

**Food Security in Rural India:
A Case Study of Vadamanappakkam, Tamil Nadu**

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ABSTRACT

Growing food shortages coupled with rising global demand have created food security crises in many parts of the world. Food security is defined as the availability of food and one's access to it. Access to food is determined by political and market forces acting on food systems, an individual's wealth, and their share in food production. Making up 85% of India's economy, the agricultural sector is crucial to India's economic and political stability, and a common method for assessing food security in this region consists of scaling up regional models. To address misguided perceptions resulting from inaccuracies inherent in these models, I assessed local food security – specifically those factors that affect access – using Vadamanappakkam, Tamil Nadu as a case study in order to create a model for small-scale assessment. I identified key factors including income levels, role in the food system, education levels of the head of the household, and use of ration cards, in order to quantitatively and qualitatively evaluate access to food in Vadamanappakkam. Individuals with higher incomes spent less of their total income on food as a percentage. Those who lived in a household where the head of the household had completed some form of higher education spent the least percentage of their income on food. Consumers and those with ration cards spent the highest percentage of their income on food. Despite the limitations of this study, Vadamanappakkam serves as a clear example of the importance of localized assessments in understanding the larger agricultural system in India and its implications for global food markets.

KEYWORDS

rural agriculture, food access, agro-industry, regional assessment, Public Distribution System (PDS)

INTRODUCTION

Growing food shortages coupled with rising global demand have created food security crises in many parts of the world (Baviera and Bello 2009). Food security is defined as the availability of food and one's access to it (Sinha et al. 1988) and climatic factors are often the best indicators of the availability of agricultural foods in any given year (Powlson and Brookes 1987, Sinha et al. 1988, Insam 1990, Kumar and Parikh 2001, Aggarwal and Mall 2002, Krishna et al. 2003, Shukla et al. 2003, Roy 2006, Rupa et al. 2007). Access to food is determined by political and market forces acting on food systems, an individual's wealth, and their share in food production (Parry 1990, Rosenzweig et al. 1993, Gregory et al. 2005). With the onset of this global food crisis, it is critical that domestic food security of key producers for the world food market, like India, be thoroughly understood (Parry 1990, Baviera and Bello 2009).

Despite the economic significance of the agricultural sector, there are undoubtedly misguided perceptions regarding the status of food security in India. The agricultural industry, crucial to maintaining India's large population, employs approximately 743 million Indians (O'Brien et al. 2004, Kapila 2009). Although agriculture constitutes only 20% of India's national Gross Domestic Product, it makes up 85% of the economy in rural India (Kapila 2009). Additionally, as a major exporter of agricultural products, large portions of India's political and economic stability depends on this industry (O'Brien et al. 2004, Kapila 2009). Though rural food security show stable positive trends of food needs being met for the rural population nationwide, it is based on scaling up regional assessments that are sporadic and not equally distributed among the various regions (Parry 1990, Rosenzweig et al. 1993, O'Brien et al. 2004, Kapila 2009). Thus, such trends can conceal potential problems in other regions of India.

Regional assessments of food security in certain Indian states – Punjab, Uttar Pradesh, Madhya Pradesh, Haryana, Bihar, Andhra Pradesh, Maharashtra, and West Bengal – are abundant due to the large contribution of these regions to India's overall agricultural productivity (Fischer et al. 2005). However, there are not adequate studies conducted in the remainder states, like Tamil Nadu, which brings to question whether stable national trends are comprised disproportionately of assessments done in agriculturally productive regions (O'Brien et al. 2004). Past studies have relied heavily on socio-economic agricultural models rather than realistic

assessments done on-site and do not take into significant consideration key economic events, like the liberalization of India's markets in 1991, to evaluate present-day food security in India (O'Brien et al. 2004, Fischer et al. 2005, Kapila 2009). A reassessment of regional trends is critical to understanding the nature of current food security in India.

I will conduct a regional assessment of rural food security in Vadamanappakkam, Tamil Nadu to identify the local trend for Thiruvannamalai District and its surrounding locales. Vadamanappakkam is representative of its encompassing district as it conforms to the same political, socio-economic, and environmental pressures as the rest of the region. This study will add to the limited localized food security assessments done previously in Tamil Nadu. Food security will be measured by the monetary amount spent on purchasing food by an individual within Vadamanappakkam. Further assessments will be made through observational studies of influential factors (e.g. income levels, role in the food system, education levels, and use of ration cards). Specifically, I will:

1. Identify producers, distributors, and consumers in Vadamanappakkam's food system and how their role impacts their food security
2. Identify the impacts of income levels, education of head of household and use of ration cards on food expenditure by Vadamanappakkam's population
3. Assess the implications are for maintaining food security in the future on a local, national, and global scale

Expected Findings

I expect discrepancies in food expenditures among producers, distributors, and consumers. I expect producers to have a moderate level of expenditure on food as they will grow a portion of their own sustenance but will not have the diversity to be completely self sustaining (Parry 1990). Vendors, I expect, will have the least expenditures as they will be able to buy a variety of food and sell it for a profit while retaining a lower purchase price for themselves (Parry 1990). I expect pure consumers to have the highest cost in the food system as they have no mechanism to offset their consumption of food (Parry 1990). Overall, I predict the intensity of impact to be greater on consumers than producers and vendors as they are at the end of the food system chain with no buffering capacity (Parry 1990).

METHODS

Study site

I conducted this study in the village of Vadamanappakkam located in the southern Indian state of Tamil Nadu. This village, located 100 km south of Chennai in Thiruvannamalai District, is encompassed within the Cheyar Taluk. In Tamil Nadu, districts are divided up into taluks for the purpose of revenue administration by the state government. There are approximately 900 households in the village, which roughly comprises a population of 3,000 individuals. The majority of adults are agricultural and textile workers who suffer from a variety of occupational maladies and socio-economic hardships, that invariably correlate with poor health and sanitation standards.

Food security and Vadamanappakkam

Food security is defined as the availability of food and one's access to it (Sinha et al. 1988). I assessed rural food security in Vadamanappakkam, Tamil Nadu in order to identify a regional trend for Thiruvannamalai District and its surrounding locales. I used Vadamanappakkam as a representative sample of the larger district as it adheres to the same political, socio-economic, and environmental pressures as the rest of the region. Food security is not thoroughly understood in this particular region despite its predominantly agricultural economy. In this study, I identified and analyzed the interactions between producers, vendors (i.e. distributors), and consumers, with respect to locally grown foods in Vadamanappakkam.

I measured local food security by quantifying the percentage of an individual's net expenditures that was used to purchase food locally. I defined net expenditure in this study as the monetary amount spent on purchasing food within Vadamanappakkam. These values were then calculated as a percentage of total income. The calculated value accounted for those who grew a portion of their food or bought it at a subsidized rate due to certain socio-economic factors (e.g. their income or role in the food system). The following is a summary of how I calculated net expenditure for each group based on how I defined each role for this study:

- Producers: Any individual that participated in growing food regardless of scale. Net expenditure for producers was calculated as follows

$$\frac{|Food\ Sold - Food\ Bought|}{Total\ Income}$$

- Distributors: Any individual that participated in the resale of food acting as the link between producers and consumers (these were often self-identified vendors). Net expenditure for distributors was calculated as

$$\frac{|Food\ Sold - Food\ Bought|}{Total\ Income}$$

- Consumers: Any individual that participated in purchasing and consuming food. Net expenditure for consumers was calculated as the value spent on purchased food.

$$\frac{|Food\ Bought|}{Total\ Income}$$

Data collection

To identify expenditure patterns, I conducted household surveys. Household surveys maximized the data that could be collected on a large number of individuals, but the unit of interest remained at the individual level. I sampled 92 households from the 892 households located within the village. Each survey took approximately 25 minutes to complete. I selected households based on visual aesthetics, as they often are a good indicator of economic status. This ensured that the sampling individuals were stratified somewhat evenly across different income groups. This sampling method, however, did not indicate their specific role – producers, distributors, and consumers – in the food system. In order to ensure that there was an equal stratification across the different groups, intermediate evaluations were done. Intermediate evaluations simply involved counting the number of the various income groups (high, middle, and low) we had surveyed and re-evaluating the number of surveys needed from the lacking groups. To cover all groups, surveys were conducted at different times in the day to ensure farmers and other working individuals were sampled during non-working hours.

The survey assessed both primary and secondary factors. Primary factors included income, family size, government ration programs, and consumption. Secondary factors included

education level, occupation, agricultural practices, insurance policies, and monetary debt. I then used a combination of quantitative and qualitative analysis evaluating select primary and secondary factors to identify and explore net expenditure patterns with relation to key factors (e.g. income, role in the food system, government program, and education levels) that affected access to food to help evaluate the implications for maintaining food security in Vadamanappakkam.

Methods of analysis

To investigate the different relationships among various factors (income, education levels, role in the food system, and the use of ration cards) and net expenditure on food, I used a series of statistical tests. For ease of analysis, I assumed the necessary statistical criteria that allowed me to run these tests as if data was collected under “ideal” conditions (please see “Limitations and future directions” section for more detail).

Income

To investigate the relationship between income and net expenditure on food, I conducted a regression analysis to determine whether the mean net expenditure on food differed by income levels. I used income as a proxy for economic status. I used data from all individuals and answered the following question: Did the data provide sufficient evidence to indicate that the mean net expenditure on food differed as income level changed? I plotted net expenditure on food as the dependent variable on the y-axis against income levels as the independent variable on the x-axis. The assumptions made were that these samples from my data were drawn independently, and the net expenditures of individuals were normally distributed. Additionally, I assumed my “populations” had equal variance which allowed me to run regression analysis on individuals’ incomes against net expenditure on food.

Education level

To investigate the relationship between the level of education and net expenditure on food, I conducted an ANOVA test to determine whether the mean net expenditure on food differed by completed education level by the head of the household (primary, secondary, higher). Primary education level included those who had completed anywhere from the equivalent of Kindergarten through 5th grade. Secondary education level included those who had completed anywhere from 6th through 12th grade. Higher education included those who had completed a diploma, bachelors, or graduate level studies. I selected individuals from each category and answered the following question: Did the data provide sufficient evidence to indicate that the mean net expenditure on food differed for at least two of the three groups?

H_a (Primary Hypothesis): The mean net expenditure on food differs for at least two of the three groups.

H₀ (Null Hypothesis): The mean net expenditure on food does not differ among all three groups

I assumed that the samples from my data were drawn independently, and the net expenditures of individuals were normally distributed for each of the three groups. Additionally, I assumed my “populations” had equal variance which allowed me to run my ANOVA test and plot the three categories – primary, secondary, and higher – as my independent variable on the x-axis against net expenditure on food as my dependent variable on the y-axis.

Role in the food system

To investigate the relationship between the roles of individuals in the food system and net expenditure on food, I conducted an ANOVA test. I aimed to determine whether the mean net expenditure on food differed for the three groups (producers, distributors, and consumers). I selected individuals from each category and answered the following question: Did the data provide sufficient evidence to indicate that the mean net expenditure on food differed for at least two of the three groups of individuals?

H_a (Primary Hypothesis): The mean net expenditure on food differs for at least two of the three groups of individuals.

H₀ (Null Hypothesis): The mean net expenditure on food does not differ among all three groups of individuals

I assumed that the samples from my data were drawn independently, and the net expenditures of individuals were normally distributed for each of the three groups. Additionally, I assumed my “populations” had equal variance which allowed me to run my ANOVA test and plot the three categories– producers, distributors, and consumers – as my independent variable on the x-axis against net expenditure on food as my dependent variable on the y-axis.

Ration card use

To investigate the relationship between the use of ration cards and net expenditure on food, I conducted an ANOVA test to determine whether the mean net expenditure on food differed between those who used ration cards and those who did not. I selected individuals from each category and answered the following question: Did the data provide sufficient evidence to indicate that the mean net expenditure on food differed between those who used ration cards and those who did not?

H_a (Primary Hypothesis): The mean net expenditure on food differs for those who do use ration cards.

H₀ (Null Hypothesis): The mean net expenditure on food does not differ for those who used ration card.

The assumptions made were that these samples from my data were drawn independently, and the net expenditures of individuals were normally distributed for each of the three groups. Additionally, I assumed my “populations” had equal variance which allowed me to run my ANOVA test and plot the two categories– those who use ration cards and those who don’t – as my independent variable on the x-axis against net expenditure on food as my dependent variable on the y-axis.

RESULTS

Overall statistical trends

The survey identified major trends that characterize Vadamanappakkam’s food security. Individuals with higher incomes spent less of their total income on food as a percentage. Those

who lived in a household where the head of the household had completed some form of higher education spent the least percentage of their income on food. Consumers and those with ration cards spent the highest percentage of their income on food.

Detailed statistical analyses

Income

Using linear regression, I found an exponential relationship between net expenditure on food and an individual's income (Fig. 1).

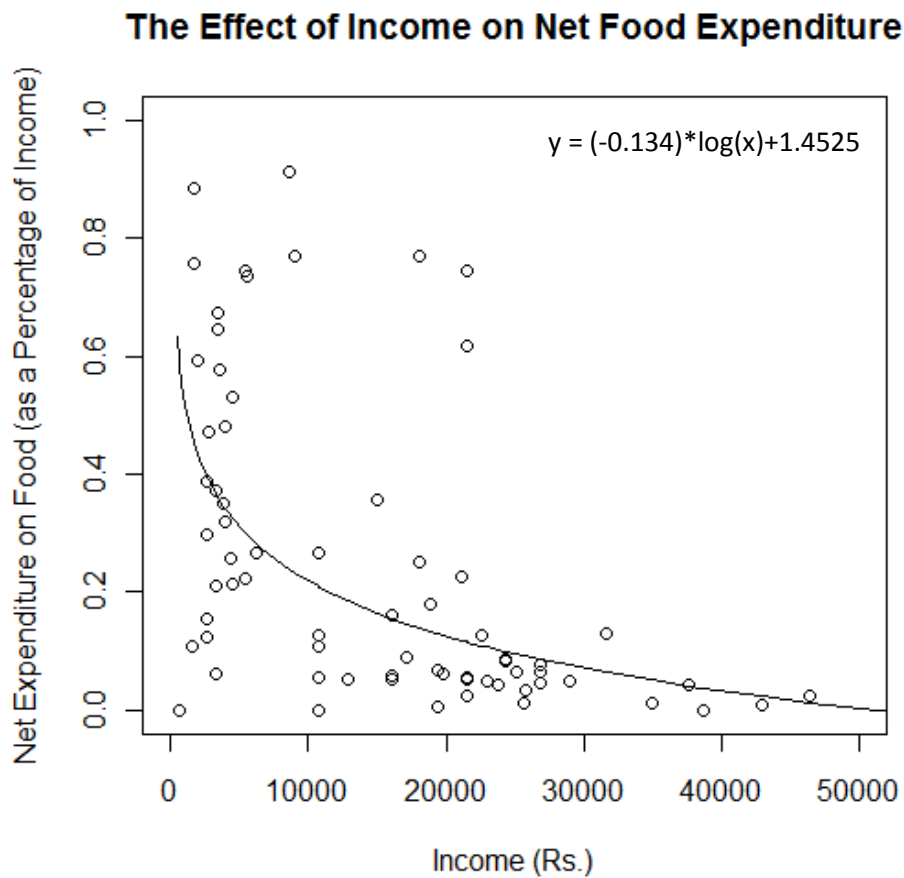


Fig. 1. The Effect of Income (Rs.) on Net Food Expenditure (n=92). The data is expressed as a fraction of total income where 1.0 corresponds with 100%.

I plotted the income in Rupees (Rs.) on the x-axis against the fraction of money spent on food from their income on the y-axis. Though the best fit line of the linear regression visually suggests that as income levels increased, expenditure on foods decreased, the linear regression model itself indicated a non-significant correlation between net expenditure on food and income levels ($R^2=.30905$, $F(1,90)=1.532$, $p=0.219$).

Education level

Using an ANOVA test, lower education levels indicated higher mean expenditure on food as a percentage of an individual's income (Fig. 2).

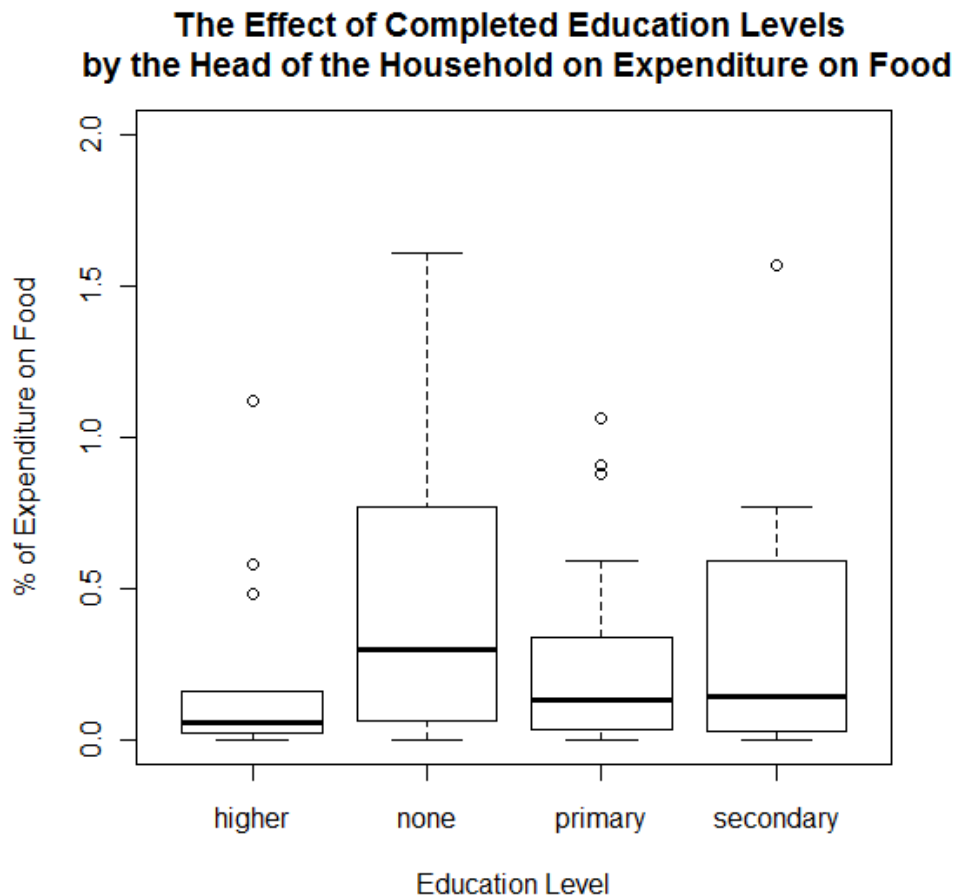


Fig. 2. The Effect of Education Levels on Net Food Expenditure (n=92). The data is expressed as a fraction of Total Income equating 1.0 to 100% and 2.0 to 200% respectively.

Increased education levels resulted in generally lower expenditures on food (as a percentage of income) ($F(3,84)=1.00$, $p=0.3969$). There was no significant trend indicating that only households in which the head of the household had completed up through 5th grade – primary education level ($M=0.4000$, $SD=1.0450$) – or up through 12th grade – secondary education level ($M=0.4200$, $SD=0.8248$) – had higher expenditure on food. However, heads of households who had no education showed some significant relative increases in the percentage of their income they spent on food ($M=0.8300$, $SD=1.500$) and those heads of households who had completed a diploma, bachelors, or graduate level studies – higher education levels – showed some significant decreases in the percentage of their income they spent on food ($M=0.1900$, $SD=0.3215$). Additionally, those with no education had the largest variation within the group, followed by those who had had secondary and primary education. Those who had higher education had the least variation within their group.

Role in the food system

Consumers had higher expenditure on food as a percentage of their income than producers and distributors (Fig. 3).

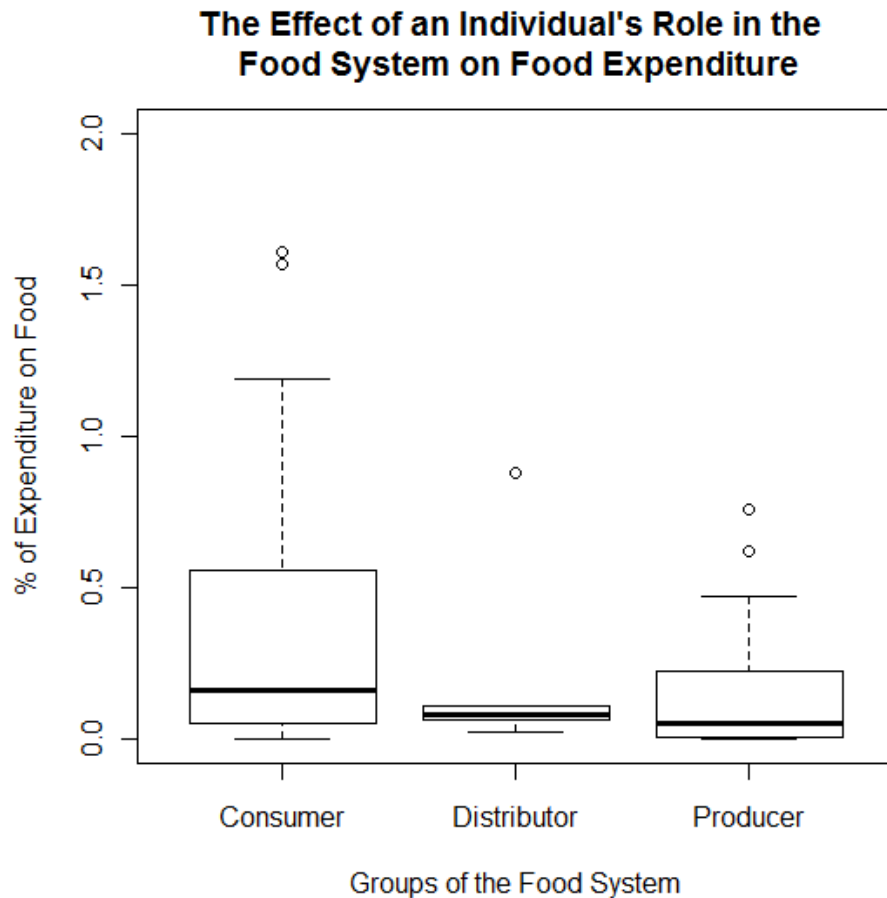


Fig. 3. The Effect of an Individual's Role in the Food System on Net Food Expenditure (n=92). The data is expressed as a fraction of Total Income equating 1.0 to 100% and 2.0 to 200% respectively.

I found that no two groups ($F(2,84)=.1306$, $p=0.8778$) showed any significant trend in the percentage of expenditure spent on food. However, being a consumer ($M=0.4700$, $SD=0.9389$) versus a producer or distributor did significantly affect the percentage of expenditure on food by an individual. Those who were distributors ($M=0.2300$, $SD=0.3663$) or consumers ($M=0.4400$, $SD=1.3066$) spent a little more and little less on food respectively.

Ration card use

Those who did not use ration cards spent on average 20% more on food as a percentage of their income (Fig. 4).

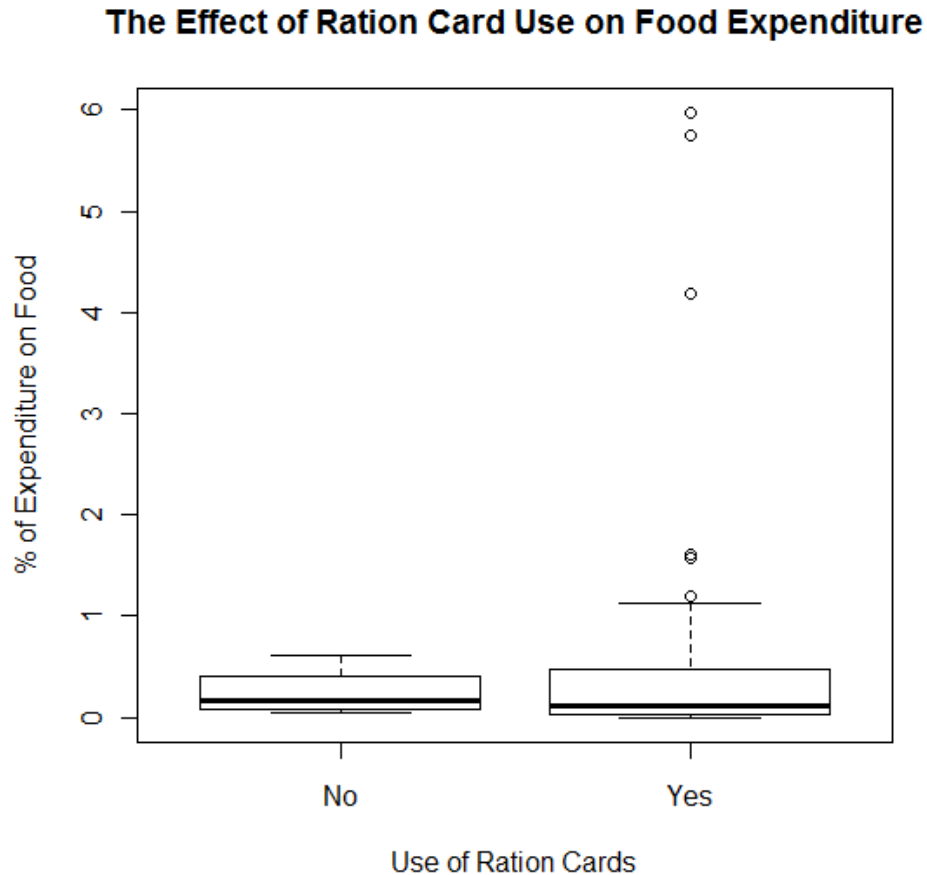


Fig. 4. The Effect of Ration Card Use on Net Food Expenditure as a Percentage of Total Income (n=92) expressed as a decimal

There was no significant difference ($F(1, 90) = 0.1584, p=0.6916$) in the percentage spent on food by those who had ration cards ($M=0.4500, SD=0.9964$) and those who did not have ration cards ($M=0.2500, SD=0.2565$). Those who had ration cards spent on average 45% on food versus those who did not spent on average 25% on food as a percentage of their total income.

DISCUSSION

Vadamanappakkam's food system is similar to food systems in surrounding villages. There are three primary players in the food system – producers, distributors, and consumers – who depending on their role show characteristic patterns of expenditure on food (see “Role in the Food System” section for complete details). My survey shows that access to food in

Vadamanappakkam was minimally impacted by different economic and social factors such as income levels, education levels, role in the food system, and the use of ration cards. This is likely because most communities value food as a basic necessity and therefore, it is a top priority for most individuals as it ensures their survival. Compromising food spending seems to be a last resort option for most families (Behrman and Deolalikar 1987, O'Brien et al 2004).

Income level

Increased incomes exponentially decreased expenditures on food as a percentage of a villager's total income. However, the notion that increased wealth increases food security cannot be linearly correlated. The ability to purchase food is undoubtedly increased by individuals having more money to spend on food (O'Brien et al 2004). However, often in agricultural societies like Vadamanappakkam, access to food is limited by factors like the accessibility of the village to other major cities that are points of trade and exchange (Adelman and Dalton 1971).

Perhaps of greater significance is the misconception that increased incomes leads to purchasing food that is "healthier" and more nutritious (Behrman and Deolalikar 1987). "Healthier" foods would include a more distributed pattern of food purchases across the food pyramid. Villagers would buy larger quantities of fruits, vegetables, grains, meats, milk and minimal quantities of oils and sugars. In Vadamanappakkam, it was quite evident that those individuals who had significantly lower incomes did not generally buy as much dairy products or fresh produce – two significant food groups that contribute to healthy diets (Behrman and Deolalikar 1987, O'Brien et al 2004). Interestingly, those surveyed expressed a stronger preference to spend on meats over dairy products and fresh produce despite the significant expense it caused for many. This may be due to structural shifts in diets with traditionally vegetarian societies moving towards non-vegetarian diets for a variety of reasons including adoption of Western culture, renunciation of religious strictures, and perceptions of food choices that most aided in physical labor (Huang and Bouis 1996). However, the most important feature binding the various explanations for the effect of income on food expenditure is ultimately the personal value placed on food as a basic need and the concurrent attitudes that each individual has towards purchasing foods (Furst et al. 1996).

Education level

Education levels to a large extent did not affect food expenditure except in the case when heads of households did not have any education as it strongly indicated a lack of technical skills that would provide increased wages. For producers, those who had completed up to secondary or higher levels of education pointed to higher farm productivity which may be because of access to different and more appropriate agricultural practices (Lockheed et al. 1980). Consumers and distributors were also perhaps more informed actors in the food system because of basic skills that were provided by their primary level education such as writing, reading, and fundamental mathematical skills (Behrman and Wolfe 1982).

Factors that could have affected education patterns include gender and cultural norms. In the households surveyed, women were seen as the key decision making entity within households including decision made about food purchases. However, head of households for which education levels were measured were generally for the eldest male of the household. This disconnect between those who were generally responding to the survey and the women who made the decisions about food purchases decreases the certainty of the impact education levels have on food purchases. At best, the education level of head of households may be treated as a proxy for education levels experienced by all individuals in that household which in turn would validate any data received on food purchases. Therefore, despite the significance education levels may have on producers and distributors food expenditures, education levels of head of households were not as indicative of consumer choices by the women and consequently, food expenditure patterns by consumers from this study (Lockheed et al 1980, Behrman and Wolfe 1982, Huang and Bouis 1996). Fundamentally, education levels by themselves cannot be seen as a singular indicator of food expenditures. Rather, a combination of gender, values, and education may provide a more accurate assessment.

Role in the food system

The most pronounced effect of differences in food expenditure resulted from the varied roles in the food system. Consumers, compared to producers and distributors, spent a larger percentage of their income on food purchases as they are at the end of the food system chain with

no buffering capacity against external influences, such as food prices, on food expenditure patterns (Parry 1990).

Specifically in Vadamanappakkam, the agricultural industry was characterized by large export-oriented units such as grains, rice, wheat, etc. Few individuals grew vegetables and far less claimed to be self-sufficient off their land. Essentially, limited crop varieties along with local labor shortages and lack of small-farm production created opportunities for distributors to control the prices of a majority of consumable goods (Tacoli 2003). Furthermore, it allowed them to keep those food products they themselves needed without incurring a large loss to their income.

Producers, on the other hand, were highly dependent on market prices to determine the success and value of their crops for any given year (Parry 1990). Especially in Vadamanappakkam, producers grew crops that are encouraged by the national government to be grown in surplus so as to provide subsidized food to rural populations through ration stores throughout India (Sarma and Gandhi 1990, Kapila 2009). By doing this, not only did they prevent themselves from becoming self-sufficient, but also were playing to highly volatile market demands from around India (Kapila 2009). As a result, their income highly fluctuated and in turn, expenditure on food as a percentage of their income varied immensely.

Consumers, unlike producers and distributors, had the misfortune of being subject to both the market and natural constraints faced by producers as well as the whims of distributors who could inflate prices of food products to consumers for no apparent reason. With limited options of buying food in Vadamanappakkam, most individuals would have to go to these vendors.

For those with higher incomes, these incremental changes would not have a great impact on the percentage of their income they would spend on food. However for those with lower incomes, this would be quite significant and financial implications for these household would be far greater and beyond the scope of this paper (O'Brien et al 2004).

Use of ration cards

The use of ration cards was not significant as most individuals in this food system were provided with basic food supplies by the public distribution system (PDS) mandated by the Government of India. The public distribution system is a food security program that subsidizes major commodities, including food, for lower income families, especially in rural India (Sarma

and Gandhi 1990, Shashidhar and Kumaraswamy 2009). In Vadamanappakkam, almost every single household surveyed had a ration card that was used regularly. Only 4 individuals did not have ration cards of which two were in the process of applying for one and the other two had lost theirs. Therefore, there can be no isolated conclusions drawn from this variable. However, it is important to consider the alternative where no food subsidies existed for any rural population in India. In such a case, villagers from Vadamanappakkam would have spent a significantly larger percentage of their income on food as they would need to purchase everything at full value (Sarma and Gandhi 1990, O'Brien et al 2004).

Additionally, the allocations of food commodities through the public distribution system are consistent throughout India disregarding regional indigenous food consumption patterns (Shashidhar and Kumaraswamy 2009). In the surveys conducted, of those who used the ration system, roughly 90% of individuals purchased additional rice – a dietary staple of South Indian cuisine. Vadamanappakkam's population profile is undoubtedly rural. However, with the wide range of poverty levels, most of Vadamanappakkam's population fall just above the poverty line and therefore, many low income families are subject to the same allocations as those in higher income brackets. As a result, food security which is supposed to be guaranteed to the vulnerable populations is not accurately granted by this system to no fault of the local population (Rao 2008, Shashidhar and Kumaraswamy 2009). Moreover, this system only provides access in the traditional sense where food is "made available". The ability to purchase these foods is completely independent of this program and can be better addressed through employment policies targeted towards the purchasing power capabilities of rural populations (Rao 2008).

Limitations and future directions

An isolated case study of rural agriculture, the findings in Vadamanappakkam must be assessed relative to its limitations. Specifically, conducting this survey as part of a larger study, I and the team had very limited intentions of analyzing rural agricultural patterns. As a result, key factors like gender were not analyzed. Moreover, the food system in Vadamanappakkam is not as static as it is assumed to be for the simplicity of analysis. In fact, there are traveling vegetable, fruit, and meat vendors that are constantly traveling through the village at different times of the year adding another layer of complexity to this system. Perhaps a more randomized and stratified

sampling by both income and role would have been more appropriate for this research than just income levels.

However, Vadamanappakkam can be used as an example of rural agricultural system in this region as the political, economic, and social forces interacting with one another are quite similar. Again, to extrapolate such studies to larger populations comes with newer variables that must be adequately assessed. Despite these limitations, Vadamanappakkam serves as a clear example of what localized assessments can provide for understanding the larger agricultural system in India and its implications for global food markets.

Broader implications and conclusions

Understanding regional trends in rural agricultural consumption patterns are important when formulating specialized government policies and protections for such vulnerable populations. Moreover, if more localized studies are conducted, population responses to the possibility of reduced yields and increased food costs can be better assessed (Parry 1990, Rosenzweig et al. 1993). Especially with recent global food shortages and increased food prices, there is a high possibility for rural food insecurity to undermine the ability of India to continue importing food for large populations (Parry 1990, O'Brien et al. 2004). With a growing global agro-industry, it is imperative that the impacts of changing food systems in India are understood (O'Brien et al. 2004). More fundamentally, domestic trends and long-term food security must be effectively evaluated to understand its implications for both the local and global population (O'Brien et al. 2004). By looking at Vadamanappakkam as a simple case study for localized assessment of food security, other regions may follow suit and allow for a more thorough understanding of domestic food security in India (Parry 1990, Rosenzweig et al. 1993, O'Brien et al. 2004). Appropriate policy measures, specifically those guiding the public distribution system, may then be taken to promote domestic food security and in turn sustain the demands of the global agro-industry (O'Brien et al. 2004).

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