Mutual Insurance and Land Security in Rural Ghana

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The present draft performs the final version of the empirical analysis. Regarding the main explanatory variable , here I have constructed the new land rights measure and I try to repeat the empirical analysis. The difference is that now we account for plots that have “selling rights” and “selling + security rights” as having selling rights. Before we only accounted for those which only had “selling rights”

Land Rights - Descriptive

Table 1: Number of plots w/ selling rights in both waves (NAs removed)

Selling-rights	Number of plots	Land size (ha)
1	2769	6198.964
0	3543	5981.470

Table 2: Number of plots w/ selling rights in both waves (NAs as 0s)

Selling-rights	Number of plots	Land size (ha)
1	2769	6198.964
0	5570	8533.558

Table 3: Number of plots w/ selling rights in wave 1 (NAs removed)

Selling-rights	Number of plots	Land size (ha)
1	1090	2136.520
0	1358	1852.262

Table 4: Number of plots w/ selling rights in wave 2 (NAs removed)

Selling-rights	Number of plots	Land size (ha)
0	2185	4129.208
1	1679	4062.444

Table 5: Number of plots w/ selling rights in wave 1 (NAs as 0s)

Selling-rights	Number of plots	Land size (ha)
1	1090	2136.52
0	3385	4404.35

Notice that in **wave 2** there are not NA entries, it is only **wave 1** that has 3,004 plots with NA entry.

Table 6: Number of plots w/ selling rights in wave 2 (NAs as 0s)

Selling-rights	Number of plots	Land size (ha)
0	2185	4129.208
1	1679	4062.444

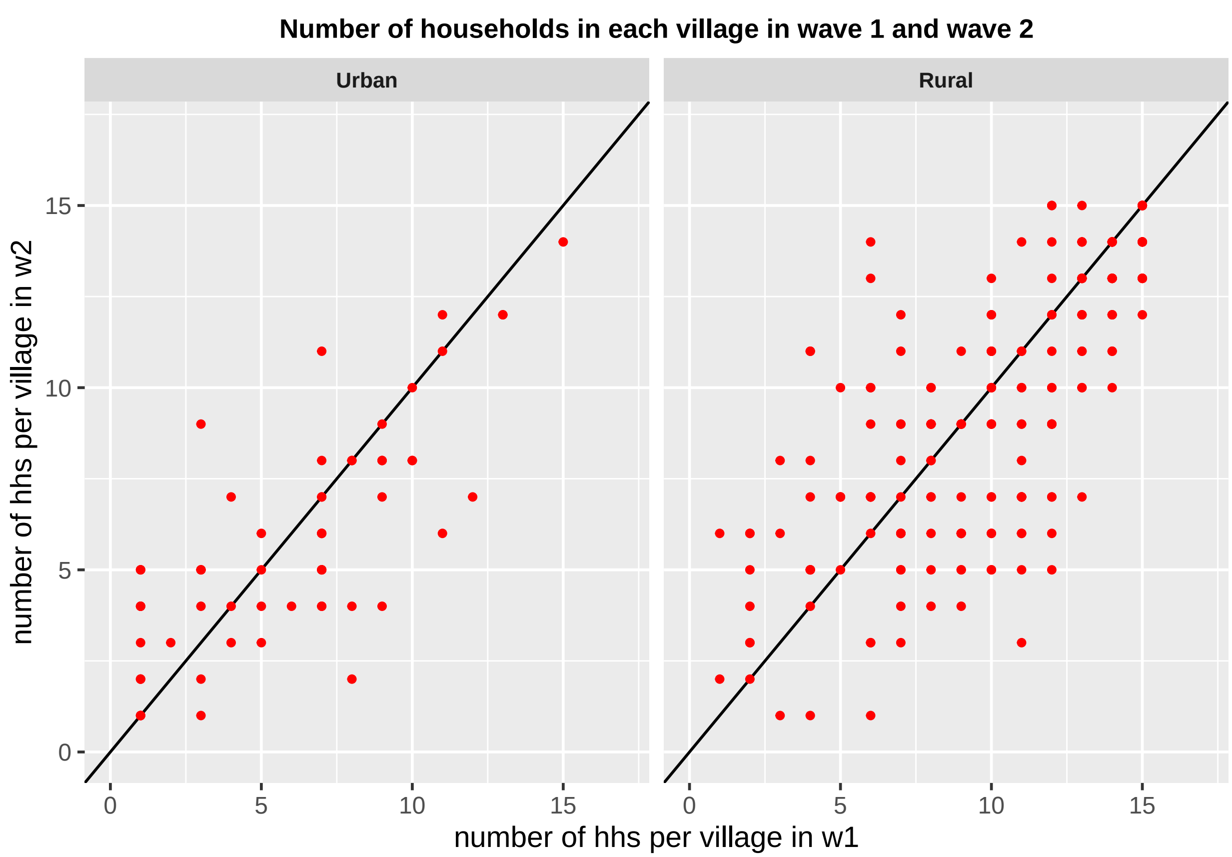
From Land Rights to Selling rights measures

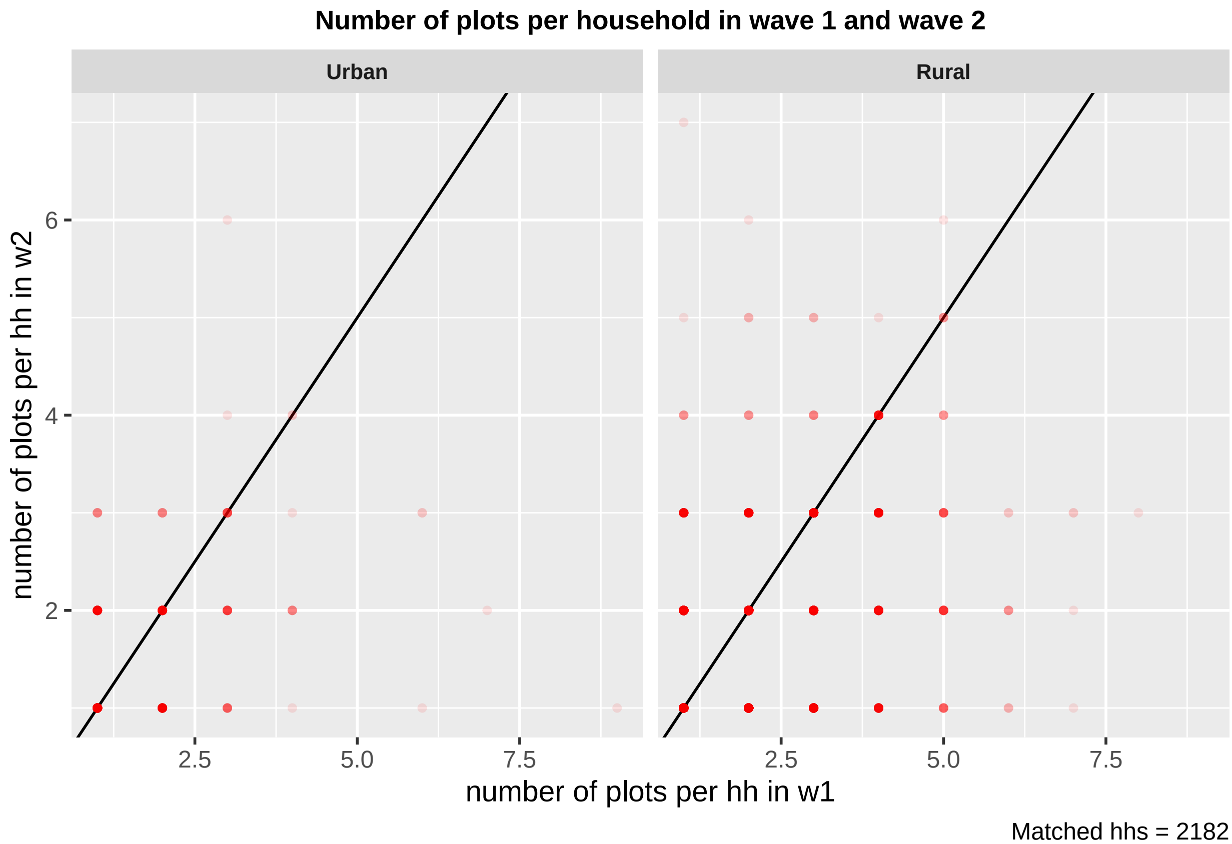
Here I have grouped by wave and village and derive the size of village land that does have selling rights. This is exactly the measure that will be the main explanatory variable described by the formula below (the weighted mean of land w/ selling rights). Notice that this is a continuous variable $\in [0, 1]$.

$$\textit{sell-rights}_{v,t} = \sum_{p \in v} \frac{\kappa_{p,t}}{\sum_{p \in v} \kappa_{p,t}} \textit{sell-rights}_{p,t}$$

Table 7: General land info at the village level (Ignoring NAs)

Wave	Locality	Land size (ha)	Number of villages
1	Rural	3446.9500	182
1	Urban	541.8319	48
2	Rural	6836.1531	198
2	Urban	1355.4990	87




Number of plots per household in wave 1 and wave 2
Urban
Rural
number of plots per hh in w2
number of plots per hh in w1
2
4
6
2.5
5.0
7.5
Matched hhs = 2182

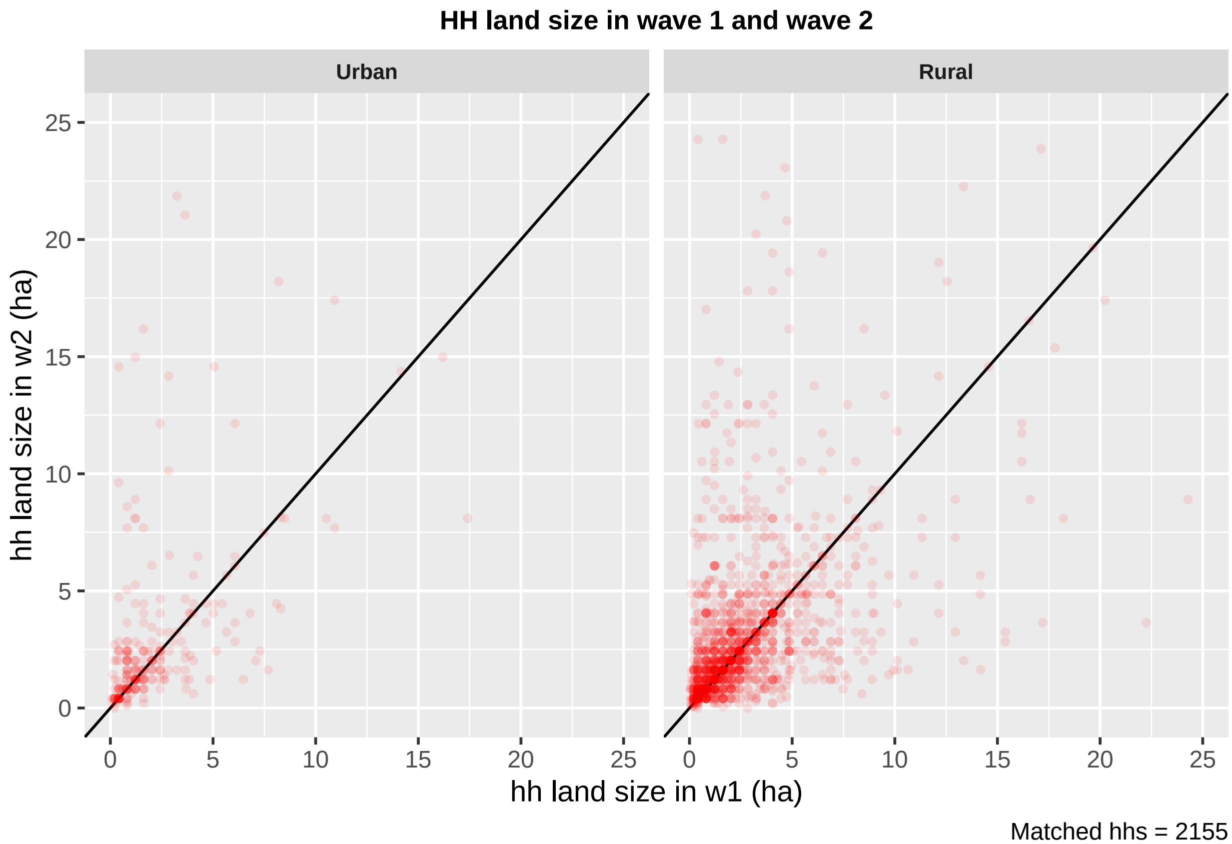
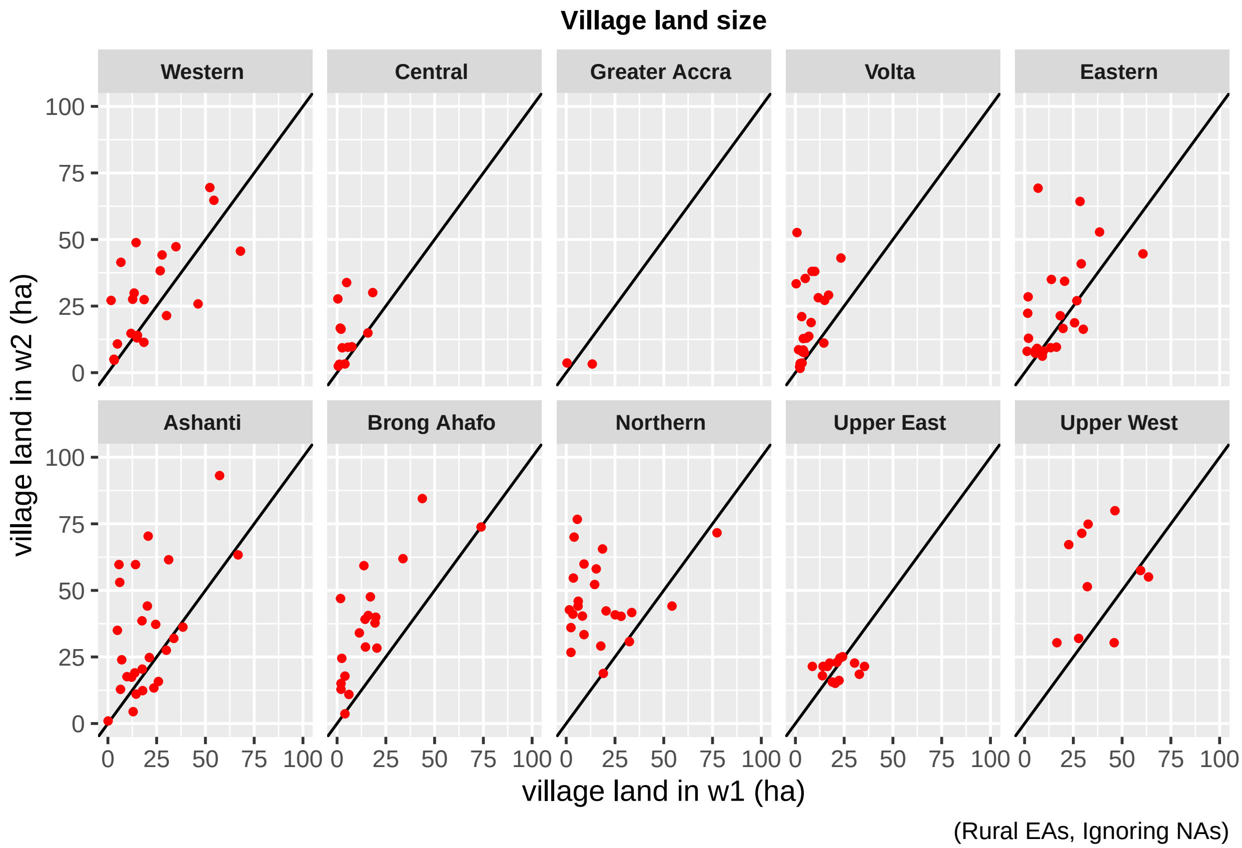


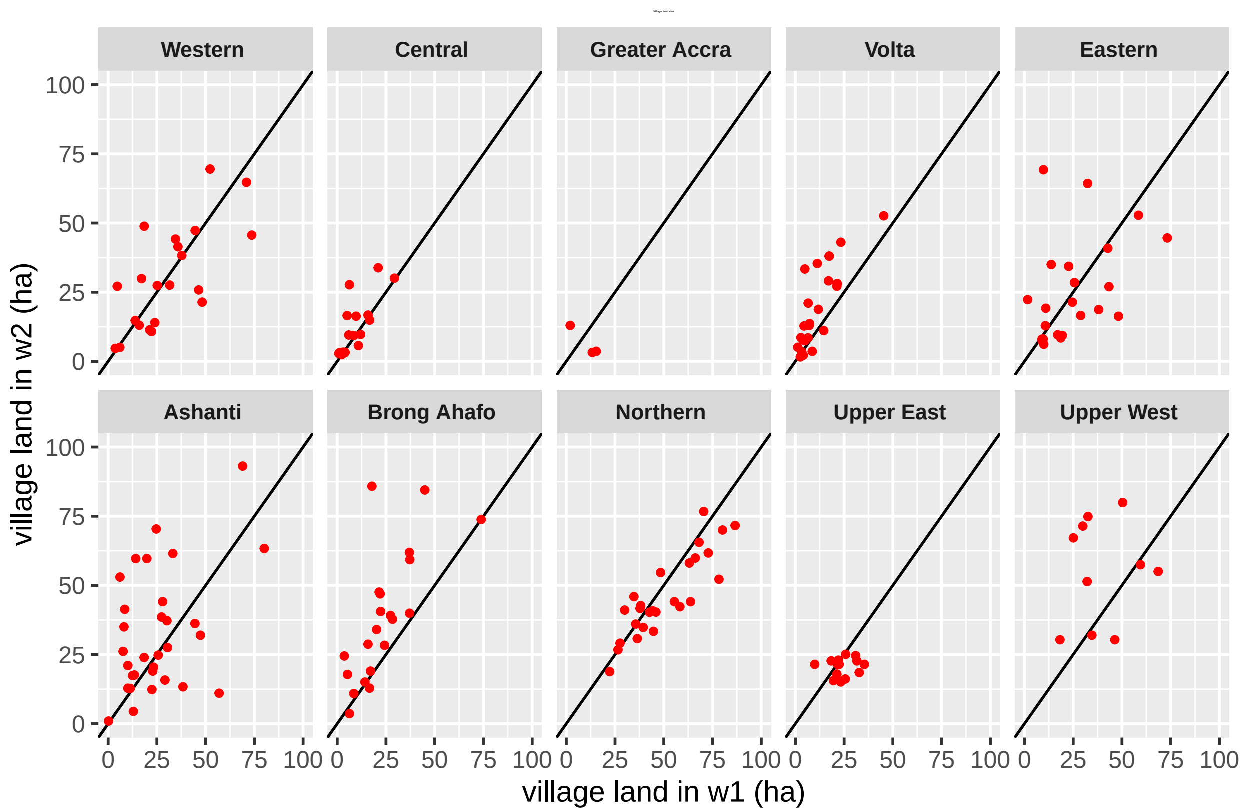
Table 8: Sell rights at the village level both waves (Ignoring NAs)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.08009	0.4167	0.4435	0.75	1

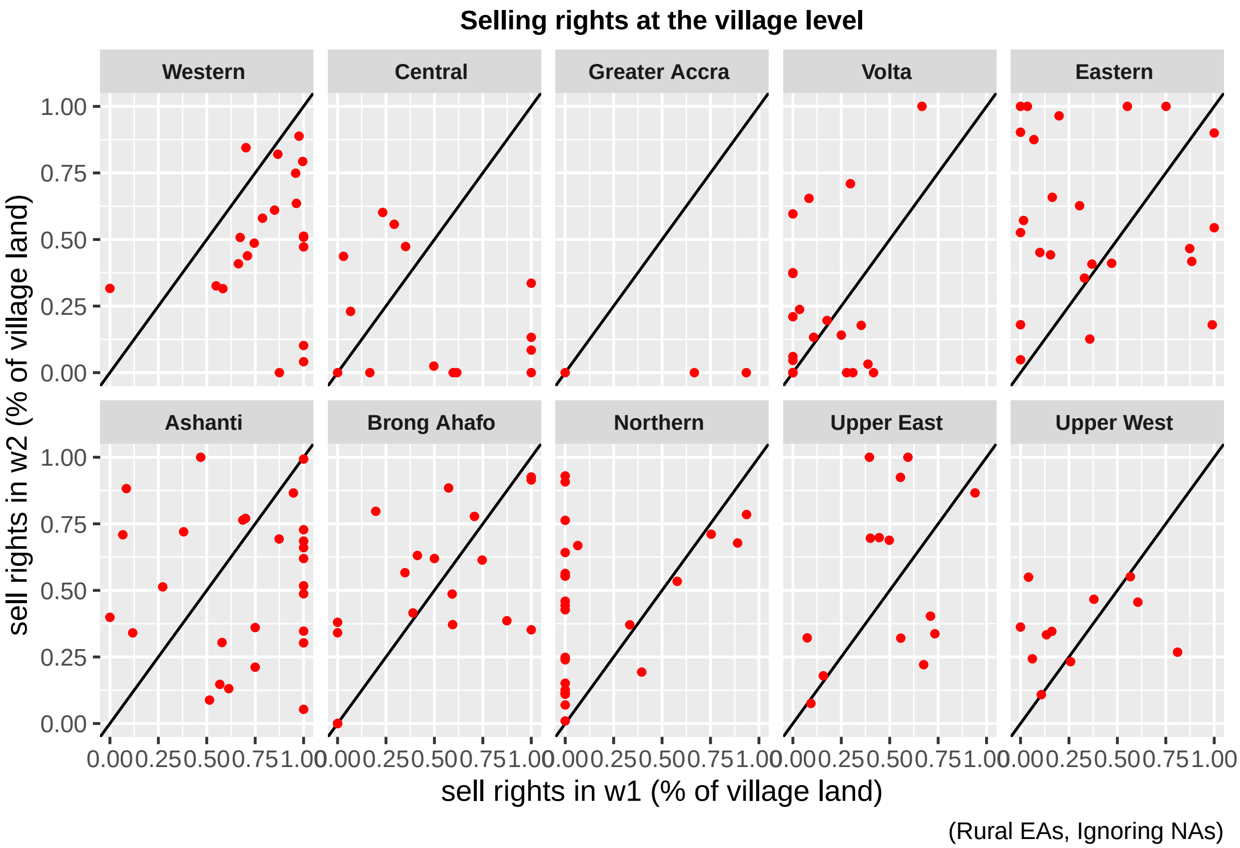
Table 9: Sell rights at the village level both waves (NAs as 0s)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.00984	0.3167	0.3624	0.62	1

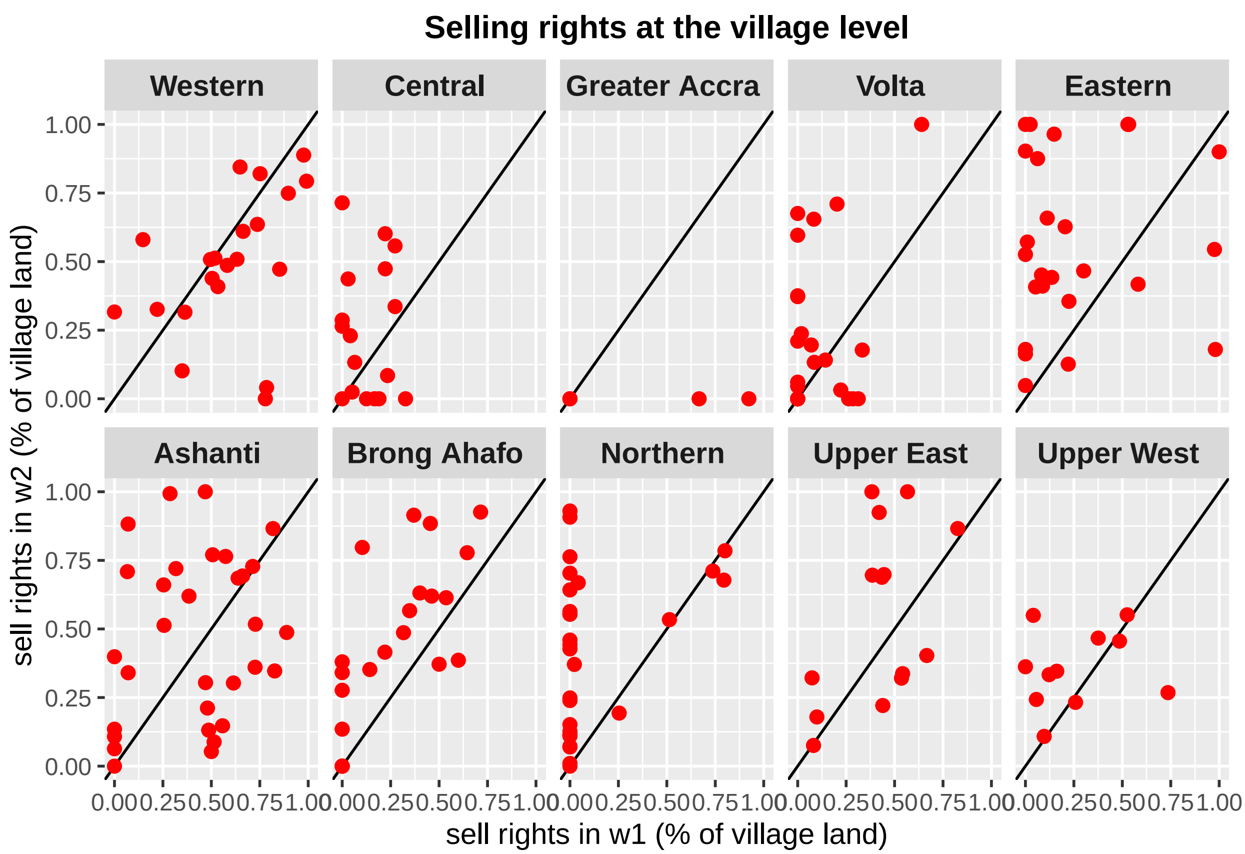

Village land size
Western
Central
Greater Accra
Volta
Eastern
Ashanti
Brong Ahafo
Northern
Upper East
Upper West
village land in w2 (ha)
village land in w1 (ha)
0
25
50
75
100
(Rural EAs, Ignoring NAs)



(Rural EAs, NAs as 0s)



Selling rights at the village level
Western
Central
Greater Accra
Volta
Eastern
Ashanti
Brong Ahafo
Northern
Upper East
Upper West
sell rights in w2 (% of village land)
sell rights in w1 (% of village land)
0.00
0.25
0.50
0.75
1.00
(Rural EAs, Ignoring NAs)


Selling rights at the village level
Western
Central
Greater Accra
Volta
Eastern
Ashanti
Brong Ahafo
Northern
Upper East
Upper West
sell rights in w2 (% of village land)
1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
sell rights in w1 (% of village land)

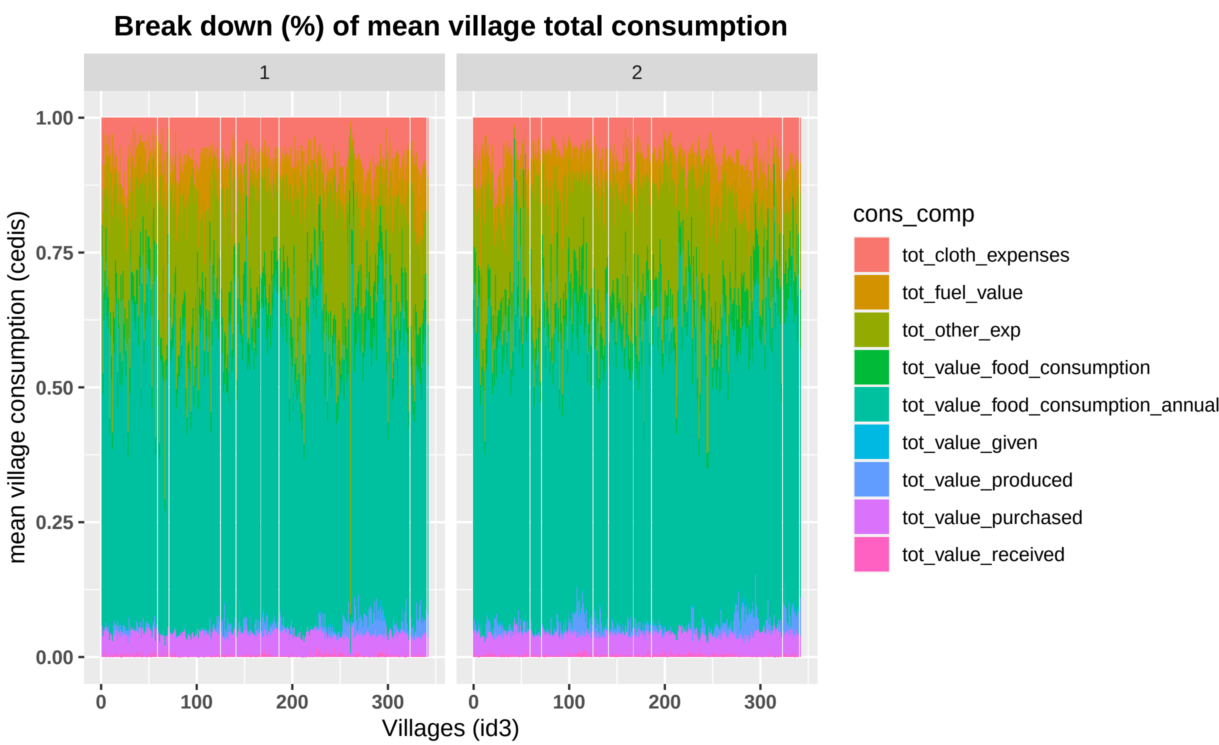
Consumption

On total consumption

Our measure of consumption consists of the following categories:

1. Food Items
2. Clothing
3. Fuels
4. Other expenditures

In the graph below, I aggregate consumption at the village level and we present the percentage contribution of each of the 4 components on total village consumption. Food consumption is the largest bulk of total consumption, however notice that the consumption spending on other expenditures has a considerable contribution. This component of consumption includes durable gooods such as structures, vehicles etc and we exclude it when computing the non-durable consumption.



Shows the percentage of each component in the mean value of village food consumption

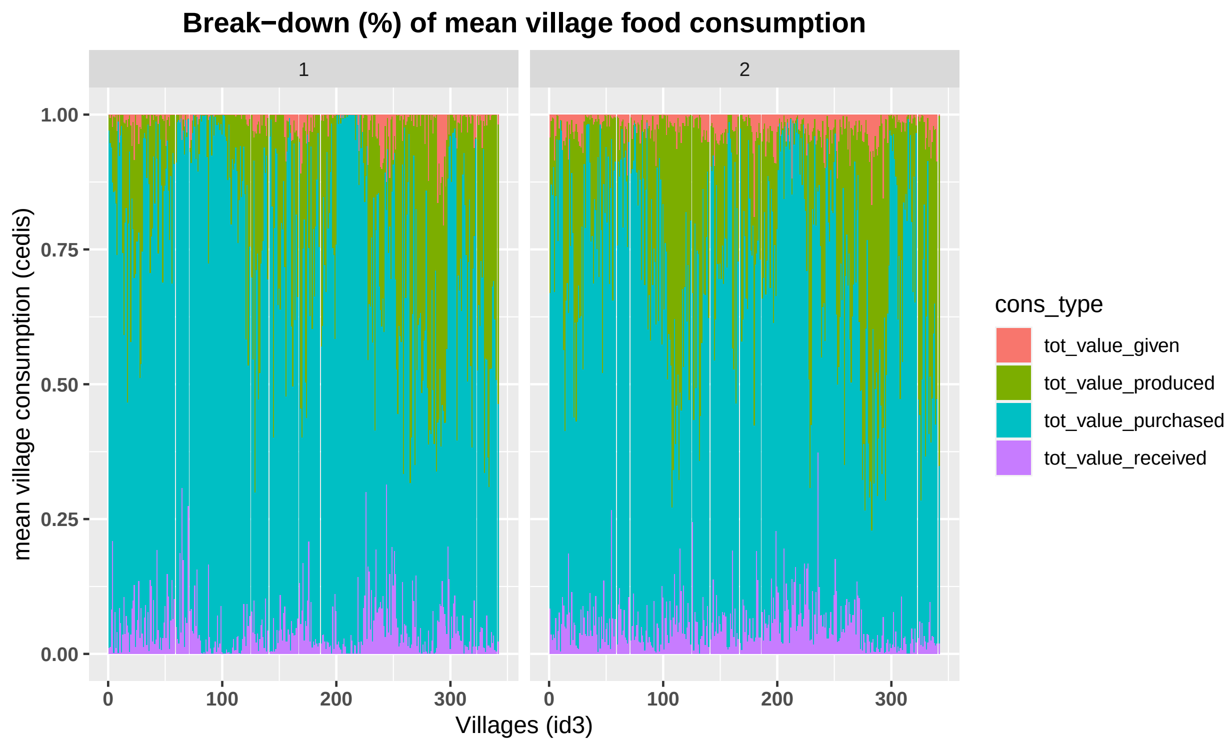
on Food Consumption

As food consumption constitutes the largest part of total consumption, we zoom in further in the components of it which are the following:

- Total value of food consumption purchased.
- Total value of food consumption produced.

- Total value of food consumption received.
- Total value of food consumption given.

Below we present the percentage contribution of each of the components above in the value of total consumption. Notice that this will be used when we compare the home - produced consumption vs the home - produced production.



Shows the percentage of each component in the mean value of village food consumption

Distribution of consumption

On deriving the winsorized data at the 2.5% level, notice that we do so grouped by wave, and you can see that as the min/max levels of the winsorized data between the two waves are different (in the opposite case, they would be the same, as consumption in both waves would be treated as one distribution). We choose that because (i) much larger value of consumption in wave 2 compared to wave 1, (ii) if we treat both waves as one distribution, we might end up with values at the max consumption in wave 1 which is not there and (iii) this difference is largely attributed to inflation between the two waves, so it would not be correct to treat it as one distribution.

Table 10: hh consumption in wave 1 (raw data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	1091	1752	2264	2814	41048

Table 11: hh consumption in wave 2 (raw data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	2505	4049	5484	6662	85802

Table 12: hh non-durable consumption in wave 1 (raw data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	847.3	1356	1702	2140	19630

Table 13: hh non-durable consumption in wave 2 (raw data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	2034	3231	4189	5081	48521

Table 14: hh consumption in wave 1 (winsorized data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
414.7	1091	1752	2195	2814	7220

Table 15: hh consumption in wave 2 (winsorized data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
842.5	2505	4049	5269	6662	18394

Table 16: hh non-durable consumption in wave 1 (winsorized data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
275.9	847.3	1356	1659	2140	5248

Table 17: hh non-durable consumption in wave 2 (winsorized data/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
676.9	2034	3231	4048	5081	13485

Notice the difference in the value of consumption between wave 1 and wave 2. The increase in consumption value between the two waves is more than twofold. This is because of increased level of prices faced in Ghana. According to world bank data, CPI in 2009 was 90.328 points and the CPI in 2014 was 150.21.

Hence, we deflate total value of consumption in wave 2 using :

$$consumption_{\text{w:2, in 2009 prices}} = consumption_{w:2} \times \frac{CPI_{2009}}{CPI_{2014}} \tag{1}$$

Table 18: hh total consumption in wave 2 (deflated/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	1506	2435	3298	4006	51593

Table 19: hh non-durable consumption in wave 2 (deflated/in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	1223	1943	2519	3055	29176

Income

1. **Main occupation income**.

   This labour income source belongs to (Part E: Employment). It is recorded for the past 7 days from the interview date but it also records the number of weeks the respondent held this occupation the past year (q. 7). In order to find the payment i sum q. 10 and q. 13 which report the payment in cedis and the value of any goods/services that were provided as a payment. Then I multiply by the number of weeks that respondent reported and derive the annual income from main occupation.

   There is no information about the value of taxes deducted from the payment, only whether the payment is gross or net.

Table 20: main occ annual income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	832	4800	10158	11450	768000

Table 21: main occ annual income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	721.6	5893	12526	16836	405877

2 **Secondary occupation income**. (Part E: Employment - same structure as the main occupation income)

Table 22: sec occ annual income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	136	3118	780	43056

Table 23: sec occ annual income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	9.621	24.05	100.6	60.73	932

3 **Non-farm enterprise income**

Belongs to section 5 where q.11 reports which months of the past year the bussiness was operating. q.12 reports whether business income belongs entirely to the household and if not then reports what percent of it flows to the hh (q.13). Then q.23 classifies each month as an High, Average, Low sales month and then q.24,25,26 report the average sales in each classification also q. 27,28,29 reports the respective bussiness costs for each classification (so the it is the net income recorded). Notice that there are household businesses that make losses.

Table 24: business annual profits in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-49200	136	510	1484	1478	115380

Table 25: business annual profits in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-71434	156.3	667.4	2725	2071	591078

4 **Animal income**

It is part of the 'Household assets' section. It records the number of animals per kind of animal and the expenses to maintain it and the revenues. So by subtracting costs of maintanance from the revenues we compute the net animal income.

Table 26: animal annual net income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-3573	-33	1	13.13	20	21251

Table 27: animal annual net income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-13358	-30.06	0	10.31	9.019	60081

5 **Financial income**

It also belongs to the 'Household assets'. It records (i) Borrowing, (ii) Lending, (iii) In transfers, (iv) out transfers and (v) Savings. To compute the net financial income we derive the net credit (lending-borrowing) + the net transfers (in - out transfers) + savings. For this case we also compute the gross fin income (lending + in-transfers + savings).

To sum up, the net financial income for each hh has been calculated as:

$$net.fin.income_{w,h} = (lending_{w,h} - borrowing_{w,h}) + (in.transfers_{w,h} - out.transfers_{w,h}) + savings_{w,h} \quad (2)$$

and the gross fin income:

$$gross.fin.income_{w,h} = (lending_{w,h} + in.transfers_{w,h} + savings_{w,h} \quad (3)$$

Table 28: net fin annual income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-9730	-17	50	198.5	270.5	19840

Table 29: net fin annual income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-19224	-60.13	66.14	292.7	402.9	66143

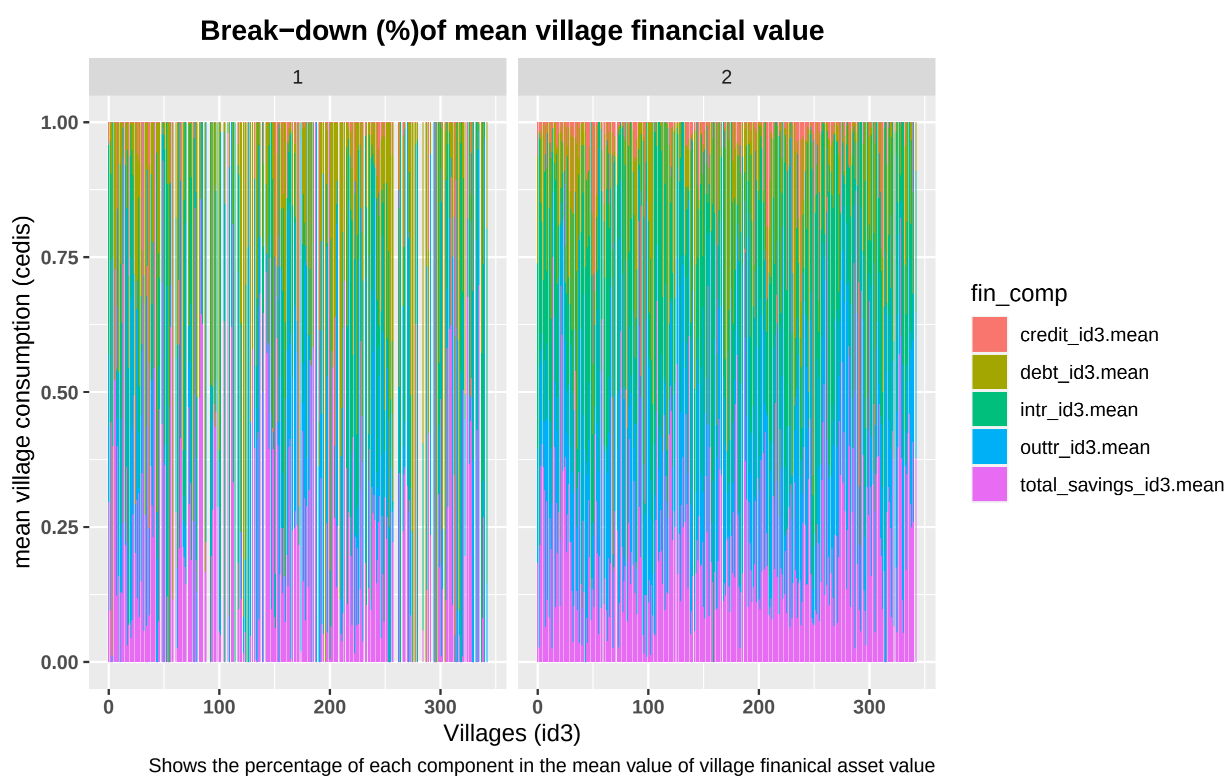
Table 30: gross fin annual income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	20	100	395.6	400	20800

Table 31: gross fin annual income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	36.08	180.4	680.2	637.4	66143

As we can see below there is no clear pattern across villages regarding the contribution of each component of the absolute value of financial assets. Here we have taken the absolute value of the components in the legend and we check their contribution to the village mean total value of finaincial assets.



6 **Land rent income**

This source belongs to section 4: Agricultural Production Part A:Land information, iv: Investment Ownership and Rental status. In this question we record both rent ins and rent outs. It is negligible less than 10 people report non zero income from land rents and also there is an inconsistency in the questions asked for land rents. In particular, the survey is not clear on the rent that was received/given the past year.

7 Crop Sales Income

Crop Sales I

We retrieve data from Section 4: Agricultural Production, Part B: Crop Sales and Storage (i) Revenues from crop production. However, note that these revenues do not correspond to crop production as they are the revenues from selling the harvest - which can be vastly different from what was produced - therefore, it does not constitute a good measure to compute productivity. We address this issue in the next section of Market Value from crop production.

In particular we use question B.71: What was the total revenue from this crop? for wave 1. Unfortunately, in wave 1 there is no question on the quantity sold, we only have the revenues from sold crops. In wave 2 the survey is more detailed providing information on the quantity sold, the price per unit and to whom it was sold.

7.1 Revenues

Table 32: net crop sales income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	50	240	697.9	704	17650

Table 33: net crop sales income income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	180.4	39349	1058	37595970

Crop Sales II

In this section we utilize another question (not from crops sales) from crops production that delivers the same information as the one above. In particular, in section V referring to crops harvest there is one relevant question: A.83: What was the total revenue from this crops harvest (sold)? which should coincide with the one above as it refers to sold production.

Notice that the comparison only refers to wave 1 as in wave 2 the particular question is absent and crop-sales information is only on the crop-sales section.

Notice that there is large difference between the two distribution of net income from crops-sales. HoWever, in order to maintain some consistency I think this information should be discarded as it does not appear in wave 2.

Table 34: crop sales income in w.1 (in cedis/from production question)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	147.2	586.2	580	60120

7.2 Costs

1. Chemicals:

   We use questions: A.165: What was the value of the amount of the chemicals that you used and A.168: What is the value of the subsidy.

   The survey asks this question for all chemicals (total 5) and for both major and minor season.

   Notes on chemicals: In wave 2 they do not ask any question about subsidy on chemicals - which apparently in some cases is larger than the cost (as seen in wave 1). Moreover, in wave 2 they as about the total cost of of chemicals in the previous farmin season (setion L q.L10)- so they do not ask separately about major and minor.

2. Tractor:

   We use questions A.244: What was the total cost of the tractor for opeartions on this plot for the last major season. and A.246: same question for the last minor season.

3. Seeds:

   We use questions A.252: What was the values of this seed (major season) and A.270 What was the value of this seed (minor season)

   The survey asks this question for all seeds (total 5)

4. Labour Input

   Here we utilize questions A.290, A.291 and A.292 which ask how much **casual work** was provided by men, women and children respectively. Questions A.293, A.294, A.295 which ask how much **permanent labour** was provided by men, women and children respectively and Questions A.296, A.297, A.298 which ask how much **family labour** was provided by men, women and children respectively. (we exclude family labour as we assume that is non-paid)

   The survey asks this set of 9 questions for all stages of crops-production (i) Land preparation, (ii) Field Management (iii) Harvesting and (iv) Post Harvest. It also asks these questions for both major and minor seasons.

   Notice that regarding labour inputs we only have the **time** for each type of labour provided. In order to assign value of this labour, we utilise information from the main occupation section which gives the income of people working on the field.

5. Transportation Costs: question B.67 for the transportation costs in the crops-sales section.

Chemicals

Table 35: net (cost-subs.) chemical costs in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-2050	20	57	124.9	135.4	4229

Table 36: net chemical costs in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	26.46	64.94	147.5	147.9	6314

Seeds

Notice that not all seeds are purchased, therefore, we include two measures of costs for seed. The first includes the total value of seeds used by the households, and the second the total value of seeds that were purchased and used. We actually drop the first measure because in wave 2, the corresponding question only asks for value of the purchased seeds leaving out all other types.

Table 37: How did you obtain the seed w1 in major season

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
Seed from own harvest	3044	68.79	68.79	58.56	58.56
Purchased	1088	24.59	93.38	20.93	79.49
Exchanged	14	0.3164	93.69	0.2693	79.76
Gift	271	6.124	99.82	5.214	84.97
Other	5	0.113	99.93	0.09619	85.07
Borrowed	3	0.0678	100	0.05771	85.13
	773	NA	NA	14.87	100
Total	5198	100	100	100	100

Table 38: seeds (purchased) costs in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	22.37	12	2205

Table 39: seeds (purchased) costs in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	37.91	22.85	6614

Tractor

Table 40: tractor costs in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	32.17	0	3875

Table 41: tractor costs in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	27.56	0	2646

Labour Inputs

The section is concerned with labour inputs in each plot is much detailed. It divides the process of harvesting in 4 different stages ((i) Land preparation, (ii) Field Management, (iii) Harvesting, (iv) Post-Harvest) and asks about three types of labour ((a) casual, (b) permanent, (c) family) separately for (1.men, 2. women, 3. children).

From this categorization we focus on all stages of harvesting, on (a) casual and (b) permanent labour, as we expect that family labour is not paid, and for men and women as child labour will not be paid.

Despite reporting the number of days, average hours per day and avergage number of workers for each plot, the survey does not ask for wages. Therefore we resort to the section of *income from main occcupation* to retrieve wages from people occupied in agriculture -related jobs. In main occupation survey section, people report the 'kind of trade, service and industry their work connects to'. From those reported we focus on the following sectors (as they appear in the responses): 1/Agric Labourer, 2/Agric Service, 3/Agric Subistence, 4/ Agriculture, 5/ Agric, 6/ Agriculture Service, 7/Farming, 8/ Harvesting crops on farm, 9/ Weeding, 10/Weeding, irrigation, harvesting. Those categories however, exhibit vast heterogeneity in terms of daily (0.4- 207 cedis per day) and hourly wages, this is also due to those categories including from farm labourers to land managers. Therefore, we restrict the sample to those that report as their main duty 'farm labourer'. Taking the mean of thei daily and hourly wage we end up in **10.9 cedis per day** and **1.6 cedis** per hour for the average farm labourer.

In wave 2, the survey divides harvesting in 7 stages (i) Clearing and land preparation, (ii) Plowing, (iii) Planting, (iv) Chemical Application, (v) Weeding, (vi) Harvesting and (vii) Post harvesting. It does not provide average hours only average days so we are going to use the average daily wage from main occupation data in wave 2. Following the same process to derive a mean wage per day and a mean wage per hour using wave 2's main occupation data, we find a mean wage per day of **7.67 cedis per day** and **1.47 cedis per hour** for the average farm labourer in wave 2.

Table 42: labour costs in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	230.4	1469	926.4	1290584

Table 43: labour costs in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	9.224	160.4	129.1	8740

Transportation Costs

Table 44: transporation costs in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	17.09	12	970.1

Table 45: transportation costs in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	8.835	0	667.4

Total Crop Costs

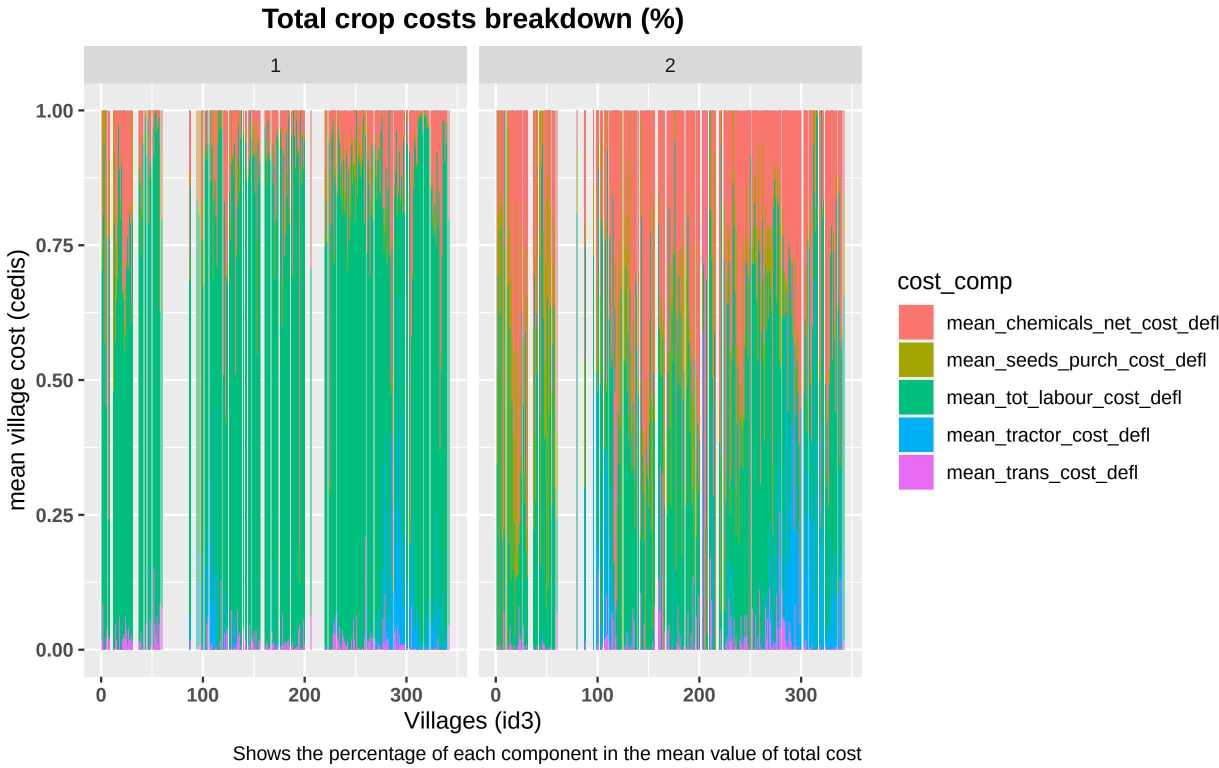


Table 46: total crop costs in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-1958	57.8	326.4	1593	1107	1291251

Table 47: total crop in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	18.04	102.2	311.3	324.7	10461

Finally, we can derive the net crop income which will be the following:

$$net.crop.income_{w,h} = crop.sales_{w,h} - transortation.cost_{w,h} - chemical.costs_{w,h} - seed.costs_{w,h} - tractor.cost_{w,h} - labour.costs_{w,h} \quad (4)$$

Table 48: crop sales net income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-1290285	-715.8	-102.2	-1134	19.6	10094

Table 49: crop sales net income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-8796	-60.09	0	35394	531.8	37595409

Total Net Income

We can now compute the total net income as the sum of all net incomes computed above:

$$\begin{aligned} total.net.income_{w,h} =& net.crop.income_{w,h} \\ &+main.occupation.income_{w,h} \\ &+secondary.occupation.income_{w,h} \\ &+non.farm.enterprise.net.income_{w,h} \\ &+animal.net.income_{w,h} \\ &+financial.net.income_{w,h} \end{aligned} \tag{5}$$

Table 50: net income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-1289335	-21	363	2661	2050	768751

Table 51: net income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-71230	134.6	914	24602	4236	37595499

Market value of production

Crop Production

Here we attempt to assign a value on the produced crops to be used for the productivity measure.

Market Value of Production (not sales)

We need to derive the market value of produced quantity in wave 1. This raises two problems. First, respondents report quantity in different units of measurement, as a result we do not have everything in one unit to allow for comparisons. Second, we do not have prices per unit, as we only have the estimated market value of the quantity harvested (q.82) which is first a rough estimate of the respondent and is rarely answered. We also have q.83 what is the total revenue from harvested sold - however, we do not know what part of harvest did end up to the market.

In order to address the first problem we we proceed as follows:

1. Employ unitcode for wave 1 by Andre. This is a conversion table from several of measurement units (e.g. American tin, Basket, Bundle etc) appearing in the survey, to kgr. It is ea-crop-unit specific and expresses kgr/'reported measurement unit' values. [1].

   We also utilize the conversion value (kgr/unit) as ea-crop specific. For example a 'bowl' of bambara beans weight ranges from 2.50 to 3.30 kgr across Ghana according to the conversion table. We maintain this variation accross areas, because (i) other kinds of the same product harvested in different areas might weight more and (ii) different areas might have a different benchmark for the measurement unit (bowl here).

   In order to exploit this information as much as possible and to capture most of the area-crop-unit combinations that can arise in the dataset, we generalize at (i) district (ii) regional and (iii) country level. In case of missing values for an ea we take the average conversion across all available EAs in the same district - we generalize in the same region and lastly in the country. To contain the variation for the same product and unit that is present in the dataset - we truncate first using the interquartile range of the sample.

   We end up with each conversion rate having a unique *ea-crop-unit* upon which we merge it to the crop-production data for wave 1 from the survey.

Note that we manage to do a good job in translating different units of measurement in kgr, however, there is some variation in the translated kgr. Take for example a 'Maxi Bag' of groundnut. In the production data from the survey there are 256 plots growing groundnut and reporting quantity in maxi bags. If we use the unit conversion we manage to match 46 out of 256.

Table 52: kgr of maxi bag of groundut w/o generalisations

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
89.1	10	21.74	21.74	3.906	3.906
92.5	1	2.174	23.91	0.3906	4.297
96	19	41.3	65.22	7.422	11.72
97.2	7	15.22	80.43	2.734	14.45
101.5	9	19.57	100	3.516	17.97
	210	NA	NA	82.03	100

[1] *there is an inconsitency here - because there is a column in the dataset that is called kilograms - and this has values other than 1*

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
Total	256	100	100	100	100

Implementing the generalizations at the district/regional/country level we manage to match all 256 instances. However, notice that we get outlier values such as 150 kgr. This comes from the original conversion table of Andre, in which there were instances of respondents reporting 160 kgr weight for a maxi bag of groundnut - by taking the mean of truncated sample of those conversation rates we reduce it but we do not eliminate it. Notice that this value was not matched (through the ea-crop-unit id) to the production data - that is why it does not appear here however this information affects other ea's in the district that appear in the production data - that is why we have 2 instances of 150 kgr here. Moreover, it is not 160 because we take the mean of ea-crop-unit conversation rates and other lower values decrease it.

Table 53: kgr of maxi bag of groundut w/ generalisations

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
89.1	10	3.906	3.906	3.906	3.906
92.5	46	17.97	21.88	17.97	21.88
92.55	10	3.906	25.78	3.906	25.78
95.0472222222222	31	12.11	37.89	12.11	37.89
95.4424189814815	57	22.27	60.16	22.27	60.16
95.6153189300412	25	9.766	69.92	9.766	69.92
96	19	7.422	77.34	7.422	77.34
96.3208333333333	17	6.641	83.98	6.641	83.98
97.2	16	6.25	90.23	6.25	90.23
101.5	23	8.984	99.22	8.984	99.22
157.375	2	0.7812	100	0.7812	100
	0	NA	NA	0	100
Total	256	100	100	100	100

In order to address the second problem of finding a price per unit for the total production per plot, we proceed as follows

1. We utilize price data from Andre (cropprice-W1), a table of 1,516 ea-crop-unit specific prices after harvest. We again do the same generalization on this table. For those entires that do not have a ea-crop-unit specific price we substitute with the mean crop-unit price at the district, regional and country level.

   We then proceed and merge the price data with the production per plot data from the survey and we perform the same generalisations at the district/regional/country level.

With the raw price data from Andre we manage to match the price for a maxi bag of groundnuts across Ghana for 38 out of 256 instances. Notice the considerable variation in prices for the same unit of the same good across Ghana. In the original dataset the price for a maxi bag of Groundnut ranges from 10 cedis to 130 cedis (in the table below the 10 cedis price was matched to a plot from production data, while the 130 cedis was not - however, it is taken into account to the mean prices substituting for not matched plot data).

Table 54: Per unit price of a maxi bag of groundut w/o generalisations

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
10	10	26.32	26.32	3.906	3.906

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
25	4	10.53	36.84	1.562	5.469
60	9	23.68	60.53	3.516	8.984
80	2	5.263	65.79	0.7812	9.766
85.8	1	2.632	68.42	0.3906	10.16
90	8	21.05	89.47	3.125	13.28
120	4	10.53	100	1.562	14.84
	218	NA	NA	85.16	100
Total	256	100	100	100	100

Via generalizing at the district/regional/country level we manage to find a per unit price for all 256 instances of a maxi bag of groundnut.

Table 55: Per unit price of a maxi bag of groundut w/ generalisations

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
10	24	9.375	9.375	9.375	9.375
25	34	13.28	22.66	13.28	22.66
60	9	3.516	26.17	3.516	26.17
62.15	76	29.69	55.86	29.69	55.86
65.58	24	9.375	65.23	9.375	65.23
80	12	4.688	69.92	4.688	69.92
85.8	1	0.3906	70.31	0.3906	70.31
87.9	45	17.58	87.89	17.58	87.89
90	8	3.125	91.02	3.125	91.02
120	23	8.984	100	8.984	100
	0	NA	NA	0	100
Total	256	100	100	100	100

So finally we can derive a value of the production of maxi bags of groundnut.

Table 56: Number of maxi bags of groundnut produced in each plot

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.3	2	4	8.171	10	80

Table 57: Range of prices of maxi bag of groundnut

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10	60	62.15	64.1	87.9	120

Table 58: Corresponding value in cedis

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10	97.08	196.7	506.5	621.5	4972

These calculations are repeated for all 5 crops recorded in each plot and for both major and minor seasons.

```
##  chr [1:5686] NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA ...
```

From these calculations, we have derived the per plot total production in kgr and its value in cedis for the last harvest season in wave 1 (major + minor):

Table 59: Value of production in cedis (wave 1)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	41	187.9	10390	655.8	2100675

In wave 2 things are simpler, as we do not need to use data outside the survey data. In wave 2 under the crop-sales section, the survey asks the per unit price in which respondents sold their crops. However, this varies according to whom the crops was sold to. In fact they have different categories (market price, community price, other community price, pre-harvest contractors, trade organization price, aggregators price, outgrowers price, cooperatives price and other) of buyers and for each of those, the respondent reports the per unit price charged. We use the mean price per unit over all those categories to derive the market value of production.

Table 60: Production value in w.1 (in cedis plot level)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	41	187.9	10390	655.8	2100675

Table 61: Production value in w.2 (in 2009 cedis plot level)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	234.3	721.6	71777	2369	117861693

Detour on crop sales net income

Now we go back in calculating net-income and we perform the following two alterations:

1. We add an extra land cost for sharecropping. This is done by accounting for the percentage of crop production that was given to the landlord.

Table 62: Value of production - accounting for sharecropping costs (wave 1 in cedis hhlevel)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	125	477.6	21001	2008	2101744

Table 63: Value of production - accounting for sharecropping costs (wave 2 in 2009 cedis hhlevel)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	469	1361	119711	4780	131327761

2 We replace crop-sale income w/ total production value (accounting for sharecropping costs) in df: crop-sales-net-income. We end up with the following summary statistics

Notice that the two tables below show crop production net income where in the revenues side we have replaced crop sales income (from the crop sales section) with the market value of production derived above. Moreover, here we have accounted for the cost of land sharing for those plots that practise so.

Table 64: Crop production net income (wave 1 in cedis hhlevel)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-1289948	-264.6	81.87	19400	1091	2101042

Table 65: Crop production net income (wave 2 in 2009 cedis hhlevel)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-6520	325.8	1144	119376	4325	131326629

Finally, using we can derive the total net income where we have used the market value of production derived in this section on the revenues side - accounting for sharecropping costs and adding all other sources of income as in the previous analysis (net finincome, main occupation, sec occupation animal income etc). We can compare this measure with tables 50 and 51.

Table 66: net income in w.1 (in cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-1288998	100.1	781	14320	4318	2101166

Table 67: net income in w.2 (in 2009 cedis)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
-71230	438.1	1745	66247	6844	131330752

Productivity Measure

In order to derive a productivity measure, we are using the market value of production per plot and we divide it by the size of plot in order to have a cedis/hectare productivity measure.

To derive it at the household level, we take the weighted sum of the per plot prodcutivities belonging to the same hh where the weights are the relative size of the plot to the household land holdings. We also use the deflated measure of total value of production for wave 2.

Table 68: plot productivity in w.1 (cedis per hectare)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	55.63	222.4	9815	638.6	2595383

Table 69: plot productivity in w.2 (2009 cedis per hectare)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	222.9	594.3	71779	1830	185726517

We also present at the hh level

Table 70: hh productivity in w.1 (cedis per hectare)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	100.6	294.6	6526	959.5	577046

Table 71: hh productivity in w.2 (2009 cedis per hectare)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	284.2	715.3	39811	2169	37160162

Regression Analysis

For the regression analysis, we use the following data:

- **Consumption**:

  1. $consumption - levels.csv$: total consumption/total consumption nd/ deflated /winsorized. (hh level)
  2. $consumption - pc$: total consumption pc/total consumption nd pc (pc2, and win-pc and win-pc2) (hh level)
  3. $consumption - log.ihs$ log/ihs(consumption levels (+nd)), log/ihs(consumption(pc)) and win(log/ihs(consumption)). (hhleve)
  4. $consumption - ea$ village consumption everything (at the village level), rest.ea consumptiion everything (hh level)

- **Income**:

  1. $all - net - incomes$: it contains all net incomes in the calculation and the the total net income. Here we have used crops sales income from the crop sales section of the survey. (hh level)
  2. $all - net - incomes.ii$: it contains all net incomes as above but the crop income has been calculated using the market value of production and we have accounted for sharecropping costs in it. (hhlevel)

- **Selling rights**:

  1. $sell.rights_e a$: selling rights ignoring NAs (at the village level)
  2. $sell.rights - ea.na0$: selling rights treating NAs as 0s (at the village level)

- **Land characteristics**:

  1. $land - controls$: with years of use, can fallow, chemicals number, boundaries conflict, lose title, given to someone else, taken, had dispute, claims, contract, purchased, inherit, can put as security, rent, allocated free, can sell, deep land, wet land, otherthanrain water source, irrigation investments plant trees (at the village level). Those measures have been calculated both as a share of plots that have those characteristics, wieghted share of plots at the village level based on the relaitve size of the plot and as average at the village level.

- **Village demographics**

  1. $village.demographics$: with the hhsize/ hhweightedsize/village population/number of hhs in each village

Townsend regression

$$ihs(c_{h,v,t}) = \alpha + \beta_1 \cdot ihs(y_{h,v,t}) + \beta_2 \cdot ihs(y_{h,v,t}) \cdot \textit{sell-rights}_{v,t} + \beta_3 \cdot \textit{sell-rights}_{v,t} + \beta_4 \cdot X_{h,v,t} + \epsilon_{h,v,t} \quad (6)$$

Per capita

First I try with the the winsorized data at 1 pc:

Below I have used non-durable consumption (adjusted not to include produced consumption), cropsales total net income and selling rights ignoring NA values. Notice that the same result holds for the ihs() specification and for the whole consumption (+nd) it holds also for the whole income sample. The signs are maintained through all specifications however we lose significance.

===
Dependent variable:

log(win_total_net_income_cropsales_pc2) 0.070*** (0.014)
sell.rights_ea.weighted_na0 0.091 (0.197)
log(winrest_ea_consumption_pc2) 0.718*** (0.049)
avg_ea_yrs_use 0.003 (0.002)
avg_ea_chem_num -0.034 (0.047)
share_ea_canfallow 0.025 (0.083)
share_ea_monthsinf -0.084 (0.092)
share_ea_losetitle -0.265 (0.279)
share_ea_givenelse -0.038 (0.115)
share_ea_taken 0.095 (0.091)
share_ea_boundaries -0.148 (0.388)
share_ea_claims 0.208 (0.410)
share_ea_purchased 0.382 (0.317)
share_ea_rent 0.124 (0.155)
share_ea_none -0.045 (0.090)
share_ea_deep 0.019 (0.072)
share_ea_otherthanrain 0.139 (0.118)
share_ea_irriginv -0.259 (0.198)
share_ea_plantrees 0.154 (0.197)
num_hhs_invil -0.010 (0.015)
log(win_total_net_income_cropsales_pc2):sell.rights_ea.weighted_na0 -0.048 (0.030)
===
===
Note: *p<0.1;* ***p<0.05;*** p<0.01
===
Dependent variable:

log(win_total_net_income_cropsales_pc2) 0.070***
(0.014)

sell.rights_ea.weighted_na0 0.091
(0.180)

log(winrest_ea_consumption_pc2) 0.718***
(0.056)

avg_ea_yrs_use 0.003**
(0.001)

avg_ea_chem_num -0.034
(0.038)

share_ea_canfallow 0.025
(0.079)

share_ea_monthsinf -0.084
(0.086)

share_ea_losetitle -0.265
(0.265)

share_ea_givenelse -0.038
(0.097)

share_ea_taken 0.095
(0.081)

share_ea_boundaries -0.148
(0.356)

share_ea_claims 0.208
(0.501)

share_ea_purchased 0.382*
(0.200)

share_ea_rent 0.124
(0.128)

share_ea_none -0.045
(0.076)

share_ea_deep 0.019
(0.062)

share_ea_otherthanrain 0.139
(0.112)

share_ea_irriginv -0.259*
(0.152)

share_ea_plantrees 0.154
(0.154)

num_hhs_invil -0.010
(0.015)

log(win_total_net_income_cropsales_pc2):sell.rights_ea.weighted_na0 -0.048*
(0.028)

==

Note: *p<0.1;* ***p<0.05;*** p<0.01

Table 73: Townsend Panel Regression Results

	Dependent variable:
	log(consumption.per.capita)
log(win_total_net_income_cropsales_pc2)	0.070***
	(0.014)
sell.rights_ea.weighted_na0	0.091
	(0.180)
log(winrest_ea_consumption_pc2)	0.718***
	(0.056)
share_ea_monthsinf	−0.084
	(0.086)
share_ea_losetitle	−0.265
	(0.265)
num_hhs_invil	−0.010
	(0.015)
log(win_total_net_income_cropsales_pc2):sell.rights_ea.weighted_na0	−0.048*
	(0.028)
Village + Land controls	*Yes*
HH x Wave Fixed effects	*Yes*
Village Clustered se	*No*
Observations	3,659
R^2	0.250
Adjusted R^2	-1.425
F Statistic	17.982*** (df = 21; 1131)
Note:	*p<0.1; **p<0.05; ***p<0.01

==

Dependent variable:

log(win_total_net_income_cropsales_pc2) 0.071*** (0.016)
log(winrest_ea_consumption_pc2) 0.729*** (0.048)
avg_ea_yrs_use 0.001 (0.002)
avg_ea_chem_num -0.037 (0.046)
share_ea_canfallow 0.013 (0.074)
share_ea_months12 0.297 (0.212)
share_ea_losetitle -0.355 (0.264)
share_ea_taken 0.040 (0.084)
share_ea_boundaries -0.054 (0.365)
share_ea_claims 0.324 (0.386)
share_ea_contract -2.845 (7.543)
share_ea_purchased 0.040 (0.352)
share_ea_inherit -0.224 (0.194)
share_ea_rent -0.102 (0.220)
share_ea_allocfree -0.170 (0.185)

share_ea_sec 0.468** (0.211)
share_ea_deep -0.015 (0.070)
share_ea_otherthanrain 0.036 (0.112)
share_ea_irriginv -0.116 (0.180)
share_ea_chemicaluse 0.018 (0.086)
hhsize -0.138*** (0.011)
vil_pop 0.008*** (0.003)
num_hhs_invil -0.047*** (0.015)
log(win_total_net_income_cropsales_pc2):sell.rights_ea.weighted_na0_avg.w -0.073* (0.038)
==
==
Note: *p<0.1;* ***p<0.05;*** p<0.01
==
Dependent variable: ————————————

log(win_total_net_income_cropsales_pc2) 0.071***
(0.015)

log(winrest_ea_consumption_pc2) 0.729***
(0.062)

avg_ea_yrs_use 0.001
(0.001)

avg_ea_chem_num -0.037
(0.034)

share_ea_canfallow 0.013
(0.073)

share_ea_months12 0.297
(0.195)

share_ea_losetitle -0.355
(0.249)

share_ea_taken 0.040
(0.068)

share_ea_boundaries -0.054
(0.349)

share_ea_claims 0.324
(0.499)

share_ea_contract -2.845*
(1.563)

share_ea_purchased 0.040
(0.258)

share_ea_inherit -0.224
(0.210)

share_ea_rent -0.102
(0.220)

share_ea_allocfree -0.170
(0.194)

share_ea_sec 0.468**
(0.183)

share_ea_deep -0.015
(0.061)

share_ea_otherthanrain 0.036
(0.095)

share_ea_irriginv -0.116
(0.138)

share_ea_chemicaluse 0.018
(0.090)

hhsize -0.138***
(0.014)

vil_pop 0.008***
(0.003)

num_hhs_invil -0.047***
(0.015)

log(win_total_net_income_cropsales_pc2):sell.rights_ea.weighted_na0_avg.w -0.073**
(0.036)

==================================

Note: *p<0.1;* ***p<0.05;*** p<0.01

Table 75: Townsend Panel Regression Results w/ avg selling rights

	Dependent variable:
	log(consumption.per.capita)
log(win(net.income.pc))	0.071***
	(0.015)
log(win(rest.consumption.pc)	0.729***
	(0.062)
log(win(net.income.pc))*avg.sell.rights	−0.073**
	(0.036)
Village + Land controls	Yes
HH x Wave Fixed effects	Yes
Village Clustered se	Yes
Observations	3,659
R^2	0.335
Adjusted R^2	-1.155
F Statistic	23.727*** (df = 24; 1128)
Note:	*p<0.1; **p<0.05; ***p<0.01

Risk-sharing panel regression

$$ihs(RS_{v,t}) = \alpha + \beta_1 \cdot sell\text{-}rights_{v,t} + \beta_2 \cdot X_{v,t} + \epsilon_{v,t}$$

Here I have used again non-durable consumption (adjusted to exclude produced consumption) and crop sales net income. It maintains the sign but loses significance when I run the ihs() - but its close so can be fixed by selecting the controls.

Table 76: Risk-sharing ratio panel regression Results

	Dependent variable:	
	log(RS)	
	(1)	(2)
sell.rights_ea.weighted_na0	-1.444^{**}	-1.444^{***}
	(0.625)	(0.548)
log(winrest_ea_consumption_pc2)	1.176^{***}	1.176^{**}
	(0.450)	(0.470)
Village + Land controls	*Yes*	*Yes*
Village x Wave Fixed effects	*Yes*	*Yes*
District Clustered se	*No*	*Yes*
Observations	386	386
R^2	0.141	0.141
Adjusted R^2	-0.922	-0.922
F Statistic (df = 15; 172)	1.889^{**}	1.889^{**}
Note:	*p<0.1; **p<0.05; ***p<0.01	

==
Dependent variable:

log(winrest_ea_consumption_pc2) 0.025** (0.012)
share_ea_losetitle 0.017 (0.068)
share_ea_sell 0.019 (0.036)
hhsize -0.0005 (0.003)
vil_pop -0.0005 (0.002)
num_hhs_invil 0.002 (0.004)
tot_ea_land_ignna -0.0001 (0.0002)
==
==
Note: *p<0.1;* ***p<0.05;*** p<0.01
==
Dependent variable:

log(winrest_ea_consumption_pc2) 0.025**
(0.010)

share_ea_losetitle 0.017
(0.054)

share_ea_sell 0.019
(0.028)

hhsize -0.0005
(0.002)

vil_pop -0.0005
(0.002)

num_hhs_invil 0.002
(0.004)

tot_ea_land_ignna -0.0001
(0.0001)

==

Note: *p<0.1;* ***p<0.05;*** p<0.01

Land Fluidity Index

$$\underbrace{\frac{\sum_{h\in v}\left(land_{h,t+1} - land_{h,t}\right)^2}{\overline{land}_{v,t/t+1}}}_{LFI_v} = \alpha + \beta_1 \cdot \overline{sell\text{-}rights}_{v,t/t+1} + \beta_2 \cdot \overline{X}_{v,t/t+1} + \epsilon_v$$

First I derive the LFI using the land-rights-final-ign.na and the land-rights-final-na0 respectively.

Table 78: LFI (based on ignoring NAs selling rights - hhlevel)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.03117	0.2846	3.701	1.804	234

Table 79: LFI (based on treating NAs as 0s selling rights - hhlevel)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.02121	0.223	10.85	1.478	6334

Table 80: LFI (based on ignoring NAs selling rights - vil.level)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.05041	0.4667	4.635	2.456	144.4

Table 81: LFI (based on treating NAs as 0s selling rights - vil.level)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0.04697	0.3292	4.988	1.831	246.1

This is not a panel one at the village level.

Land Fluidity Index

```
Dependent variable:
----------------------------
LFI
```

mean_sell.rights_ea.weighted_na0 0.593 (0.606)
mean_share_ea_months12 -1.856 (2.811)
mean_share_ea_months48 -2.909 (2.484)
mean_share_ea_monthsinf -5.443** (2.144)

Village + Land controls Yes

Note: *p<0.1;* ***p<0.05;*** p<0.01

Village Consumption

$$log(c_{v,t}) = \alpha + \beta_1 \cdot \textit{sell-rights}_{v,t} + \beta_2 \cdot X_{vt} + \epsilon_{v,t} \tag{7}$$

Village Productivity

$$log(productivity_{v,t}) = \alpha + \beta_1 \cdot sell\text{-}rights_{v,t} + \beta_2 \cdot X_{v,t} + \epsilon_{v,t}$$

Table 83: Village Productivity

	Dependent variable:
	log(vil-productivity)
sell.rights_ea.weighted_na0	1.195**
	(0.489)
Constant	5.417***
	(1.848)
Village + Land controls	*Yes*
District x Time FE	*Yes*
Observations	380
R^2	0.832
Adjusted R^2	0.628
Residual Std. Error	1.027 (df = 171)
F Statistic	4.081*** (df = 208; 171)
Note:	*p<0.1; **p<0.05; ***p<0.01

Structural Estimation - Data counterpart

In this section we run the regressions that generate the moments to be targeted in our structural estimation procedure. The corresponding $\theta-$vector is the following

$$\theta = \begin{bmatrix} \beta \\ \alpha \\ \theta_L \\ \rho_\phi \\ \theta_H \end{bmatrix} = \begin{bmatrix} \text{Discount factor} \\ \text{Output elasticity of land} \\ \text{Magnitude of idios. shock} \\ \text{Persistence of idios. shock} \\ \text{Magnitude of aggr. shock} \end{bmatrix}$$

While the vector of moments is the following:

$$g = \begin{bmatrix} \text{Consumption elasticity} \\ \text{Coefficient of variation of income} \\ \text{mean std of idiosyncratic risk} \\ \text{Persistence of idiosyncratic risk} \\ \text{Weather shock effect} \end{bmatrix}$$

Discount Factor - Consumption elasticity

Regarding the consumption elasticity we take the estimates directly from the Townsend regression above.

Output elasticity of land - alpha in reg. 29

To retrieve information on the total household land holdings and given the specification, I use the dataframe "productivity_hh" which contains total household's land holdings and run the following regression - (specification 29 in the draft):

$$log(y_{h,t}) = \alpha + \beta \cdot log(\kappa_{h,t}) + \beta_h + \gamma_{v,t} \tag{8}$$

Table 84: Output Elasticity of Land

	Dependent variable:
	log(income)
log(household land))	0.280***
	(0.108)
Constant	4.956***
	(0.096)
HH FE	Yes
Villate-Time FE	Yes
Note:	*p<0.1; **p<0.05; ***p<0.01

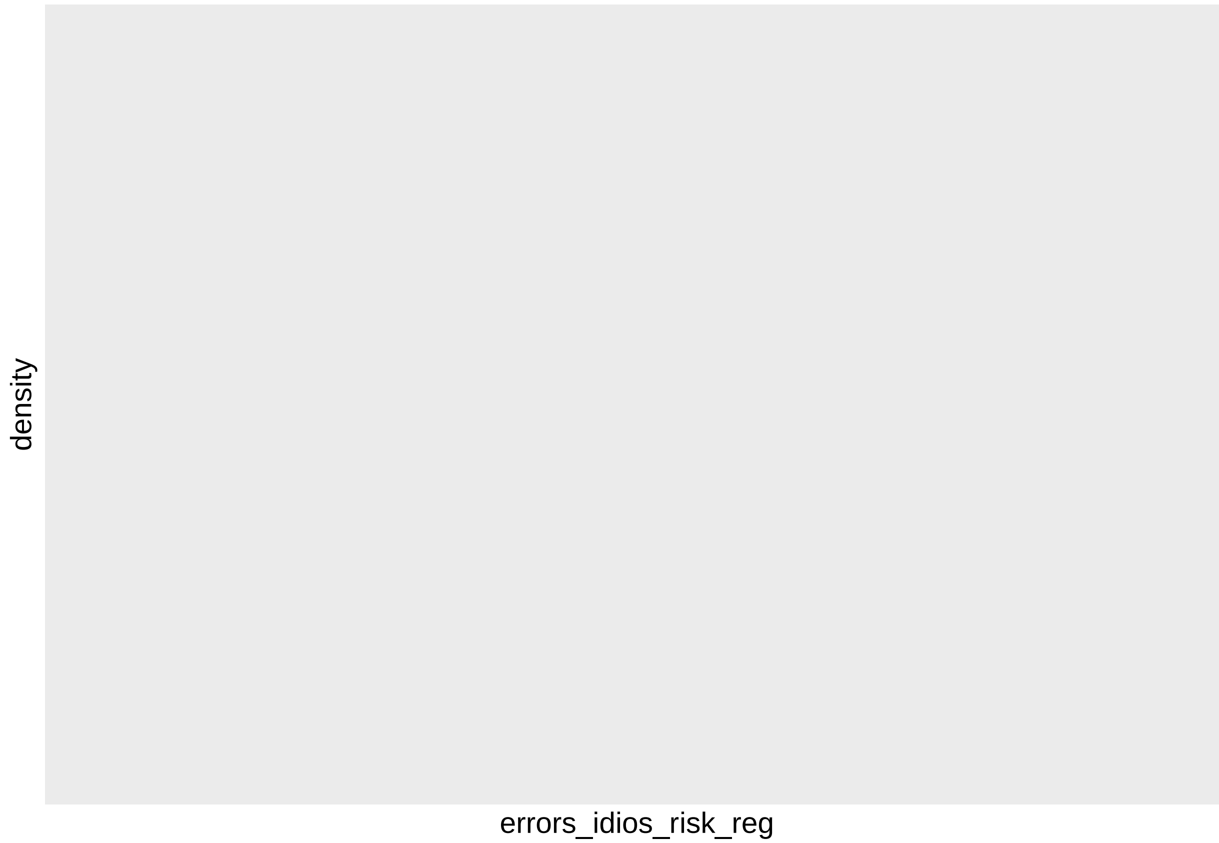
Idiosyncratic risk - $\epsilon_{h,t}$ in reg. 30

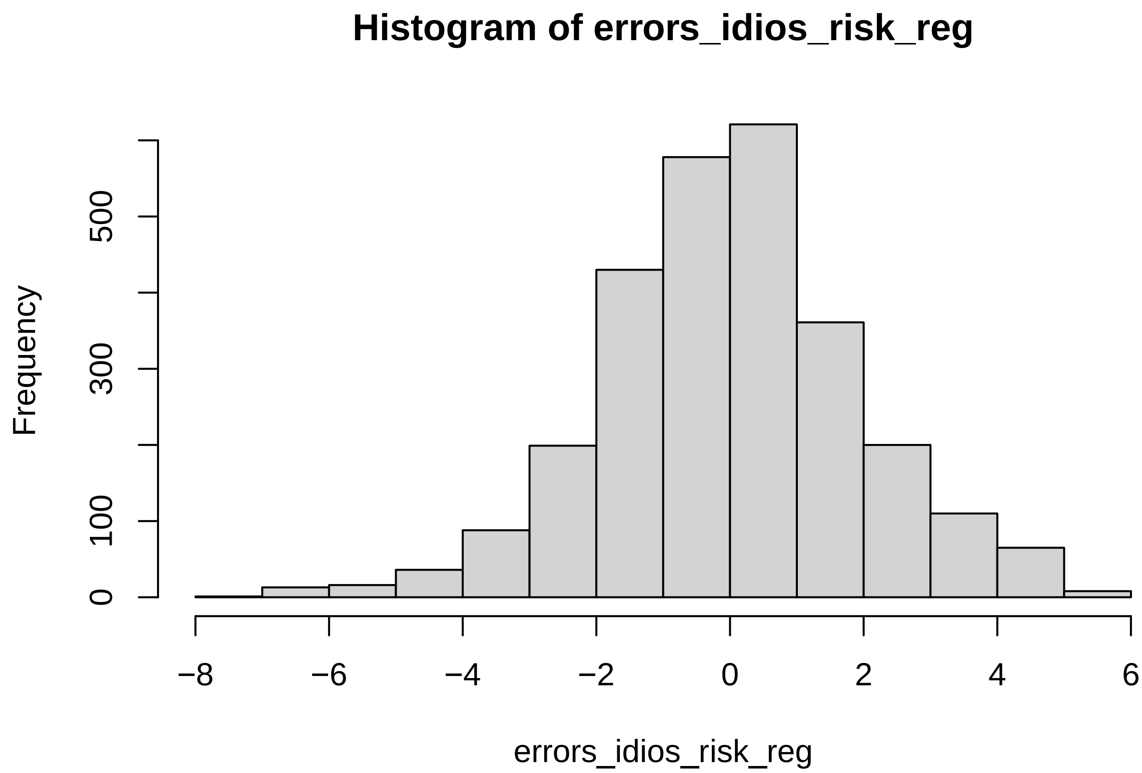
To retrieve the empirical magnitude of the idiosyncratic component of income, we run the following regression - (specification 30 in the draft):

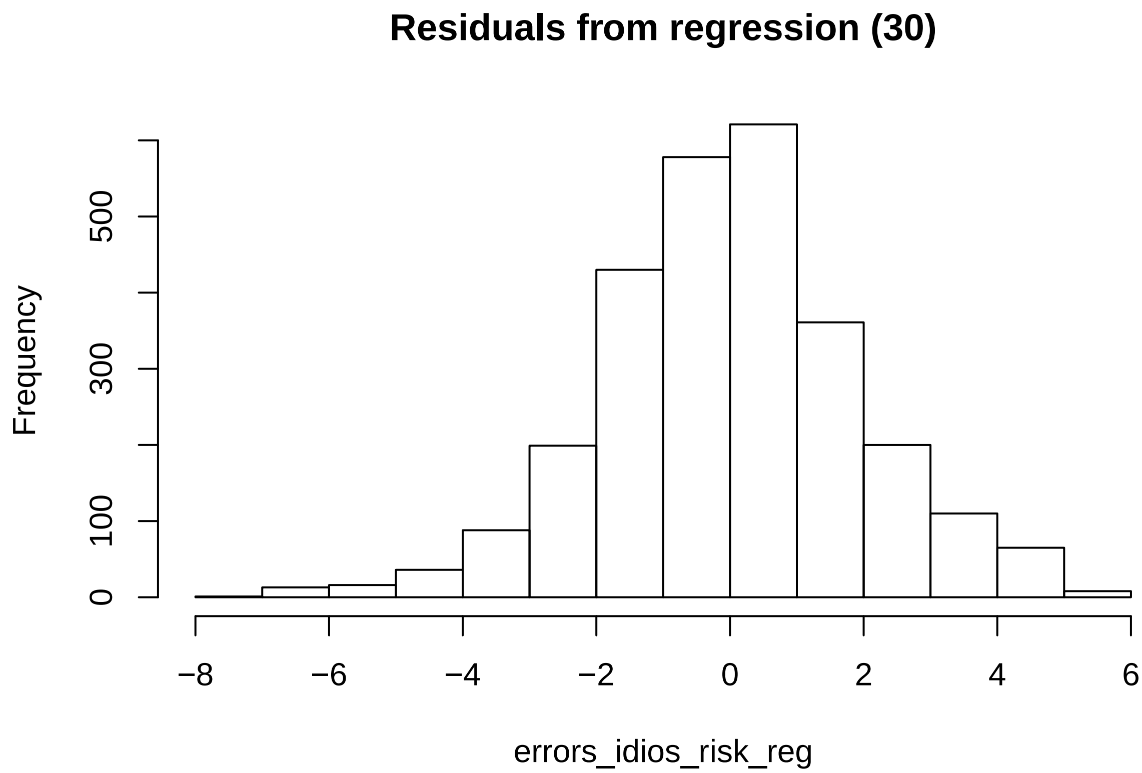
$$log(y_{h,t}) = \alpha + \beta_h + \gamma_{v,t} + \epsilon_{h,t} \tag{9}$$

```
##
## ===========================================================
##                              Dependent variable:
##                      --------------------------------------
##                      log(win_total_net_income_cropsales_pc2)
## -----------------------------------------------------------
## hhsize                             -0.130***
##                                     (0.015)
##
## hh_land                             0.010**
##                                     (0.004)
##
## Constant                           6.517***
##                                     (0.087)
##
## -----------------------------------------------------------
## Observations                         2,726
## R2                                   0.049
## Adjusted R2                          0.048
## Residual Std. Error            1.930 (df = 2721)
## F Statistic                 35.163*** (df = 4; 2721)
## ===========================================================
## Note:                          *p<0.1; **p<0.05; ***p<0.01
```

```
## [1] NA
```




Histogram of errors_idios_risk_reg
Frequency
0
100
300
500
−8
−6
−4
−2
0
2
4
6
errors_idios_risk_reg



Next we proceed in the decomposition of the error term as an AR(1) process.

$$\epsilon_{h,t} = \Pi_{\theta}\epsilon_{h,t} + \theta_{h,t} \tag{10}$$

Coefficient of Variation of Income

Here I use the dataframe of townsend.1.pc2 to derive this statistic.

```
## [1] 0.3215104
```

```
##
## ===================================================================================================
##                                                                            Dependent variable:
##                                                                        ----------------------------
##
## ---------------------------------------------------------------------------------------------------
## log(win_total_net_income_cropsales_pc2)                                          0.061***
##                                                                                   (0.016)
##
## sell.rights_ea.weighted_na0                                                      3.994***
##                                                                                   (1.497)
##
## log(win_total_net_income_cropsales_pc2):sell.rights_ea.weighted_na0               -0.021
##                                                                                   (0.033)
##
```

```
## Constant                                                                                3.872***
##                                                                                         (0.946)
##
## =============================================================================================
## =============================================================================================
## Note:                                                             *p<0.1; **p<0.05; ***p<0.01
```

Also last thing is to find the Q1 and Q2 village level of land security. To do so I take the variable in the main Townsend regression $sell - rights_{v,t}$ and take the values from there.

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##  0.0000  0.1422  0.3549  0.3751  0.5658  1.0000       2
```

```
##        0%       20%       40%       60%       80%      100%
## 0.0000000 0.1041038 0.2783235 0.4216388 0.6151078 1.0000000
```