Inclusive value chain development through evidence-based targeting of actors



Presented by Zoltan Ferenczi

Ferenczi, Zoltan; Bokelmann, Wolfgang Humboldt-Universität zu Berlin, Faculty of Life Sciences, Division of Horticultural Economics



Project HORTINLEA



Cluster analysis for the classification of households

Poverty reduction and food security measures frequently targeted at smallholder farmers. However, evidence-based targeting and differentiation between possible subgroups of smallholder farmers in developing countries is scarce; generalized results inform policy design.

Aim: to study the characteristics of smallholder producers of African Indigenous Vegetables (AIVs) in Western and Central Kenya and the degree of similarity between them through cluster classification.

Livelihood framework and cluster methodology

Application of livelihood framework as it integrates various endowments and also the institutional frame household participants of VCs operate in.

Proxies selected for human, social, financial, natural and physical capital (see bold variables in Table 1)

Identification of outliers using hierarchical clustering

TO IMPROVE THE LIVELIHOOD AND NUTRITIONAL SITUATION **OF THE URBAN AND RURAL POOR**

HORTINLEA is an interdisciplinary research project addressing food security in East Africa, particularly in Kenya. HORTINLEA uses an integrated approach that encompasses the entire value chain from production to marketing and consumption of leafy vegetables (AIVs) and integrates poverty, environmental and gender dimensions.

Possible and useful to generate clusters, homogeneous inside an heterogeneous in relation to each other?

Socio-economic data from approximately 700 farmers from western and central Kenya from 2015. Captures multifaceted dimensions of livelihood e.g. demographics, production, education, health, marketing, etc.

with single linkage method, (approx. 15 cases eliminated)

Euclidean measure of distance:

$$d(\mathbf{p},\mathbf{q}) = d(\mathbf{q},\mathbf{p}) = \sqrt{(q_1-p_1)^2 + (q_2-p_2)^2 + \dots + (q_n-p_n)^2}$$

$$=\sqrt{\sum_{i=1}^n (q_i-p_i)^2}.$$

Two-step clustering, resulting in four clusters: 1) "moderately stable", 2) "poor smallholder", 3) "assetless smallholder" and 4) "wealthy part-time farmers".

Description of clusters



enfassung			Moderately stable (n=421)	Poor small- holder (n=185)	Assetless smallholders (n=48)	Wealthy part- time farmers (n=28)
Step			Mean (std.dev)	Mean (std.dev)	Mean (std.dev)	Mean (std.dev)
		Average age of household head and spouse	47.59 (11.51)	51.67 (13.39)	44.40 (11.89)	53.08 (10.97)
		Female headed household (%)	16.15 (36.84)	20.00 (40.10)	31.25 (46.84)	14.28 (35.63)
		Household size	5.80 (2.23)	6.30 (2.47)	5.18 (1.74)	6.64 (2.07)
ualität		Land size (ha)	0.48 (0.52)	0.52 (0.58)	0.29 (0.30)	3.83 (1.66)
		Livestock (Tropical livestock units)	2.74 (2.93)	2.45 (1.72)	0 (0)	5.67 (5.24)
lecht Mittel 0,5 sion und Separatio	Gut 1,0	Education (Average years spent by HH and spouse)	11.33 (2.36)	8.98 (3.00)	10.79 (2.70)	10.67 (2.79)
Juality measure		Value of durable assets (2015 USD\$)	1132.36 (1696.13)	669.39 (1161.35)	699.15 (880.65)	3533.68 (5907.97)
		Dependency ratio in family	0.46 (0.22)	0.38 (0.22)	0.40 (0.22)	0.42 (0.16)
t-value	p-value	Share of farm income to total income	47.15 (30.84)	85.39 (19.37)	44.29 (37.31)	54.04 (30.58)
-2.6101	0.0047	「Income per capita (adult equivalent), per month (2015 USD\$)	152.45 (149.51)	74.34 (80.56)	90.33 (118.25)	199.88 (125.50)
0 7792	0 2181	Sells AIVs to supermarkets and wholesalers (%)	8.75 (28.29)	6.81 (25.27)	4.54 (21.07)	4.00 (20.00)
0.7792	0.2101	Sells AIVs directly to consumers (%)	44.25 (49.73)	50.00 (50.14	47.72 (50.52)	44.00 (50.66)
-3.820	0.0001	Food consumption score (FAO method, 0 -> 112)	72.50 (15.21)	68.01 (15.12)	68.51 (17.59)	76.37 (15.61)
6.689	0.0000	From Kisii county (%), rural	28.02 (44.96)	32.43 (46.93)	27.08 (44.90)	14.28 (35.63)
		From Kakamega county (%), rural	26.18 (43.98)	37.29 (48.49)	12.50 (33.42)	35.71 (48.79)
-1.6128	0.0538	From Kiambu county (%), peri-urban	23.75 (42.60)	17.83 (38.38)	25.00 (43.75)	7.14 (26.22)
-2.7142	0.0036	From Nakuru county (%), peri-urban	22.09 (41.53)	12.43 (33.08)	35.41 (48.33)	42.85 (50.39)

Km / X	·	Silhouettenmaß für K	ohäsion und Separatior	
Figure 1: HORTINLEA baseline survey sites, source: HORTINLEA SP9 Report	Figure 2: Cl "moderate	Cluster silhouette quality measu e - good" , own research		
T-test		Diff. (std. error)	t-value	
Percentage difference in share of "female headed" how between "asset-less" and "moderately stable" clusters	useholds	-15.09*** (5.78)	-2.6101	
Percentage difference in share of sales of AIVs to supe between "poor" and "moderately" stable	ermarkets	1.1931 (2.47)	0.7792	
Age difference between "poor" and "moderately stable	2″	-4.084*** (1.06)	-3.820	
r capita income difference between "poor" and "mo ble"	derately	78.113*** (11.67)	6.689	

Per capita income difference between "stable" and "wealthy part-time"	

Difference in food consumption score between "poor" and "wealthy part-time"

Table 2: Two sample T-tests of statistical differences

Table 1: Descriptive statistics broken down to clusters, own research

Finding moderately strong cluster solutions

-47.43*

(29.40)

-8.361**

(3.080)

Outlook and open questions, implications for strategy

K-means partitioning cluster method as robustness check finds similar cluster solutions.

Shortcoming: Due to the cluster silhouettes being of "middle" quality, higher data spreads and heterogeneity within clusters. (Results tend to get insignificant): Trade-off as strategic choice between a low number of clusters and data accuracy.

Cluster silhouette quality measure of cohesion and separation is 0.4. ("moderategood", figure 2)

Female headed households have a significantly higher share (p<0.01) in the assetless cluster than in the stable cluster.

The poor smallholder cluster sells AIVs in a lower share to supermarkets than the stable cluster; however, not significant (p=0.2).

The poor cluster tends to spatially concentrate in rural rather than peri-urban areas.

The poor cluster tends to have less quality nutrition (in terms of weekly food intake frequency and dietary diversity) (p<0.05)

The poor household clusters tends to show less education years than other clusters.

While being of limited usability, some basic differentiations in regard to policy recommendations can be derived: Focus on the households belonging to the "poor" and "asset-less" should be increased for policy design. Female headed household tend to have less assets. Poor household in rural regions of Kakamega tend to have less education, smaller incomes and high intra-household dependency (large number of children to bread-earning adults). Sales to supermarkets, are on the whole, very low and should be promoted. Also, it appears improving conditions of local markets has a high potential as most sales are realized on local markets.

Open questions:

To what extent do the clusters and their characteristics persist over time? Check against different waves of the panel survey (2014 – 2016).

Would it make sense to try cluster solutions with a high number of end clusters?

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