

# Understanding Food Security through the perspective of Livelihood Capitals and Value Chains



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**THE WORLD  
FOOD PRIZE**



**MSSRF**

*Science for Sustainable Development*

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## **Learning to Do, Living to Serve: My Borlaug-Ruan Internship**

Growing up in rural Iowa, I was surrounded by people with a central drive to learn, improve their surroundings, and work hard to achieve their goals. Each person I met seemed to thoroughly enjoy their work and would strive towards improving their lives and the lives of those persons living in their community. I knew nothing else, other than these lessons that were taught through words and action.

Entering high school in Emmetsburg, I continued to carry these same traits with me. I entered as many activities and classes as I could with the hope of finding a path in life that would allow me to learn and improve. From my diverse palate of daily activities, I discovered a love for the social sciences, economics, and life sciences. Each seemed to be leading me in a different direction, until I was presented with an opportunity that could bring all those aspects into one project.

During my sophomore year my biology teacher, Mrs. Tricia Reichert, shared with the class the story of Norman Borlaug and his work and the story of the World Food Prize. The presentation culminated with a predictable academic connection, as she shared our class's upcoming project of researching and finding solutions to issues related to global food insecurity. It was the prompting moment I needed. I have enjoyed every step of the process whether it be speaking with World Food Prize dignitaries visiting our high school biology class, attending the 2014 Global Youth Institute (GYI), to presenting this very research at the 2016 GYI.

As I took each step forward, I hoped to gain experience and begin to make an impact on the world. When I applied for the Borlaug-Ruan Internship the opportunity seemed far from the grasps of a small town Emmetsburg High School student. I took the opportunity with the expectations that at most I could travel and research abroad, and at least I could gain experience in filling out an application and grow from the feedback. After coming up short of an internship in spring 2015, I took the selection committee's recommendations and was able to assist in the startup and workings of new local non-profit Feed Our Kids-Emmetsburg, focused on dealing with school-age food insecurity. I found success in a second attempt in 2016. Each step of the process has been life-changing and helped me to discover my passion for addressing global food insecurity which I will carry on for the rest of my life.

## **The M.S. Swaminathan Research Foundation**

The M.S. Swaminathan Research Foundation was founded in August of 1989 as a non-profit trust in Chennai, India shortly after its founder, Dr. M.S. Swaminathan received the inaugural World Food Prize (Twenty-Third Annual Report, 2012-2013). With a commitment towards "pro-nature, pro-poor, and pro-women", the foundation has made impacts in the lives of small-holder farmers and claimed stakes in many national and international initiatives through legislation involvement on the local, state, and national levels (Lele & Gandhi, 2009). Since its inception, the far reaching effects of M.S.S.R.F. have improved the lives of millions across India and the world through the foundation's work to promote equality, sustainability, and food security.

Biotechnology, biodiversity, coastal area management, information technology, food security, informatics, and ecotechnology have all been staples of the foundation since its creation. Each of the above topics has held a crucial role in developing rural communities in southern India. The success of the M.S. Swaminathan Research Foundation has been recognized by numerous awards presented to Dr. M.S. Swaminathan and staff since the foundation's inception. A sampling of the diverse achievements includes: the UNESCO Gandhi Gold Medal (1999), Young National Women Bioscientist Award (2001), The Economic Times Award for Corporate Excellence-Lifetime Achievement (2002), Sahametrei Medal of the Royal Government of Cambodia (2006), and the B.M. Birla Science Prize in Biology in 2005 (Lele & Gandhi, 2009). Each achievement is a testament to the foundation's profound impacts in improving the lives of those disadvantaged in India and abroad.

### **The Kolli Hills**

My internship began at the M.S.S.R.F. head office in Chennai, and from that point I embarked to the Kolli Hills where I would be conducting the entirety of my internship's research. For forty days, I stayed in the Kolli Hills studying the tribal village of Thuvarapallam with assistance from the foundation's staff working at the field office located in Semmedu. The Kolli Hills is a region of southeastern India known as a hotspot of biodiversity, which made it an especially interesting location to conduct research.

The field office established by M.S.S.R.F. in Semmedu was originally established as a center of agrobiodiversity research, but has since branched out to include research in a number of fields including the life sciences, social sciences, and my own work studying resource economics.

### **Understanding Livelihood Capitals**

I shared my interests of economics and sociology with my mentor, Dr. Oliver King, would be assisting me in my project while in India. In turn, I was made aware of the Kolli Hills region and was given an overview of the foundation's work in the area.

During my first days in India I was informed that I would be staying in the Kolli Hills for my program and after a short discussion with my mentor, Dr. Oliver King, we arrived at a topic that would fit the interests I had shared and allow me to further explore the regions culture, farming practices, and lifestyle all while staying within the research model. My objective, "Understanding Livelihood & Food Security in Thuvarapallam: A scenic village in the Kolli Hills, India from the perspective of Value Chains and Livelihood Capitals" would require me to study a small village in the Kolli Hills and identify the livelihood capitals, value chain actors and locations, and gain an understanding of the microeconomics of agricultural production of two families with a focus on two cash and two food crops.

By examining the livelihood capitals and value chain of Thuvarapallam, I was immersed into each step of pre- and post-harvest activities as well as the regular transactions of business. In the Kolli Hills, I was given the opportunity to view business transactions, speak with middlemen, and visit governmental programs that benefitted farmers both in and out of Thuvarapallam. Each

experience was valuable in gaining an understanding of the lifestyle of villagers in Thuvaparallam and the lives of others living in similar conditions in the Eastern Ghats.

### **Goals and Objectives**

A brief literature review of the Tropical Agricultural Research and Higher Education Center's (CATIE) model of assessing value chain development through poverty impacts revealed the complexity of the livelihood capital and value chain research model (Donovan & Stoian, 2012). Based upon CATIE's research model, Dr. Oliver King outlined the research tools and allowed me to understand each one through experiential learning with the objective of understanding the transitory food insecurity faced by farmers in Thuvaparallam. In addition to understanding the current agricultural systems, I was also exposed to developing projects by M.S.S.R.F. and government programs that would allow me to take a long run view when outlining recommendations at the end of my program.

A key point I wished to cover in my research is the study of both food and cash crops of Thuvaparallam. Both types of crops are vital to the community's sustained success, so it was important not to turn a blind eye to the production of either. In understanding each type of crop I was given a chance to gain a total understanding of production processes and pathways to market in each enterprise and understand how market trends would later affect smallholder producers. Cost/Benefit Analysis, Resource Mapping, Resource Flow Mapping, and a number of smaller research tools were used to draw out the information necessary to fully understand the actors and actions involved in each step of each crop.

The information gathered using the research tools focused on the four crops culminated with a presentation shared with the staff of the M.S. Swaminathan Research in Chennai, India.

### **Research Contributions**

For the duration of my internship, I was able to function as a relatively independent research intern and freely set my schedule. Early in the second week of my internship Dr. Oliver King outlined the research tools that I would be using in my research program and outlined an end date, at which point I would return to Chennai for the International Pulses Conference. This allowed me to create weekly plans with days designated for either field visits or data compilation on the computer. The schedule was utilized, and save all but two days of rain, my summer was organized on a week-to-week basis with timelines for the completion of each research tool.

During my research project I was responsible for planning interviews, collecting data from the field, keeping notes, and compiling information as it was gathered. This, of course, would not have been possible without the help of my facilitators who would help me bridge the language gap that existed between myself and all of Thuvaparallam. All of my responsibilities of carrying out the project and interpreting the information would not have been possible without their daily assistance in translating Tamil back to me in English.

The research I conducted was largely my own, as I was the only person in the M.S.S.R.F. in the Kolli Hills working with the livelihood capitals and the value chain project in Thuvaparallam, or any other similar village. As I worked to complete my own project, I was able to tour other

projects of researchers and M.S.S.R.F. faculty in the Kolli Hills. Not only did it allow me to expand my knowledge of what types of research were conducted in the Kolli Hills, but I was also able to catch a glimpse of what interventions and implementations were upcoming in communities much like Thuvrapallam.

My role was that of a research intern, but the objectives of my research did not limit the experiences that I had outside of the set program. I was often encouraged to interact with other researchers, government workers, and farmers on the street to gain a complete understanding of the Kolli Hill's agriculture, as opposed to a singular look at what Thuvrapallam had to offer. The experience was fulfilling on many levels and I believe it gave me great insights about food security and an appreciation for culture that I could not have gained in any other program.

### **Livelihood Capitals, Value Chains, and Food Security**

My Borlaug-Ruan Internship was an experience that will long shape my view of food security from a singular focus on increased yields, to a wider angle that includes the quantity, quality, and distribution of that product. In addition, my understanding of resource economics and its applications grew expansively, as I was given the opportunity to conduct such research firsthand with an agrarian community very different from my own, all while being reminded the importance of biodiversity and conservation in the quest for expanded production.

When I began writing my first World Food Prize research paper for the Iowa Youth Institute in 2014, I immediately typed into the internet's search bar "World's Hungriest Countries." The search engine provided me with plenty of information about nations which infrastructure and political corruption hindered people's abilities to gain access to food, leading to starvation. The numbers were compelling and I proceeded to write about Zimbabwe. But, I believe I may have missed the full scope of what "food insecurity" meant.

Through my internship in the Kolli Hills, I have come to realize that a perfectly stable nation has just as many issues as a nonfunctioning or war torn one. Food security can affect anyone, anywhere. From Zimbabwe to southern India, food security is an issue with a common denominator, nutrition. From this experience, I was able to make connections between nutrition, infrastructure, education, economics, and food security while understanding food security in its entirety.

The Kolli Hills region of Tamil Nadu, India is peaceful and one would hardly imagine the issues faced by the small holder farmers living in rural areas. Given a decision between improving their standard of living and providing themselves and their family a nutritious meal, small-holder farmers are often more willing to meet their material wants before considering the benefits of a balanced diet. This is uninformed decision is especially frustrating, as the Kolli Hills is well equipped to serve its population with a healthful diet due to its notable biodiversity.

In addition to the economic decisions involved with meal planning, people of the Kolli Hills are faced with decisions relating to the preservation of numerous native plant varieties. As new, foreign cash crops were introduced to the area, indigenous plants were often cast aside in favor of profit and advancement, instead of preservation of the incredible biodiversity that is

paramount in the region. Impressed upon me was a deep appreciation of the conservation of biodiversity and natural genetic base of all crops, while also recognizing the tradeoffs associated with sustainable living in such an environment.

From my internship I have found that improving nutrition is as large a part of solving global food insecurity as biotechnology, or the never ceasing quest for peace. I have grown to see food security as an issue that people can face in war and in peace, in rural communities and in the cities, and it occurs in the old and very young. The many people I have interacted with at M.S.S.R.F. inspire me daily with their passion, perseverance, and persistence as we all work towards solving the greatest challenge in history: feeding the world.



## **Research Overview**

This summer, under the direction of Dr. Oliver King and with support from the M.S. Swaminathan Research Foundation in Chennai, I studied the livelihood capitals and value chains of four crops in the tribal community Thuvarapallam, an agrarian village located in Tamil Nadu's Kolli Hills.

During my Borlaug-Ruan Internship, I participated in what could best be described as an exploratory study. Dr. Oliver King noted early in the course of my internship that I would not be testing a set hypothesis, instead only using a number of research tools that would allow me to gain a complete understanding of Thuvarapallam's agriculture and resource economics with a focus on two food and two cash crops. Of those four crops, I studied the livelihood capitals and value chains of tapioca, coffee, finger millets, black beans and the role each of the crops share in the nutrition of the village. I was then able to present a recommendation, from the research conducted that could be sustainably implemented by M.S.S.R.F.

The village of Thuvarapallam is a site that the M.S.S.R.F. has worked with for the past fifteen years and its strength in biodiversity makes it an excellent site to sample study the food security of the Kolli Hills region. By studying the livelihood capitals, I have been able to understand the community's development and learn about the village's functions, members, and value chain, which all were applied to my final interpretation and recommendations.

To investigate the topic, I planned to collect data through a number of formal and informal group discussions, interviews, surveys, social mapping, resource mapping, transect walks, and observations that led me to find both quantitative and qualitative results that were compiled, communicated, and interpreted. All research was directed with the purpose of finding solutions for sustainable food and nutritional security.

Results from the research would be best measured as interpretations and recommendations are utilized in future projects. Measuring the success of the experiment would require a return to the village, conducting interviews to determine if a greater amount of livelihoods have been attained. If interventions are implemented based on the knowledge gained from my research, one could easily gather information and compare it with the existing livelihood capital charts.



## **Research**

### **Research Tools Utilized**

The livelihood capitals and value chain are two perspectives often utilized by researchers in organizing and identifying the factors contributing to production and distribution in a developing community or region. During my stay in the Kolli Hills, I utilized both perspective to fully understand the resource economics of Thuvarapallam and propose a solution that would work within the farmer's system.

The first approach, livelihood capitals, constructs a framework for one to analyze capital assets available in forms of: human capital, social capital, physical capital, natural capital, and financial capital. Each capital is vitally important to the sustainability of the area in study and a balanced amount of capitals can signify stability. As one would expect, the greater amount of capitals available to the community leads to a greater potential to produce efficiently and sustainably, but unequal or low amounts of capitals leave a community at the whims of disaster.

Tools utilized in understanding the livelihood capitals of Thuvarapallam include: social mapping, transect walks, resource mapping, seasonal calendar, value chain analysis, gender roles in crop production, cost/benefit analysis, and the Grandstaff Income Usage Distribution Activity.

Through the second perspective of value chains, one is able to map the cycling resource movement in a community, or in this case, households. As inputs are entered by profits and then used to again generate further profits, the microeconomics flows were placed into charts to offer greater understandings of the resource flow of four separate enterprises. In addition, actors were identified and activities at each step were elaborated upon through tours of marketing points and interviews with village members and middlemen involved in the processes.

### **Focus Crop Selection**

Four enterprises were analyzed in this study, two food crops and two cash crops. The diverse production of Thuvarapallam offered a number of crops that could be studied, each important to different households. The crops analyzed were selected based on their history in the community and the amount of land utilized to cultivate that crop. Tapioca, coffee, finger millet, and black beans were studied, to determine the profitability and sustainability of production.

A short explanation of the focus crops' selection is included below.

Tapioca is a staple cash crop for Thuvarapallam. A perennial crop, tapioca has offered farmers a source of income for the past twenty years. Prior to the growth of tapioca, food crops were singularly cultivated with little concern for the income or burdens brought about by cash crops. After tapioca was introduced, a seventy-five percent cash crop versus twenty-five percent food crop split became the rule of thumb in determining how a producer's land is utilized. The sudden cropping system shift interested me a great deal, and so the crop was included in the study.

Coffee, another cash crop, is grown in large amounts in increasingly high altitudes in southern India. Unlike tapioca, coffee is an annual crop and requires shade for a suitable growing environment. Often grown alongside silver oak trees, coffee is a fairly profitable venture with relatively less labor inputs than other cash crops. I selected coffee because of its annual growing cycle, economic advantages (given sustaining suitable weather), and a general curiosity of what goes into the morning drink of hundreds of millions across the globe.

Finger millet is a crop that has long been cultivated in the Kolli Hills primarily for its nutritional value as a multiuse food crop, but also for its traditional use in select Hindu ceremonies. Compared to other millet varieties of the Kolli Hills, I found that finger millet sells at the lowest price (of millet varieties) in market.

Black beans, my final crop of the four, is pulse crop, high in protein and nutrients, generally used as a compliment to a carbohydrate in a Tamil staple “daal.” Similar to snap green beans in plant structure, black beans are used in a number of side dishes and are more likely than millets to have a surplus when harvest has finished a production cycle. I was familiar with the black colored daal served many times for breakfast and lunch, and quickly decided to study the crop to completely understand its role in the southern Indian diet and, perhaps, income.

### **Objective of Project**

Unlike other true experiments, mine was a study with the overall objective of identifying shortcomings in the livelihood capitals instead of studying the effects of a change in a variable. I was driven to study all aspects of the four crop’s production, resource economics on a microeconomic scale, and the value chain of each of those four crops. From my interviews, discussions, and visits I was able to compile data that did lead to a proposed solution. Research from the summers data collection was then compiled into graphs, tables, and interview transcripts, all which were utilized in the compilation of a number of different presentations for numerous purposes to be shared with students, community members, and the World Food Prize.

### **Research Tools:**

#### **Social Mapping and Transect Walk**

Housing is one of man’s most basic needs. The dwellings of Thuvarapallam were one-to-two rooms and made the definition “basic” especially fitting. The average size of a house is between one and three rooms and an average household is small, consisting of 3.5 persons. Homes often had a television provided by a national government scheme, a ceiling level shelf, a state government scheme separated bathroom, and lime-coated walls of varied bright colors.

In the tribal villages of the Kolli Hills, all housing can quickly be classified into four distinct categories based upon roofing materials. In the first transect walk of Thuvarapallam, a facilitator noted that much could be surmised if one mapped houses as shown from above. Each roofing material corresponded with a number of household characteristics including: income, openness to governmental assistance, and general trends of when houses were built. The four materials

include: corrugated metal sheets, concrete slabs, tiled shingles, and thatch. Each of the first three were used in the construction of housing, as to the latter that was only used for unattached kitchens or animal shelters.

The first, corrugated metal sheets (locally known as “asbestos”), were used primarily on small structures such as disconnected bathrooms or small “lean-to” additions on the sides of larger houses. Such structures often were signs that the household had participated in a government scheme to provide a subsidy for building structures, although the scheme’s intended purpose was often abandoned upon completion. On several occasions, I came into contact with government funded washrooms (bathrooms) that were built to specifications to meet subsidy requirements and then converted to kitchens. The intended program failed to improve sanitation by offering a clean washroom in opposed to open defecation, although the household improved cooking facilities.

Working in their best informed interest, villagers utilized state and federally funded programs to better their own lifestyle in one way or another, whether their purpose aligns with that of the government’s intention is a matter of the user’s discretion.



Figure 1 - Social Map

Concrete homes in Thuvarapallam signified two distinct, but contrasting, characteristics of their occupants. Either the family residing therein was relatively wealthy or had participated in a Tamil Nadu state government scheme. Determining the funding source was simple, as the scheme households all were required to be built with a picture of the state’s chief minister visible on the side. Many concrete households in higher elevation sites were not built with the chief minister’s likeness and were notably closer to the village’s water tower. Newer households that were generally further from the village’s main water source, contained the sign of the state governmental subsidy. From this observation, I was able to differentiate the socioeconomic standings of people living in similar concrete homes.

Tiled shingles were the most common roofing materials, appearing as the primary roofing material on many homes and as lean-to roofing for concrete homes. The tiled shingles were made from sun-dried soil and were an earthy red color. Thuvarapallam’s local temple also shared this roofing material, signaling that tiled shingles certainly were not a home characteristic that was looked down upon.

The fourth and final roofing material, thatch, was less prevalent than the other three. As I travelled through the Kolli Hills to Thuvarapallam and to local markets, I noticed few homes

were covered with thatch. The material was utilized primarily for roofed structures built for cattle or for unattached kitchens outside of the home,

By understanding the types of roofing, I was better able to understand the community of Thuvarapallam and other villages like it in the Kolli Hills. Although the land cultivated by a farmer had little correlation with the house he/she occupied, the information allowed me to recognize the characteristics about the person that I was speaking with and better cater my questions to that individual.

## Resource Mapping

To develop a resource map, data was collected by visiting each plot of land cultivated by villagers of Thuvarapallam. Cropping systems, forests, fields, or pasture were recorded in each plot of land. During the first large group discussion (LGD) conducted with Thuvarapallam small-holder farmers, the question was posed “How is your land divided, between cash and food crops?” The resulting answer uncovered that farmers attempted to use their arable land as seventy-five percent cash crops and twenty-five percent food crops. The primary objective of the resource map was to gain an understanding of the ratio of cash versus food crops cultivated in land held by community members. The secondary objective was to study the ratio of cash crops versus other cash crops.

Although the original draft of the resource map was created by hand, a computer program was utilized to measure each parcel of land. Information obtained was then transferred to a third document where calculations were compiled and each crop and cropping system labelled.

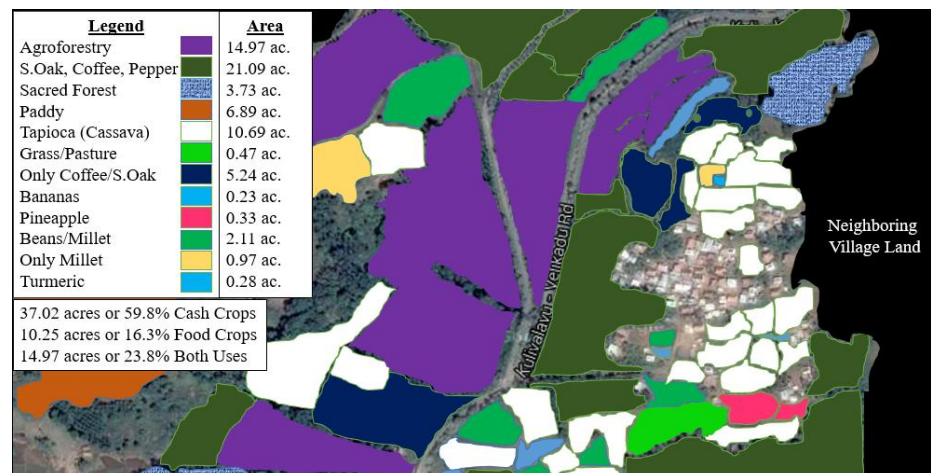


Figure 2 - Resource Map

For this research tool, cash crops were defined as commodities sold largely to consumers, as opposed to being saved for use in the home. Included in the category of “cash crops” are the following crops and cropping systems: the silver oak (S. Oak), coffee, and pepper system; only coffee and silver oak system; tapioca; bananas; and pineapple.

Food crops were defined as acres designated to the growth of crops primarily used in the home and traded within a family. Through interviews the following were included in this category: paddy (rice), beans/millet rotational cropping, millet, and turmeric.

The single cropping system divided evenly between use as market produce and for use in the home is agroforestry. Agroforestry in the Kolli Hills consists of mango trees, banana trees, guava trees, and assorted plants suitable for the climate of the Kolli Hills.

As shown in Figure 2 above, much of the land in and around Thuvrapallam is used for cash crop production, whether it be cultivated in rotation with food crops or not. Nearly sixty percent of cropping systems are used purely for cash crops, which if paired with the “both uses” crops, nearly eighty-four percent of the land is utilized for the production of cash crops. When compared to the initial LGD response of a targeted seventy-five percent cash crop to twenty-five percent food crop ratio, one can recognize that the response was valid and the de facto tradition holds true.

### Seasonal Calendar

The resource calendar allows one to identify annual activities associated with each of the four crops in study. A key objective of the resource calendar was to identify the lean seasons, or times during the year when little activity occurs, for farmers in Thuvrapallam. Data for this tool was collected with interviews

from two farmers in Thuvrapallam who were familiar with tapioca, coffee, finger millet, and black bean seasons. Eighty-one percent of smallholder farmers in Thuvrapallam cultivate tapioca and 96.5% produce coffee, each suitable for the climate and profitable for producers in the Kolli Hills. A large majority of farmers cultivate each of the four crops in study, making this resource calendar applicable to a wide range of producers in the village and region.

| Month     | Tapioca  | Coffee                    | Millet (Finger)      | Black Beans |
|-----------|--|---------------------------|----------------------|-------------|
| January   | Third weeding                                      | Season Begins             |                      |             |
| February  | Lean Season  |                           |                      |             |
| March     |  |                           |                      |             |
| April     | Fourth weeding and Potash added                    | Weeding, Flowering begins | Plowing              |             |
| May       | Harvest  | Flowering begins          |                      | Sowing      |
| June      | Harvest  |                           | Sowing               | Weeding     |
| July      | Land is plowed three times Planting (end of month) | Weeding and manure added  | Sowing               | Weeding     |
| August    | Planting (first two weeks)                         |                           | Weeding and Thinning | Harvest     |
| September | First weeding (30-45 days from planting)           |                           | Rouging and Harvest  |             |
| October   | Lean Season  |                           |                      |             |
| November  | Second Weeding and NPK added                       | Harvest                   |                      |             |
| December  |  | Harvest                   |                      |             |

Figure 3 - Seasonal Calendar

Within each crop, a green cell indicates planting season, an orange cell signifies a month used for harvest. Crops that have no designated planting season on the graph are perennials and resume growing buds immediately following harvest. The banana is a crop without either a planting season or harvest season because they are in constant harvest.

Weather in the Kolli Hills is suitable for plant growth at any time of the year, but it is especially conducive in the late summer months of August and September, when many crops are being planted and harvested. The lean seasons fall in periods of growth, during the noted lean seasons farmers often work for hire in nearby areas, whether that be in agricultural work or construction.

## Value Chains

Value chains can be found in any profit generating enterprise, starting from a product's most basic form and progressing to the final good that is supplied to consumers. Objectives in studying the value chains were established prior to the investigation with a key goal of understanding the value chain's actors and locations for each step of the production and sale of each crop.

Thuvarapallam is small village that is dependent on the services and exchange points of other villages located eight to ten kilometers away. Semmedu is a major trading village of the Kolli Hills and we traced where most major governmental offices and services are located. A primary trading point for agricultural produce is Solakkadu, known as the gateway to the Kolli Hills, for its location on the threshold of the mountains. To collect data, visits were made to the Semmedu Coffee Board; Solakkadu Market; Semmedu Horticulture Department; and Semmedu Agricultural Department. Each visit, along with supplementary questions asked to the villagers of Thuvarapallam allowed me to gain a greater understanding of each actor and location of each action and exchange pre- and post- market, along the chain.

Tapioca has become a staple crop for Thuvarapallam in the past twenty years with the main reason being its high value potential. Being a labor intensive crop, much drudgery occurs as the parcels are weeded four times in the crop's ten-month life cycle. In addition to the high labor inputs, many tapioca producers in Thuvarapallam apply a complex inorganic fertilizer or cattle manure to tapioca. The high value potential is often negated by the equally high value of labor and fertilizer inputs. The balance is shifting as inputs have increased in price resulting in diminishing annual returns. For planting of the tapioca plant, the bottom of the tapioca stem, the "sets", are saved post-harvest and replanted year-after-year. This is one reason tapioca yields have remained stagnant for nearly a decade- the genetic pool for the plants has remained the same.

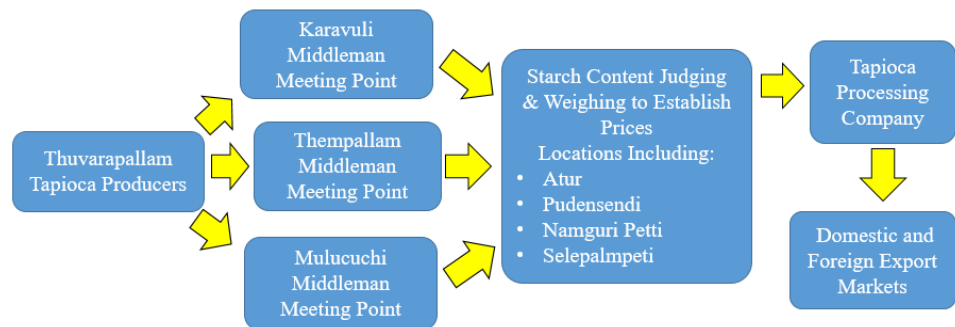


Figure 4 - Value Chain: Tapioca

Contracted labor is hired to harvest the tapioca which is then transported in seventy-five kilogram bags via lorry to a meeting point for the producers and middlemen. A price is determined at this meeting point, at a rate that is competitive, as farmers have access to market information via television and newspaper. Once the tapioca is sold to the middlemen, the sacks of tapioca are taken to be judged on starch content and weight, which determines the eventual selling price for the middlemen. Upon sale to the processing company, the tapioca is then used in products and marketed in domestic and foreign markets.

The oft produced Selection 9 Arabica variety of coffee found in the Kolli Hills has a much more regulated value chain than that of tapioca. The Coffee Board of Semmedu offers a number of programs specific to the crop, which has aided large portions of farmers in producing the crop in places of relatively high elevation, namely Thuvarapallam.

The large amount of producers of Selection 9 coffee in Thuvarapallam has led to a competitive market, despite the villages relatively small output. Fifty-five of the fifty-seven agrarian sustained households in Thuvarapallam maintain a parcel of coffee, which attracts up to ten middlemen who

visit the village annually to buy the harvest. If coffee producers are not satisfied with prices offered by the middlemen visiting

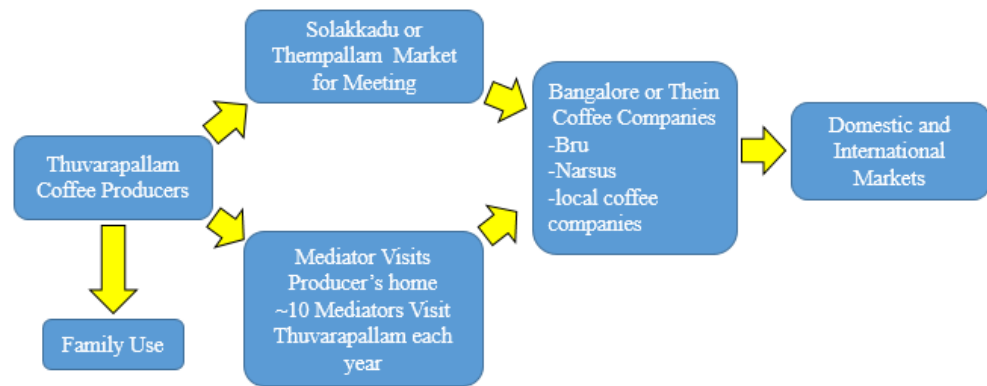


Figure 5 - Value Chain: Coffee

Thuvarapallam, they

are also able to take their produce by bus to the Solakkadu or Thempallam markets for access to more middlemen, in hopes of finding a higher price. Once coffee is sold to the middlemen, collective quantities of are then transported to the base of the Kolli Hills to be sold to major coffee companies, who then move the product to domestic and international markets for eventual consumer consumption.

### Gender Roles of Cash and Food Crop Production

The development of a country can often be tied directly to the role women share in the many levels of production. According to the United Nations India is considered a lower income developing nation (Country Classification, 2016). Similarly, the rights of women in smallholder production is

also developing, but there is still a definite gap when compared with fully developed nations. The main objective of the gender role tool is to shed light on the labor trends between food and cash crops. Data was collected for this tool through interviews of two families, the Arapuli and Nakesh households.

The interviews were conducted with candor, and both myself and facilitator were diligent in

| Gender Roles of Tapioca Production |     |       |      |
|------------------------------------|-----|-------|------|
| Activity                           | Men | Women | Both |
| Land Selection                     |     |       | XX   |
| Land Cleaning                      | X   |       | X    |
| Application of Manure              | X   | X     |      |
| Plowing of Land                    | X   |       | X    |
| Stem Cutting                       |     | X     | X    |
| Planting Stems                     |     | X     | X    |
| Weeding I                          |     |       | XX   |
| Fertilizer Application             | X   |       | X    |
| Weeding II                         |     | X     | X    |
| Harvest                            | X   |       | X    |
| Marketing                          | XX  |       |      |

Figure 6 - Gender Roles Tapioca

For Figures 6-9  
X=One Household XX=Two Households

| Gender Roles of Millet Production |     |       |      |
|-----------------------------------|-----|-------|------|
| Activity                          | Men | Women | Both |
| Land Selection                    | X   |       | X    |
| Plowing                           | X   |       | X    |
| Seeding Sowing                    | XX  |       |      |
| Weeding                           |     | XX    |      |
| Harvest                           |     | X     | X    |
| Dehusking                         |     | XX    |      |
| Flour Mill                        | XX  |       |      |
| Transport Flour to Mill           |     |       | XX   |
| Manual Flour Grinding             |     | XX    |      |
| Selling Surplus                   | XX  |       |      |

observing the full scene that unfolded in each interview. We were careful to identify dissonance between couples when they delivered their initial answer. The older couple, Arapuli, were very much in agreement with all of their answers as compared to the younger couple. We had raise follow up questions two to three times for a full understanding of who partook in completing which tasks.

Figure 9 – Gender Roles Black Beans

The data collected showed the labor inputs for cash crops are completed predominantly by males. Because men can be hired at a higher wage outside of the home, they often work for other producers in addition to tending for their own cash crops. In contrast, food crops have a nearly equal amount of labor being completed by both genders, the main reason is that food crops have no profit incentive, leaving farmers with no motivation to hire outside labor for a crop that will not improve their immediate standard of living. With nutrition as an afterthought, much less time was partitioned for the production of food crops whether it

Figure 8 – Gender Roles Millet

be by women or men. When women do participate in the production of any crop, often their work is considered drudgery, as it is repetitive or made obsolete by machinery, however it persists due to the relatively cheap costs of women’s labor.

| Gender Roles of Black Bean Production |     |       |      |
|---------------------------------------|-----|-------|------|
| Activity                              | Men | Women | Both |
| Land Selection                        |     | XX    |      |
| Obtaining Seed                        | XX  |       |      |
| Manure Application                    | XX  |       |      |
| Sowing                                | XX  |       |      |
| Weeding                               |     | X     | X    |
| Harvest                               |     |       | XX   |

### Cost/Benefit Analysis

The key quantitative measurement of an enterprise’s success is often the income that such a product generates. The C/B analysis of in this study collected data through interviews from the same households (Arapuli and Nakesh) to compare and compile to give the best representation of the profitability in the two cash and two food crops. With the key objective of understanding the input costs per acre for each enterprise, both cash and food crop C/B Analysis have been figured with an expected 100% of the produce being sold at expected market value for the upcoming season.

| C/B Analysis of Tapioca Production |            |               |            |
|------------------------------------|------------|---------------|------------|
| Inputs/Acre                        | Costs/Acre | Output/Acre   | Value/Acre |
| Land Preparation                   | 3500       | 135 75kg Bags | 74250      |
| Plowing                            | 2350       | 550Rs./Bag    |            |
| Planting                           | 3000       |               |            |
| Farm Yard Manure                   | 2000       |               |            |
| Weeding I                          | 2500       |               |            |
| Fertilizer&App.                    | 2080       |               |            |
| Weeding II                         | 2150       |               |            |
| Potash                             | 3500       |               |            |
| Weeding III                        | 2350       |               |            |
| Harvest&Transport                  | 15000      |               |            |
| TOTAL:                             | 38430      |               | 74250      |
|                                    |            | Net Income:   | 35820      |

Figure 10 – C/B Tapioca

In Thuvarapallam, the production of tapioca is generally associated with a constant reliable income. What was not divulged in the cost/benefit analysis of tapioca is the downward trend of tapioca prices since 2013, as a result of its favorable view by producers. As more producers have begun to cultivate the crop, prices have begun to decline while inputs have remained constant. Additionally, decreases in starch content due to soil

| C/B Analysis of Coffee Production |             |                   |            |
|-----------------------------------|-------------|-------------------|------------|
| Inputs/Acre                       | Costs/Acre  | Value Yielded     | Value/Acre |
| Land Digging                      | 2875        | 1 year-85kg       | 13600      |
| Coffee Plants                     | 2800        | 2 years-200kg     | 32000      |
| Coffee Planting                   | 790         | 3 years-360kg     | 57600      |
| Mulching & FYM                    | 2750        | 4 years-400kg     | 64000      |
| Weeding I and II                  | 4550        | (ICO 2015 Prices) |            |
| Harvest                           | 7650        |                   |            |
| 1st Year/Variable                 | 21415/14050 |                   | Variable   |

| C/B Analysis of Finger Millet Production |            |              |            |
|--|------------|--------------|------------|
| Inputs/Acre                              | Costs/Acre | Output/Acre  | Value/Acre |
| Land Preparation/Plowing                 | 2020       | 500 kg./Acre | 12500      |
| Line Sowing                              | 680        |              |            |
| Cattle Manure                            | 3000       |              |            |
| Weeding I                                | 1000       |              |            |
| Weeding II                               | 1000       |              |            |
| Harvesting/Cleaning                      | 3000       |              |            |
| TOTAL:                                   | 10700      |              | 12500      |
|  |            | Net Income:  | 1800       |



degradation have also taken place from the intensive mono-cropping of tapioca on a single plot since the crop's introduction to Thuvarapallam twenty years ago.

Coffee production is another crop that is dependable in its outputs annually, which is a reason fifty-five of the fifty-seven agrarian sustained households in Thuvarapallam cultivate the crop. Although coffee requires up to four years to reach peak production, the crop continually produces at a rate of 400 kilograms/acre of coffee for twenty-five years after the enterprise is established.

Finger millet is a traditional crop that has been cultivated in the

Figure 12 – C/B Millets

Kolli Hills for centuries, its uses can range from the cooking flour to out-of-the-home sale to the Kolli Hills Agrobiodiversity Conservers Federation (KHAbCoFed) cooperative store in Semmedu. The cost/benefit analysis of both food crops is assumed that all produce from the crop is taken to market and sold at a price that finger millet surplus has been sold at in the past. Additionally, labor costs were factored into the cost/benefit analysis, although most labor in food crop production is provided by the farmer. In an average year, it is unlikely for either to occur, but understanding the theoretical value of millet was important in establishing why the crop was losing favor with smallholder producers- high labor inputs with few little returns.

| C/B Analysis of Black Bean Production |            |               |            |
|---------------------------------------|------------|---------------|------------|
| Inputs/Acre                           | Costs/Acre | Output/Acre   | Value/Acre |
| Land Preparation                      | 2360       | Value Yielded | 15900      |
| Plowing                               | 2000       |               |            |
| Sowing                                | 680        |               |            |
| Cattle Manure                         | 1200       |               |            |
| Weeding                               | 3240       |               |            |
| Harvest                               |            |               |            |
| TOTAL:                                |            |               |            |
|                                       |            | Net Income:   | 3700 Rs.   |

All costs are figured in Rupees with the exchange rate at 67Rs/\$

The pulse black beans are similar to finger millets in the respect that both crop require high labor inputs and result in relatively small returns for the farmer. The overwhelming costs of producing these food crops has driven farmers from the production of the vitamin rich millets and high-protein pulses, instead favoring cheap government scheme rice that fills stomachs, but leaves many at risk for nutrient deprivation and stunted growth.

### Grandstaff Income Usage Determinant Activity

Of the research tools, inputs and outputs of each enterprise were easy to understand, as the cost/benefit analysis and resource flow made identifying inputs and outputs simple. But, I was unaware of how one might understand how one might understand the resources that flow back into agriculture from the profits generated from the cash and food crops. To overcome the hurdle, I created a simple activity (bearing my namesake) that would allow farmers to use stones to represent how they utilize their income and allow researchers to quickly collect this data from mid-sized groups of people. The setup is simple enough, six pieces of paper are spread in front of a smallholder farmer with the

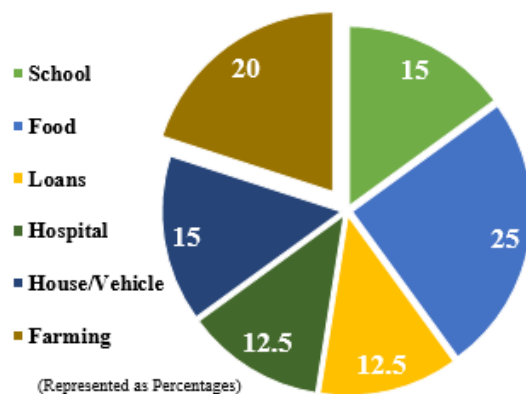


Figure 14 – GIUDA

six main expenses listed in Tamil. The farmer is provided with twenty stones and the instructions to allot the stones as similarly to last year's budget as possible.

The activity was successful and many trials were run with villagers before the two households in study were involved. The Nakesh and Arapuli households gathered together to allot the stones, with input from their spouses. Although the household heads were of different ages, the results showed a trend that agricultural inputs and food were the major costs of both families collectively accounting for 45% of their budgets.

### Livelihood Capitals

Livelihood capitals are factors involved in production. The final research tool, took the broadest view to identify livelihood capitals. This tool identified each function of the livelihood capitals, for the crops studied. Through field visits, large group discussions, and conversations with villagers of Thuvarapallam, I placed the livelihood capitals of each crop into charts and then translated the information to

the pentagon graphs at right. Livelihood capitals are points on the graphs and the pentagon in the center shows which capitals are most significant for each crop.

Tapioca, despite being a cash crop, was a crop with surprisingly low livelihood capitals. Farmers were most likely to receive loans, from the Indian State bank, for the production of tapioca. Little human capital, for research toward crop improvement was put into this crop. The land that had supported tapioca for the past twenty-five crop cycles was depleted of nutrients. Farmers apply chemicals and manure to the land. Neither improve the farmer's situation: manure does not replace all nutrients in the soil and inorganic fertilizers are quickly add cost to production.

Coffee is similar to tapioca in livelihood capitals. Natural resources are a constant and research is not available to help farmers improve. Unlike that of tapioca, much of coffee's financial capitals are provided by the Coffee Board, a federally funded institution that provides many financial programs for capital improvements to Kolli Hills coffee producing operations. Because the financial capitals are plentiful, physical capitals are too, because funds directly contribute to improving the smallholder's operation.

Famers who raise finger millets (referred to as millet in Fig. 17) receive development assistance from M.S.S.R.F. The foundation offered seminars in 2013 to teach the Kolli Hill's farmers improved row sowing methods (as opposed to broadcasting), thus improving human capital. Seeds for

#### Capitals of Tapioca

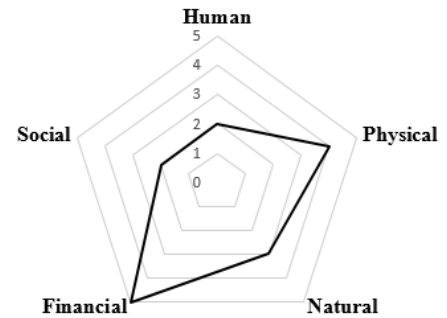


Figure 15 – Capitals of Tapioca

#### Capitals of Coffee



#### Capitals of Millet

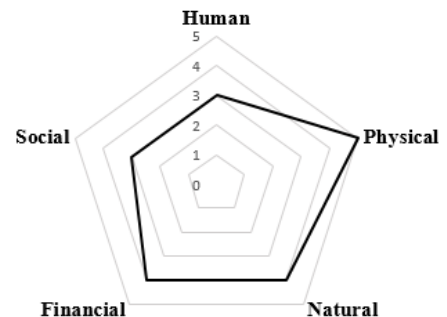


Figure 17 – Capitals of Millet

#### Capitals of Black Beans

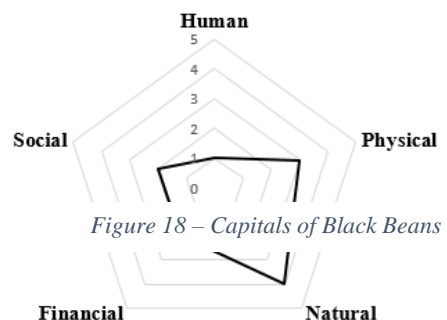


Figure 18 – Capitals of Black Beans

many millet varieties are stored in a seed bank in Thuvarapallam, and are lent to farmers at a 1:2 ratios. A farmer may borrow a kilogram of finger millet seed, but is required to “repay” the seed bank two kilograms after harvest. The M.S.S.R.F. also help establish Self-Help groups that provide loans to farmers, and the foundation assists farmers with financial record keeping and working with the bank.

Of all crops studied, black beans are the least developed. Pulses, like millets, are excellent sources of nutrients, but because they do not generate significant profit, farmers are loath to invest any extra time in improving the seemingly sufficient yields. Like Figures 15-17, the social capital in black beans is less developed than any other, the communication from farmer-to-farmer and with farmer-to-government programs (i.e. Kolil Hill’s Horticulture and Agricultural Departments) is nearly nonexistent.

### **Interpretation and Humble Recommendations**

From an outside perspective, one could draw the conclusion that Thuvarapallam is a food secure village, as few people are going hungry each night. But, a careful study of the livelihood capitals would reveal that this conclusion is not fully true. There are issues that can be addressed simply by further developing the livelihood capitals in short and simple interventions.

Food insecurity in Thuvarapallam can best be described as transitory, as it is not continuous, but arriving only in times of shortage. Nutrition in these times is especially concerning, as stunting is a noticeable problem in the village and in India as a whole. I saw many instances of people in the Kolli Hills opting for cheaper food instead of healthful foods. Although this trend exists in the United States, in India the issue takes another form. Children who do not receive sufficient nutritious diets early in their lives are affected by stunted growth, an oft discussed problem for the nation. State programs provide nutrient-scarce starches to smallholder farmers at marginal costs, further promoting the less healthful choice. The ease of access to cheap, empty calories logically leads villagers to choose the financially feasible option. This uninformed decision is the beginning of a cycle that produces nutritional deficits, especially in times of financial strain.

After understanding the situation in Thuvarapallam, I looked for a way to integrate some of M.S.S.R.F.’s developing projects into a new solution that would incentivize healthful food crop production while also improving cash crop yields. But, before explaining the recommendation, I will give a brief overview of the projects I will integrate in this relatively simple solution.

The M.S.S.R.F. is currently researching the effectiveness of intercropped pigeon pea and millet systems. The pigeon pea is a bio-irrigating pulse that mobilizes nutrients in the soil with its three to four-meter taproot. The second is the inexpensive vermicompost organic fertilizer input which improves soil nutrition, with a relatively easy to establish bacteria that once applied seven times in a span of three to four years continually develops in the soil for next twenty years. A notable feature of the vermicomposting units is that inorganic fertilizers can be used on top of the organic inputs for the first three years of establishment.

Utilizing both, I recommend that a one-acre parcel of land be split into four sections, cultivating tapioca on three plots and the intercropped pigeon pea and millets on the other. This split

resembles the traditional 75% to 25% cash/food division already in place and ensures that farmers do not increase their level of cash crops. Because millet is a crop that can be sowed and harvested in six months, the intercropped system can be cycled twice. In the first year inorganic fertilizers can be used on the tapioca portions while vermicompost can be applied to all sections of the plot twice. Vermicompost application can coincide with potash application on tapioca plots in April and again after harvest in July.

Each year, the plots rotate, moving the quarter of intercropped pigeon pea around the one-acre parcel. Each movement will leave the intercropped system's former section with improved soil nutrition that will assist tapioca growth, improving the crop's potential yield. After the third year, end inorganic fertilizer use as the vermicompost will be established.

The full parcel can then be established, tested, and introduced to farmers. Assuming that the smallholder producers of the Kolli Hills will be hesitant to overhaul their current system, I recommend test plots be established to communicate this or any other improved cropping methods. My recommendation, if successful, will improve Kolli Hills farmers with greater accessibility to highly nutritious foods (pigeon peas and millets), improve cash crop yields, and shift cropping systems from dependence on expensive inorganic inputs to a sustainable and renewable bio fertilizing system.

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To the villagers of Thuvarapallam - *miga nandri*.

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## Additional Data Charts

Tapioca Livelihood Capitals Full Chart

| Human                    | Physical  | Natural                              | Financial  | Social  |
|--------------------------|---|--------------------------------------|--|---|
| Village Knowledge Center | New roads for easier transportation to market     | Sloped/Terraced Land                 | Loans from middlemen                                 | Farmer's Club   |
| Labor from family        | Temporary storage for tapioca                     | Rocky soil, quite sandy              | Partnered with MSSRF and Indian State Bank           | Open area for social and training meetings                      |
|                          | Fertilizer available from Horticulture Department | Moderate Climate with ample rainfall | LAMP Society   | KHABCOFED (Kolli Hills Agro-Biodiversity Conservers Federation) |
|                          | Market is held twice weekly (9k distance)         |                                      | Self-Help Agricultural Loans                         |   |
|                          |   |                                      | Agricultural Department loans and programs available |   |

Coffee Livelihood Capitals Full Chart

| Human  | Physical                                  | Natural                                      | Financial  | Social                                     |
|--|---|--|--|--|
| Village Knowledge Center                           | Basic Utilities- Electricity and Water    | Sloped/Terraced Land                         | Coffee Board provides replanting cost assistance     | Farmer's Club                              |
| Estate work in Kerala helps workers develop skills | Water Tower                               | Rocky soil, quite sandy                      | Partnered with MSSRF and Indian State Bank           | Open area for social and training meetings |
| Horticulture Department training in Kolli Hills    | Multiple Wells                            | Cattle manure available at 5000Rs/Lorry Load | Horticulture Dept. of Kolli Hills offer cheaper seed |  |
| Labor from family                                  | Compost piles                             | Moderate climate with ample rainfall         | LAMP Society & Indian Bank                           |  |
|  | Market is held twice weekly (9k distance) | 3-4 years growth before full production      | Marketmen come to village to buy coffee              |  |

### Finger Millets Livelihood Capitals Full Chart

| <b>Human</b>                | <b>Physical</b>                           | <b>Natural</b>                                      | <b>Financial</b>                               | <b>Social</b>                              |
|-----------------------------|---|---|--|--|
| Value Addition Training     | Basic Utilities-<br>Electricity and Water | Sloped/Terraced Land                                | Self-Help Group Loans                          | Farmer's Club                              |
| Village Knowledge Center    | Threshing Yard                            | Rocky soil, quite sandy                             | Partnered with MSSRF and Indian State Bank     | Value Addition Training                    |
| MSSRF line training in 2012 | Multiple Wells                            | Humid temperate climate                             | LAMP Society                                   | Open area for social and training meetings |
| Labor from family           | Millet Flour Mill                         | Millet's have always been cultivated in Thuvapallam | Community Seed Bank/Seed Loans in-village site |  |
|                             | Compost piles                             |   |  |  |

### Black Beans Livelihood Capitals Full Chart

| <b>Human</b>             | <b>Physical</b>                           | <b>Natural</b>                       | <b>Financial</b>                           | <b>Social</b>                                     |
|--------------------------|---|--------------------------------------|--|---|
| Village Knowledge Center | Basic Utilities-<br>Electricity and Water | Sloped/Terraced Land                 | Self-Help Group Loans                      | Farmer's Club                                     |
| Labor from family        | Compost piles                             | Diverse Cash and Food Crop Selection | Partnered with MSSRF and Indian State Bank | Open area for social training meetings gatherings |
|                          | Multiple Wells                            | Rocky soil, quite sandy              |  |   |
|                          |   | Moderate climate with ample rainfall |  |   |

Social Mapping Data

| Household Name (HH)    | Members of this HH? |       |       |       |         | Who heads the HH and age? | Maximum educational achievement of HH head? | Primary Occupation | Land Holdings |
|------------------------|---------------------|-------|-------|-------|---------|---------------------------|---|--------------------|---------------|
| Family Name            | Ad. M               | Ad. F | Ch. M | Ch. F | HH Size | Age(Gen)                  | Grade                                       |                    |               |
| Kolapandi Muthuai      | 1                   | 2     |       |       | 3       | 55                        | 9th   | farmer             | 1.5           |
| Chirmanyam             | 1                   | 2     | 1     | 1     | 5       | 60                        | 0   | farmer             | 2             |
| Chirmasamy             | 1                   | 1     | 1     | 1     |         | 40                        | 0   | farmer             | 2             |
| Thamgarel              | 1                   | 1     | 1     | 1     | 4       | 38                        | 7th   | farmer             | 2             |
| Palamisamy             | 1                   | 1     | 1     |       | 3       | 39                        | 8th   | farmer             | 3             |
| Tamilarasu             | 1                   | 1     |       |       | 2       | 47                        | 0   | farmer             | 3             |
| Auburaj                | 1                   | 1     | 2     |       | 4       | 34                        | 5th   | farmer             | 1             |
| Gowisamkar             | 1                   | 1     | 1     |       | 3       | 32                        | 12th  | farmer             | 2             |
| Kolapomdi Chimanshamay | 1                   | 1     | 1     |       | 3       | 54                        | 0   | farmer             | 2             |
| Annadurai              | 1                   | 1     |       |       | 2       | 45                        | 0   | farmer             | 3             |
| Muthusamy              | 1                   | 1     | 1     | 2     | 5       | 35                        | 7th   | farmer             | 3.5           |
| Nallamuthai            | 1                   | 1     | 1     |       | 4       | 46                        | 12th  | farmer             | 2             |
| Kolamtham              | 1                   | 1     | 1     | 1     | 4       | 58                        | 0   | farmer             | 2             |
| Chinnasamy             | 1                   | 2     |       |       | 3       | 50                        | 0   | farmer             | 5             |
| Chinnamutha            | 1                   | 2     | 1     |       | 4       | 60                        | 0   | farmer             | 0.5           |
| Subaramani             | 1                   | 1     | 1     | 1     | 4       | 34                        | 7th   | farmer             | 0.5           |
| Ramesh                 | 1                   | 1     |       |       | 2       | 27                        | 7th   | farmer             | 1.5           |
| Chetiiappam            | 1                   | 1     | 1     | 1     | 4       | 39                        | 7th   | farmer             | 1.5           |
| Palamisamy             | 1                   | 1     |       |       | 2       | 28                        | 6th   | farmer             | 1.5           |
| Mattaya Ayyalamy       | 1                   | 1     | 1     |       | 3       | 55                        | 0   | farmer             | 2             |
| Naratharaj             | 1                   | 1     |       | 1     | 3       | 34                        | 12th  | farmer             | 2.5           |
| Arumachalam            | 1                   | 2     |       | 1     | 4       | 42                        | 12th  | farmer             | 2             |
| Nevdiya Ayyasamy       | 1                   | 2     |       | 2     | 5       | 51                        | 0   | farmer             | 4             |
| Jayarathinam           | 1                   | 2     |       |       | 3       | 55f                       | 10th  | teacher            | 0             |
| Nakesh                 | 1                   | 1     | 1     | 1     | 4       | 35                        | 12th  | farmer             | 2.5           |
| Chinthamani            | 1                   | 2     |       |       | 3       | 40f                       | 0   | farmer             | 1             |
| Mattaya Gopal          | 1                   | 1     | 1     | 2     | 5       | 35                        | 9th   | farmer             | 3             |
| Rajendram              | 1                   | 1     | 2     |       | 4       | 36                        | 5th   | farmer             | 4             |



|                      |                       |    |    |    |            |     |      |                       |              |
|----------------------|-----------------------|----|----|----|------------|-----|------|-----------------------|--------------|
| Mattaya Chandram     | 1                     | 1  | 1  |    | 3          | 40  | 0    | farmer                | 4            |
| Muthayam             | 1                     | 3  |    |    | 4          | 47  | 0    | farmer                | 4            |
| Prakasam             | 1                     | 1  | 2  |    | 4          | 30  | 7th  | farmer                | 3            |
| Eswaran              | 1                     | 1  | 1  | 1  | 4          | 28  | 8th  | farmer                | 3            |
| Ayyasamy             | 1                     | 1  |    |    | 2          | 52  | 0    | farmer                | 1            |
| Rajam                | 1                     | 2  |    | 1  | 4          | 52  | 11th | post master           | 2            |
| Radhakrishanam       | 1                     | 2  |    |    | 3          | 29  | 12th | farmer                | 2            |
| Periakkal            | 1                     | 1  |    |    | 2          | 75f | 0    | farmer                | 2            |
| Chandrakumar         | 1                     | 1  | 1  |    | 3          | 40  | 5th  | farmer                | 3            |
| Subramani            | 1                     | 2  | 1  |    | 4          | 38  | 0    | farmer                | 3            |
| Raju                 | 1                     | 1  |    |    | 2          | 62  | 0    | farmer                | 1            |
| Paulraj              | 1                     | 1  | 1  | 1  | 4          | 45  | 10th | farmer                | 4            |
| Rajamanickam         | 1                     | 1  | 2  | 1  | 5          | 38  | 8th  | farmer                | 2            |
| Mattaya Chandrakumar | 1                     | 1  | 1  | 1  | 4          | 38  | 8th  | farmer                | 3            |
| Allimutha            | 1                     | 1  |    | 1  | 3          | 38  | 5th  | farmer                | 3            |
| Mathialagam          | 1                     | 1  | 2  | 1  | 5          | 28  | 6th  | farmer                | 2            |
| Murugesam            | 1                     | 1  |    | 1  | 3          | 35  | 6th  | farmer                | 2            |
| Chinnamutha          | 1                     | 1  |    |    | 2          | 60  | 5th  | farmer                | 2            |
| Solaba Gopal         | 1                     | 2  | 2  |    | 5          | 22  | 6th  | farmer                | 2            |
| Ponnaiyam            | 1                     | 1  | 1  | 1  | 4          | 40  | 9th  | farmer & driver       | 2            |
| Sotha Selvam         | 1                     | 1  |    |    | 2          | 52  | 0    | farmer                | 2            |
| Sivakumar            | 1                     | 1  |    | 2  | 4          | 37  | 6th  | farmer                | 2            |
| Sellasmal            | 1                     | 2  |    | 1  | 4          | 60f | 5th  | farmer                | 3            |
| Sotha Ayyasamy       | 1                     | 1  | 2  |    | 4          | 40  | 12th | Conductor & Farmer    | 3            |
| Kasi                 | 1                     | 2  | 1  | 2  | 6          | 38  | 6th  | farmer                | 3            |
| Sivakumar            | 1                     | 1  |    |    | 2          | 33  | 9th  | farmer                | 3            |
| Arapulli             | 1                     | 1  |    |    | 2          | 60  | 0    | farmer                | 2            |
| Mattaya Murkesham    | 1                     | 1  |    | 1  | 3          | 41  | 5th  | farmer                | 3            |
| Ulganathan           | 1                     | 1  |    | 1  | 3          | 33  | 12th | Farmer & Lorry Driver | 3            |
| <b>Totals</b>        | 57                    | 73 | 37 | 31 | 3.48<br>21 |     |      |                       | 2.3596<br>49 |
|                      | Total Population: 198 |    |    |    |            |     |      |                       |              |