Mismatch of farmer practices and consumers' attitudes: The use of chemical pesticides in vegetable production in Sri Lanka.[1]

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Abstract

While production of high value vegetables are increasing worldwide, concerns on adverse health and environmental effects of pesticide use in agriculture are also increasing. The concern that farmers use excessive amounts of pesticides leading to health hazards to consumers and pollution of environment through accumulation of excess chemicals in soil and water bodies is common among environmental groups in Sri Lanka too.

The objectives of this study were to study trends of pesticide use by vegetable farmers and to understand perceptions and attitudes of urban vegetable consumers on the impact of pesticide use on their health and their awareness on potential remedial measures. Data from seasonal reports of cost of cultivation of agricultural crops were used to analyze changes in pest and disease control practices by farmers. Trends of input use related to pest and disease control were studied using aggregate farm budgets. A primary survey was conducted among 150 semi-urban households to learn about attitudes and perceptions.

Findings indicate that the percentage of farmers adopting pest and disease control methods has increased. However, contrary to the popular belief and findings of some studies of over-use of pesticides by farmers, this study reveals that the cost shares, real cost of material, used in pest and disease control in vegetables have declined over time. Consumers in the contrary believe that farmers use excess amounts of pesticides. A contingent valuation survey found that consumers are willing to pay premiums for higher quality vegetables. Although they like to consume pesticide-free vegetables their opinion is that the existing information is insufficient for them to differentiate vegetables during purchasing. The study proposes to develop appropriate extension and action research methods to closely work with farmers to understand and disseminate best practices on environmentally friendly methods of pest control.

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1.0. Introduction

Vegetables are considered as high value crops in all agricultural economies. The practice of growing vegetables indicates diversification from growing subsistence crops and generates higher net incomes to farmers. On the consumers' end, availability of vegetables at affordable prices provides diversity of diets and is a good source of vitamins and minerals in the diet. Agricultural marketing systems have evolved to handle vegetables that are a highly perishable commodity. These systems together with production activities support livelihoods of millions of farmers and market participants in agri-food sub systems of many economies.

Despite the growing importance of vegetables as a produce to farmers and demand from consumers, it is widely believed that vegetable farmers use extensively chemical means of pest and disease control. Some studies have reported extensive use of pesticides by farmers. These findings have cautioned consumers on their modes of consumption of vegetables. It also have studies alarmed policy makers of environmental pollution and health hazards associated for users and consumers of products.

Understanding of the trends of pest and disease control measures by farmers and attitudes of consumers on current modes of production and potential changes in consumption that would signal producers is therefore an important exercise. This study was conducted with objectives of a) to understand the current pattern of vegetable production in Sri Lanka with respect to land use by different crops and regions, b) to understand changes in material use and costs in pest and diseases control in selected vegetables over time, and c) to consumer attitudes towards current practices of production and their willingness to pay a premium if quality of vegetables are improved in an anticipated direction. We hypothesized that consumers consider vegetables grown without pesticides as preferred and thus are ready to pay a premium price. This scenario was offered in a contingent market as actual markets of certified pesticide-free vegetables are not found in Sri Lanka to enable us to use revealed preference methods in estimating premiums paid. Stated preference methods are the appropriate method in estimating the willingness to pay for pesticide-free vegetables over the vegetables produced using conventional modes of production.

This paper is organized into five sections. This introduction will follow a section to present an overview of the vegetable production in Sri Lanka. The third section will ddescribe the data sources used and the theoretical basis and methods of non-market valuation methods used to estimate consumers' willingness to pay a premium for higher quality vegetables. The subsequent section will present and discuss results to show current patterns of vegetable production and changes in pest and disease control measures. The final section will conclude.

2.0. Vegetables in Sri Lanka: An overview

Products that are considered as vegetables in Sri Lankan context largely vary in descriptions of production and consumption. Inclusion of vegetables in analysis of consumption patterns are based on "what is consumed", while production side descriptions are based on mode of production irrespective of how the end product is used. This difference may be emanating from the culinary perceptions on Sri Lankan diet that is mainly rice based.

Rice meals in Sri Lanka are usually prepared by boiling non-sticky *indica* types of rice with water and then consumed together with vegetables or fish/meat cooked in coconut milk or tempered with oil. Vegetables in this context are referred to any plant based product that can be prepared to make a dish giving required structure that can subsequently be consumed with rice. Included in the category of vegetables in consumption side presentations are field vegetables proper, produce from trees, mushrooms, leafy vegetables, grain legumes, and forest products. Yams and tubers are also used to prepare similar dishes but exact share of these products used in similar preparations are not known. For example Sri Lanka Department of Census and Statistics (DOCS) follows a method based on mode of final consumption. Department of Agriculture (SLDA) on the other hand reports extent and production of vegetables based on type of production. SLDA however includes red pumpkins that are always consumed in row form similar to fruits. In this study we consider in both production and consumption ends only vegetables proper. They are defined as produce grown under field conditions requiring frequent crop management practices and are consumed as cooked or in row from.

In Sri Lanka, field vegetables are cultivated in highland areas with or without irrigation or in lowlands (rice fields) under irrigation. The most common practice is to grow vegetables in highlands under rain-fed conditions during the major cultivation season spanning from October to March. This season also coincides with the northeastern monsoon that brings the larger share of annual precipitation in the dry zone areas. In many areas vegetables are cultivated in paddy lands during yala season, the minor cultivation season that spans from May to September. Although the historical practice was to grow vegetables under rain-fed conditions during the major cultivation season, year-round cultivation of vegetables under irrigation using large diameter agro-wells has become a widespread practice beginning mid-1980 (Kikuchi et.al. 2003). Total annual area under vegetables has fluctuated in the region of 62 to 72 kha during the period of 1981-2009 (Figure 1). Although a continuing trend of increasing area is observed since 2005, this data is not sufficient to conclude on the continuity, as similar cycles of changing total area are observed earlier.

Vegetable cultivated in the country are broadly included in two groups based on the altitude of major areas of cultivation as a) up country and, b) low country. Geographical considerations include areas in the Central Highlands, (of altitudes 308m amsl) as up country areas. This geographical demarcation however does not coincide with administrative divisions and three districts in the Central Province and areas of adjoining districts that has similar climatic conditions are considered as up country. Vegetables that are predominantly grown in three districts of the Central Province (Kandy, Matale, and Nuwaraeliya) and in high elevation areas of Badulla and Ratnapura are classified as up country vegetables. It should be noted that large areas of four districts other than Nuwara Eliya falls in low altitude areas while some vegetables classified as up country are grown in low country areas too. A more relevant classification perhaps can be exotic versus traditional vegetables. Exotic vegetables are those introduced by the Europeans after the 16th Century and are predominantly grown in up country areas and are subsequently identified as up country vegetables. Traditional vegetables are those appeared to exist in the country over a longer period of time and are referred to in historical sources as used even several centuries ago.

3.0. Data and Methods

This study uses both secondary data and primary data. Secondary data came from two major sources as, a) Department of Agriculture (SLDA), and b) Department of Census and Statistics (DOCS). Data from the Socioeconomic and Planning Center of the Department of Agriculture were used in analyzing trends of total area under vegetables, and shares of area under different vegetables and groups for 2008/09 cultivation year. Data from Cost of Cultivation of Agricultural Crops, a bi-annual publication of SLDA were used to compute changes in total cost of production and share of pest and disease control by cultivation season for 2004 and 2009. Data on consumption side were available from Income and Expenditure Survey of the DOCS. Data from these sources were used mainly in graphical and tabular analysis of trends and current status.

This study also uses in the contingent valuation study, data collected through a sample of randomly selected semi-urban households on attitudes on pesticides use in vegetables and the willingness to pay of households of a premium price if vegetables are produced without pesticides. A contingent valuation component was a key requirement in this study as observable markets to conduct a revealed preference study to determine consumers' differential valuation of two commodities, i.e. conventionally produced and quality enhanced/"pesticide-free" vegetables were not available in the market. A hypothetical market was created to estimate the mean premium willing to pay by consumers for higher quality vegetables. This was the only tool at our disposal and contingent valuation survey was planned and conducted following the procedure by Carson (2000). We describe briefly the theoretical framework and the procedure to conduct a contingent valuation survey.

The indirect utility function of a representative consumer shows changes occurred as a result of his/her consumption of higher quality vegetables. In the context of the study quality of vegetables are considered higher if they are grown pesticide-free, and consumers get higher satisfaction if "pesticide-free" vegetables are consumed. In this representation, superscripts 'o' denote a situation that the consumer has access to conventional vegetables, and 'h' to denote the situation if pesticide-free vegetables are available for consumption. The values of indirect utility functions are the same in both situations, and are written as,

$$v(P, G^h, m - WTP) = v(P, G^o, m) \quad (1)$$

where, $G^h \geq G^o$ and indicates a situation where higher quality "pesticide-free" vegetables are available, m is monetary income, and P is a vector of parametric prices. Availability of higher quality vegetables can be considered desirable if changes in the value of the indirect utility function are positive with respect to increase of the j^{th} vegetable, such that for the j^{th} vegetable, $(\partial V / \partial e_j > 0)$.

Alternatively, the WTP can be defined using the expenditure function of the individual.

$$WTP = m\left(P, G^o, u\right) - m\left(P, G^h, u\right) \quad (2)$$

when, $u = V\left(P, G, m\right)$, assuming that the situation with the availability of conventionally produced vegetables is described first, the WTP is the amount of income an individual would give up to make him or her indifferent between the two situations-consuming conventional vegetables, and consuming "pesticide-free" vegetables. Income is initially at level *m* and the availability of vegetables is at G^o. Once the new quality of vegetables are increased to the level G^h, the individual gains utility from the opportunity to consume improved quality vegetables, his or her WTP is the situation in comparison to the proposed alternative.

In estimating willingness to pay through stated preference methods, various elicitation formats, such as open ended questions, bidding games, payment ladders, or referendum methods, are used. Single bounded dichotomous choice (SB-DC) format is the most widely used referendum method. In conducting a SB-DC survey, the sample is selected randomly. This sample will be divided to sub-samples of equal size. Number of sub-samples will be equal to the number of elements of the previously decided bid vector. Each member in a sub-sample is asked if they would agree to pay the value assigned to them if improved quality of the good in question is available. The bid can be specified as an absolute payment of as an increased percentage of the current price. Responses are recorded in binary format.

A respondent will answer "yes" only if his/her true willingness to pay is equal or greater than the bid presented to him/her. Lower-bound of the mean willingness to pay for the population of interest is estimated using the following the non parametric approach to

estimate WTP used by Kristrom (1990). This method based on empirical survivor function. In this method, the distribution-free estimate of mean WTP is obtained by area bounded by the NSF. This is calculated using,

$$\bar{\mu} = (\hat{WTP}) = \sum_{m=1}^{m+k} \eta_m [B_m - B_{m-1}]$$

(3)

Where, η_m is the proportion of respondents agreed to pay the bid presented for the m^{th} bid , and $B_{m+1} - B_m$ is the value difference between two successive bid values and k is any positive integer.

Survey

Survey was conducted in 150 randomly selected households in sub-urban areas of Galle District in southern Sri Lanka. Galle is a net consumption area of edible agricultural products although tea and rubber are grown as a plantation or smallholder crop in many parts of the district. From the consumption side administrative districts in Sri Lanka can be divided into two as major production districts and consumption districts. Consumption districts account only for a mere four percent of all area under vegetables (Table 2). Consumer survey was conducted in the southern district of Galle where only 2.4 percent of national annual area under all vegetables are reported as grown in 2008/09. Although some vegetables and tree-nuts originate from home gardens a large fraction of consumers purchase vegetables from nearby convenience stores to which supply chains are established from major production districts.

Respondents were randomly selected from three sub-urban residential areas of Galle. Interviewing consumers were done at home. A pre-tested survey schedule was used in the survey. Trained enumerators visited households on prior agreed times to interview the principal decision maker of food purchases. This method of interview was different than used by other researchers (McCuskey et.al. 2005, Abeywickrama et.al 2010), who interviewed purchasers of food items at the point of purchase. We were in the opinion that this mode of interviewing is more comfortable to respondents so more informed decisions can be made. We interviewed the principal decision maker of the household as any increase

in the price of a commodity included in the consumer basket has implications on the household's consumption expenditure.

After a series of questions on pattern of vegetable purchase, the principal CV question was offered. We selected two vegetables with different market prices to examine the relative effect on current price on the decision to pay a higher price for higher quality vegetables. The vegetable variety was randomly assigned to respondents at the first stage. A one half of the respondents were assigned the question on green beans and the rest the question on brinjals (egg plant). These two vegetables also account for the largest share of expenditure (Table 3). Prices of two selected vegetables always have shown a ratio of 2:3 with green beans having a consumer price about 50 percent higher than that of brinjals. This selection therefore facilitates an investigation of the impact of base price on the premium willing to pay. The bid vector included five elements, as 10, 20, 30, 40, and 50 percent premiums over the current price. Value of the premium was assigned randomly to $1/5^{th}$ of the sample. Responses were recorded in binary format.

4.0. Results and Discussion

4.1. Regional shares of area under vegetables

We present in Table 1 annual areas under different vegetables and their respective shares in the area under major group and that in all area under vegetables. In 2008/09 about 72,000 ha of vegetables were reported in the country. The shares of low country and up country vegetables of the total extent under vegetables are respectively 0.57 and 0.43. About two-third of area under low country vegetables are under three vegetables, brinjals (egg plant), ash plantains, and okra, while two most widely grown up country vegetables, green beans and carrots, accounted for almost a half of all area under up country vegetables.

Table 2 shows the regional shares of annual area under vegetables in 2008/09 cultivation year. Five districts in and around the Central Highlands, where up country vegetables are predominantly grown, account for 0.47 percent of all area under vegetables. Low country dry zone districts excluding districts in the Northern Province covers 39 percent of annual area under vegetables. Districts in the north only accounted for 10 percent of the area under vegetables during this year. The share of Northern Province in total area

under vegetables however is expected to rise during the no-terrorism regime as rehabilitation and reconstruction activates will bring back large areas under cultivation. The table also shows that wet zone districts accounts for a mere three percent of total areas under vegetables indicating the minor role played by wet zone districts vegetable production currently.

4.2. Patterns of consumption

Monthly household consumption quantities of vegetables by major vegetable category are presented in Table 3. Data for this analysis comes from SLDCS's 2006/07 Household Income and Expenditure Survey that is the latest available data source for national level household consumption data. The table indicates that Sri Lankan households on average consumed about eight kg of vegetables per month. They consume 4273 g and 4023 g of low country and up country vegetables respectively. Brinjals reports the highest level of consumption of low country vegetables while green beans is the up country vegetable with the highest consumption and the vegetables with highest consumption quantity for all vegetables. ll Monthly consumption quantity of green beans is almost twice as high as the quantity consumed of cabbages, the up country vegetable with the second highest consumption level.

The same table presents expenditure data for individual vegetables and their summation over major categories. Although consumption quantity for all low country vegetables is higher than that of the up country vegetables, household expenditure for the latter group of vegetables is higher. This indicates that unit consumer prices for up country vegetables are higher than that of low country vegetables. Although, capsicum, a low country vegetable, reported the highest unit price, four up country vegetables reported prices over 70.00 SLR/kg while only capsicum in the category of low country vegetables reported prices above 70.00 SLR.

4.3. Patterns of cost of production and pesticide use

Using data from Cost of Cultivation of Agricultural Crops that publishes seasonal data we compared total costs of production, and share of plant protection costs in total costs

of production for selected vegetables for two seasons for cultivation years 2003/04 and 2008/09. It was the expectation based on popular claims by the press that farmers tend to increase use of pesticides over the years. Table 4 presents total cost of production of vegetables per acre per season. All values are presented in 2004 constant values so changes in costs can be compared. Table 4 also shows that changes in total cost of production in constant 2004 values for vegetables that has data available through published sources. It is evident that the total cost of production for all vegetables except for tomato and carrots have decreased. The magnitude of decrease in percentage terms vary by season and by vegetable. A special note on the price deflator needs attention. We were unable to use a standard deflator due to current non-availability of such a suitable series due to changes in methods and base years and discontinuation of publishing popular series of Colombo Consumer Price Index. We therefore used the series of producer prices for respective vegetable to create indexes for each vegetable.

Table 5 presents data on percentage of farmers that adopted pest and disease control measures in 2004 and 2009 by season for selected vegetables. Vegetables included in this analysis too are based on published data by the SLDA. For vegetables included in the table, percentage of farmers adopting pest and disease control has increased to 100 percent except for pole-beans under rain-fed regime. This indicates that prevalence of the use of pest and disease control measures have increased during the period under consideration. Changes in magnitudes should be interpreted with caution as SLDA uses small samples in reporting cost of cultivation data.

Increases in adopting cost of control measures do not indicate necessarily an increase in the use of chemicals in this operation. In Table 05 we also present the shares of a) material cost in pest and disease in total cost of pest and disease control, and b) share of total cost of pest and cost control in total cost of production, for two years studied by season and by vegetable. As the table indicates, share of materials in total cost of pest and disease control is non increasing for all vegetables in both seasons. This share is decreasing for all vegetables except pole-bean under rain-fed regime. It should be noted that this share for cabbages is larger than all other vegetables. Share of pest and disease control in total cost of

production also has decreased with the exception for brinjals, cabbages, and pole-beans in maha season.

These data therefore suggest contrary to the popular belief on increasing use of pesticides in vegetable production, a decrease in use of materials and overall costs in yala season for all vegetables and for some vegetables in maha season. Share of material costs has increased for cabbages and brinjals for maha season. However these increases in shares are small. Although pole-beans under rain-fed regime has registered an increase, this observation is puzzling as data for adoption of pest and disease control measures are decreasing and this exception should be investigated further.

4.4. Consumers' willingness to pay for Quality vegetables

Table 6 presents results of the contingent valuation survey to estimate mean premiums willing to pay if higher quality vegetables are available. Vegetable quality is expected to be improved through production of "pesticide-free" vegetables. Sixty-four percent and 59 percent of respondents for brinjals and green beans respectively agreed to pay a premium price over the current base price if improved quality vegetables are available. These responses sums to an overall percentage of 59 indicating that the majority of respondents value the availability of better quality vegetables and are willing to pay a premium price. These data are used to calculate mean premium willing to pay for each group of respondents.

Using Kristom (1990), non parametric survivor function approach, the mean premium for brinjal is calculated as 27.92 percent while that for green beans is 31.05 percent. Both estimated means were within the range of the elements in the bid vector. As these estimates are distribution free and consistent, they can be transformed into average price increases for brinjals and green beans respectively as 127.92 SLR/kg and 197.58 SLR/kg. It can be concluded that high quality green beans will fetch higher prices than high quality brinjals but the price ratios will be slightly reduced from current 2:3. This effect is consistent with the economic theory as current higher prices for green beans are expected to result in lower percentage of respondents agreeing to pay the suggested premium.

As consumers are willing to pay for high quality vegetables, and it can be assumed that there will be no resultant changes in quantity demanded, increasing prices can be transferred to producers. Transportation costs will remain unchanged as the quantity will remain unchanged. It can be expected that higher production costs to account for labor in "pesticide-free" production of vegetables can be compensated with higher producer/farmgate prices.

5.0. Conclusions, Policy implications and limitations of the research

It can be concluded for this analysis that total cost of production in constant values for a large majority of vegetables have decreased. Although use of pest and disease control measures are more widespread today among farmers than five years ago, share of costs of pest and disease control in total costs has largely remained unchanged. On the consumers' side, demand for high quality "pesticide-free" vegetables exist. Therefore, the need to study in detail the current practices in pest and disease control by farmers and the potential to change such practices to meet consumer expectations while maintaining production is imperative.

Policy implications arising from this research should be considered as indicative as both production side and consumer survey information have originated from small samples. Further research using large and more focused approaches are required to arrive at sound conclusions. Involvement of farmers through action research is needed to understand the dynamics of pest and disease control methods while conclusions from consumers' side should be improved using more focused work.

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Table 1: Area under vegetables and shares of major vegetables and vegetable groups in area under vegetables 2008/09.

Vegetable and group	Annual Area (ha)	Share in group	Share in total area
Low Country			
Brinjall	10,762	0.26	0.15
Ash Plantain	8,449	0.21	0.12
Okra	7,230	0.18	0.10
Bitter Gourd	4,170	0.10	0.06
Capsicum	3,287	0.08	0.05
Snake Gourd	3,167	0.08	0.04
Cucumber	3,092	0.08	0.04
Ash Pumpkin	976	0.02	0.01
Total Low Country Vegetables	41,133	1.00	0.57
Up Country			
Beans	7,910	0.25	0.11
Tomato	7,137	0.23	0.10
Cabbage	4,016	0.13	0.06
Raddish	3,342	0.11	0.05
Carrot	2,896	0.09	0.04
Beet Root	2,693	0.09	0.04
Leeks	1,680	0.05	0.02
Knolkhol	1,435	0.05	0.02
Total Up Country Vegetables	31,108	1.00	0.43
All Vegetables	72,240	-	1.00

Data Source: SLDA 2011

Notes: Red Pumpkins excluded as it is used mainly as a desert.

Table 2: Shares of districts of annual extent under vegetables 2008/09.

	Extent in "000" hectares	Region Share
Up Country	34	0.47
Low Country Dry Zone	28	0.39
North	7	0.10
Other Wet Zone	3	0.04
Sri Lanka	72	1.00

Data Source: SLDA 2011

Notes: Red Pumpkins excluded as it is used mainly as a desert.

Table 3. changes in total cost of production 2004 to 2009 by season and vegetable

		(2)			
		2004	2009	change	Percentage change
Maha Season					
Brinjal	Irrigated	58479	52383	-6096	-10.42
Polebean	Irrigated	69679	62207	-7472	-10.72
Tomato	Irrigated	73217	89967	16750	22.88
Polebean	Rainfed	48042	43611	-4431	-9.22
Cabbage	Irrigated	74868	72428	-2440	-3.26
Yala Season					
Polebean	Irrigated	65671	64286	-1385	-2.11
Tomato	Irrigated	76219	86642	10423	13.68
Cabbage	Irrigated	82980	73576	-9404	-11.33
Carrot	Irrigated	78939	94630	15691	19.88

Data Source: SLDA cost of Cultivation of Agricultural Crops.

Table 4: Pest control measures, and cost shares 2004 and 2009

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Maha		2003/04					2008/09						
Brinjal	Irrigated	93	58479	10658	0.18	0.71	100	104354	17930	0.17	0.72	-0.01	0.01
Polebean	Irrigated	86	69679	5851	0.08	0.71	100	122709	8485	0.07	0.68	-0.01	-0.03
Tomato		97	73217	16127	0.22	0.65	100	144985	26118	0.18	0.62	-0.04	-0.03
Polebean	Rainfed	100	48042	4397	0.09	0.65	94	86028	7632	0.09	0.66	0.00	0.01
Cabbage		90	74868	16923	0.23	0.61	100	134045	15387	0.11	0.64	-0.12	0.03
Yala		2004					2009						
Polebean		97	65671	5549	0.08	0.69	94	126812	8021	0.06	0.65	-0.02	-0.04
Tomato		97	76219	15353	0.20	0.67	98	139626	23285	0.17	0.60	-0.03	-0.07
Cabbage		97	82980	12530	0.15	0.73	100	136170	11786	0.09	0.68	-0.06	-0.05
Carrot	Irrigated	97	78939	7412	0.09	0.72	100	151707	10302	0.07	0.64	-0.02	-0.08

Column Headings

(1) and (6): Percentage farmers adopted pest and disease control methods
(2) and (7): total cost of production in SLR/ha in current values
(3) and (8) total cost of pest and disease control SLR/ha in current values
(4) and (9) share of material cost in total pest and disease control cost
(5) and (10) share of pest and disease control in total cost of production
(11) change in share of cost of materials in total cost of pest and disease control cost in total cost of production between two seasons
(12) change in share of total cost of pest and disease control in total cost of production between two seasons

Data Source: SLDA. Cost of Cultivation of Agricultural Crops

Table 5: Household consumption of vegetables in Sri Lanka: by major group

Vegetable	Monthly household consumption (g)	Monthly expenditure (SLR)	Consumers' Price (SLR/kg)
Low Country			
Brinjal	955	48.25	50.52
long beans	657	31.96	48.62
okra	420	20.93	49.81
ridge gourd	345	17.17	49.77
snake gourd	304	13.60	44.71
Ash plantain	284	14.08	49.49
bitter gourd	276	17.71	64.06
kekiri	240	6.87	28.66
elabatu	207	10.90	52.63
capsisum	197	15.58	79.01
cucumber	196	7.23	36.94
Wing-beans	161	9.99	62.03
ash pumpkin	29	1.01	34.76
other veg	-	14.85	-
Total Low country	4273	230.13	
Up Country			
beans	1352	103.21	76.33
cabbage	640	36.94	57.72
carrots	576	43.78	76.03
beetroot	461	30.09	65.25
leeks	399	28.11	70.53
raddish	277	11.21	40.49
tomato	252	18.05	71.73
knol khol	123	5.94	48.17
Total Up Country	4079	277.33	
All vegetables	8352	507.46	

Source: Household Income and Expenditure Survey 2006/07

Note: Included are field vegetables only.

Table 6. Point estimates of non parametric survivor function

Vegetable	Brinjals, base price = 100.00 SLR/kg			Green Beans, base price = 150.00 SLR/kg		
(1) Bid Value (B_i)	(2) Number of respondents (h_m)	(3) Number of responses "Yes" (g_m)	(4) V_j [a]	(2) Number of respondents (h_m)	(3) Number of responses "Yes" (g_m)	(4) V_j [a]
00.0	na	na	1.00 [b]	na	na	1.00 [b]
10.0	14	11	0.82	17	14	0.79
20.0	12	8	0.71	17	12	0.67
30.0	13	7	0.65	17	11	0.54
40.0	18	8	0.50	12	6	0.44
50.0	14	5	0.43	14	6	0.36
Total						

Source: Urban Consumer Survey-2011

Notes:
[a] Point estimate of Non-Parametric Survivor Function (g_m/h_m)

[e] Assuming everyone answers "yes" if the bid value is zero

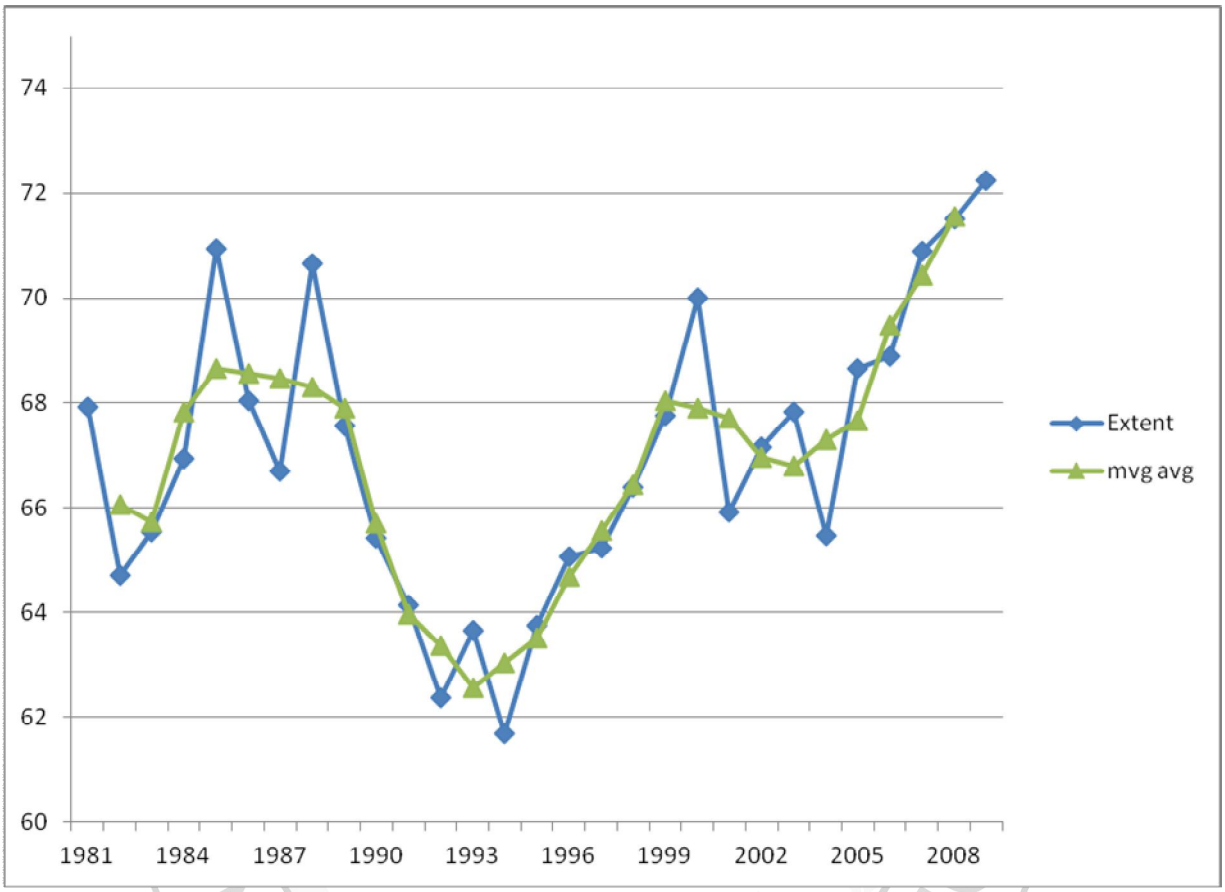

Figure 1: Patterns of change in annual land extent under vegetables 1981-2009

Area under vegetables is in ha is in Y axis.

Data source: Department of Agriculture

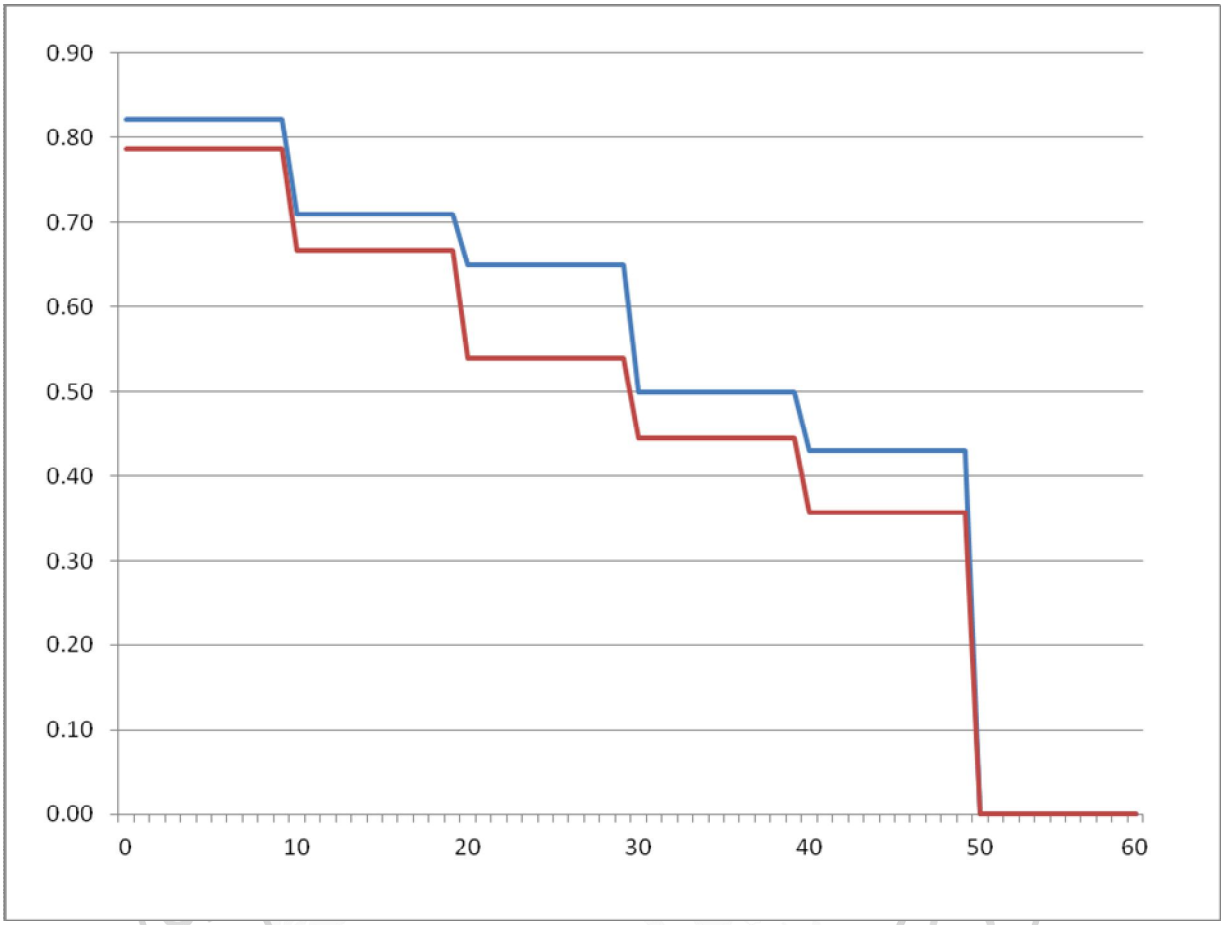

Figure 2: Non-parametric survivor function for premium green beans and brinjals

Premium bids (percentages) are in X axis. Proportion of respondents agreed to pay in Y axis.

NSF for brinjals is on top

Source: Urban consumer survey 2011.