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Expanding Agricultural Production in Tanzania

Scoping Study for IGC Tanzania on the National Panel Surveys

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Purpose and Aims

As agriculture accounts for a large share of employment, export earnings and even GDP in Tanzania, the sector is seen as a main vehicle in any national economic strategy to combat poverty and enhanced agricultural productivity is crucial to realize this objective. Despite this, there are no comprehensive studies of agricultural production and productivity using farm-level data in Tanzania. The National Panel Surveys (NPS) of 2008/09 and 2010/11 provide extensive data on some 3,280 farm households sampled throughout Tanzania, including information on area planted, quantity and value of harvest and input use (purchased and household) for a wide a variety of crops. Analysis of these panels offers the potential to provide insight on the determinants of productivity and supply response, in particular to identify factors amenable to policy influence that can provide effective incentives for farmers to increase production and efficiency. The basic aim of the scoping study is to assess the potential of analysing this data by describing and summarising the information.

Principal aims:

1. Detail and describe the available farm-level data on production, value and input use classified by principal crops and regions.
2. Establish the current status of output, yield and return (value of output) per acre by crop and regions.
3. Identify crops with growth potential in terms of output and productivity.
4. Show that appropriate data are available to estimate supply response and determinants of yield and production.

1 Context: Agriculture in Tanzania

After 50 years of independence, despite apparent commitment to policies and strategies to transform the agriculture sector, performance in agricultural output and productivity has been disappointing. Policies and plans, such as 'agriculture is the mainstay of the economy' and *Kilimo Kwanza* (agriculture first), have remained slogans to the public as there is so little experience of reforms that have improved livelihoods and millions in the agriculture sector remain in poverty. Tanzania is endowed with considerable fertile agricultural land and inland fresh water resources that can be utilized for irrigation, but much of the land is underutilized and what is utilised often exhibits very low productivity. In this sense Tanzania has yet to achieve the traditional 'structural transformation' whereby increasing agricultural production provides a platform for manufacturing and economic growth. Balanced growth is achieved if agriculture becomes increasingly commercialized while the manufacturing sector grows. Initially manufacturing may be based on agriculture, through processing and agri-business, but ultimately manufacturing and the economy will become diversified. This has not happened in Tanzania, and the economy remains essentially agriculture-based, mostly a peasant economy with low productivity. Understanding the factors that can expand production and enhance agricultural productivity in Tanzania is critical for ensuring 'structural transformation' and economic growth, boosting development and reducing poverty (given that the majority of the poor are in rural areas).

Some 80 per cent of Tanzanians depend on agriculture for their livelihood; the sector accounts for about 50 per cent of GDP and 75 per cent of export earnings. Consequently, the National Development Vision 2025, the main national development strategy in Tanzania, places considerable emphasis on the sector and envisages that by 2025 the economy will have been transformed from a low productivity agricultural economy to a semi-industrialized one led by modernized and highly productive agricultural activities that are integrated with industrial and service activities in urban and rural areas. Against this background, in the last decade a number of polices and strategies have been formulated to support agriculture in a more systematic way. The Agricultural Sector Development Strategy (ASDS) was adopted in 2001, and gave rise to the Agricultural Sector Development Program (ASDP) of 2005; and the Cooperative Development Policy (CDP) of 2002, complemented by a variety of sector policies. The strategy and the ASDP are embedded in the National Strategy for Growth and Reduction of Poverty (NSGRP), which is a medium term plan to realize Vision 2025. *Kilimo*

Kwanza (agriculture first), developed in 2009, provides additional inputs for the implementation of ASDP and other programs favourable for the agricultural sector. It is an assertion of the commitment of the government and the private sector to agricultural development, and it invites all Tanzanians to become part of this commitment. Its ten pillars support the ASDS and the ASDP and strengthen them by adding additional initiatives, in particular in rural finance.

The agriculture sector is therefore seen as a main vehicle in any national economic strategy to combat poverty, enhanced agricultural productivity is crucial to realize the objectives, and the policy statements have at least identified the issues and proposed a strategy. The ASDS emphasized the need to improve the efficiency of input markets and product marketing, increase access to credit, enhance the provision of extension services and increase investment in rural areas (especially for irrigation and transport). The ASDP was in principle the strategy to implement these aims, but had limited impact – the strategies were not a success. Thus, the culmination of these initiatives was the formulation of a belief in the need to 'reintroduce selective subsidies, particularly for agricultural inputs, machinery and livestock development inputs and services' (ESRF, 2005: xii). The second phase of the research, by providing some quantitative assessment of the importance of different factors (such as prices, access to credit and other inputs, access to markets and marketing) to output levels for the major crops, will contribute to understanding why the strategy has failed and providing recommendations of factors to target for an effective strategy.

Despite the CDP, the cooperative sector has failed to respond to the challenge of liberalization. The sector suffers from weak managerial (and advocacy) skills, a lack of financial resources (in particular undercapitalization of cooperative banks, so credit constraints remain), and a weak institutional structure (especially in that they are not accountable to members). Thus, although the cooperative sector remains significant it is not viewed as successful, either in supporting development and growth or in representing the interests of members, giving added impetus to liberalization initiatives.

Agriculture is recognized as integral to the Poverty Reduction Strategy, and agricultural sector growth is essential if Tanzania is to achieve sustained economic development. While this may seem somewhat obvious, it marks a change in emphasis – the whole sector (not only export crops) has attained a higher status on the policy (and political) agenda, and a view is emerging that there is a need for positive support to the sector. In this context, it is timely to attempt to assess the determinants of production and productivity in

agriculture using crop and farm level data. This scoping study aims to assess the types of productivity and supply response analysis that can be undertaken with the NPS data.

2 Overview of Agricultural Performance

There was some growth in agriculture, especially food production, in the latter half of the 1980s that contributed to increasing the income and welfare of rural households, and hence in principle to poverty reduction (World Bank 1994). However, this growth was not sustained beyond 1994 when the removal of all subsidies for agriculture was associated with stagnation if not decline in production as the large increase in fertilizer prices reduced use and hence yields, especially for maize and wheat (Skarstein, 2005). Production of maize and paddy are very sensitive to drought, which can reduce paddy production by up to half (Isinika et al. 2005, pp. 199-200). Although levels of maize and rice production did increase during the 1990s, low real prices and limited marketing opportunities meant that much of this was for household own consumption. Tanzania had strong economic performance over 2000-04 and although agriculture had lower growth rates than industry or services it made a larger contribution to GDP growth (World Bank 2006, p. 4).

Although there have been many studies of agriculture in Tanzania, there are no recent nationwide studies of production and productivity covering all major crops. As part of the World Bank project on Distortions to Agriculture in Africa (Anderson and Masters, 2009), Morrissey and Leyaro (2009) provided an analysis and discussion of the bias in agriculture policy in Tanzania over the period 1976-2004. They found that reforms implemented since the late 1980s have reduced distortions in agriculture, but certain crops (especially cash crops) have become less competitive due to serious deficiencies in marketing and productivity. Morrissey and Leyaro (2009) analyzed 18 products, covering about 80 per cent of the sector (in terms of value of output), classified as:

Cash crops (8 exports): coffee, cotton, tea, sisal, tobacco, cashew nuts, pyrethrum and beans (a non-traditional export).

Import-competing food crops (4): maize, rice, wheat and sugar. While maize and sugar often had exports, sometimes even net exports, net imports are the norm and tend to be significant.

'Non-traded' crops (6): cassava, sorghum, millet, Irish potato, sweet potato, cooking (green) bananas.

Morrissey and Leyaro (2009) implemented the Anderson *et al*. (2006) methodology to measure the Nominal Rate of Assistance (NRA) for individual products and Direct Rate of Assistance (DRA) for processing sectors. The basic principle underlying these measures is that the price received by producers (farmers or processors), adjusted to allow for taxes (subsidies), margins (marketing and transport) and exchange rate distortions, is compared to a reference international price. In principle, the result is an estimate of the difference between the domestic and world price (for a product at a comparable point in the supply chain), a non-zero wedge implying distortions. For the non-traded goods there is no reference international price and given data limitations distortions could not be measured.

The results for **maize** provide evidence of sustained negative assistance to producers, usually corresponding to a subsidy to consumers: farm-gate and wholesale prices tended to move in line with the reference import price but retail prices tended to remain below the import price. To some extent this overstates the actual distortions, as prior to about 1990 and since about 2000 maize farmers have been able to avail of some fertilizer subsidies. As fertilizer (when used) accounts for 30 percent of production costs on average and the subsidy amounts to 50 percent of the fertilizer costs (on average for those who get the subsidy), production costs would be reduced by 15 per cent on average. As margins are fairly low, this could largely offset the distortion in the 2000s providing real incentives for some maize producers. The results for **rice** are similar and producers able to avail of fertilizer subsidies may receive a net subsidy (in 2000-04). This is consistent with the observation that the share of rice in total production increased slightly whereas that of maize declined in the first half of the 2000s. **Wheat** is a much less important crop and although the negative distortions faced by producers appear to have been eliminated since 1990, retail prices were consistently above the import price and local prices for wheat appear to have grown significantly faster than prices for other cereals, few farmers grew wheat. This may be because of inefficiency in transport and distribution so the high marketing margin reduced the effective farm-gate price By the early 2000s there were no significant distortions against the major food crops, so one would expect to see a subsequent increase in output of maize and rice.

For cash crops, products with high estimated distortions appear to be those where there is limited competition and inefficient marketing or processing (cotton, tea and tobacco), whereas distortions are lower for those products where competition has been introduced and efficiency increased (coffee, cashewnuts and sisal). The level of distortion against agriculture remained reasonably high for all cash crops up to the early 2000s. Analysing time series data

over 1964-1990, McKay *et al* (1999) find that food crop production increased as prices relative to export crops increased, but aggregate export crop production was not responsive to prices. As producers seem to respond to the relative price and incentives for food crops compared to cash crops, with a high relative price elasticity for food crops (McKay *et al*, 1999), one expects increasing food production in the latter half of the 2000s.

Arndt *et al* (2012) use representative climate projections in calibrated crop models to estimate the impact of climate change on food security (represented by crop yield changes) for 110 districts in Tanzania. Treating domestic agricultural production as the channel of impact, climate change is likely to have an adverse effect on food security, albeit with a high degree of diversity of outcomes (including some favourable). Four different climate change scenarios are considered (the most favourable is 'wet' and the least favourable is 'dry') and the effects estimated for a projection to 2050 (Arndt *et al*, 2012, p 388). Under the 'wet scenario' agriculture output (in real GDP terms) could increase by 1percent, with gains for cereals, horticulture and export crops (only root crops decline). Under the other scenarios, however, agriculture output declines by 1.2percent to 12percent; the decline is about these ranges for cereals and export crops (lower in some scenarios, higher in others) and generally worse for horticulture (Arndt *et al*, 2012, p 388). Unless measures are undertaken now the most probable forecast of declines in agricultural output. The analysis points to the benefits of interventions that focus on irrigation and water collection/conservation measures and on crops that are less water intensive (Abrar *et al*, 2005).

Ahmed *et al* (2012) identify the potential for Tanzania to increase its maize exports as climate change scenarios suggest a decline in maize production in major exporting regions. Specifically, climate predictions suggest that some of Tanzania's trading partners will experience severe dry conditions in years when Tanzania is only mildly affected. Tanzanian maize production is far less variable than that of major global producers (no significant growth, but no large declines due to weather shocks), including compared to other SSA producers (Ahmed *et al*, 2012, p 403), so has scope to respond to the adversity other producers will face. However, as shown by Arndt *et al* (2012), Tanzania may itself suffer a decline in production. Addressing the reasons why production in Tanzania has not grown is crucial to create a production environment within which productivity can increase, and maize is a crop worthy of specific attention.

3 Data Measures and Definitions

The National Panel Surveys (NPS) are a series of nationally representative household panel surveys that assemble information on a wide range of topics including agricultural production, non-farm income generating activities, consumption expenditures and socio-economic characteristics. The 2008/09 NPS is the first in the series conducted over twelve months, from October 2008 to October 2009, and the 2010/11 NPS is the second and ran from October 2010 to September 2011 (the third round was scheduled to start in late 2012). Both the first and second rounds were implemented by the Tanzania National Bureau of Statistics (NBS) with a sample based on the National Master Sample frame, but are largely a sub-sample of households interviewed for the 2006/07 Household Budget Survey.

The 2008/09 NPS of 3,280 households from 410 Enumeration Areas (2,064 households in rural areas and 1,216 urban areas) was used to produce disaggregated poverty rates for 4 different strata: Dar es Salaam, other urban areas on mainland Tanzania, rural mainland Tanzania, and Zanzibar. The second round of the NPS revisits all the households interviewed in the first round of the panel, as well as tracking adult split-off household members to re-interview. For the 2010/2011 TZNPS sample design, a total sample size of 3,265 households were covered for 409 Enumeration Areas (2,063 households in rural areas and 1,202 urban areas).

The NPS data are collected and reported by plot (j) for household (i) and crop (c), recording inter-cropping and allowing for the long and short seasons. Most variables have to be calculated at the plot level as although over 40 percent of households have only one plot and fewer than 10 percent have more than three plots, most plots are used to grow more than one crop either by inter-cropping or sub-dividing the plot. Plot-level data are calculated and aggregated up to the farm (household) level. The descriptive statistics will mostly be presented at the farm-level (mean and median to capture the distribution of farm size) by crop and region.

The core variables for the descriptive statistics are:

Q_{Tic} = Total output quantity (typically in kgs) that can be broken down by sales (Q_S), post-harvest loss (Q_{PHL}), storage (Q_K) and own-consumption (Q_O, derived by deducting the previous three from Q_T).

V_{Sic} = Value of sales (in '000s of TShs)

P_{ic} = Unit value (farm-crop price, hereafter P) = V_{Sic} / Q_{Sic} (in TShs)

V_{ic} = Value of output is reported in the NPS as estimates by the farmer at the plot level. The estimates can be checked by calculating $P_{ic}.Q_{Tic}$ (in TShs)

A_{ic} = Area planted with crop c (derived from information on how much of a plot is planted with the crop and summed over plots for i)

A_{Hic} = Area harvested (in acres) summed over plots [note this can be less than total plot size, A]

H_{ic} = Harvested area share of crop c [calculated as A_{ic} / $\Sigma_i A_{ic}$] for use as a weight

X_{Pij} = purchased inputs (TShs), comprising fertilizer, pesticides, new seeds and hired labour, are reported at the plot level; $X_{Pi} = \Sigma_j X_{Pij}$

w_{ijc} = share of crop in estimated value of output from plot = V_{ijc} / $\Sigma_j V_{ijc}$ (for use as weights)

S_{ic} = Crop share (hereafter S) in farm output = V_{ic} / $\Sigma_i V_{ic}$ (for use as weights)

Derived measures are (where A_{Hic} weighted by H_{ic}):

Y_{ic} = yield = Q_{Tic} / A_{Hic} (typically in kgs per acre)

R_{ic} = return or income from crop = V_{ic} / A_{Hic} (in TShs per acre); from the data one can also calculate V_{Sic}/A_{Hic} (value of sales, marketed output, in TShs per acre)

Π_{ic} = profit = $(V_{ic} - X_{Pic})/ A_{Hic}$ (in TShs per acre)

4 Descriptive Statistics from NPS 2007/08 and 2010/11

Agricultural sector still remains an important sector in Tanzania, as it contributes 24 percent of GDP and employs around 70 percent of Tanzanians (ES, 2010). Although the area under cultivation is continually increasing, the same is not the case when it comes to agricultural productivity. According to NSCA (2003/04), 9.1 million hectares were cultivated in 2002, which increased up to 10 million hectares in 2008 (about a 12percent increase, equivalent to 182,200 hectares per year). On average, annual agricultural output growth in 1970s was recorded at 2.9percent, in 1980s at 2.1percent, in 1990s at 3.6 percent and in 2000s at 4.7percent (ES, 2010). As area under cultivation grew at a lower rate, especially more recently, aggregate productivity appears to have increased (albeit not dramatically).

The descriptive statistics reported in this section and the Appendix for NPS I (2008/09) and NPS II (2010/11) reveal considerable variability in yields (kg/acre) and income (TShs/acre) across crops and regions and, for given crops, in unit values (TShs/kg) across and even within regions. One difficulty in dealing with the NPS data is that most variables are measured at the plot or crop/plot level, some are measured at the farm (household) level, and more than one crop may be grown on a given plot or a given crop may be grown on more than one of a farm's plots. For this reason the descriptive statistics reported here should be considered preliminary: the data are indicative of patterns across crops and regions but also highlight discrepancies that require further investigation, such as unusual values for particular crops and regions or large changes in a crop/region measure across the two surveys. Furthermore, as can be observed in the tables, not all questions were answered for all plots (sample sizes vary) and/or some answers appear inconsistent. Some of the major anomalies will be highlighted in the discussion.

Table 1: Plot Usage in 2008/09 and 2010/11 NPS

Plot Number	2008/09 (%)	2010/11 (%)	Plots Usage	2008/09 (%)	2010/11(%)
M1	44.54	43.56	Cultivated	85.99	81.19
M2	30.55	30.19	Rented out	0.57	0.56
M3	14.79	15.14	Given out	0.76	1.36
M4	6.13	6.36	Fallow	10.22	14.31
M5	2.56	2.72	Forest	1.60	1.72
M6	0.92	1.14	Other	0.86	0.86
M7	0.29	0.43	**Observation**	**5,126**	**6,038**
M8	0.12	0.28	**Cultivated**	**2008/09 (%)**	**2010/11 (%)**
M9	0.08	0.15	YES	85.99	81.19
M10	0.04	0.03	NO	14.01	18.81
Observation	**5,126**	**6,038**	**Observation**	**5,126**	**6,038**

Note: Based on information reported by plot for the long season only.

Table 1 shows that just over 43 percent of farms had only one plot and over 90 percent of farms had three or fewer plots (in both surveys). Over 80 percent of plots were cultivated with 10-14 percent left fallow; the proportionally large increase in the share left fallow in 2010/11 deserves further investigation. There is no plots attrition between the 2008/09 and 2010/11, instead the plots increased by 912 (more than 17 percent of 2008/09 total). This is likely to be due to households' splits that lead to new entrants acquiring new plots. Table 2 provides the distribution of farm size: over half of farms are one acre or less, more than 10 percent are two acres and less than 15 percent are four or more acres.

Table 2: Household Farm Size by Acre in 2008/09 and 2010/11 NPS

Acreage	2008/09 percent	2010/11 percent
< 0.50	12.38	13.89
0.50	15.65	13.24
1.00	25.72	20.39
1.50	8.02	7.36
1.75	0.18	0.56
2.00	12.49	11.12
2.50	2.76	3.45
3.00	7.10	4.86
3.50	0.54	1.1
4.00	4.76	3.35
4.50	0.26	0.39
5.00	2.70	2.89
> 5.00	7.57	6.05

Note: As for Table 1; based on adding up all plots for each farm.

Table 3: Distribution of Crops by Plots in 2008/09 and 2010/11 NPS

No.	Crops	2008/09		2010/11	
		Freq.	%	Freq.	%
1	*Maize*	1,608	38.99	2,044	42.36
2	*Paddy*	489	11.86	610	12.64
3	*Sorghum*	155	3.76	172	3.56
4	*Millet*	75	1.82	69	1.43
5	*Wheat*	19	0.46	18	0.37
6	*Cassava*	670	16.25	720	14.92
7	*Irish Potatoes*	30	0.73	25	0.52
8	*Sweet Potatoes*	107	2.59	102	2.11
9	*Beans*	205	4.97	189	3.92
10	*Nuts, Seeds*	199	4.83	142	2.94
11	*Cotton*	61	1.48	56	1.16
12	*Tobacco*	22	0.53	27	0.56
13	*Pytherum*	-	-	7	0.15
14	*Sisal*	3	0.07	3	0.06
15	*Coffee*	35	0.85	45	0.93
16	*Tea*	5	0.12	6	0.12
17	*Cocoa*	8	0.19	14	0.29
18	*Cashew nuts*	141	3.42	112	2.32
19	*Sugarcane*	20	0.48	19	0.39
20	*Spices*	9	0.22	15	0.31
21	*Banana*	174	4.22	293	6.07
22	*Fruits*	27	0.65	50	1.04
23	*Vegetables*	41	0.99	50	1.04
24	*Others*	21	0.51	37	0.77
	Observation /Total	**4,124**	**100**	**4,825**	**100**

Note: As for Table 1; based on reported main crop planted on plot in the long season. The difference in sample between Table 1 and 2 are attributed to different files with different focus plots/crops.

Table 3 reports the distribution of crops by plot for the long season; cash crop production is understated as the separate information on permanent (tree) crops has not yet been incorporated into the summary tables. The figures for cash crops such as tobacco or coffee can be interpreted as relating only to plots where they are inter-cropped (the share of plots with cashew nuts is probably accurate). The major food crops (maize, paddy and cassava) are grown on more than two-thirds of all plots; sorghum, banana, nuts and seeds, beans, and sweet potatoes are also grown on significant numbers of plots. These shares refer only to the major crops grown on the plot; almost 60 percent of plots are inter-cropped (Table 4), often with more than two crops (the plot may be partitioned for separate crops; tree crops may be mixed, such as coffee and bananas; or food crops may be planted under trees).

Table 4 reports important characteristics of the farms. Over 80 percent of plots are owned by the farmer and up to 95 percent are owned or used with free access; renting accounts for about 5 percent of plots. Very few plots are irrigated, 3 percent or fewer, demonstrating that farming is almost always rain-fed; in this context it is unfortunate that farmers were not asked questions about the reliability of rainfall, quantity and timing, as in the Ethiopian surveys analysed in Abrar and Morrissey (2006). About 10 percent purchase inorganic fertilizer or pesticides (these are likely to be same farms) or use organic fertilizer (which may be different farms). Inconsistencies between the two surveys are evident: although the sample was larger in 2010/11, fewer answered questions on fertilizer use. Almost a third use improved seeds and also about a third employ hired labour.

One reason for the low use of purchased inputs is the high cost for farmers with low incomes (although not reported here, the NPS reports than only one or two per cent of farmers are able to obtain inputs on credit). Table 5 reports that almost two-thirds have loam soil and most others are either sandy or clay; about half report the soil is of good quality and 45 percent that it is average; less than 15 percent of plots suffer from erosion and more than half are flat, with about another third gently sloped. In sum, the majority of farms are small, owned, rain-fed with good soil and orientation but do not use purchased inputs (except perhaps for seeds and hired labour). An important issue to address in future analysis is the differences between those farms that purchase inputs (especially fertilizer) and those that do not. One would expect that only larger and/or more commercial farms are able to purchase inputs, and this may be related to the crops grown (and the availability of irrigation). For example, vegetables, beans and perhaps fruits should be relatively profitable and responsive

to fertilizer. However, as noted in Section 2, some producers of maize or paddy may be able to obtain fertilizer subsidies.

Table 4: Farming Characteristics 2008/09 and 2010/11 NPS

	2008/09			2010/11		
Ownership status	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Owned	4,268	83.26	83.26	5,088	84.27	84.27
Used free of charge	567	11.06	94.32	698	11.56	95.83
Rented in	256	4.99	99.32	201	3.33	99.16
Kushirikiana	6	0.12	99.43	3	0.05	99.21
Shared - own	29	0.57	100	48	0.79	100
Total	*5,126*	*100*		*6,038*	*100*	
Plot Irrigated	***Freq***	***Percent***	***Cum.***	***Freq***	***Percent***	***Cum.***
Yes	108	2.54	2.54	103	2.06	2.06
No	4,144	97.46	100.00	4,886	97.94	100
Total	*4,252*	*100*		*4,989*	*100*	
Plot Intercropped	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	3,298	63.56	63.56	3,886	64.76	64.76
No	1,891	36.44	100	2,115	35.24	100
Total	*5,189*	*100*		*6,001*	*100*	
Organic Fertilizer	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	446	10.66	10.66	513	10.68	10.68
No	3,738	89.34	100	4,292	89.32	100
Total	*4,184*	*100*		*4,805*	*100*	
Inorganic Fertilizers	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	456	10.90	10.90	615	12.80	12.80
No	3,729	89.10	100	4,190	87.20	100
Total	*4,185*	*100*		*4,805*	*100*	
Pesticides	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	450	10.75	10.75	433	9.01	9.01
No	3,735	89.25	100	4,372	90.99	100
Total	*4,185*	*100*		*4,805*	*100*	
Improved Seeds	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	1,690	29.79	29.79	1,524	25.41	25.41
No	3,983	70.21	100	4,474	74.59	100
Total	*5,673*	*100*		*5,998*	*100*	
Hired Labour	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	1,302	31.14	31.14	1,299	27.03	27.03
No	2,879	68.86	100	3,506	72.97	100
Total	*4,181*	*100*		*4,805*	*100*	

Note: As for Table 1; based on reported main crop planted on plot in the long season; table reports frequency (Freq), percentage and cumulative percentage (cum).

Table 5: Soil and Land Quality 2008/09 and 2010/11 NPS

	2008/09			2010/11		
Type of Soil	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Sandy	895	21.04	21.04	984	19.72	19.72
Loam	2,625	61.72	82.77	3,043	60.98	80.70
Clay	640	15.05	97.81	891	17.86	98.56
Other	93	2.19	100.00	72	1.44	100
Total	4,253	100		4,990	100	
Quality of the Soil	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Good	2,143	50.39	50.39	2,315	46.40	46.40
Average	1,884	44.30	94.69	2,336	46.82	93.23
Bad	226	5.31	100	338	6.77	100
Total	4,253	100		4,989	100	
Erosion Problem	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	555	13.05	13.05	644	12.91	12.91
No	3,697	86.95	100.00	4,345	87.09	100
Total	4,252	100		4,989	100	
Measures taken	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Yes	659	15.50	15.50	511	10.24	10.24
No	3,593	84.50	100	4,477	89.74	100
Total	4,252	100		4,989	100.	
Steep slope	***Freq.***	***Percent***	***Cum.***	***Freq.***	***Percent***	***Cum.***
Flat bottom	2,176	51.19	51.19	2,941	58.95	58.95
Flat top	502	11.81	63.00	332	6.65	65.60
Slightly sloped	1,414	33.26	96.26	1,501	30.09	95.69
Very steep	159	3.74	100	215	4.31	100
Total	4,251	100		4,989	100	

Note: As for Table 4.

The remaining tables provide summary data on the 24 main crops (and on 'others' category) for 8 regions (some 7 aggregated from the 21 regions in Mainland Tanzania and 1 from the 5 regions in Zanzibar). For convenience we limit the discussion to median values for 2010/11 but where relevant will refer to mean values and statistics for 2008/09 (all in Appendix Tables). As there is considerable variability in farm and plot size, the median is a better indication of the 'norm' for the average farm (and is typically considerably lower than the mean). The simple pattern is one of significant variation across regions for every crop, although every region has at least one productive crop (and often a crop for which it is the most productive region).

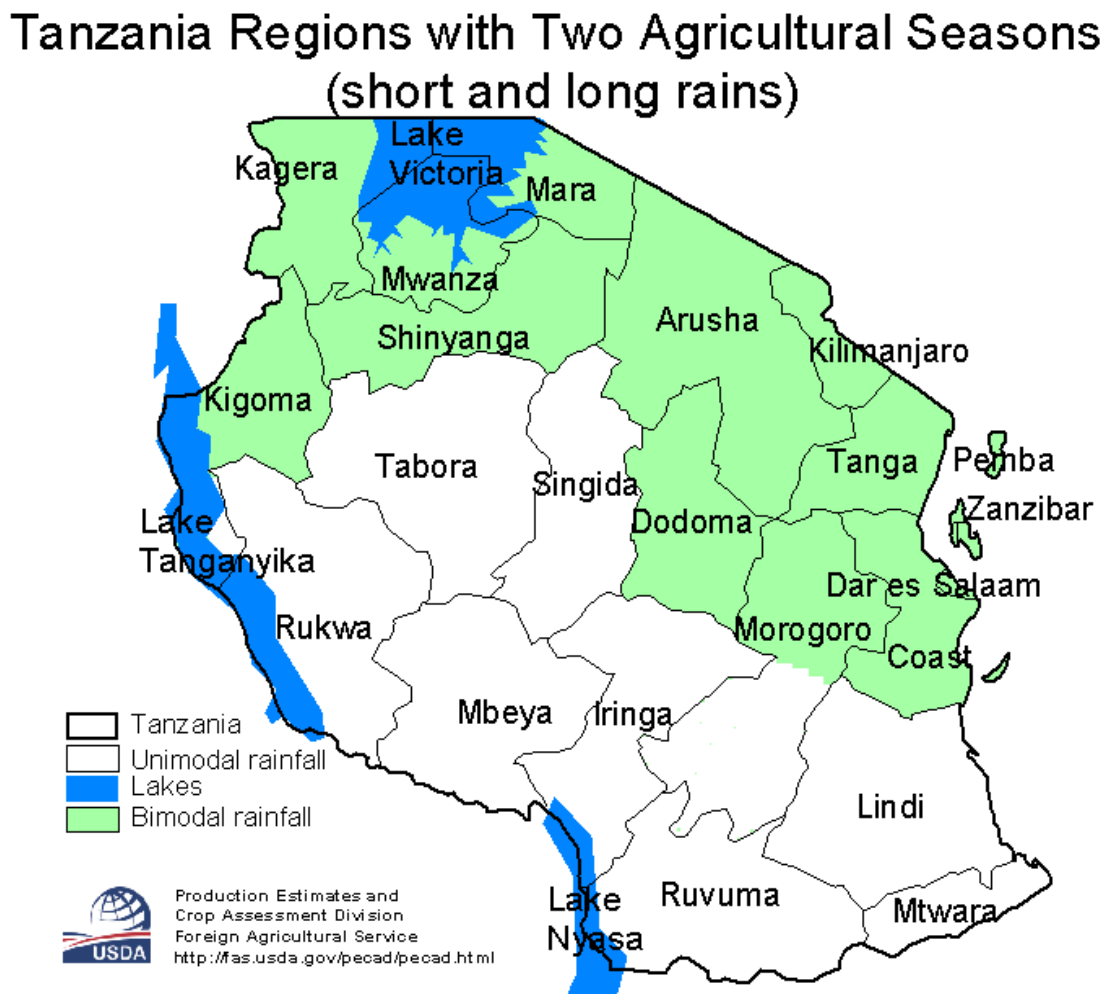

Table 6 reports the median harvest in kg/farm. For the major crop, maize, Zanzibar, Mbeya and Dodoma have the highest median production (Arusha, Morogoro and Dodoma have highest mean production), whereas for paddy Mbeya, Arusha, Kigoma and Morogoro have the highest median values. Zanzibar, Dar and Mbeya have the highest values for cassava; Dar is also high for Irish potatoes (with Mwanza and Mbeya) and beans (with Mbeya and Zanzibar). Cashew nuts are mainly grown in Morogoro, Dar and Kigoma, sugarcane in Dodoma, Arusha, Morogoro, Dar, Mbeya and Kigoma, and banana is grown mostly in same regions including Mwanza. Fruits are mostly grown in Arusha, Morogoro, Dar and Zanzibar, and vegetables in every region except for Mwanza. Regions with the highest median quantity do not always have (among) the highest mean quantity, although in general the broad rankings are similar or consistent (Table A3).

Table 6: Median Quantity by Harvested Crop (Kg/farm) by Region 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	680	500	498	610	800	580	150	960
Paddy	255	1238	575	600	1420	800	200	600
Sorghum	460	1300	472	425	1392	700	150	600
Millet	460			1269	800	900	2670	
Wheat				1080	400	250		
Cassava	0	203	80	260	180	40	105	700
Irish Potatoes		540		2630	800		1680	
Sweet Potatoes	420	0	221	605	5826	600	170	
Beans	0	370	480	820	600	190	0	1140
Nuts, Seeds	1020	1225	150	650	810	2526	275	
Cotton	0			0	990	1216		
Tobacco				1912	550	2156		
Pytherum			790	785	303			
Sisal	1500							
Coffee		1011	0	1060	3690	80		
Tea		520			2880			
Cocoa					180			
Cashew nuts		0	200	240		1674		
Sugarcane	150	840	584	420	1100	8349		
Spices		65				240	175	
Banana	300	50	0	140	175	50	70	
Fruits	0	1058	0	230		0	0	700
Vegetables	120	2000	624	2025	980	136	485	
Others	100	1320	45	790	1105	50	0	

Note: Based on crop/farm data in 2010/11 NPS. The 21 regions identified in the NPS for Mainland Tanzania and 5 regions identified for Zanzibar are combined into regions as listed here (see Appendix Table A1).

Unit values vary across regions so the rankings in terms of value of output per plot (Table 7) are not always identical to those for quantity. For maize, Zanzibar, Dar, Mbeya and Dodoma have high value but Dodoma (not Dar) has the highest median value, whereas for paddy Arusha, Mbeya, Kigoma and Morogoro remain with the highest median values. Zanzibar, Dar and Mbeya again have the highest values for cassava; Dar is also the highest value for Irish potatoes (with Mwanza and Mbeya as before) and Zanzibar is again highest for beans (followed by Dar, Mbeya and Morogoro). Cashew nuts are mainly grown in Kigoma, Morogoro and Dar, sugarcane in Kigoma, Mbeya, Arusha and Morogoro, banana is grown mostly in same regions including Mwanza, fruits in Arusha, Zanzibar and Dar, and vegetables in all regions except Mwanza and Zanzibar; in all these cases the regions also have the highest median values. Regions with the highest median quantity do not always have (among) the highest mean quantity, although in general the broad rankings are similar or consistent (Table A3).

Table 7: Median Value Harvested Crop (000' TShs/farm) by Region 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	172	145	144	185	180	151	70	315
Paddy	175	598	203	255	420	320	110	246
Sorghum	112	158	169	133	321	314	81	246
Millet	135			1140	238	44	854	
Wheat				362	66	146		
Cassava	0	43	24	80	48	14	72	204
Irish Potatoes		130		444	210		210	
Sweet Potatoes	60	0	129	144	1152	101	90	
Beans	0	82	202	272	180	60	0	230
Nuts, Seeds	312	634	150	256	364	1120	256	
Cotton	0			0	480	503		
Tobacco				2759	1650	2431		
Pytherum			261	193	65			
Sisal	285							
Coffee		402	0	361	544	8		
Tea		210			468			
Cocoa					128			
Cashew nuts		0	90	80		502		
Sugarcane	75	345	166	108	334	1098		
Spices		19				120	96	
Banana	85	18	0	40	107	10	35	
Fruits	0	300	0	105		0	0	204
Vegetables	240	624	500	957	261	9	259	
Others	30	551	23	252	158	10	0	

Note: Based on crop/farm data in 2010/11 NPS.

As plot sizes may vary by region it is more informative to examine yields (kg/acre, in Table 8), income per acre (Table 9) and 'profit' (income minus purchased inputs) per acre (Table 10). As purchased inputs are report at the plot level and have to be allocated to crops, as most plots have more than one crop, the profit estimates may be unreliable (especially as answers for apportioning crops to plots are not always consistent). In general the 'ranking' of regions is unaltered. For maize (Zanzibar, Mwanza, Dodoma and Arusha) and for paddy (Arusha, Kigoma, Mbeya and Dodoma) the same regions have the highest yield, income and profit. Dodoma, Arusha, Morogoro and Mwanza have the highest yields and incomes for cassava; Mbeya and Dar have the highest yield and income for Irish potatoes (with Arusha, which appears to have far higher profit) and Mbeya, Mwanza and Dar have highest for beans (although a number of regions appear to have similar profits).

Table 8: Median Crop Yield (kg/acre) by Region 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	330	300	237	213	255	208	350	480
Paddy	330	909	275	300	360	400	235	150
Sorghum	164	650	216	180	192	136	269	150
Millet	182			333	182	100	763	
Wheat				390	541	46		
Cassava	355	350	226	187	200	199	210	140
Irish Potatoes		308		1533	3200		560	
Sweet Potatoes	667	1500	388	293	544	400	350	
Beans	135	211	199	229	275	150	270	253
Nuts, Seeds	160	411	194	168	300	151	141	
Cotton				125	176	132		
Tobacco				283	550	329		
Pytherum			790	209	223			
Sisal	710							
Coffee		407	200	397	688	296		
Tea		558			2880			
Cocoa					550			
Cashew nuts			384	160		431		
Sugarcane	150	420	389	280	437	1868		
Spices		325				480	175	
Banana	286	230	130	280	202	144	269	
Fruits		276	142	173			320	140
Vegetables	120	533	210	409	571	272	373	
Others	240	660	267	675	321	100	350	

Note: Based on crop/farm data in 2010/11 NPS.

Table 9: Median Crop Income (000' TShs/acre) by Regions 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	78	85	68	63	60	64	175	158
Paddy	130	484	113	115	119	140	132	62
Sorghum	51	144	67	67	21	52	126	62
Millet	34			127	64	5	244	
Wheat				97	89	27		
Cassava	156	142	73	56	65	58	137	41
Irish Potatoes		92		260	840		70	
Sweet Potatoes	175	250	86	87	120	83	200	
Beans	84	47	114	79	90	64	255	51
Nuts, Seeds	71	204	150	66	74	160	105	
Cotton				46	69	76		
Tobacco				368	1650	375		
Pytherum			261	51	73			
Sisal	143							
Coffee		97	51	87	222	35		
Tea		164			347			
Cocoa					180			
Cashew nuts			168	42		129		
Sugarcane	75	173	159	72	121	667		
Spices		93				240	96	
Banana	75	146	51	80	106	29	140	
Fruits		75	43	97			224	41
Vegetables	240	166	180	628	201	17	199	
Others	132	290	147	188	47	20	175	

Note: Based on crop/farm data in 2010/11 NPS.

Table 10: Median Profit (000' TShs/acre) by Regions 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	141	119	82	80	90	71	150	108
Paddy	153	354	135	129	144	183	167	37
Sorghum	54	115	74	74	48	63	145	43
Millet	51			88	66	5	224	
Wheat				93	89	21		
Cassava	132	128	85	72	82	68	152	41
Irish Potatoes		150		203	93		21	
Sweet Potatoes	223	159	136	117	103	117	288	
Beans	74	57	103	75	89	56	255	29
Nuts, Seeds	90	148	198	88	87	119	128	
Cotton				43	64	93		
Tobacco				373	960	248		
Pytherum			218	51	81			
Sisal	144							
Coffee		88	46	79	124	24		
Tea		151			18			
Cocoa					159			
Cashew nuts			135	77		89		
Sugarcane	75	116	121	92	106	562		
Spices		134					46	
Banana	135	127	59	64	115	44	212	
Fruits		73	52	72			216	41
Vegetables	305	209	175	556	169	63	167	
Others	130	271	170	122	34	20	175	

Note: Based on crop/farm data in 2010/11 NPS.

Cashew nuts are mainly grown in Morogoro and Dar, and sugarcane in Kigoma, Morogoro, Mbeya, Arusha, Dodoma and Dar. Although banana has highest production and in Dodoma, Mbeya and Dar and profit in Mwanza, Dodoma, Arusha and Mbeya, yield and income are highest in Dodoma, Dar and Mwanza. Fruits production and profit is highest in Mwanza, but yield and income is highest in Arusha and Mwanza. Vegetables production, yield and income is highest in Mbeya, Arusha, Dar and Mwanza, profit are higher in Dar, Arusha and Dodoma.

Three general conclusions can be drawn. First, we can be quite confident in identifying which crops are most important in which regions and vice versa, although it is not a one to one correspondence (many regions are important for a number of crops, and most crops are grown productively in a number of regions) and high production quantities and values do not necessarily imply high yield and income per acre. Second, the NPS data require further careful checking before proceeding to econometric analysis. The problem in deriving a measure of 'profit' has been shown, and apparent inconsistencies between farm and acre level measures have to be investigated. Furthermore, if results for 2008/09 (Appendix tables)

are compared to 2010/11 there are apparently inconsistent changes in magnitudes and rankings across crops and regions. Third, and following, careful checking of the data measured at the farm level will be required before embarking on econometric analysis. Although 'adding up' the plots in a farm is easy, the difficulty arises in determining the actual acreage devoted to each crop when more than one crop is grown on a plot (as is common) as the information reported is only approximate. This creates a particular problem in allocating purchased inputs (reported at the plot level) to crops. Furthermore, permanent and short season crops have to be included to accurately capture farm output and income. However, having undertaken this scoping investigation of the data it is evident that analysis of productivity and supply response is feasible.

5 Conclusion: Productivity and Supply Response

Although the NPS are small in sample size (3,280 households), they provide recent farm level household panel data with two waves (so lagged prices are available) and econometric analysis is feasible. The first preliminary analysis would be of the determinants of yields at the crop/farm level. This would employ variables subsequently used in analysing supply response as yield is posited to be a function of land size and quality, fertilizer and pesticide use, irrigation (unfortunately data on adequacy of rain was not collected) and farmer characteristics (age, education). We do not propose to estimate technical efficiency, but could as a final stage estimate supply response incorporating efficiency following the method employed by Abrar and Morrissey (2006).

The core analysis will be of supply response, the price and non-price factors determining production and how responsive farmers are to these factors. Two fundamental approaches are used in studying production decisions: the production function (primal approach) and the profit function (dual approach). Under appropriate regularity conditions, and with the assumption of profit maximization, both functions contain the same essential information on a production technology. The dual approach has several advantages: prices are specified as the exogenous variables as opposed to input quantities (prices are usually less collinear than input quantities); estimates of output supply, input demand, and the price (and cross-price) elasticities are more easily derived (as derivatives of the profit function); and it is more flexible for modelling multiple outputs and inputs systems (as is the case here).

Following Abrar *et al.* (2004) a profit, cost, or revenue function is estimated employing a variant specification of the profit function. Assume that farmers attempt to maximise restricted profit, defined as the return to the variable factors, so the profit maximisation problem can be expressed as:

$$\text{Max } \Pi(\mathbf{p},\mathbf{w};\mathbf{z}) = Ma\,x\ \mathbf{p}'\mathbf{y} - \mathbf{r}'\mathbf{x} \qquad (1)$$
$$s.t.\ F(\mathbf{y},\mathbf{x};\mathbf{z}) \leq 0,$$

where Π , $\mathbf{p}$, $\mathbf{w}$, respectively, represent restricted profit, and vectors of output and input prices. The variables $\mathbf{y}$ and $\mathbf{x}$ represent vector of output and input quantities respectively. $F(.)$ is the production technology set of the producer, and Z is a set of control variables. The restricted profit function represents the maximum profit the farmer could obtain with available prices, fixed factors, and production technology. The profit-maximising output supply and input demand functions are derived as:

$$Y_m(p,w;z) = \frac{\partial\Pi(p,w;z)}{\partial P_m}, \quad \forall\ m = 1,...,M, \qquad (2)$$

and

$$-X_n(p,w;z) = \frac{\partial\Pi(p,w;z)}{\partial W_n}, \quad \forall\ n = 1,...,N. \qquad (3)$$

where m and n index the outputs and variable inputs respectively. There are usually four (translog, generalised Leontief, generalised Cobb-Douglas, and the quadratic forms) functional forms of the profit function that have been used in the literature. A choice of a particular specification, in part, depends on the nature of the data set available, and the translog profit function is generally preferred. These estimated parameters can be used to derive the elasticities for production relations of multiple-input, multiple-output farms.

The Translog profit function can be specified as:

$$ln\pi^*(p,w,z;\beta) = \beta_0 + \sum_i \beta_i \ln(\mathrm{P_i^*}) + \sum_v \beta_v \ln\mathrm{W_v^*} + \sum_m \beta_m \ln\mathrm{Z_m} +$$
$$\sum_i \sum_v \beta_{iv} \ln(\mathrm{P_i^*}) \ln\mathrm{W_v^*} + \sum_i \sum_m \beta_{im} \ln(\mathrm{P_i^*}) \ln\mathrm{Z_m} + \sum_v \sum_m \beta_{vm} \ln\mathrm{W_v^*} \ln\mathrm{Z_m} \qquad (4)$$

$$+\frac{1}{2}\left[\left(\sum_i \sum_j \beta_{ij} \ln(P_i^*)\ln(P_j^*)\right) + \sum_v \sum_r \beta_{vr} \ln W_v^* \ln W_r^* + \sum_m \sum_k \beta_{mk} \ln Z_m \ln Z_k\right)\right] + e$$

where

π^* = restricted variable profit, normalized by the price of labour

P_i^*, P_j^* = Price of outputs, respectively, normalized by the price of labour

W_v^*, W_r^* = Price inputs, respectively, normalized by the price of labour

Z = quantity of fixed and quasi-fixed inputs (land size, family labour, animal capital) and other farmer social-demographic and human capital factors (age, education and farming experience).

The *βs* are parameters to be estimated and *ε* is an error term with the usual properties. All prices are normalized by the price of labour. The core variables to be derived from the NPS are summarized in Table 11.

Table 11: Summary of variables to be used (measured farm-level by crop)

Variable Category	Variable Name/Symbol	Description/Measurement
Profit	Restricted farmer profit (π^*)	Total revenue less cost of variable inputs (purchased inputs plus hired labour)
Prices of Outputs	Output price (P_i^*, P_j^*)	Unit price of crop sales
Prices of Inputs	Input Price (W_v^*, W_r^*)	Prices of variable inputs
Fixed/quasi fixed (Z)	Land Size	Total area cultivated in acres
	Family Labour	Total own labour available to the household, between the ages 15 and 65 inclusive
	Animal Capital	Total number of hooved animals available to a farming household
Control Variables	Age	Farmer age in years *
	Education	Farmer formal education in years
	Irrigation	Binary variable (yes = 1)
	Soil quality	Index combining indicators
	Market access	Distance to nearest market/village

Notes: Age is used (*) on assumption that farmer has always been in farming. If there is information on those only recently in farming or who took a break, years of experience in farming may be included as a separate variable. Information on land and soil quality for plots will be used to construct binary variables [Good = 1, Poor =0] (at farm level) combining soil erosion [Yes = 0, No =1], are there control measures [Yes = 1, No =0], soil type and land slope categories converted to [1, 0].

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Appendix A: Supplementary Tables

Table A1: Correspondence of the 10 to the 21 regions in Tanzania

No.	Region name	Comprises	Ecological zone
1	Dodoma	Dodoma, Singida, Tabora, Shinyanga	
2	Arusha	Arusha, Kilimanjaro, Manyara	
3	Morogoro	Morogoro,Tanga, Coast, Lindi, Mtwara	
4	Dar es Salaam	Dar es Salaam,	
5	Mbeya	Mbeya, Ruvuma, Iringa	
6	Kigoma	Kigoma, Rukwa	
7	Mwanza	Mwanza, Mara, Kagera	
8	Zanzibar	North Unguja, South Unguja, West Unguja, North Pemba, South Pemba	

Source: Authors own compilation

Table A2: Weather Condition at GPS Measurement: 2010/11 NPS

Climatic Zones	Freq.	Percent	Cum.
Clear/Sunny	3,953	34.07	34.07
Mostly Clear/Mostly Sunny	1,422	12.26	46.33
Partly Cloudy/Partly Sunny	5,038	43.42	89.75
Mostly Cloudy/Considerable Cloudiness	592	5.10	94.85
Completely Cloudy	398	3.43	98.28
Rainy	199	1.72	100.00
Total	**11,602**	**100**	

Source: Authors own compilation

Table A3: Mean Quantity of Harvested Crops by Regions 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	1480	29502	1399	1077	1475	1086	342	1227
Paddy	1566	1854	986	1187	2129	1631	216	816
Sorghum	768	6451	795	519	1789	1011	110	600
Millet	920			1622	4220	900	2670	
Wheat				1354	377	250		
Cassava	169	972	436	490	1099	453	127	700
Irish Potatoes		657572		3336	1714		1680	
Sweet Potatoes	620	177	1146	1360	4195	1700	168	
Beans	887	652	624	1443	1173	450	15	1140
Nuts, Seeds	1606	1076	583	800	2029	2096	323	
Cotton	0			1928	1609	1520		
Tobacco				1779	1056	2082		
Pytherum			730	785	388			
Sisal	1293							
Coffee		1011	150	1292	3415	66		
Tea		1260			2210			
Cocoa					416			
Cashew nuts		0	587	547		1674		
Sugarcane	150	708	584	775	840	6154		
Spices		1486				240	277	
Banana	552	653	78	752	406	364	139	
Fruits	0	936	855	428		0	40	700
Vegetables	453	7816	1648	9160	1367	811	653	
Others	91	876503	95	839	1105	50	47	

Note: Mean in kg per farm based on 2010/11 NPS.

Table A3: Mean Value of Harvested Crop (000' TShs/plot) by Regions 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	918	304	313	354	509	378	147	399
Paddy	732	971	330	457	797	612	123	240
Sorghum	190	263	248	177	387	474	60	246
Millet	284			650	1257	44	854	
Wheat				405	188	146		
Cassava	60	102	135	165	174	162	75	204
Irish Potatoes		288		726	284		210	
Sweet Potatoes	195	46	249	250	919	488	95	
Beans	236	180	286	440	316	170	14	230
Nuts, Seeds	765	565	380	350	650	1306	249	
Cotton	0			711	694	721		
Tobacco				2471	1945	2599		
Pytherum			268	193	131			
Sisal	257							
Coffee		274	38	383	889	14		
Tea		382			372			
Cocoa					145			
Cashew nuts		0	229	267		502		
Sugarcane	75	277	166	330	233	1578		
Spices		404				120	165	
Banana	206	85	27	225	145	119	85	
Fruits	0	250	248	165		0	28	204
Vegetables	296	789	909	3760	436	270	274	
Others	47	383	52	253	158	10	23	

Note: Mean in thousand (000') TShs per farm based on 2010/11 NPS.

Table A4: Mean Crop Yield (Kg/Acre) by Regions 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	487	4384	315	301	358	251	322	398
Paddy	372	864	426	371	421	521	327	191
Sorghum	225	1697	224	213	222	172	208	150
Millet	214			275	232	100	763	
Wheat				360	387	46		
Cassava	417	676	322	266	280	277	292	140
Irish Potatoes		100705		1301	2585		560	
Sweet Potatoes	832	955	633	812	564	795	564	
Beans	264	201	198	259	319	154	270	253
Nuts, Seeds	275	370	227	212	338	198	177	
Cotton				125	169	210		
Tobacco				309	466	288		
Pytherum			638	209	259			
Sisal	710							
Coffee		407	200	373	1109	229		
Tea		546			2283			
Cocoa					435			
Cashew nuts			357	227		431		
Sugarcane	150	348	454	251	437	1531		
Spices		485				480	209	
Banana	391	1505	215	322	279	325	324	
Fruits		303	251	259			320	140
Vegetables	259	128190	340	1808	625	370	414	
Others	272	117465	323	591	321	100	350	

Note: Yield in Kg per acre based on 2010/11 NPS.

Table A5: Mean Crop Income (000' TShs/acre) by Regions 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	157	142	88	91	106	81	156	126
Paddy	177	446	157	141	161	197	186	57
Sorghum	58	123	73	81	46	71	116	62
Millet	54			89	72	5	244	
Wheat				125	107	27		
Cassava	164	136	106	83	82	77	180	41
Irish Potatoes		218		253	578		70	
Sweet Potatoes	253	177	155	107	108	116	346	
Beans	88	58	114	98	123	73	255	51
Nuts, Seeds	96	194	168	97	97	140	143	
Cotton				46	75	101		
Tobacco				427	1125	347		
Pytherum			220	51	97			
Sisal	143							
Coffee		97	51	96	284	28		
Tea		163			347			
Cocoa					181			
Cashew nuts			155	83		129		
Sugarcane	75	135	159	85	121	632		
Spices		134				240	124	
Banana	149	146	61	79	146	51	214	
Fruits		78	67	95			224	41
Vegetables	322	241	201	604	184	79	184	
Others	130	381	170	190	47	20	175	

Note: Mean in thousand (000') TShs per acre based on 2010/11 NPS.

Table 6: Mean Profit in '000'TSHs by Regions: 2010/11 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma	Mwanza	Zanzibar
Maize	141	119	82	80	90	71	150	108
Paddy	153	354	135	129	144	183	167	37
Sorghum	54	115	74	74	48	63	145	43
Millet	51			88	66	5	224	
Wheat				93	89	21		
Cassava	132	128	85	72	82	68	152	41
Irish Potatoes		150		203	93		21	
Sweet Potatoes	223	159	136	117	103	117	288	
Beans	74	57	103	75	89	56	255	29
Nuts, Seeds	90	148	198	88	87	119	128	
Cotton				43	64	93		
Tobacco				373	960	248		
Pytherum			218	51	81			
Sisal	144							
Coffee		88	46	79	124	24		
Tea		151			18			
Cocoa					159			
Cashew nuts			135	77		89		
Sugarcane	75	116	121	92	106	562		
Spices		134					46	
Banana	135	127	59	64	115	44	212	
Fruits		73	52	72			216	41
Vegetables	305	209	175	556	169	63	167	
Others	130	271	170	122	34	20	175	

Note: Mean in thousand (000') TShs per acre based on 2010/11 NPS.

Table A7: Mean Quantity of Harvested Crop (Kg/farm) by Regions 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	1042	960	978	1090	2399	705
Paddy	1018	793	957	1006	1897	1105
Sorghum	1117	81	862	920	1949	507
Millet	961	102		1133	814	351
Wheat				1435		
Cassava	0		1993	680	1274	427
Irish Potatoes		1591		1043	1482	260
Sweet Potatoes	500	766	743	717	1108	983
Beans	1355	565	889	1430	1754	723
Nuts, Seeds	1307	557	439	1221	1777	478
Cotton					2126	338
Tobacco				1319	1421	
Sisal				1136		
Coffee				380		
Cashew nuts			3886	161	3160	
Sugarcane			525			
Banana		754	454			522
Fruits		300	492	184	4050	
Vegetables	470	852	3218	1350	2221	1171
Others		286	7674	444		

Note: Mean in kg per farm based on 2008/09 NPS.

Table A8: Median Quantity of Harvested Crop (Kg/farm) by Region 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	708	400	310	468	980	300
Paddy	232	209	432	552	1080	300
Sorghum	720	70	400	440	1630	245
Millet	750	64		629	387	345
Wheat				1480		
Cassava	0		235	218	1274	220
Irish Potatoes		960		810	320	240
Sweet Potatoes	500	500	210	579	425	336
Beans	1029	254	449	780	936	320
Nuts, Seeds	995	260	400	450	1070	320
Cotton					1242	200
Tobacco				1150	888	
Sisal				1380		
Coffee				380		
Cashew nuts			375	161	3160	
Sugarcane			525			
Banana		80	500			120
Fruits		300	550	184	4050	
Vegetables	470	400	520	300	776	240
Others		360	60	255		

Note: Median in kg per farm based on 2008/09 NPS.

Table A9: Mean Value of Harvested Crop (000' TShs/farm) by Regions 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	206	303	203	242	389	230
Paddy	336	275	228	238	495	197
Sorghum	250	52	384	244	527	162
Millet	178	46		282	197	84
Wheat				409		
Cassava	0		296	175	188	138
Irish Potatoes		264		304	308	50
Sweet Potatoes	48	183	174	210	262	382
Beans	285	198	232	420	414	236
Nuts, Seeds	273	140	184	237	432	216
Cotton					570	80
Tobacco				277	298	
Sisal				171		
Coffee				77		
Cashew nuts			253	33	447	
Sugarcane			1500			
Banana		109	189			106
Fruits		54	215	44	1404	
Vegetables	90	265	281	209	596	484
Others		71	209	407		

Note: Mean in kg per farm based on 2008/09 NPS.

Table A10: Median Value of Harvested Crop (000' TShs/farm) by Regions 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	119	106	84	120	177	103
Paddy	106	38	107	138	239	80
Sorghum	216	49	136	135	244	72
Millet	146	28		135	83	90
Wheat				250		
Cassava	0		84	75	188	74
Irish Potatoes		72		269	96	30
Sweet Potatoes	48	144	60	110	75	85
Beans	163	80	117	154	244	96
Nuts, Seeds	174	82	140	120	200	85
Cotton					327	55
Tobacco				217	171	
Sisal				201		
Coffee				77		
Cashew nuts			260	33	447	
Sugarcane			1500			
Banana		20	200			85
Fruits		54	69	44	1404	
Vegetables	90	132	192	85	180	84
Others		90	18	236		

Note: Median in thousand (000') TShs per plot based on 2008/09 NPS.

Table A11: Mean Crop Yield (Kg/acre) by Region 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	275	476	380	450	3312	380
Paddy	437	593	881	300	431	1129
Sorghum	286	144	318	320	508	392
Millet	226	78		456	303	483
Wheat				301		
Cassava			405	355	203	571
Irish Potatoes		713		262	240	824
Sweet Potatoes	100	874	390	250	438	313
Beans	222	315	301	464	395	441
Nuts, Seeds	254	400	373	443	419	487
Cotton					434	246
Tobacco				699	287	
Sisal				327		
Coffee				253		
Cashew nuts			1421	161	181	
Sugarcane			105			
Banana		355	198			567
Fruits		300	98	92	900	
Vegetables	121	537	719	474	413	394
Others		291	691	90		

Note: Yield in Kg per acre based on 2008/09 NPS

Table A11: Median Crop Yield (Kg/acre) by Region 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	214	300	187	251	313	235
Paddy	312	400	230	192	358	350
Sorghum	217	175	156	132	318	245
Millet	217	64		267	254	493
Wheat				291		
Cassava			122	231	203	347
Irish Potatoes		1056		233	128	960
Sweet Potatoes	100	200	400	205	391	217
Beans	155	200	150	314	288	264
Nuts, Seeds	217	288	190	275	273	296
Cotton					385	200
Tobacco				221	205	
Sisal				325		
Coffee				253		
Cashew nuts			162	161	181	
Sugarcane			105			
Banana		160	200			480
Fruits		300	107	92	900	
Vegetables	121	400	157	133	270	200
Others		360	80	68		

Note: Based on crop/acre data in 2010/11 NPS.

. **Table A12: Mean Crop Income (000 TShs/acre) by Region 2008/09 NPS**

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	54	141	98	114	101	122
Paddy	148	214	237	74	115	117
Sorghum	66	98	111	68	170	108
Millet	40	35		100	74	119
Wheat				85		
Cassava			68	86	26	187
Irish Potatoes		112		78	61	110
Sweet Potatoes	10	151	111	74	83	160
Beans	44	112	71	109	105	142
Nuts, Seeds	53	103	134	97	85	148
Cotton					113	58
Tobacco				156	88	
Sisal				52		
Coffee				51		
Cashew nuts			101	33	26	
Sugarcane			300			
Banana		61	83			189
Fruits		54	38	22	312	
Vegetables	23	178	110	101	261	179
Others		71	69	84		

Note: Based on crop/acre data in 2010/11 NPS.

Table A12: Median Crop Income (000 TShs/acre) by Region 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	36	91	60	57	63	69
Paddy	134	150	62	50	108	95
Sorghum	43	123	53	37	64	69
Millet	38	28		64	53	129
Wheat				70		
Cassava			46	43	26	100
Irish Potatoes		119		65	38	120
Sweet Potatoes	10	60	100	47	63	56
Beans	32	73	49	71	68	70
Nuts, Seeds	47	81	63	60	60	96
Cotton					92	50
Tobacco				46	52	
Sisal				47		
Coffee				51		
Cashew nuts			74	33	26	
Sugarcane			300			
Banana		40	80			136
Fruits		54	32	22	312	
Vegetables	23	132	60	67	66	96
Others		90	24	63		

Note: Median in thousand (000') TShs per acre based on 2008/09 NPS.

Table A13: Mean Profit (000'TShs/acre) by Regions 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	46	117	95	112	94	123
Paddy	116	207	223	70	118	112
Sorghum	47	75	113	57	158	97
Millet	40	34		96	67	114
Wheat				79		
Cassava			78	53	22	179
Irish Potatoes		116		66	55	104
Sweet Potatoes	8	118	95	63	79	153
Beans	42	96	68	105	89	130
Nuts, Seeds	50	63	130	95	76	138
Cotton					102	57
Tobacco				87	85	
Sisal				50		
Coffee				51		
Cashew nuts			110	28	26	
Sugarcane			296			
Banana		61	43			158
Fruits			42	15	299	
Vegetables	22	131	118	102	269	139
Others		71	67	83		

Note: Median in thousand (000') TShs per acre based on 2008/09 NPS.

Table A13: Median Profit (000'TShs/acre) by Regions 2008/09 NPS

Crops	Dodoma	Arusha	Morogoro	Dar	Mbeya	Kigoma
Maize	34	80	57	53	53	71
Paddy	108	71	59	45	133	89
Sorghum	36	94	50	28	53	51
Millet	38	28		62	39	126
Wheat				62		
Cassava			53	43	22	83
Irish Potatoes		192		38	34	120
Sweet Potatoes	8	30	24	46	60	48
Beans	46	63	46	67	57	52
Nuts, Seeds	40	23	56	58	49	81
Cotton					82	45
Tobacco				25	45	
Sisal				46		
Coffee				51		
Cashew nuts			74	28	26	
Sugarcane			296			
Banana		40	27			126
Fruits			32	15	299	
Vegetables	22	96	64	57	55	84
Others		90	12	56		

Note: Median in thousand (000') TShs per acre based on 2008/09 NPS.

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