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Agricultural Supply Response in Fiji

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Agricultural Supply Response in Fiji[1]

Phillip Hone[2], Henry Haszler[2] and Tevita Natasiwai[3]

Abstract

The agricultural sector is a central part of the Fiji Islands economy. Policies to alleviate poverty and stimulate economic growth need to be based on a sound understanding of the local agricultural systems involved. This understanding needs to extend to the responsiveness of production to price changes. To date there have been no published quantitative estimates of the responsiveness of agricultural supply in Fiji to output price changes. In this paper we present a set of highly disaggregated supply elasticities covering many of the major food crops produced and consumed in Fiji. These results have been derived from a stated intention survey of rural households. The results appear consistent with the dual nature of Fiji's agricultural sector and show that agricultural supply response in Fiji is own-price elastic for the ten commodities analysed.

Key Words

Stated intention survey, agricultural, supply elasticities, developing country

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Background

The agricultural sector is an important part of the Fiji Islands economy. It represents a significant part of national GDP and directly contributes to the incomes of a substantial proportion of the population – especially in the case of some of the poorer people. As the figures in Table 1 show, the incidence of poverty is much greater in the rural than urban areas and in general is higher for Indo-Fijians than for other ethnic groups. In recent years the economic performance of rural enterprises in Fiji has suffered from declining prices for key commodities and disruption in land tenure arrangements for sugarcane growers. The end result has been a crisis in the financial outlook for those dependent on the rural sector.

Table 1: Incomes and Poverty in Fiji: Results from 2002-03 Household Survey

Group	Annual Household Income (F$)			Population Poverty Incidence (%)		
	Rural	Urban	All Fiji	Rural	Urban	All Fiji
Fijians	11,082	16,539	12,972	38	27	34
Indo-Fijians	9,653	13,593	11,902	43	29	36
Others	11,066	21,877	19,105	41	17	24
Average	10,559	15,267	12,753	40	27	34

Note: The exchange rate on 23 January 2008 was roughly A$1 = F$1.35 or F$1 = A$0.74.
Source: FIBoS (2008), *2007 Facts and Figures*.

The ability of the agricultural policy community to respond to the challenges facing Fiji is impaired by a lack of basic information about the sector. Information on current incomes is relatively scarce and projections of future incomes are difficult. Models to forecast the likely consequences of the current market disruptions and the impacts of possible alternative policy regimes designed to deal with these problems are not well developed. Similarly, basic economic information concerning the supply of agricultural production is missing. For example, there are no published estimates of supply response to food price changes. Therefore, policy makers have little idea about the extent of the changes in food production and prices – both levels and mixes - that could be expected to occur over the medium term. This is particularly important given the rural to urban drift of the population and the high proportion of family incomes that poorer people spend on basic foods.

There is a substantial literature on agricultural supply response but little of this is directly relevant to the situation in Fiji. Country and time specific data on supply elasticities are needed to ensure analysis based on such parameters will be reliable and relevant. The nature of the farming system within which agricultural production decisions are made in Fiji is likely to differ from the systems in other countries. Similarly, the various farming systems may have changed other time with changes in technology and resource constraints.

There are no published estimates of supply elasticities for food crops in Fiji and limited data on comparable production systems in other countries. Fleming and Hardaker (1986) analysed supply

response in a number of South Pacific countries, but not in Fiji. They found that the export supply of bananas and taro – or dalo in Fiji – from Western Samoa was quite elastic in the longer run (bananas 2.1 and taro 2.8). The short run elasticities were markedly lower at 0.6 for bananas and 0.4 for taro.

Fleming and Hardaker also estimated domestic supply functions for root crops in Tonga. Their results showed that the supply response of root crops tended to be highly sensitive to the level of prices. In low price periods they reported a negative response to price changes while there was a positive response when prices were relatively high. The apparent perverse response in low price periods was explained as a reflection of the dominance of small producers who were focusing on income targets. The higher the price, the less these families needed to sell to achieve their income target to cover things like school fees and family obligations. In higher price periods commercial motives tended to dominate supply decisions and the supply functions were positively sloped. At relatively high prices they found the supply of taro was inelastic but the supply of cassava and yams were both elastic.

In addition, Fleming (1999) estimated supply elasticities for copra, cocoa, coffee and palm oil in Papua New Guinea. He found the supply of all these commercial tree crops was inelastic in both the short and long-term. Similarly, Rosegrant *et al* (1998) report inelastic long-term supply elasticities in Indonesia for rice, corn, cassava and soybeans, which can be and are also grown in Fiji.

Unfortunately the presumption has to be that the policy relevance for Fiji of these earlier estimates is questionable given they relate to other countries and were based on data from up to 30 years ago.

The objective of the research reported here is to develop a set of own-price elasticities of supply for a range of the important individual food items produced and consumed in Fiji and reflecting price response under current conditions. In subsequent research it is planned to extend the analysis to include important generic food groups such as “Other Fruits” and “Other Vegetables” and to disaggregate the results by the overall degree of commercialisation of rural households.

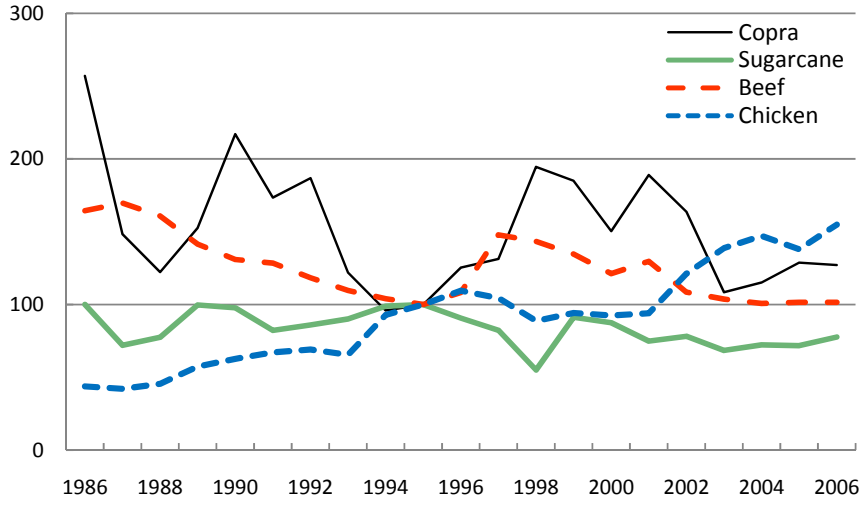
Conceptual Framework

There are a number of ways supply elasticities can be estimated. The most obvious is to summarise past responses econometrically by estimating supply systems using historical data – generally, but not always, using time series data. Another is to develop a supply response model based on an optimising framework and to derive the elasticity estimates through simulations of the model – for example, see Singh *et al* (1986).

We have taken neither path. The estimation of time series models is precluded by the absence of reliable data (see Walton, 2002). For example, the interpretation that can be placed on the production data is unclear. Individual crop data frequently relate largely to commercial production and exclude much of the subsistence production for home use which is an important component of total production of most food crops. Moreover, the basis of collection has changed overtime so the consistency of data is questionable. A selection of the available official production and price data is

presented in Appendix Tables 1 and 2. There is considerable variation in both production and prices as can be seen from Figure 1 which shows index numbers for some of the production series.

Figure 1: Annual Production of Selected Rural Commodities: Fiji (Indexes 1995 = 100)



We use a stated preference technique. We surveyed rural food producing households and asked them how much they produce of each of a range of products and how that production would change if prices were to fall. In particular, we asked households to indicate their choke price for each product – that is the price at which they would stop producing that item. From this information we derive implicit household product supply curves for each item. We then derive household and product specific supply elasticities that can be averaged or aggregated up to market supply elasticities.

Consequently our method is to use an essentially non-parametric approach to implicitly derive individual demand elasticities from stated preference data gathered in a producer/household survey.

The general form of the own price elasticity of supply is given by the following:

$$\varepsilon = \frac{\partial Q}{\partial P} * \frac{P}{Q} \qquad (1)$$

Where: ε = own price elasticity of supply for some good x

Q = quantity of good x supplied

P = farm gate price of good x

Rearranging (1) gives the elasticity in terms of prices:

$$\varepsilon = \frac{P}{\frac{\partial P}{\partial Q} * Q} = \frac{P}{\Delta P} \qquad (2)$$

Where: ΔP = the difference between the current market price and the threshold price or price intercept of the supply curve.

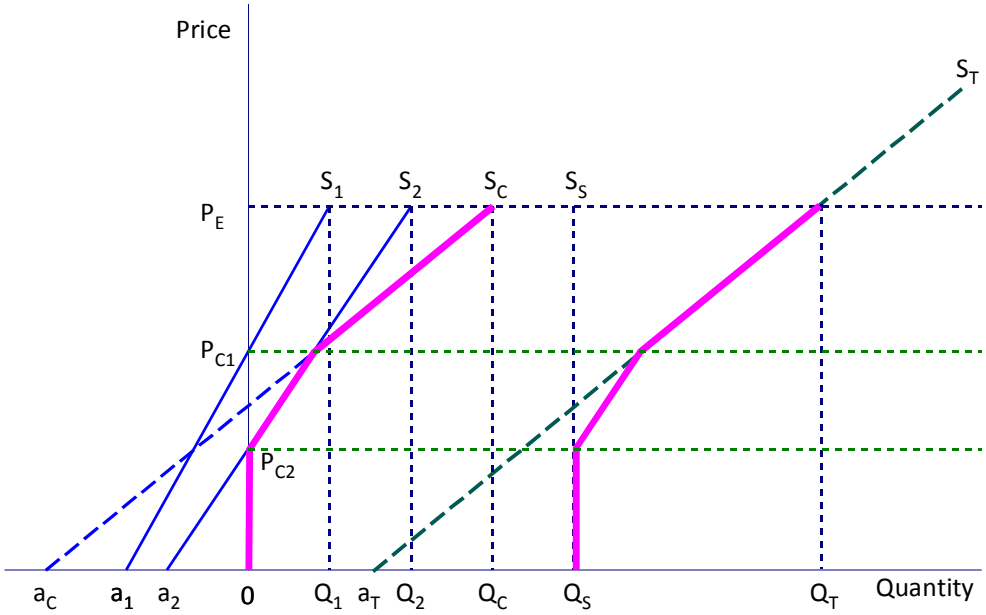
Under the assumption of approximate linearity, the individual producer's own-price supply elasticity is completely identified from knowledge of the existing market price and the change in price that would be necessary to induce the producer to cease production of the good. This threshold – or choke – price is effectively the lower limit on the opportunity cost of resources in the production in the good for that particular producer and can be obtained directly in a stated preference sense by surveying producers of food. The market price is usually easily obtainable from official data or can be collected from each respondent. In our survey, producers were asked to recall and list market prices received by – or familiar to – them as a means of self-referencing their stated production responses, thereby helping to allow for any quality differences in production between producers.

This survey approach to estimating elasticities employs contingent valuation techniques widely used in the environmental economics literature and has the distinct advantage that it does not require possibly questionable time series data sets. It also has the advantage of generating supply elasticities based on current circumstances rather than on some average set of circumstances potentially extending to a long time in the past. Ideally of course the "current circumstances" should be reasonably "normal" if the estimated elasticities are to have a reasonable shelf life. The stated preference method does rely on the assumption that the individual supply curves are at least approximately linear and suffers from all the well known reservations attached to the CVM approach to valuation (see Hanemann (1994) for a discussion of these issues).

The supply system that is assumed to underpin our approach is illustrated in Figure 2. Assume there are three rural households engaged in farm production. Two of these are "commercial" farming households in that they produce for market sale. One household is a subsistence producer – it produces only for its own use. The two commercial farm households are represented by their supply curves S_1 and S_2. The subsistence household is represented by its supply curve S_S which shows that subsistence production is Q_S regardless of the level of market prices. For each crop produced by each commercial household we obtain their choke price (P_{C1} and P_{C2}) and production for each crop they produce (Q_1 and Q_2) at the current market price P_E. We use the survey information on P_E, Q_1, Q_2, P_{C1} and P_{C2} to estimate the supply curves S_1 and S_2 for each household. There is no choke price for the subsistence household because, as noted already, it produces Q_S regardless of price.

The supply curves for each commercial farm derived from the survey responses can be summed in the usual way to generate the aggregate commercial supply curve Sc. The addition of subsistence production Q_S to S_C generates the total supply curve S_T. In the case of S_C its intercept a_C is the sum of the intercepts a_1 and a_2 of S_1 and S_2. Similarly the slopes of S_C and S_T are identical and equal to the sum of the slopes of S_1 and S_2. The aggregation procedure shown in Figure 2 will result in a non-continuous or kinked function with as many kinks as there are households with differently sloped household functions.

Figure 2: A System of Implicit Supply Curves



The supply elasticities we estimate here are intended ultimately as inputs to an agricultural policy simulation model for Fiji. So our primary concern is to obtain estimates of the market elasticities at the points where P_E intersects S_C and S_T. Our intended approach is to estimate the relevant market elasticities and then to derive the functions making up the simulation model by imposing an appropriate functional form onto the elasticities. This procedure is analogous to the more conventional time series approach under which functional forms are imposed on the data and elasticity estimates are then derived from the estimated equations.

Data and Estimation

The data for the reported elasticity estimates were collected in a 2007 survey of rural food producing households in Fiji. The survey was a quasi-random sample. For our sampling frame we used the survey list from Fiji's Household Income and Expenditure Survey (HIES) undertaken over 2002 and 2003 which itself had been based on the distribution of households in the 1996 Census[4]. Narsey (2006) provides a description of the HIES and summarises some of its results.

To be included in our survey, households had to have sold any one of a number of farm products and/or to have indicated their involvement in subsistence food production in 2003[5]. The HIES identifies a total of 20 agricultural and fisheries products including cassava, dalo, rice, bananas, pineapples, poultry, sugarcane and, of course yaqona – the base of Fiji's national drink, kava. We

[4] Another advantage of using the HIES frame is that it opens up the possibility of data matching.

[5] The urban component of the HIES was conducted over March 2002 to February 2003 while the rural survey covered the period May 2003 to April 2004. As Narsey (2006, p1) explains, the urban and rural components of the HIES had to be split because of funding constraints related to the political events of 2000.

attempted to select statistically adequate samples of households which had produced the "smaller" crops in 2003 while leaving it to the sampling as a whole to bring up sufficient numbers of households growing major crops such as cassava and sugarcane.

The sample was stratified by statistical division and in selecting the sample we sought to cluster households to reduce travel costs. We were also mindful of including adequate numbers of Fijian and Indo-Fijian households because earlier research by Tubuna *et al* (2007) had indicated differences in the farming systems applicable to the two groups. For financial reasons we did not include households from the more remote outer islands but households from isolated areas on Viti Levu and Vanua Levu were surveyed. The survey also covered the island of Kadavu as it is an important location for commercial yaqona production. The survey data were obtained in face to face interviews conducted by staff from the Fiji Islands Ministry of Primary Industries.

Details of the originally drawn sample of 929 households are summarised in Table 2 below. These data suggest the sample is broadly consistent with the geographical and ethnic distribution of rural households and also with their agricultural commodity focus.

Overall, the HIES sample represents 2.7 per cent of rural households. The sampling fraction for Fijian households is slightly lower than the average while that for "Other" ethnic groups is somewhat larger. Our sample of 929 households represents a 1.1 percent sample of the population. Broadly speaking our sample sizes are about 40 percent of the respective HIES samples. However, Indo Fijian households are underrepresented in our sample. This is because our sample contains seemingly "too few" Indo-Fijian households from the Western Division for the reason that Western Division sugarcane producing households are relatively underrepresented. Nevertheless, we consider the sample of 52 Western Division sugarcane producers is sufficient for statistical purposes.

Interim Results

The elasticities reported here show medium term responses under certainty. Respondents were asked to consider a scenario with a guaranteed medium term price rather than an immediate change in price of uncertain duration. The results of the analysis are summarised in Table 3 below.

The estimates reported in the Table represent the output from an interim stage of the overall research designed to obtain market level elasticities of supply. The estimates presented here should be treated as preliminary mainly because they are based on essentially raw survey data. In addition, the individual household data have not yet been calibrated to a single representative market price – that is P_E in Figure 2 – and have not yet been weighted by their sample weights. However, the estimated household elasticities have been winsorised to reduce the impacts of outliers on the mean elasticities.

Table 2: Selected Details of Rural Sample (No. households)

Item	Central Division (a)		Northern Division		Western Division		Total Fiji (a)		
	HIES	Sample	HIES	Sample	HIES	Sample	Total Population	HIES	Sample
Ethnic Group									
Fijian	687	336	271	197	376	171	51,282	1,334	704
Indo-Fijian	53	21	210	103	583	84	30,631	846	208
Other	19	1	25	15	6	1	1,756	50	17
	759	358	506	315	965	256	83,669	2.230	929
Commodity Earnings (b)									
Cassava	187	120	10	10	84	59	10,582	281	199
Dalo	1	1	17	17	0	0	716	18	18
Rice	218	161	108	93	59	52	15,781	385	306
Sugarcane	0	0	63	31	306	52	13,128	369	83
Yaqona	218	134	131	109	51	45	16,196	400	288
Bananas	91	67	5	5	58	49	5,559	154	121
Pineapples	16	12	5	5	6	6	1,062	27	23

(a) Eastern Division included in Central Division. (b) Households reporting earnings from the products shown.
Source: Personal Communication, Toga Raikoti, Fiji Islands Bureau of Statistics, October 2006.

Winsorisation is a procedure that falls under the heading of Robust Statistics (Olive 2007) and refers to the formalised editing or transformation of outliers in statistical data sets. In its simplest form, winsorisation would involve setting all values above and below critical values to equal the critical values. The critical values might be defined by some percentile value. Winsorised means are less affected by outliers than raw means and – compared with trimmed means, for example – are based on the whole sample rather than just a component of it. Winsorisation appears to be a reasonably common procedure. For example the procedure has been used by the Australian Bureau of Statistics in its Household Expenditure Survey (go to www.abs.gov.au and search for "winsorised").

In our case, we have winsorised the derived elasticity values rather than the source data on which they are based. In principle the values of the household elasticities can range widely – from negative values (the peasant effect) to zero (pure subsistence production), and then to a range of positive values extending even to infinity (when the current price equals the choke price). Our main problem at this stage has been with a few households for which the elasticities appear to be very large and in some cases even infinite. The winsorisation procedure enabled us to keep these households in the calculations at elasticity values that are both arithmetically tractable and – we believe – plausible.

Table 3: Estimated Own-Price Elasticities of Supply: Selected Commodities: Fiji (a)

Item	Cassava	Dalo	Rice	Coconuts	Sugarcane	Yaqona	Bananas	Pawpaws	Pineapples	Bele
All Reporting Households										
Weighted Mean (b)	1.59	1.95	2.29	2.48	2.52	2.99	1.25	1.76	1.32	1.11
Mean	1.49	1.81	1.22	1.42	2.55	2.51	1.01	1.14	0.90	0.77
Standard Error	0.06	0.07	0.48	0.18	0.28	0.17	0.07	0.16	0.16	0.10
RSE %	4.07	3.83	39.73	12.91	10.90	6.87	7.16	13.85	17.30	13.05
95% Confidence Interval	0.12	0.14	0.95	0.36	0.54	0.34	0.14	0.31	0.30	0.20
Median	1.45	1.67	0.00	1.07	1.65	1.67	1.07	0.00	0.00	0.00
Mode	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skewness	0.97	0.86	3.23	1.21	2.40	1.68	0.65	1.23	1.49	1.32
Price Responsive Households										
Weighted Mean (b)	1.89	2.34	10.19	3.01	3.34	3.91	1.84	1.94	2.58	2.15
Mean	2.06	2.28	4.52	2.67	3.45	3.55	1.96	2.37	2.51	2.29
Standard Error	0.06	0.07	1.50	0.23	0.33	0.20	0.07	0.19	0.22	0.12
RSE %	2.86	2.93	33.24	8.63	9.63	5.63	3.35	7.84	8.77	5.33
95% Confidence Interval	0.12	0.13	2.94	0.45	0.65	0.39	0.13	0.36	0.43	0.24
Median	1.67	1.83	1.11	2.00	2.43	2.52	2.00	2.00	2.00	2.00
Mode	1.50	1.67	1.09	1.33	2.43	11.25	2.00	2.00	3.00	2.00
Skewness	1.66	1.34	1.11	0.80	2.31	1.70	0.99	1.42	1.01	1.31

(a) Outlier values excluding zero values but including apparently infinite elasticities are winsorised to values equal to the means plus two standard errors of the distributions of the unadjusted values of the raw elasticities greater than zero but excluding the infinite values. (b) Weighted by household production but not sample weights.

The winsorisation rule used here was to truncate the top elasticities at values equal to the means plus two standard errors of the distributions of the unadjusted values of the raw elasticities greater than zero but excluding the infinite values. If the distributions were normal, the procedure would cut off only the top 2.5 percent of the distribution of the unadjusted raw estimates[6]. As indicated in Appendix Table 3, for the individual commodities the winsorisation ranged from a low 5 percent (cassava) to a high of 24 percent (rice) and averaged 6 percent over all the elasticity estimates.

Strictly speaking our elasticities are not directly comparable with estimates published elsewhere because ours are individual household, not total market elasticities. That said, the results from our sample appear to be reasonably consistent with the Fleming/Hardaker (1986) estimates for bananas and dalo in Western Samoa – despite the differences of time and country. In fact, our elasticities for bananas and dalo for price responsive – ie non-subsistence – households fall quite close to the long-run values reported in the earlier study. For those commodities the similarity is even closer given that the Fleming/Hardaker estimates are export supply elasticities. And like Fleming and Hardaker's estimates for Tonga, our estimates indicate that agricultural supply in Fiji is own-price elastic.

Table 4: Ethnicity Related Differences in Elasticities (a)

Commodity	All Fiji	Fijians	Indo-Fijians	t value	Significant Difference (b)	
					95%	99%
Cassava	2.06	2.05	2.16	-6.43	Yes	Yes
Dalo	2.28	2.21	2.96	-40.34	Yes	Yes
Rice	4.52	13.69	2.99	11.50	Yes	Yes
Coconuts	2.67	2.43	2.99	-6.02	Yes	Yes
Sugarcane	3.45	3.71	3.38	2.84	Yes	Yes
Yaqona	3.55	3.56	3.28	3.07	Yes	Yes
Bananas	1.96	1.95	2.02	-2.59	Yes	Yes
Pawpaws	2.37	2.34	2.41	-0.82	**No**	**No**
Pineapples	2.51	2.85	1.74	11.33	Yes	Yes
Bele	2.29	2.34	2.23	2.18	Yes	**No**

(a) Ethnicity based on ethnicity of the head of household or "Person 1". (b) Test of the significance of the difference between two sample means using a two tail test. See Karmel (1963, p 98). Sample statistics not adjusted for winsorisation of the elasticities.

Aside from the Fleming/Hardaker comparison, our elasticities appear to be relatively high compared with the values reported by Fleming (1999), Rosegrant *et al* (1998) and values used in some world level partial equilibrium models. One example is the SWOPSIM model used to inform the policy debate for the Uruguay Round trade negotiations (see Roningen and Dixit 1989; Kirby *et al* 1988).

[6] As an interim ad hoc measure we excluded any negative elasticity values thrown up by the arithmetic because on the basis of casual observation the negative values seemed to be the result of yet-to-be-corrected data input errors.

The data for that model included 33 countries/regions and 22 commodities represented by 638 medium-term supply elasticities. Of these elasticities – admittedly mostly for temperate zone products – only two were greater than 1.0 (Sullivan et al 1992).

So far we have precluded the possibility of negative supply elasticities associated with the "peasant effect" reported by Fleming and Hardaker. However, we do find evidence of a dual production system, consistent with the results of earlier research for Seaqaqa Tikina – or District – on Vanua Levu in the Northern Division (Tubuna *et al* 2007). In particular, we find significant differences between the own-price responses of Fijian and Indo-Fijian households as shown in Table 4 above.

Table 5: Land Tenure "Plot 1": Surveyed Households

Household Ethnicity (a)	Freehold	NLTB Lease	Mataqali	Other Lease	Share-Cropping	Total
			– Percent of Households –			
Fijian	2.5	5.6	88.8	2.0	1.1	100.0
Indo-Fijian	30.7	46.7	5.0	17.6	0.0	100.0

(a) Ethnicity of head of household or "Person 1".

These differences are likely to be even more dependent on differences in the farming systems applicable to the two groups than on ethnicity *per se*. Most of the Fijian households in our sample – at least 89 percent – operate on Mataqali, or communal, land by customary right rather than under any formal lease arrangements and many Fijian households most probably follow a farming system characterised by a very low reliance on purchased inputs. The figure of 89 percent probably represents a lower bound because it is based on the tenure details for "Plot 1" which is usually – but not always – the largest of the various land plots farmed by a household. In comparison, as the figures in Table 5 indicate, only 5 percent of Indo-Fijian households seem to farm Mataqali land with the remainder all farming either freehold or formally leased land. Nearly 60 percent of the Indo-Fijian households farming under Native Lands Trust Board (NLTB) leases – of Mataqali land – grow sugarcane.

The highest values of the estimated elasticities are those for rice, coconuts, sugarcane and yaqona. The high values for rice and coconuts may just reflect the relatively small number of households in the sample that reported price responsive production of those items. But there may be more substantive reasons for the relatively high supply elasticities for sugarcane and yaqona.

Yaqona can be harvested after about a year but becomes more potent if left to mature in the ground for longer. In this sense yaqona is like a "bank account in the ground". That is the capital stock in the ground earns interest if left in the "bank". Because of the considerable flexibility in harvesting the crop, yaqona appears to be a particularly useful crop for meeting the family and social obligations – for example school fees and donations to the household's church – of subsistence and smaller commercial producers. Significantly, yaqona plays this banker role principally for Fijian households. Of the 190 households producing "price responsive" yaqona, only six were indo-Fijian households.

For their part, the relatively high elasticities for sugarcane may be a result of our sampling procedure. Our sample of sugarcane producing households may better represent mixed rather than specialist sugarcane farms. The mixed farms are likely to be on more marginal sugar country and at current prices already have profitable alternatives to sugarcane and are therefore likely to be more responsive to price changes [7]

In addition to these ethnic/farming system related differences, the estimated elasticities also differ by region as shown in Appendix Table 3. For all the possible pair-wise comparisons in the elasticities, there are significant differences between all the elasticities shown. As with the ethnicity related differences, these regional differences are also likely to reflect differences in farming systems.

The discussion so far has concentrated on the averages of the household elasticities. However, given that this paper is unusual in reporting individual household elasticities, some brief comments do need to be made on the distributions of the estimated values. The distributions for cassava, dalo and sugarcane are shown in Figure 3 above. The distributions for the three commodities shown – as for all the commodities – are positively skewed with that for dalo possibly the most uni-modal of the three shown. The overall distribution for sugarcane is clearly bi-modal and the figure helps "explain" the difference between the Western Division and the Northern Division elasticities. The modal elasticity for the larger number of Western Division sugarcane growers is around 1.75 while that for the Northern Division growers is higher at 2.75.

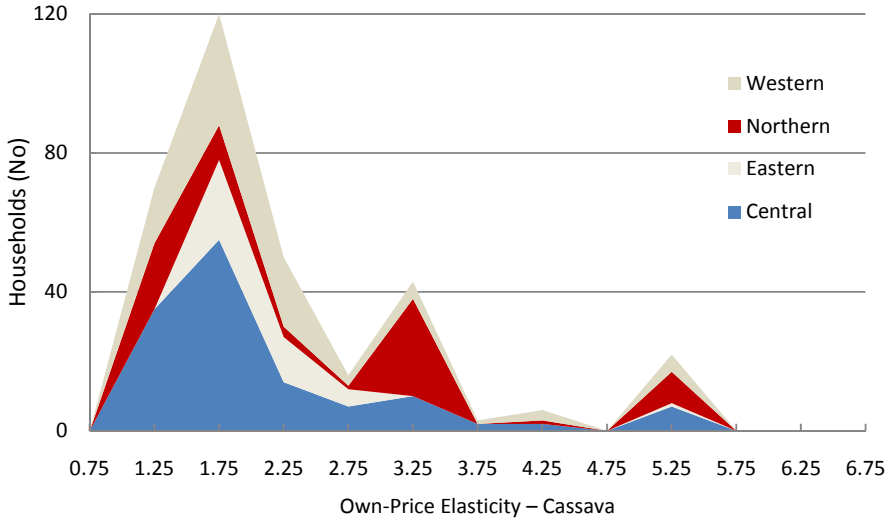
Concluding Comments

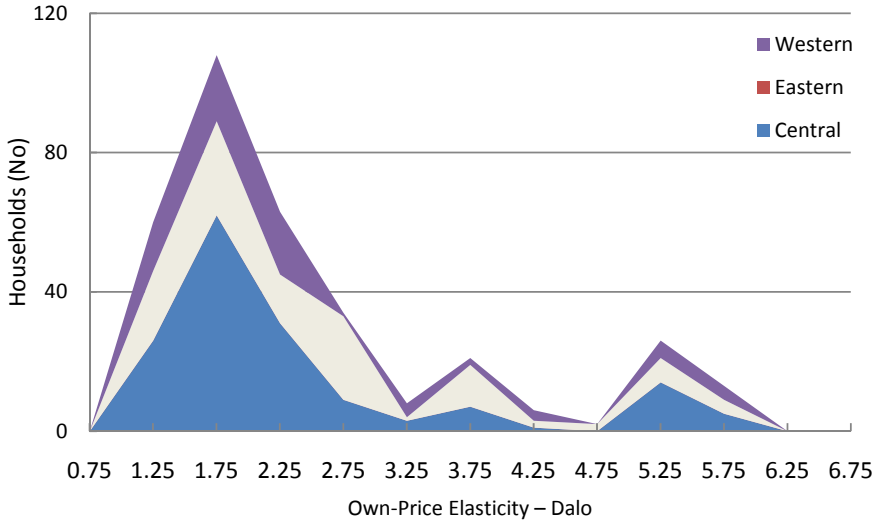
At this early stage of processing the survey information it would be premature to be drawing strong conclusions. But one technical conclusion does stand out. It is that while we did consider restricting to survey to Viti Levu to save time and costs, it was clearly appropriate to spread our sample reasonably broadly across Fiji.

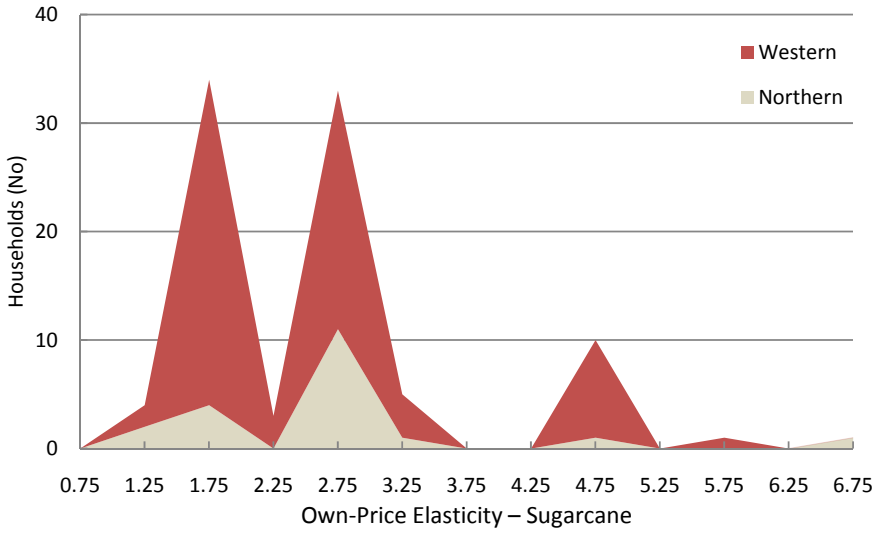
Contrary to our initial expectations, the elasticities reported here – medium-term elasticities – appear to be generally consistent with the levels reported by Fleming and Hardaker some 20 years ago. But perhaps this result is not surprising after all?

[7] The uncertain outlook for the industry in Fiji may also be a contributor. The recent reluctance of some traditional land owners to renew sugar leases is a significant factor behind the decline in sugarcane production since about 2000 (see Figure 1 and Appendix Table 1). In addition, the returns outlook for sugar is poor because of the changes to the EU's import arrangements – the "sugar shock" – due to cut in this year. In addition to being influenced by sugar returns, future levels of sugarcane production also depend on the returns for the substitute crops that can be grown on current sugar land. However, depending on world market conditions, the sugar shock may reduce the market returns for Fiji's sugar by about 30 percent below the current price of F$51 in 2007, that is to around F$35 per tonne. Based on the raw sample data, about 20 percent of the sugarcane producing households indicated a choke price above F$35 per tonne. That means that, according to the preliminary results from our survey, it is possible that Fiji's sugarcane production might, other things constant, drop by a further 20 percent as a result of the sugar shock.

Figure 3: Distributions of Selected Elasticities by Division







Much of Western Samoa's and Tonga's agriculture probably was then – and probably is still – based importantly on traditional farming on communal land. This is certainly still the case for a very significant part of Fiji's agriculture. So the similarities in elasticities may be the result of similarities in farming systems then and now. The fact that the elasticities reported here are higher than levels that have been used for largely temperate zone products may be attributable to the fact that a good deal of Fiji's agriculture relies on few if any purchased inputs. Given that and the availability of generally ample land – at least to the traditional owners –it is probably quite easy for households to modify production levels and switch between outputs.

Whatever the final judgement about the values of the elasticities, it is very clear from our estimates that the food production sector in Fiji is highly diverse. The present analysis supports the earlier conclusions of Tubuna *et al* (2007) that the agricultural sector of the Fiji Islands is essentially characterised by a dualism. This is based importantly on the differences in the land tenure systems applicable to Fijian and Indo-Fijian households but there are also substantial differences in the estimates for individual producers within each group. In addition there is a dualism in regard to the key cash crops produced – yaqona appears to be one of the prime cash crops for Fijian households while sugarcane is one of the dominant cash crops for Indo-Fijian households.

While acknowledging that generalisations can be dangerous, it seems the predominant features of Fiji's agriculture can be well enough captured by the phrase "Two ethnic groups, two farming systems and two cash crops".

For each individual crop considered here, we have divided the sample households producing the crop into pure subsistence and "price responsive" households. Considered over all their production, however, the exposure of rural households to the market will be one of degree rather than a simple dichotomy. Commercial producers will all produce some food for family consumption and most subsistence producers have at least some limited exposure to the market through the sale of surplus produce from time to time or through the provision of labour to commercial farms. We believe the own price elasticities of supply for food crops are likely to differ markedly between producers who – taking account of their *entire* production regime – might be classified as "commercial" and subsistence producers. The identification of these differences will be the subject of further research.

Overall, on the basis of our stated intention survey, we find agricultural supply response in Fiji to be own-price elastic, at least over the medium-term. The implications of this result are that the contribution of agriculture to the economic development of Fiji could be quite substantial under circumstances that help to improve the profitability of farming. Agricultural policies that help relax the resource constraints in the sector offer the potential for significant welfare gains for the community as a whole. In this regard, Fiji has much to gain from policies that help to resolve land tenure problems and the related problems in accessing credit, and policies that support targeted extension and R&D in an appropriate way and improve marketing efficiency.

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Appendix Table 1: Indicators of Rural production: Fiji (Index Numbers 1995 = 100)

Year	Copra	Ginger	Rice	Sugar-cane	Virginia Tobacco (a)	Beef (b)	Chicken (c)	Goat (d)	Pork (b)	Fish (e)	Eggs (f)
1986	257	249	133	100	215	164	44	85	85	57	77
1987	148	219	127	72	153	170	42	86	81	71	72
1988	122	168	174	77	106	161	46	86	70	75	71
1989	153	201	172	100	165	141	57	85	74	78	78
1990	217	248	174	98	176	131	63	87	80	77	84
1991	173	293	157	82	217	128	67	82	95	79	85
1992	187	206	122	86	205	118	69	90	94	78	96
1993	122	183	120	90	270	110	66	80	101	80	95
1994	96	208	97	99	200	104	93	95	110	97	98
1995	100	100	100	100	100	100	100	100	100	100	100
1996	125	108	94	91	157	108	110	101	105	80	110
1997	131	132	94	82	158	148	104	104	98	76	102
1998	195	102	28	55	123	143	89	109	103	80	159
1999	185	122	94	91	171	135	94	113	99	118	122
2000	150	163	71	88	230	121	92	117	118	121	124
2001	189	100	79	75	287	130	94	121	89	107	104
2002	164	148	69	78	175	108	121	126	86	119	105
2003	109	148	84	69	283	104	139	100	106	90	101
2004	115	166	78	72	100	101	147	150	119	132	105
2005	129	165	82	72	245	102	138	116	141	170	147
2006	127	145	69	78	234	102	155	118	123	142	137

(a) Excludes tobacco used for twist tobacco. (b) Production of slaughterhouses only. (c) Dressed and live, registered chicken abattoirs only. (d) Both subsistence and slaughterhouse production to 2003; from 2004 slaughterhouse production only. (e) Estimated catch inside Fiji waters but excluding subsistence catch. (f) Data revised from a conversion of 636g to 694g per dozen.

Source: Fiji Island Bureau of Statistics, *Key Statistics* (various issues).

Appendix Table 2: Retail Prices of Selected Foods: Fiji ($F)

Food Item	Units	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Stewing Beef	kg	4.41	4.17	4.16	4.43	4.63	4.76	5.11	5.35	6.21	6.70	7.13
Canned Beef	340 g	2.50	2.72	2.62	2.70	4.11	3.00	3.06	3.36	3.53	3.60	3.78
Mutton	kg	3.11	3.55	3.57	3.69	3.60	3.75	4.87	5.85	6.55	6.53	6.59
Carrots	kg	1.90	2.01	1.76	1.88	1.89	1.59	2.02	1.76	1.95	1.91	1.86
Tomatoes	kg	4.73	4.83	4.66	5.44	6.15	6.68	6.61	6.76	6.84	7.09	7.27
Full Cream Milk Powder	500 g	2.98	3.23	3.25	3.29	3.28	3.15	3.74	3.72	3.40	3.88	4.16
Onions	kg	1.10	0.84	0.85	1.12	0.85	0.68	1.10	0.92	1.17	1.00	0.94
Potatoes	kg	0.82	0.76	0.75	0.88	0.87	0.61	0.89	0.85	0.98	0.99	0.98
Rice	5 kg	5.49	5.91	5.63	6.63	6.47	5.32	5.16	5.14	5.49	5.35	5.50
Soya Bean Oil	750 ml	1.84	1.86	1.77	2.36	2.40	1.99	1.97	1.87	2.37	2.28	2.04
Wheat Flour	4 kg	3.62	3.67	3.57	3.78	3.61	3.12	3.64	3.82	4.05	3.96	3.99

Note: Simple averages of monthly prices for the Central, Eastern and Northern Divisions. Data for 2003 are the average of prices for 2002 and 2004.
Source: Personal communication, Fiji Islands Bureau of Statistics, 2007.

Appendix Table 3: Summary of Own-Price Elasticities by Division

Item	Cassava	Dalo	Rice	Coconuts	Sugarcane	Yaqona	Bananas	Pawpaws	Pineapples	Bele
Elasticities: Price Responsive Households										
Central Division (a)										
Mean	1.90	2.19		1.86		4.11	1.57			2.45
RSE %	3.7	4.4		13.2		7.7	3.9			30.8
Median	1.67	1.67		1.67		3.00	1.50			2.00
Northern Division										
Mean	2.54	2.40	4.52	2.78	5.98	2.63	2.00	2.48	2.54	2.34
RSE %	6.1	4.8	33.2	9.2	15.7	8.1	6.2	8.3	9.5	6.0
Median	3.00	2.00	1.11	2.00	2.55	2.13	2.00	2.00	2.14	2.00
Western Division										
Mean	1.99	2.28			2.39	3.39	2.18	1.62	2.38	1.91
RSE %	5.7	6.9			5.3	13.1	5.0	11.1	23.9	4.6
Median	1.67	2.00			2.32	2.50	2.00	1.67	2.00	2.00
Price Responsive Households (No.)										
Central Division	174	158	0	6	0	99	33	0	0	3
Northern Division	71	113	14	45	30	54	37	35	23	38
Western Division	85	70	0	0	71	37	51	5	6	6
	330	341	14	51	101	190	121	40	29	47
Significance of Mean Difference (99% Confidence) (b)										
Central – Northern	Yes	Yes	na	Yes	na	Yes	Yes	na	na	Yes
Central – Western	Yes	Yes	na	na	na	Yes	Yes	na	na	Yes
Northern – Western	Yes	Yes	na	na	Yes	Yes	Yes	Yes	Yes	Yes

(a) Central Division includes Eastern Division. (b) Test of significance between two sample means; see Karmel (1963) p 98. Sample statistics not adjusted for winsorisation of the elasticities.