you tried this? (g) All that apply; spontaneous	<b>[Ask only if never practiced]</b> 1=Too much time 2=Too expensive 3=Insufficient labor 4=Not effective 5=Reduction in yield 6=Insufficient knowledge 7=Other (specify) 8=No barriers						
Do you consider	Do you consider this practice risky? (h) SHOW CARD 4 1=Not at all	SHOW CARD 4 1=Not at all 2=A little 3=Moderately 4=Very 4=Very						

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SEADS-HH	Cultivation Practice												10. Sri Method (SRI; System of Rice Intensification; Madagascar method)	(keeping a small distance between two plants and	planting only one plant in each place)
	Have you heard of? (a)	Yes 1 (go to b) No2 (skip to next row)											1 2		
	Have you ever practiced? (b)	Yes1 No2 (skip to f)											1 2		
Cohorts 1 & 2	Did you practice during the last Maha (2014/15) or Yala (2014) seasons?	(c)	1=Maha 2=Yala	3=Both	4=Neither (skip to f)							Ask only i			
April 17,	For what purpose…? (d)	All that apply; Spontaneous	1=Increase income	2=Due to	water scarcity 3=Advised bv	expert(eg:agri cultural	extension officers)	4=Common in	area/	5=Custom/tra dition	6=Other	f ever practiced			
2015	Was it effective? (e)	SHOW CARD 4	1=Not at all 2=A little	3=Moderately	. 4=Very										
	Do you intend to practice in the future? (f)	1=Yes 2=No											1 2		
	Why haven't you tried this? (g)	All that apply; spontaneous	[Ask only if never practiced] 1=Too much time	2=Too expensive	3=Insufficient labor 4=Not effective	5=Reduction in yield 6=Insufficient knowledge	7=Other (specify) <i>8=No barriers</i>								
	Do you consider this practice risky? (h)	SHOW CARD 4 1=Not at all	3=Moderately	4=Very											

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# Table FIN 3: Voluntary Insurance

Can you please tell us whether this household currently holds any of the following forms of insurance.

Item #5 refers to cropland insurance that is purchased voluntarily, such as through the Agrarian and Agricultural Insurance Board. Cropland insurance that the farmer is required to purchase (such as with a loan or when buying fertilizer) should not be counted here. If the household holds any forms of insurance not listed here, enter them in line 6.

1 1 ifo	Vec
	No
2. Property	YesNo
3. Home	YesNo.
<ol> <li>Voluntary cropland insurance (this does not include fertilizer insurance scheme or insurance required for loan)</li> </ol>	YesNo
5. Are you a member of a farmer's pension?	Yes
6. Other voluntary Insurance excluding vehicle insurance specify	Yes 1 No 2

April 17, 2015

2=Education fee 1=Consumption Purpose (b) No. (a) Have you got any debt or a borrowed amount from any source that is yet to be settled?. If the farmer has debt, collect the following information on 5 loans. If the farmer has no debt, mark the **Table FIN 4: Head Farmer Debt** table as NA. Purpose? (b) See codes See codes Sources <u></u> 6=House construction 7=Marriage How much did you Rupees: receive? đ 99=No fixed term or any other time months period, convert to If giving in season, Loan Term Months: (e Government commercial bank ...... Private commercial bank..... 3=Both cash and crop 2=Crop only ..... skip to g (e.2) Source (c) 4=Other 1=Cash only Are you repaying this loan by cash, by crop, or a combination? (f.1) % Ask only if paying in cash N Unit (f.2) 6=Other (specify) 5=Yearly 4=Seasons 3=Once a month 2=Twice per month Interest Rate (e.2 = 1 or 3)1=Once a week € Ask only if paying in form other (if a crop, which crop and how If not paying in cash, how are you paying back the loan? than cash (e.2 = 2, 3, or 4) much is owed?) 9

5=Migration .....

..... 10=Other (specify) 9=Health 8=Funeral

Special projects (e.g. Divi Neguma) ..... Rural development bank ..... Sanasa Samurdhi.....

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Others (specify) .....

6

4=Startup or expand non-farm enterprises......

3=Ag production ....

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#### **Table ENV1: Perceived Changes in Environment**

Ask each of the statements and record the respondent's perception of whether the following conditions have changed since he/she was a child. If the farmer states that he/she does not know or cannot say, indicate this in the last column. Do not offer 'can't say' as a response option.

#### According to your experience since childhood... (Read out the statement)

1.	The environment temperature	1	2	3	4
	*	Has decreased	Has not changed	Has increased	Can't say
2.	The beginning of the rain in Maha	1	2	3	4
	season	Is earlier	Has not changed	Is later	Can't say
3.	The rainfall during Maha season	1	2	3	4
		Has decreased	Has not changed	Has increased	Can't say
4	The approad of roin during the Maha	1	2	2	4
4.	The spread of rain during the Mana	l Laga generad	L Llag not showcod	5 Mana annood	4 Con't corr
	season	Less spread	Has not changed	wore spread	Can't say
5.	Heavy rain within a short period in	1	2	3	4
	Maha season	Has decreased	Has not changed	Has increased	Can't sav
			ind not manged		Cull Courj
6.	The beginning of the rain in Yala season	1	2	3	4
	0	Is earlier	Has not changed	Is later	Can't say
			Ũ		2
7.	The rainfall during Yala season	1	2	3	4
		Has decreased	Has not changed	Has increased	Can't say
8.	The spread of rain during the Yala	1	2	3	4
	season	Less spread	Has not changed	More spread	Can't say
-		-			
9.	Heavy rain within a short period in Yala	1	2	3	4
	season	Has decreased	Has not changed	Has increased	Can't say
10	the predictability of rainfall	1	2	2	4
10.	the predictability of rainfan	I Has deereesed	Luce not changed	C Llos increased	4 Con't corr
		nas decreased	rias not changed	rias increased	Can t say
11	The frequency of drought (a period of	1	2	3	4
	severe water shortage which is much	Has decreased	Has not changed	Has increased	Can't say
	more severe than a typically dry Yala)	This deeredbed	ind not changed	The moreused	Cuil t Suy
	incre service than a cyproanty any Tulay				
L			1	J	
Are	there any other environmental conditions th	at I didn't mention	here that you've notion	ced a change in? (er	nter up to 3)

Are there any other environmental conditions that I didn't mention here that you've noticed a change in? (enter up to 3)
12a
12b
120
120

80	<b>4</b> 8	<b>8</b> a	Are tl	7	6	J	4	3	2	1			In you	Table
			here any other problems for your agricultural yield that I have	Pests (insects, worms)	Damages by Wild animals (elephants, monkeys, peacocks wild boars, parrots)	Irrigation water not being distributed evenly by government officials (if rain-fed farmer, code a1)	Uncertainty of the start of the monsoon (in Mahaweli interview may need to probe for perceptions about rainfall)	Drought (a period of severe water shortage, which is much more severe than a typical dry season)	More rainfall	Less rainfall			ur opinion, how much of a problem do you think will be to	ENV 3: Potential problems for agricultural yields (including
			not mentioned	1	1	1	1	1	1	1	Yield will not be affected (a1)		your agricultu	paddy and OF
			l? (enter up to 3 be	2	2	2	2	2	2	2	Yield will be somewhat affected (a2) (ask (b))		ral yields in the fut	Cs)
			low)	3	υ υ	3	3	υ υ	3	3	Yield will be moderately affected (a3) (ask (b))	A	ure? SHOW CARI	
				4	4	4	4	4	4	4	Yield will be extremely affected (a4) (ask (b))		) 5	
				1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	Affected in Maha and/or Yala 1=Maha only 2=Yala only 3=Both seasons	В		

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#### Table NDP1: Drought

#### SHOW CARD 6

	Not at all	To a small extent	To a moderate extent	To an extreme extent
<ol> <li>In case of an unexpected drought, to what extent would it affect your family?</li> </ol>	1	2	3	4

#### Table NDP4: Disaster Outreach

I am going to ask whether you or any of your family members have received any information /knowledge/education about drought or other disasters.

#### In the last 5 years, have you or any of your family members have ever ...

		Yes	No
1.	Attended a meeting in order to prepare for a drought?	1	2
2.	Attended a meeting in order to prepare for any other disaster?	1	2
3.	Have you received information about drought?	1	2
			➔ If no, skip to next table
4.	(if yes) From whom?	1 = Media	
		2 = Farmer organ	nization
		3 = Government	official
		4= NGO	
		5=Other	

#### Table NDP7: Aid received in the past for drought

### In the past 5 years, has your household actually received any aid due to drought. If yes, I will read out one by one.....(Int Read out) ?

		1=Yes	s 2=No
1.	Drinking Water	1	2
2.	Food (cooked food/dry rations)	1	2
3.	Compensation for lost income (e.g., giving seeds, giving fertilizer, giving money)	1	2
4.	Loan forgiveness	1	2
5.	Aid in rehabilitation (to move to a temporary/permanent shelter)	1	2
6.	Other (specify)	1	2

#### Table NDP 9: Expected assistance

If a drought were to occur, how likely is it that you would receive assistance from.....(Int read out)

#### SHOW CARD 7

		Not at all likely	Somewhat likely	Very likely
1.	The government	1	2	3
2.	My relatives	1	2	3
3.	Community members/organizations	1	2	3
4.	Religious groups	1	2	3
5.	NGOs or other voluntary groups (societies) that work in the community	1	2	3
6.	Other sources? (specify below)			
	a.	1	2	3
	b.	1	2	3
	С.	1	2	3

#### Table CAP 5: Adaptive Capacity

I will read out some statements about your beliefs regarding your ability as a farmer to adapt to climate change, or to change your farming practices accordingly. Please tell me which answer best describes your response.

S	how Card 8	(1) Not at all	(2) A little amount	(3) A moderate amount	(4) A large amount	(4) Others
1.	With the changing climatic conditions, how far do you think it is necessary to change current farming practices?	1	2	3	4	5
2.	How far do you have the knowledge to change current farming practices with the climate change such as drought?	1	2	3	4	5
3.	Do you have enough money in your hand to change current farming practices to match with the climate change, like drought?	1	2	3	4	5
4.	How much do you like to use new farming techniques to overcome problems in farming or to increase the yield?	1	2	3	4	5

#### Table CAP 3: Efficacy in Farming

I will read out some statements about *how confident you are in your abilities as a farmer*. Please tell me which answer best describes your response.

Show Card 8

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1.	When you are doing farming, <u>how far</u> do you <u>use</u> your traditional knowledge?	1 Not at all	2 A little	3 A moderate amount	4 Very often	(4) Others
2.	For different insects, weeds, or pests how far do you know about selecting proper pesticides, insecticides, weedicides or other methods to overcome the problem?	1 Not at all	2 A little	3 A moderate amount	4 Very often	(4) Others
3.	Do you buy fertilizer from the store and apply to the paddy field?	Yes 1	No 2			
4.	When there is low water, how far do you know how to do the farming for the season with managing water that you have?	1 Not at all	2 A little	3 A moderate amount	4 Very often	(4) Others
5.	If there is a problem in the farming, whose opinion do you trust the most?	Government official related to agriculture	Other farmer(s) 2	Farmer organization 3	My own opinion 4	(4) Others

#### Table PID 2: Risks taken in farming

I will read out some statements about *your* willingness to take risks in farming. Please tell me which answer best describes your response. (Read out answers)

1.	Imagine a season in which there is not enough water for farming. Would you consider farming with the expectation of the rain water?	1 Yes	2 No				
2.	Imagine a season in which the Farming Organization or Irrigation dept/ Mahaveli official recommends that you cultivate half of your land. How much of your land would you plant? <b>(Read out answers)</b>	1 None at all	2 Less than half	3 Half your land	4 More than half	5 All of your land	6 Other
3. (	Imagine a season in which the Farming Organization or Irrigation dept/ Mahaveli official recommend a 3-month variety. What variety would you plant? <b>Read out answers)</b>	1 2.5 month variety	2 recommended 3 month variety	3 3.5 month variety	4 4 month variety	5 Other	
4.	If you get to know about a seed variety that promises to improve yields, but is vulnerable to disease, flood, or drought; would you consider using it?	1 Yes	2 No				

#### Table CAP 4: Locus of Control over Farming

I will read out some statements about how much your own behavior impacts your yield, compared to other factors that are outside of your control (e.g., luck, climate/weather). Please tell me which answer best describes your response. SHOW CARD 9

		(1) Not at all	(2) Moderately	(3) To a large extent
1.	If there is money in the hand, how much would affect the yield?	1	2	3
2.	How far do government policies decisions affect the yield? (such as water, fertilizer)	1	2	3
3.	How far do things like luck and evil eye affect the yield?	1	2	3
4.	How far do God and destiny affect the yield?	1	2	3
5.	How far do weather and climate affect the yield?	1	2	3
6.	How far does community harmony affect your yield?	1	2	3
7.	If you do your farming activity properly, how much does it affect your yield	1	2	3

#### **Table CAP 1 Collective Actions**

I will read out some statements about communal activities that take place in the village. Communal activities are non-paid activities. Please tell me which answer best describes your response.

		(1) Not at all < 10%	(2) Rarely 10 – 40%	(3) Mostly 40 – 80%	(4) Very > 80%	(5) Not applicable
1.	How willing are the farmers in this village to participate in cleaning the canal or bunds?	1	2	3	4	5
2.	As a farmer, how willing are you to participate in cleaning th canal or bunds in the village?	1	2	3	4	5
3.	To what extent do the villagers of this village help each oth	er? 1	2	3	4	5
		1=Yes go 2=N	o to (b) Io	lf y	(b) /es, do you do ti 1=Yes 2=Nc	nis?
4.	Do farmers in this village share farming equipment such as tractors, sprayers etc. among families in this village	1	2		1 2	
5.	Do farmers in this village practice attamt/help each other for farming activities without taking money	1	2		1 2	
6.	Is this village doing yaya kremaya (i.e., all farmers do land preparation and sowing together or doing things like "joined" pest management	1	2		1 2	
7.	Does this village organize new year festivals, Processions (Perahera), Dansal etc	1	2	[do	you help orgar 1 2	iize]

#### Table CAP 2: Social Cohesion

I will read out some statements about how much people help each other in this village Please tell me which answer best describes your response.

F	1	Would you have another farmer take care of your farming activities if you were unable (e.g., bunding, fertilizing)	1 Yes	2 No		
	2	Do you trust other farmers to do yaya practice/coordinated eradication of insects) Show card 8	1 Not at all	2 A little	3 A moderate amount	4 Very often
	3	Overall, to what extent do you think people in village are harmonious?	1 Not at all	2 A little	3 A moderate amount	4 Very often

#### **PID 1: Personality and Personal Changes**

#### Table PID 1A – Positive and Negative Affect

I am going to read to you a few words that describe feelings. Could you please tell me how often you actually felt this way last week? SHOW CARD 1

	<b>Never</b> (0 days)	A small amount of the time (1-2 days)	Moderately (3-4 days)	Most of the time (5-6 days)	All of the time (7 days)
1b. Happy	1	2	3	4	5
2b. Sad	1	2	3	4	5
3b. Nervous	1	2	3	4	5
4b. Serene	1	2	3	4	5

#### Table. PID 1B. Current Satisfaction

I will read out some statements about how you feel nowadays. Please tell me which answer best describes your response. SHOW CARD 9

	Dissatisfied	Neither dissatisfied or satisfied	Satisfied
1. How satisfied are you with your current work situation NOWADAYS	2	3	4
2. How secure do you feel economically NOWADAYS?	2	3	4
3. How satisfied are you with your social activities NOWADAYS?	2	3	4

Table PID 2: Health and Well-being							
INTERVIEWER: use the ladder SHOW CARD 2 for the following questions. Before asking the questions, Enter ladder rung # explain what is the best and what is the worst etc							
Assume that this ladder is a way of representing your life. The top rung of the ladder represents the best possible life for you (rung #10). The bottom rung of the ladder represents the worst possible life for you (rung #1).							
Best possible life Best possible life Worst possible life							
1. On which step of the ladder do you feel you personally stand at this time?							
<ol> <li>On which step do you think you will stand in about five years from now? Please give your best guess.</li> </ol>							

#### SRI LANKA ENVIRONMENTAL AND AGRICULTURAL DECISION-MAKING SURVEY— HOUSEHOLD QUESTIONNAIRE (SEADS-HH)

#### Household Module- mainly with Female Head

1.	1 <sup>st</sup> session	MM:	DD	From	То	1 AC	2 BC
2.	2 <sup>nd</sup> session	MM:	DD	From	То	1 AC	2 BC
3.	3 <sup>rd</sup> session	MM:	DD	From	То	1 AC	2 BC
4.	Interviewer Name & Code						
5.	Supervisor Name & Code						

Prior to beginning the survey, make sure of the following:

- 1. Confirm that you are talking to the selected farmer of the household.
- 2. Ask if this is a good time to talk to him/her about the survey. If not, reschedule.
- 3. Introduce any other interviewers/observers.
- 4. Provide the following explanation of the project.

We are from The Nielsen Company Lanka Pvt) Ltd, a survey firm in Colombo. We are working with researchers from the National Building Research Organization under Ministry of disaster Management along with few international Universities to conduct a survey. This survey is to learn about issues that may be affecting your farming practices and your daily life.

We will ask some questions from the female head about your household members, drinking water sources, places from which you obtain medical facilities and how you prepare for financial challenges etc. From the main farmer, we are interested in obtaining details on challenges faced, equipment and materials used for agriculture activities, crop cultivated in the last Maha and Yala seasons, perceptions about Farmer Organizations, farming practices and perceptions on community activities. We may ask some of the questions today and some of the questions on another day during this week.

The findings of this research may lead to actions that could improve some of the conditions in this area, as well as in the country in future and improve farming and agriculture among the farmers. But this will not benefit your village at this point of time, nor will it cause you or the village any harm. Households/ farmers who participate will receive a thank you gift - a mammotie.

Your participation in this research is voluntary and you can stop the interview at any time. If there are any questions that you would prefer not to answer, please tell us that you would like to skip that question. Everything you tell us will be kept completely confidential. This means that no personal identification can be in the data set and in the analysis of results. But your participation in the study may be known to other people in the village because they may see an interviewer approach your household. Your participation is really important for this research and we really appreciate your time.

- 5. Confirm that the participant agrees to the following.
  - Will you complete this survey? [ ] No [ ] Yes

Please identify the head female for this module as the main respondent. If there is no female head please note down. The head farmer and other family members may assist. PID 1A and PID 2 should only be answered by the female head.

Table HH1: Head Farmer and Head Female Demographics (RESPONDENT: HEAD FEMALE AND HEAD FARMER)									
Please ide	entify tl	he head female	for this ta	able as the	main respon	dent. For som	e questions you ma	y have to interview tl	he head farmer
and may r	need as	sistance from	other fam	nily membe	rs.	1			
Res pon den t (A)	Rel atio n to far mer (B)	Were you born in this GN division? (C) 1=Yes1 ->(f) 2=No2 ->(d	In wh w at I dis d tric ie t A we w re y yo b u bo ( rn 99 ? (D) %	In Ho /hat Ion DS sind ivis yo on/ firs /GA sett /our in ? thi (E) villa 9=d e n't (F now (In four digit	w Do you come from a farming family? le (G) 1=Yes 9 2=No s g	How many years have you been a farmer? (years) (H) 95=Since childhood 96=After leaving school 97=After coming to this village 98=Other	Out of the following categories what is the best answer describe your family settlement? Int. Readout 1=Traditional people 2= Traditional people 2= Traditional people but Internally displaced during the war. 3=Encroachers 4=Resettled in scheme from elsewhere by Mahaweli DP 5=Displaced by Mahaveli DP & Resettled 6= Newly settled after the war 7=Other (Specify)	What is your Religion? 2=Hinduism 3=Islam 4=Roman Catholic 5=Other Christianity 6=Other (specify)	What is your Ethnicity? (J) 1=Buddhism (K) 1=Sinhalese 2=Sri Lankan Tamil 3=Indian Tamil 4=Sri Lankan Moor 5=Burgher 6=Malay 7=Sri Lanka Chetty 8=Bharatha 9=Other Specify
1 Hea d Far mer	XX	12			1 2				
2 Hea d fem ale		1 2		N/A	1 2		N/ A		

#### Relation to farmer codes

1	=	Farmer	(self)
2	_	Casara	

- 2 =Spouse
- 3 = Son/daughter
- 4 = Father/mother
- 5 = Brother/sister
- 9 = Grandfather/grandmother10 =

6 = Nephew/Niece7 = Uncle/aunt

Grandson/granddaughter

8 = Cousin

- 11 = Stepson/stepdaughter 12 = Stepbrother/stepsister
- 13 = Stepfather/stepmother
- 14 = Son-in-law/daughter-in-law
- 15 = Brother-in-law/sister-in-law
- 16 = Father-in-law/mother-in-law
- 17 = Other blood relative
- 18 = Other relative by marriage

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19 = Non-relative

20 = Adopted/foster child

#### Table HH2: Household Demographics

Record the following information about all other people currently living in this household.

Member # (A)	Name (short/fami liar, what is used in the HH) (B)	Relatio n to farmer (C)	Gend er (D) 1= Male 2=Fe male	What is 's age? (E)	Highest level of education completed (F) 1=No schooling 2=Grade 1-5 3=Grade 6-11 4=Passed GCE OL 5=Grade 12 -13 6=Passed GCE AL 7=Degree or diploma level	Does participate to the household's farming activities? (G) Yes=1 No=2	What is 's Primary occupation ? (H) (ISCO codes)	What is's Secon dary occupa tion? (I) (ISCO codes)	Member/s who responded (J)
1 Farmer		XX	1 2			1 2			
2 Head Female		XX	1 2			1 2			
3			1 2			1 2			
4			1 2			1 2			
5			1 2			1 2			
6			1 2			1 2			
7			1 2			1 2			
8			1 2			1 2			
9			1 2			1 2			
10			1 2			1 2			
Relation to	farmer codes				•	L	L		
1 = Farmer (self) $6 = Nephew/Niece$ $2 = Spouse$ $7 = Uncle/aunt$ $3 = Son/daughter$ $8 = Cousin$ $4 = Father/mother$ $9 = Grandfather/grandmother$ $5 = Brother/sister$ $10 =$ Grandson/granddaughter		11 = Ste $12 = Ste$ $13 = Ste$ $14 = Son$ $15 = Bro$ $16 = Fat$	pson/stepdaughter pbrother/stepsister pfather/stepmother n-in-law/daughter-in-la other-in-law/sister-in-la her-in-law/mother-in-l	19 = Nc $20 = Ac$ ww aw aw	on-relative lopted/foster chi	ld			

17 = Other blood relative18 = Other relative by marriage

#### Table HAC 3: Household Construction

Instructions: Record the following information about the household structure. For some information, you may be able to observe without asking the respondent. For other information, you will need to ask the respondent to report.

1.	Is this house owned by the family or rented/ leased?	Owned by family member1
		Rented/ leased
		Other (specify) 3
2.	Type of housing structure	Single house 1
		Flat2 (Go to 3 <sup>rd</sup> question)
		Attached house/annex
		Line room/row house4
		Slum/shanty5
		Other
3.	i# of stories (if applicable)	
4.	How many years ago was this house constructed (if	
	huilt over many years refer to when construction	
	started)	
-		Dubble 1
5.	Foundation	
		Other (specify)
6.	Wall (Multiple answers)	Brick1
		Cabook
		Cement block
		Pressed soil block 4
		Mud 5
		Plank/metal sheet
		Cadian/Palmyrah7
		Other (specify)
7	Roof (Multiple answers)	Tile
1.		Aspestos 2
		Concrete 3
		Metal Sheet 4
		Cadian / Palmyrah / Straw 5
		Other (specify)
0	Eleer (Multiple enguere)	Earth floor 1
0.		Dung floor
		Wood floor
		Nood 11001
		Polisileu woou/ parquet lioor
		Cement floor
		Other
9.	# of rooms (include bedrooms and other rooms	
	including kitchen)	
10.	Is the kitchen located inside the house or outside the	1=Inside the house
	house? (Multiple answers)	2=Outside the house
11	le toilet inside or outside (Multiple answers)	1=Inside the house
11.	is tollet inside of outside (multiple answers)	2-Outside the house
		2-Not Applicable
40	Toma of tailet	J-Weter and connected to a nit/continue to the
12.	i ype of tollet	I = vvater seal - connected to a pit/septic tank
1		2 = vvater seal - connected to a piped sewer
		3 = Not water seal
1		4 = Direct pit
		5 = No facilities
		6 = Other (specify)

Tab	Table HAC 1: Household Assets, Equipment and Facilities					
Regardless of who in the household owns it can you please tell us whether this household has these assets that						
I am going to read out (Enter the # of units owned by the household where prompted with # If the household						
Ap	Annliances Yes=1 No = 2					
1	Electricity (any source)	1	2			
2	TV	1	2			
3	Radio or stereo	1	2			
4	Refrigerator/Freezer	1	2			
Furi	niture					
5	Almirah (clothes cupboard)	1	2			
6	Wooden Set (sofa, chairs, tables)	1	2			
Trai	<b>sportation Modes <h></h></b> Enter the # of units owned by the house	hold where prom	pted with #			
lf tł	he household does not have this item, enter 0.		#			
7	Phone (landline or mobile)					
8	Bicycle					
9	Car/Van/Bus/Truck (excluding mini-truck)					
10	Small truck/mini-truck (batta)					
11	Motor cycle/ Scooter					
12	Three wheeler					
Live	stock					
13	Cattle/Buffaloes					
14	Goats					
15	Poultry					

3. What source do you use during periods of severe water shortage, more severe than a typically dry yala	2. What source do you use in Yala season?	1. What source do you use normally?		Table HAC 4: Primary Si List the drinking water s
				ource of Drinking Water sources used by the household throu Source (a) 1=Streams/River/Canal 2=Dug well; Unprotected 3=Dug well; Unprotected well 4=Pipe borne water (main line – NWSDB) 5=Rural Water Supply Project 6= Tube Well 7=Bowser 8=Tank/Lake 9=Rain water 10=Bottled water1 11=Agro well 12=Spring 13=Other (Specify)
				<pre>ghout the year. List in order o</pre>
				<i>f how frequent</i> Travel time to source by foot (C) Minutes: Located on household plot 0
				<i>Iv that source is used. If s</i> What do you think about the quality of your drinking water? (D) 1=Good quality 2=Bad quality 3=Don't know/ can't say
				<i>burce is not a we</i> How deep (E) Feet: Don't know 999
			→ only if Source	How many times did the well run dry in the last five years? (F) 0= Never 99 = Don't know
1 2 3 4	1 2 3 4	1 2 3 4	is well	Are you concerned that there may not be sufficient water in your well during the next 5 years? (G) 1=Yes 2=No 3=Don't know 4 = Can't say

SEADS-HH

Cohorts 1 & 2

April 17, 2015

1. From where do you and your family normally get treated for heatth problems? (Multiple answers)	Government Health Institute       1         Private Health Institute       2         Directly from a Pharmacy/Shop       3         Field Heath officers ( eg mid wife)       4         From an individual Aurveda doctor       5         Traditional treatments       6         Mobile Clinics       7         Do not receive medical services       8         Other       9
2 Has anyone in this household been admitted to the boshital in	Yes
the last 3 years (stay in hospital for at least a day)?	a) Total number of admits (including all persons)
	(b) Number of people in the household who have been admitted
3. Have you or anyone in your family not received medical facilities while being ill in the last 3 years?	Yes1 No
	Not very serious illness
<ol> <li>What are the reasons for not been able to obtain medical facilities? (Multiple answers)</li> </ol>	Too expensive
	Self-medicate at home
	No faith in medicine
	Other7

SEADS-HH

Cohorts 1 & 2

April 17, 2015

 Table H 3: Access to Medical Care

 Record the respondents' answers to each of these questions. Read each question and provide them with response options.

#### Table FS 1: Dietary Diversity

In the past 1 week how often, how many days has your household eaten each of the following food types? For How many <u>days.....(INT read out</u> each food group) has been consumed in this household in the past one week (7-day period) each food that has been eaten, please state where the food came from.

		Number of <u>days</u> eaten by household in last 7 days (a) 1=Didn't eat (0 days 2=Occasionally (1-2 days) 3=Few times (3-5 days) 4=Frequently/all the time (6-7 days)	Source of food (b) All that apply 1=Own production 2=Purchased 3=Exchanged/taken 4=Gift 5=Borrowed 6= Food aid 7=Other
1	Rice (paddy)	1 2 3 4	1 2 3 4 5 6 7
2	Grains (cowpea, mung beans, chick peas etc.)	1 2 3 4	1 2 3 4 5 6 7
3	Bread and starchy staples (e.g., string hoppers, hoppers, pittu)	1234	1 2 3 4 5 6 7
4	Tubers (yams, manioc) maize etc	1 2 3 4	1 2 3 4 5 6 7
5	Vegetables (leafy vegetables, brinjal, squash, pumpkin, ladyfinger, gourd, dhal, etc.)	1 2 3 4	1 2 3 4 5 6 7
6	Fruits (mango, pineapple, passion fruit, banana, jackfruit, etc.)	1 2 3 4	1 2 3 4 5 6 7
7	Cooking oils/fats (coconut oil, etc.)	1 2 3 4	1 2 3 4 5 6 7
8	Dairy products (fresh milk, milk powder, curd, yogurt, ice cream, cheese etd)	1 2 3 4	1 2 3 4 5 6 7
9	Meat/ Fish/ Eggs/dry fish (fish, poultry, eggs, goat, beef, pork, buffalo, other aquatic animals)	1 2 3 4	1 2 3 4 5 6 7
10	Sweets	1 2 3 4	1 2 3 4 5 6 7

#### Table FS2: Food Insecurity Coping

I will readout some statements on how an average family limits their food consumption during difficult times. Can you please tell me whether your family has followed these practices in the last 5 years? In which months did you follow these practices?

		1 = 2 = 3=1	(a) = Yes = No NA	>(b)	(b) Circle all months that apply
1.	Eat alternative foods, like home grown jack fruit or potatoes, when there is no money or food?	1	2		1 2 3 4 5 6 7 8 9 10 11 12
2.	Borrow food, or rely on help from a friend or relative?	1	2		1 2 3 4 5 6 7 8 9 10 11 12
3.	Limit portion sizes at meal times	1	2		1 2 3 4 5 6 7 8 9 10 11 12
4.	Restrict consumption by adults in order for small children to eat?	1	2	3	1 2 3 4 5 6 7 8 9 10 11 12
5.	Reduce the number of meals eaten in a day?	1	2		1 2 3 4 5 6 7 8 9 10 11 12

#### Table NDP8: Household preparedness

1. Has your household taken on any debt due to drought in last 5 years?	Yes1 No2
2. If you to face droughts in the last 5 years how did your family prepare?	<ul> <li>1= Keep the harvest (fully or part) without selling until the next season</li> <li>2= Limit food/rice consumption</li> <li>3= Limit non food related expenses</li> </ul>
	4=Keeping money in the bank/safe place 5= Going for alternative income activities 6= Expecting government assistance

	7 =Others 8= No droughts expected/experience
3. Do you think your family is prepared to face/ handle a drought in the future?	Not at all

## Table PID 1A – Positive and Negative Affect (Only the female head should answer this table)I am going to read to you a few words that describe feelings. Could you please tell me how often you actually felt this way last week?SHOW CARD 1

	Never (0 days)	A small amount of the time (1-2 days)	Occasionally (3-4 days)	Most of the time (5-6 days)	All of the time (7 days)
1b. Happy	1	2	3	4	5
2b. Sad	1	2	3	4	5
3b. Nervous	1	2	3	4	5
4b. Serene	1	2	3	4	5

Table PID 2: Health and Well-being (Only the female head should answer this table)				
INTERVIEWER: use the ladder SHOW CARD 2 for the following questions. Before asking the questions, explain what is the best and what is the worst etc	Enter ladder rung #			
Assume that this ladder is a way of representing your life. The top rung of the ladder represents the best possible life for you (rung #10). The bottom rung of the ladder represents the worst possible life for you (rung #1).				
Best possible life 9 8 7 6 5 4 3 2 1 Worst possible life				
1. On which step of the ladder do you feel you personally stand at this time?				
<ol> <li>On which step do you think you will stand in about five years from now? Please give your best guess.</li> </ol>				