

Understanding resilience profiles in the context of a high-frequency data

collection in Ethiopia

Conference on International Development

ICID-IFAD-SITES, Rome, Italy

3 OCTOBER 2018



Alessandra Garbero

Bezawit Beyene Chichaibelu



- Many different conceptualizations of resilience
- No peer reviewed measures
- Empirical application challenging
 - From "how to measure resilience"
 - To "how to evaluate resilience interventions & learn from it"
- Need a measure which is
 - empirically viable
 - ex-ante \rightarrow probability based
 - forward looking \rightarrow useful for targeting
 - suitable to an aggregation process or decomposable for sub-groups
 - cost-effective
- So far focus on ex-post analyses (vulnerability)



Research questions

- 1. Appraise the sustainability of the impacts of an irrigation project under the scenario of a protracted drought
 - Well-being outcomes
 - Agricultural indicators,
 - food security
 - market access
 - resilience outcomes
- 2. Compare the performance of existing resilience methodologies in quasi-experimental design framework



Features of the resilience construct

"Resilience is the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences".

(Constas et al. 2014b)

- Ex-ante capacity with predictive function
 - Adaptive, Absorptive, Transformative
- Positive effect on outcomes in the face of shocks and stressors
 - Path dependent and time-sensitive
 - Multi-scale or multi-level
 - Multi-dimensional
 - Interdependent with agro-ecology

• Functional forms: predictor and predicted variable

Resilience Measurement Integrated Framework

Resilience defined as an instrumental capacity that affects well-being in the face of shocks and stresses



Operational and analytical goal of resilience measurement

Collect and analyze data to model recovery and wellbeing trajectories over time as a function of initial states and shocks/stressors, mediated by resilience capacity

Time- and event-sensitive measurement



Source: Constas et al., 2014b

Resilience Measures: RIMA I & II



Investing in rural people

Resilience Measures: PRIME

- PRIME: Ethiopia Pastoralist Areas Resilience Improvement and Market Expansion Project (Frankenburger, 2015)
- Impact of shocks on wellbeing outcomes mediated by a measurable set of capacities
- Components:
 - Absorptive
 - Adaptive
 - Transformative

HH Resilience Capacity:

 $Resilience_{ht} = PCFA(IAbC_{ht}; IAdC_{ht}; ITC_{ht})$

Community Resilience Capacity:

Resilience_{ct} = *PCFA*(*SPI_{ct}*; *Conflict_{ct}*; *CDRI_{ct}*; *Groups_{ct}*)



Resilience Measures: PRIME

Absorptive capacity	Adaptive capacity	Transformative capacity			
Informal Safety nets	Access to financial resources	Formal Safety nets			
Shock Preparedness/ Mitigation	Human Capital	Access to market			
Ability to recover (corrected)	Diversity of Livelihood	Access to Infrastructure			
Access to savings	Exposure to information	Access to basic services			
Asset ownership	Asset ownership	Access To Livestock Services			
Bonding capital	Aspiration and confidence to adapt	Access to Communal Natural Resources			
	Bridging Social Capital	Linking social capital			
	Linking social capital	Bridging social capital			



Resilience Measures: Development resilience

- Poverty trap and vulnerability literature
- Moment based approach (Cisse and Barrett, 2016):

$$\begin{split} W_{it} &= g_{M} \big(W_{i,t-1}, X_{it}, \beta_{M} \big) + u_{Mit} \\ \hat{\mu}_{1it} &= E \big[W_{it} \big| W_{i,t-1}, X_{it} \big] = g_{M} \big(W_{i,t-1}, X_{it}, \hat{\beta}_{M} \big) \\ \hat{\mu}_{2it} &= E \big[u_{Mit}^{2} \big] = \hat{\sigma}_{it}^{2}, \text{ where } \sigma_{it}^{2} = g_{V} \big(W_{i,t-1}, X_{it}, \beta_{V} \big) + u_{Vit} \& E [u_{Vit}] = 0. \\ \rho_{it} &= P \big(W_{it} \geq \underline{W} \big| W_{i,t-1}, X_{it} \big) = \bar{F}_{W_{it}} \left(\underline{W}; \hat{\mu}_{1it}(W_{it}, X_{it}), \hat{\mu}_{2it}(W_{it}, X_{it}) \right) \\ Resilient \ \theta_{it} &\equiv \begin{cases} 1, if \ \hat{\rho}_{it} \geq \bar{R} \\ 0, Otherwise \end{cases} \end{split}$$

- Normative thresholds:
 - W: For wellbeing \rightarrow normally PL
 - R: For the resilience probability \rightarrow arbitrary: 0.25; 0.5; 0.8
- Advantages of aggregate measures: useful for targeting and for policy evaluations
- A la FGT:
 - Development resilience headcount ratio
 - Mean development resilience of non-resilient HH
 - Resilience gap ratio

JIFAD • Inherently pro-poor measure

Project Background: PASIDP | Ethiopia

- Participatory Small-scale Irrigation
 Development Programme
 - National in scope, but focuses on drought prone, food insecure and high-density woredas in:
 - Southern Nations, Nationalities and Peoples Region,
 - Oromia,
 - Amhara and
 - Tigray regional states.
- <u>Beneficiaries estimated</u>: Total direct beneficiaries HH 62,000





Evaluation design: Data & Sampling frame

- Ex-post high frequency data on 1,033 households
- 4 rounds of data:
 - Baseline survey collected in November 2016
 - 3 follow-up survey conducted every 3 months
- Secondary data (precipitation, NDVI, and temperature)
- Sampling strategy:
 - Two-stage stratified sampling by region, agro-ecological zone, and precipitation levels
- Modules:
 - Demographics, wellbeing, agriculture, shocks, capacities, coping strategies and risk preferences



Shock indicators

- Subjective shocks: # reported shocks 5 years prior to the 1st round and 4 months before each round
- Objective shocks: 1981-2017
- Standardized Precipitation Evapotranspiration Index (SPEI)
- Seasons: Meher (Rainy Season); Belg (short rainy season); Dry

Matching v	ariables								Outcome v	ariables															
													Round 1 sta	ırt			Round 2 sta	art			Round 3 st	art			Round 4 sta
	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17
Round 1		Dry seaso	n 2008			Belg seas	on 2008		M	eher seasor	n 2008/200	9													
Round 2						Belg seas	on 2008		M	eher seasoi	n 2008/200	9		Dry sease	on 2009										
Round 3									M	eher seasoi	n 2008/200	9		Dry sease	on 2009			Belg seas	on 2009						
Round 4														Dry sease	on 2009			Belg seas	on 2009		M	eher seaso	n 2009/2010)	Ĩ
														Dry sease	on 2009			Belg seas	on 2009		M	eher seaso	n 2009/2010)	
																		the 4th r	ound will r	ecall this					



Matching results

Table 1: Summary statistics before, after matching and bias reduction

		Before n	natching						
	Treat.	Control			Treat	Control			Reduction
	Mean	Mean	p-value	Bias	Mean	Mean	p-value	Bias	in Bias (%)
Male head	0.92	0.89	0.138	9.26	0.93	0.927	0.94	0.55	94.02
Age of head	44.28	45.26	0.28	3.4	44.2	44.256	0.95	0.45	86.89
Education of head (1= Elementary)	0.44	0.51	0.072*	12.41	0.44	0.433	0.78	2.25	81.83
Education of head (1=Secondary)	0.07	0.04	0.043**	10.74	0.06	0.057	0.9	1.22	88.66
Number of adult HH members	6.01	5.67	0.053*	8.88	5.98	6.04	0.77	2.49	71.95
Dependency ratio	1.35	1.33	0.738	3.88	1.35	1.305	0.57	4.52	-16.43
Marital status of head (1=married)	0.92	0.89	0.141	8.16	0.93	0.926	0.91	0.86	89.52
Altitude	1859	1830	0.452	5.03	1857	1875	0.66	3.39	32.63
Total land owned	2.09	1.93	0.337	5.13	2.08	2.082	0.99	0.11	97.95
Improved wall	0.05	0.07	0.261	6.21	0.05	0.058	0.65	3.58	42.44
Modern kitchen	0.87	0.88	0.536	1.21	0.87	0.866	0.85	1.54	-27.41
Number of rooms	2.22	2.16	0.374	2.86	2.22	2.259	0.6	4.43	-55.23
Toilet	0.82	0.85	0.305	5.37	0.82	0.804	0.59	4.74	11.7
Improved oven	0.06	0.06	0.712	5.09	0.05	0.05	0.91	0.82	83.92
Improved waste	0.11	0.08	0.232	6.95	0.11	0.111	0.96	0.45	93.55
Number of oxen (12 months ago)	1.25	0.96	0.003***	13.56	1.16	1.211	0.7	3.83	71.74
Number of donkeys (12 months ago)	0.5	0.33	0.002***	14.6	0.45	0.463	0.79	2.46	83.14
Radio	0.39	0.31	0.058*	9.89	0.37	0.377	0.92	0.9	90.93
Incidence of all shocks experienced (5 years before)	1.85	1.8	0.637	1.1	1.85	1.875	0.87	1.32	-20.03
Drought index (SPEI<=-1, 2 years before)	0.84	0.8	0.215	2.53	0.84	0.847	0.76	2.36	7
Number of obs.	422	348			403	328			

Note:

1) *** p<0.01, ** p<0.05, * p<0.1; Standard errors not presented for the sake of brevity.

2) Point estimates are sample means.

3) Asterisks represent level of statistical significance of t-test/chi-squared test of difference in means. Investing in rural people

Matching results





Descriptive results:

Table 2: Summary statistics of Resilience indicators by season

		Tre	ated			Mean			
	Meher 1	Dry	Belg	Meher 2	Meher 1	Dry	Belg	Meher 2	(Dry)
RIMA I	52.3	52.9	51.6	52.5	52.5	52.1	53.8	52.9	0.79**
RIMA II	26.2	21.6	14.6	17.7	25.8	20.2	14.5	17.9	1.38**
PRIME	6.8	5.1	5.25	4.4	5.8	3.9	4.26	4.01	1.15***
Absorptive capacity	4.2	2.2	2.71	2.5	3.9	1.7	2.36	2.41	0.48***
Adaptive capacity	5.8	5.5	5.64	6.1	4.6	4.1	4.52	5.13	1.34***
Transformative capacity	3.7	3.7	3.50	4.4	3.8	3.6	3.59	4.68	0.021
Development resilience (Assets)	0.61	0.44	0.59	0.52	0.63	0.53	0.64	0.52	-0.08**
No. of observation	402				328				

Note:

1) *** p<0.01, ** p<0.05, * p<0.1; Standard errors not presented for the sake of brevity.

2) Point estimates are sample means.

3) Asterisks represent level of statistical significance of t-test/chi-squared test of difference in means.



Table 3: Treatment effect on Resilience outcomes: RIMA I & II

		IPWRA	IPW	NN	PSM	RA	Control mean
RIMA I (dummy)	Meher 1	-0.0458	-0.0306	0.0211	-0.0105	-0.00902	0.476
	Dry	0.0341	0.0424	0.109**	0.0428	0.0779**	0.442
	Belg	-0.0389	-0.0354	-0.0360	0.00496	-0.0257	0.628
	Meher 2	-0.0119	-0.00577	-0.0161	-0.00806	-0.00722	0.500
	Meher 1	-0.00212	0.000956	0.0513	0.0298	0.0485	0.454
	Dry	0.00989	0.0323	0.124***	0.0354	0.0452	0.213
RIMA II (dummy)	Belg	-0.0122	-0.0125	0.0199	-0.00310	-0.00109	0.0854
	Meher 2	-0.00856	-0.0160	0.0397	-0.0205	-0.00351	0.168

Notes:

- 1. Results are based on four rounds of high frequency data.
- 2. .01 ***; .05 **; .1 *; Standard errors not shown for sake of brevity



Table 4: Treatment effect on Resilience outcomes: PRIME & Development resilience

		IPWRA	IPW	NN	PSM	RA	Control mean
PRIME (dummy)	Meher 1	0.0998***	0.0989***	0.0695	0.146***	0.134***	0.518
	Dry	0.191***	0.203***	0.186***	0.191***	0.195***	0.174
	Belg	0.161***	0.163***	0.185***	0.164***	0.175***	0.220
	Meher 2	0.0911***	0.0837***	0.145***	0.0757***	0.0994***	0.162
	Meher 1	-0.00201	-0.00497	0.0174	-0.00682	-0.0422	0.680
Development	Dry	-0.0172	-0.0209	-0.0563	-0.0100	-0.0405	0.505
resilience (Assets)	Belg	-0.0258	-0.0271	-0.0401	-0.0407	-0.0451	0.652
	Meher 2	0.0309	0.0309	0.0174	0.0304	0.0169	0.512

Notes:

1. Results are based on four rounds of high frequency data.

2. .01 - ***; .05 - **; .1 - *; Standard errors not shown for sake of brevity



Table 5: Impact on asset growth based on systems GMM estimation

	Basic asset growth model (1)	Asset growth model with shock and PASIDP beneficiary interaction term (2)
Lagged overall assets	0.41***	0.41***
Initial overall assets	-0.63***	-0.45***
PASIDP beneficiary status	0.22***	0.175***
Drought		-0.02
PASIDP beneficiary status * Drought		0.13***
Dry season (dummy)	-0.27***	-0.16
Belg season (dummy)	-0.078**	-0.01
Rainy season (dummy)	-0.14***	-0.09
Constant	1.84***	-0.09
Wald F statistic	183.54***	114.49***
Sargan test	2.78	1.51
AR (2) test	0.44	0.54
No. of observation	2924	2924

Note:

1).01 - ***; .05 - **; .1 - *; Standard errors not shown for sake of brevity.

2) Drought indicator is a dummy variable based on reported drought shock.

3) Initial conditions included in model 2, but not shown for the sake of brevity.



Table 6: Impact on resilience gains (PRIME) based on systems GMM estimation

	Resilience gains model (PRIME)
Lagged resilience (PRIME)	0.103***
PASIDP beneficiary status	0.144***
Drought	-0.049***
Belg season (dummy)	0.065***
Rainy season (dummy)	0.109***
Constant	-0.029
Wald F statistic	17.37***
No. of observation	2193
Note	

1).01 - ***; .05 - **; .1 - *; Standard errors not shown for sake of brevity.

2) Drought indicator is a dummy variable based on reported drought shock.

3) Initial conditions included, but not shown for the sake of brevity.



Table 7: Impact of resilience (PRIME) on asset growth: systems GMM estimation

Asset growth model with lagged Resilience (2)
0.532***
0.223***
0.064**
-0.047*
-0.055
-0.108***
0.136
91.88***
2193

Note:

01 - ***; .05 - **; .1 - *; Standard errors not shown for sake of brevity.
 Drought indicator is a dummy variable based on reported drought shock.
 Initial conditions included, but not shown for the sake of brevity.





- Treatment effects on resilience outcomes (PRIME) positive
- Higher resilience level for treated compared to counterfactual
- Results not consistent across all resilience metrics
- Benefits of irrigation on assets growth contingent on the drought → largely positive → implying resilience
- Growth →inversely related to initial assets, indicating that the growth rate → potentially slower for those with higher level of assets at the first round
- Resilience gains model→ treatment positively related to past resilience status



Conclusion 2

- IAs of resilience -building programmes require specific data collection systems (panel)
- Baseline, mid-term and completion surveys: covariates (household demographic and socio-economic characteristics, resilience capacities, information on wider context)
- High frequency data: shocks/stressors, household responses, change in well-being indicators
- Choosing a metric?
 - Composite indices vs development resilience: high vs minimal data requirements
 - Panel data, assets and lagged assets (recalled), shocks (objective)
 GIS can help with historical distribution
 - Trade-off between cost-effectiveness and depth of information for impact assessment surveys



Questions?

Alessandra Garbero: a.garbero@ifad.org

