# Resilience and Agroforestry Options in Rural Zambia – Identifying the Vulnerable and Tailoring Support to Their Aspired Future

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## Introduction

- Poverty concentrated in rural areas with agricultural livelihoods [1]
- Resilience: reaction of (e.g.) households or ecosystems to adverse shocks to avoid poverty [2, 3]
- Agroforestry as a sustainable solution to current and emerging challenges [4] → increasing resilience by improving food security and income
- Alleviating poverty by increasing resilience and developing rural livelihoods

**Research Objectives:**

1. Examining determinants of resilience and the role of livelihood aspirations in the context of rural Zambia.
2. Characterizing resilience-related household clusters and identifying their agroforestry adoption potential and most suitable adaption strategy.

## Data

- Quantitative survey (Zambia 2022), 745 households
  - socio-economic household characteristics, food production and marketing, livelihood aspirations
- Collected as part of the 'Fruit Tree Portfolio' Project [5]
  - location-specific portfolios of fruit trees and crops → improving diets



**Fig. 1** Survey sites in Zambia. Pictures from plot and market in Zambia (own source).

## Methodology

### 1. Multivariate Regression on Resilience

- Three separate regressions on resilience indicators
  - Joint distribution of residuals of dependent variables
- Correlation of $\varepsilon^{(j)} \triangleq$ partial correlation of $Y^{(j)}$, controlled for $x^{(k)}$

$$Y_i^{(j)} = \beta_0^{(j)} + \sum_k \beta_k^{(j)} x_i^{(k)} + \varepsilon_i^{(j)}$$

$j = 1, \dots 3$ → resilience measures (life satisfaction [a], recovery time [b], loss [c])

$k = 1, \dots, m$ → determinants (aspirations, socio-economic HH and respondent characteristics, shocks)

[a] accounted for number of shocks experienced, [b] accounted for severity (in months), [c] accounted for severity (in % of total income)

### 2. Cluster Analysis

- K-means cluster analysis (Euclidean distance), with resilience measures (life satisfaction [a], recovery time [b], loss [c])
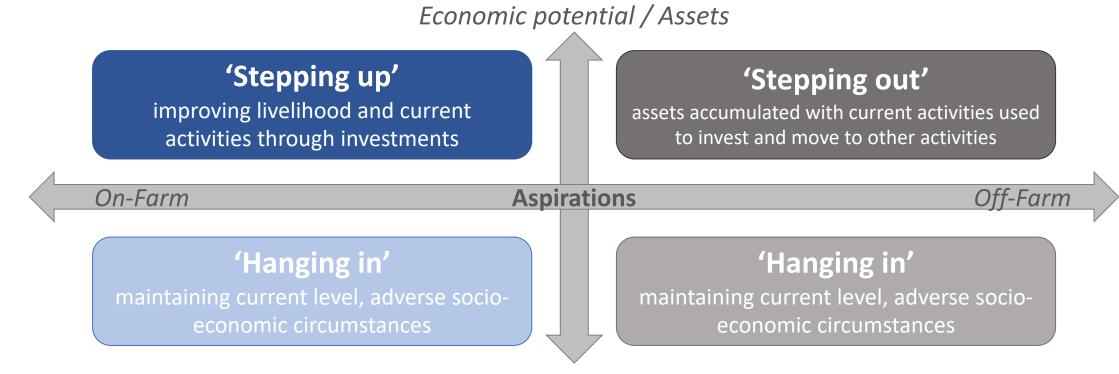- Assessment based on 'Livelihood strategies of the poor' [6, 7]



**Fig. 2** Framework for assessing adoption potential based on the 'Livelihood strategies of the poor'.

## Results

### Results Multivariate Regression

|  | (1) Life satisfaction | | (2) Recovery time | | (3) Loss | |
|---|---|---|---|---|---|---|
| Variables | Coef. | SE | Coef. | SE | Coef. | SE |
| aspirations index: high | -0.13 | 0.15 | 0.12 | 0.08 | 1.56* | 0.91 |
| PPI [x] | -0.49*** | 0.17 | -0.05 | 0.09 | -1.76* | 1.02 |
| income portfolio diversity [xx] | -0.04 | 0.05 | -0.12*** | 0.03 | -0.87*** | 0.28 |
| number of memberships respondent | -0.01 | 0.14 | -0.24*** | 0.07 | -0.39 | 0.80 |
| farm size (ha) | -0.01 | 0.01 | 0.00 | 0.01 | 0.24*** | 0.07 |
| TLU | 0.04 | 0.03 | -0.02 | 0.02 | -0.44** | 0.19 |
| crop diversity [xx] | 0.08*** | 0.02 | 0.01 | 0.01 | 0.09 | 0.13 |
| number of shocks (last 3 yrs.) | 3.93*** | 0.17 | -0.17* | 0.09 | -1.99** | 0.98 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. [x] Poverty Probability Index, [xx] number of different income streams / crop species cultivated.

### Results Cluster Analysis → three resilience related clusters identified

|  | Cluster | | | Significance [*] |
|---|---|---|---|---|
|  | (low resilience) | (medium resilience) | (high resilience) |  |
| aspirations index: high | 0.57 | 0.42 | 0.34 | 0.00 |
| productive assets | 0.09 | 0.10 | 0.16 | 0.13 |
| life improvement | 0.39 | 0.22 | 0.25 | 0.00 |
| income portfolio diversity | 2.54 | 3.20 | 3.61 | 0.00 |
| main crop use: food (vs. both) | 0.45 | 0.57 | 0.57 | 0.05 |
| crop diversity | 6.33 | 6.97 | 5.91 | 0.05 |
| education HH head | 1.89 | 1.80 | 2.14 | 0.04 |
| number of shocks (last 3 yrs.) | 1.03 | 1.26 | 1.17 | 0.00 |

Notes: [*] respective significance levels for each combination, based on Cramer's V/Chi² and ANOVA/F-Test.

## Conclusion

|  | Low resilience | Medium resilience | High resilience |
|---|---|---|---|
| *Current Focus* | – low income portfolio diversity<br>– mainly food crop production → medium crop diversity | – medium income portfolio diversity<br>– mixed (cash/food) crop production → high crop diversity | – high income portfolio diversity<br>– mixed (cash/food) crop production → lowest crop diversity |
| *Aspirations* | high aspirations (general life improvement)<br>→ high perceived need for change, medium adoption potential | medium aspirations (no specific focus)<br>→ low adoption potential | low aspirations (focus on productive assets)<br>→ low perceived need for change, medium adoption potential |
| *Potential* | – strengthening agricultural income<br>– crop diversification | – diversify income streams<br>– focus crop production | – strengthening existing income sources<br>– possible market orientation |

- Resilience positively correlated with: income and crop portfolio diversity; social networks and education of the household head; experience with shocks
- Individual aspirations decrease with increasing household level resilience, and become more focused
- Designing '*Basket of Options*' based on household characteristics, resilience and livelihood aspirations
- Considering additional external factors (local market opportunities, infrastructure etc.)

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Tropentag 2023