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Effect of market system interventions on household resilience: comparison of two methodologies

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A B S T R A C T

The bulk of the poor mainly lives in rural areas and is primarily dependent on small-scale agricultural production for their livelihoods. Promoting inclusive market system development, through income and livelihood opportunities, has been increasingly employed as a way to contribute to poverty reduction and other wellbeing outcomes, among which climate resilience.This paper analyses the resilience measurement approaches used in two projects, the first, Anukulan, in the Mid and Far-West of Nepal and the second, MERIT, in the Central Highlands of Vietnam. The projects are at two different stages of development, both aiming at building smallholder farmer resilience, particularly to climate shocks and stresses.

To track resilience Anukulan used a project-specific composite analysis made of five individual determinants at the household level: (1) income, (2) dietary diversity, (3) access to climate-smart technologies and services, (4) access to an improved water source, and (5) access to early warning system. To better understand the effect of market-based approached upon climate resilience, the treatment group is disaggregated between household participating in high and low market intensity interventions. Findings from the analysis are presented and the difference in resilience scores among the experimental groups are discussed.

MERIT, on the other had, will test a contextualized version of the Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP), a digital application developed by FAO, which combines an academically rigorous, quantitative assessment of resilience with a self-assessment component across different agronomic, environmental, social, governance and economic aspects of the farming systems and households. For its use under MERIT, a 'market sensitive' SHARP+ version is co-developed between iDE and FAO specifically to capture the impact of market system interventions upon household resilience. The version is tailored to the Vietnamese context to better capture and understand the specificities of the communities and market systems assessed. The newly developed SHARP version is expected to be made openly available and further documentation for its use is forthcoming.
The two measurement approaches are compared and contrasted, and their application is discussed.

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1. Introduction

1.1. *Market system development interventions for household resilience*

Between 75-85% of the poor is estimated to live in rural areas [1][2] and it is expected that the majority will continue to live in rural areas well into the 21st century. As most of the rural poor are primarily dependent on small-scale agricultural production for their livelihoods, investments in rural agriculture have long been a priority for accelerating rural development.

Lack of, or limited, participation in market systems is understood to hamper the ability of the rural poor to escape the poverty cycle, impeding them from moving out of subsistence agriculture, and into commercial agriculture profiting from increased opportunities for growth [3]. Promoting inclusive market system development, through livelihood and income generating opportunities, has been increasingly employed as a way to contribute to poverty reduction and other wellbeing outcomes, among which increased food security and climate resilience.

In the early 2000s, donor organisations introduced the *Making market systems work for the poor approach* (M4P) to promote pro-poor market outcomes in their roles as entrepreneurs, employees or consumers. M4P focuses on changing the structure and characteristics of markets to increase participation by the poor in ways that benefit them - e.g. access to information, financial services and technology, linkages between producers, output markets and consumers. M4P also addresses the behaviour of the private sector and therefore reinforces the strengths of the market system, rather than undermining it [4].

Several studies have emerged in recent years attempting to characterise the vulnerabilities of households to various risks, including climate-related risks, and analysing the household-level determinants of resilience. While resilience-building interventions vary depending on the specific socio-economical and ecological context, some common elements have been identified and include: promoting mechanisms that improve the asset base of households, the ability of the household to access basic services, information, financial services and technologies, improved natural resource management abilities, access to early warning systems (EWS) [5]. Access to market has also been identified as an underlying factor to increase resilience, with the underlying thinking that market-led economic development, which raises incomes and reduces poverty, contributes to building resilience [6][7].

For over 30 years iDE has been focusing on creating income opportunities for the poor in agriculture and WASH by connecting them to the markets that deliver products and services, and enabling easier access to output markets to sell high-value produce. As opposed to subsidies and handouts, iDE treats poor people as potential customers and producers. To reach the most vulnerable households, iDE works closely with local community based organizations (CBOs), government agencies and private sector, and develops the partners' capacity to scale up and scale out developed models to ensure further reach and long-term sustainability. Among its impacts, a project in Vietnam found that introducing micro-irrigation technologies to the local market resulted in $9 PPP-adjusted greater income per square meter of land cultivated as well as a 32% reduction in water use for farmers who adopted the technology [8]. By supporting smallholder farmers to engage in irrigated high value crop production and connecting them to profitable market opportunities, farmers in Ethiopia increased their annual household income by $1,110 PPP-adjusted [9].

Over the last decade iDE has been increasingly focusing on ensuring development efforts are not further compromised by climate hazards, explicitly focusing on longer term resilience building. This paper will draw from two ongoing projects in Nepal and Vietnam working through the power of markets, and the approaches taken to measure the effect of resilience building at the household level. This paper will introduce the two methodologies and compare their application in the context of market system development initiatives.

1.2. ***Anukulan***

Anukulan (resilience in Nepalese) is a UKAid-funded five and half year (Jan 2015 - June 2019) project implemented by iDE and ten consortium partners under the BRACED programme[1] in Western Nepal. The overall

[1] braced.org

goal is to improve the well-being of 120,000 poor rural household, especially focusing on women and children, coping with climate change related shocks and stresses.

Anukulan's interventions include market system development promotion in rural areas, capacity development around improved climate-smart technologies and practices, local and national policy facilitation, and disaster risk reduction and management.

Anukulan's unique market-based approach - the 'commercial pocket approach' - facilitates the development of sustainable rural organisations around commercial pockets focused on climate-smart economic opportunities in agriculture, water resource management, and community forestry. The commercial pocket approach facilitates producing and marketing sufficient volume of production. The approach includes establishing a profitable community managed collection center providing market access, information, grading/processing to smallholder farmers, women and men, and the last mile of agro supply chains through community business facilitators (CBFs). The CBFs are entrepreneurial farmers earning commissions on sales and providing training to customers. The collection centers working with government, private sector, and stakeholders develop crop calendars and provide climate-smart advice. Collection centers are managed by an elected marketing and planning committee (MPC) that initially selects an entrepreneur for its operation and overtime becomes a cooperative. The MPCs are in a unique position to assess local agricultural needs and impacts of climate change, and then advocate with local government including for climate adaptation. Similarly, essential oils distillation units, working with Community Forest User Groups (CFUG) aim to promote the production of essential oils, their harvesting and commercialization.

At the policy level, Anukulan also facilitates the harmonisation of disaster risk reduction (DRR) planning and climate change adaptation strategies. Additional climate risk management interventions include the development of EWS. The initiative also aims to explicitly empower women and the disadvantaged to take leading roles in rural institutions and contribute to economic opportunities.

By working with the BRACED Knowledge Manager, led by ODI, Anukulan has developed a composite index to measure climate resilience, the Anukulan composite resilience index (ACRI).

1.3. ***Building Markets for Enhanced Resilience In VieTnam (MERIT)***

MERIT is a 3-year long project launched in February 2018 in the Central Highlands of Vietnam with the support of a private Foundation and led by iDE in collaboration with the local Agriculture Extension Station (AES) arm, a local government office. MERIT's objectives include the promotion of resilient economic opportunities in the Central Highlands of Vietnam, specifically in the Gia Lai Province, while substantially reducing the risks associated with future climate hazards to safeguard the livelihoods of 2,500 farming household.

The political context in Vietnam makes it particularly challenging to implement market-based initiatives. However, over the last 15 years, iDE's approach successfully delivered positive outcomes, enabling poor people to move out of poverty, improving household food security and resilience, and access basic services.
Gia Lai is a mountainous province located in the northern part of the Central Highlands in central Vietnam. The province shares a border with Cambodia and is close to the border with Laos, giving it a key position in the economic development of the region. The Highlands, where agriculture is the dominant economic activity, represent some of the poorest areas in the country. The production of the local smallholder farms has historically been insufficient to allow farmers to achieve food security and rise out of poverty. Further contributing to their vulnerability, smallholder farmers face many challenges including poor transportation infrastructure, regular climate hazards, poor markets for crop inputs, and poor integration into markets for outputs.

In the short to medium-term the MERIT project is expected to improve the livelihoods of the participant households by promoting income-generating opportunities and improved practices and strengthening markets for local climate-resilience inputs and output markets. The project will enhance local resilience resulting in better coping mechanisms to climate risks. In the longer term the improved technologies and practices, and strengthened capacity of the local government institutions, will contribute to increased resilience and sustainable growth across the region and other parts of the country. Following receipt of the permit to implement in the province, the project has now started the implementing activities.

The project will pilot a contextualized version of the SHARP+ tool, introduced in Section 2.2.

2.Methodology

2.1. *Anukulan composite resilience index (ACRI)*

Resilience is the key outcome of the Anukulan project. In the context of the project, resilience to climate shocks and stresses is considered to be a composite attribute possessed by each individual. Improved resilience means that the individual, when experiencing a shock or stress, is better able to maintain or improve their well-being.

Based on substantial inputs and analysis conducted during a preliminary scoping study, the project consortium developed a composite index of resilience to measure how many people have experienced improvements in their ability to cope with climate-related shocks and stresses as a result of market development project activities. The composite index is assessed at the household level through measures of: agricultural income, food security, access to sufficient water, general health, and access to services and technologies related to livelihood security. The index was designed to reflect a sufficiently broad array of characteristics of resilience with the higher score reflecting a higher level of resilience in the Western Nepal context. The sub-indices are not, however, intended to be exhaustive of all characteristics of resilience and should not be interpreted as such; similarly, each sub-index indicator should not in itself be interpreted as a measure of resilience. The five sub-indices are detailed in Table 1.

Table 1: ACRI composition, description and resilience capacity

Sub-indices	Description	Resilience capacity [11]
Households above poverty level characterised by per capita income of US $ 1.25 per day (PI)	Reflects both household food production and livelihood security through diversified income streams. Without market intervention, many of the poorest households in rural Nepal cannot make substantial income from agricultural production and instead depend on their produce as their primary food source.	Absorptive Capacity
Dietary diversity (Dd)	Measured as Household Dietary Diversity Score (HDDS) [10], is a proxy indicator for availability of, and access to food sufficient to ensure a balanced diet, from any source. This can ultimately be seen as a reflection of general health conditions of the members of the household. The HDDS is a validated instrument that produces comparable results across cultures and settings, so that the status of different population groups can be described in a meaningful way to assess programmatic interventions. The cut-off score to indicate a sufficiently 'diverse diet' is equal to the average of the baseline scores of the top 1/3 of households by total income.	Absorptive Capacity
Access to climate smart services and technologies (Cs)	Households are using six or more climate smart technologies out of 24 options. The index assesses both a household's connection to markets and access to knowledge of the kinds of technologies that support resilience. A diverse array of energy- and agriculture-focused technologies will be promoted by the project according to specific local needs, and all are not expected to be adopted by every household, so this measure of access will be based on knowledge of one or more of the technologies made available in a given area.	Adaptive Capacity
Access to an improved water source less than 30 minutes from home or fields (Iw)	Indicates the likelihood a household has access to water protected from contamination and can engage in irrigation-related activities for farming and income generation.	Adaptive Capacity
Access to Flood Early Warning System (fEWS)	This reflects the ability to receive and respond beneficially to the improved flood warning system. It also includes the access to emergency radio announcements heeding improved early warning system.	Anticipatory Capacity

The ACRI is computed as seen in the formula (1).

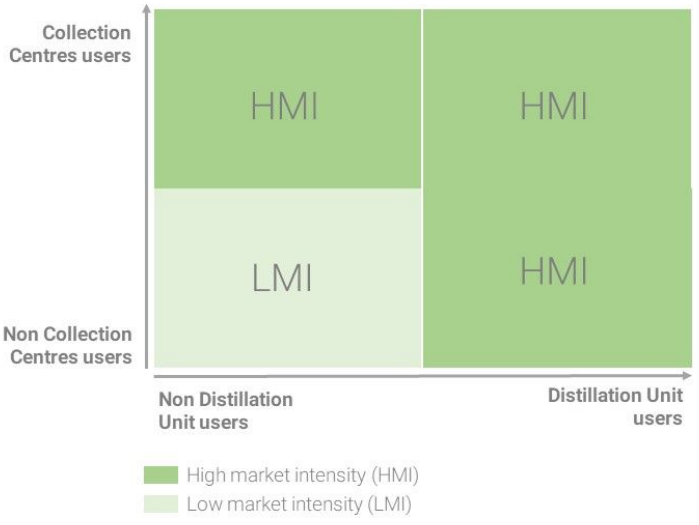
$$ACRI = Pl + Dd + Cs + Iw + fEWS \quad (1)$$

Indicators are binary measures (1 = YES; 0 = NO) that added together create a 'resilience score' from 0 to 5. The composite resilience score is a simple index used to assess progress against the primary project outcome indicator 'number of households with increased resilience, assessed as change over time'.

Households with a score of 3 to 5 are assumed to have access to a sufficient combination of inputs and support mechanisms to sustain livelihoods in the face of climate extremes, and therefore these households are considered 'resilient' in the context of this intervention.

The impact evaluation design follows a 'difference-in-differences' quasi-experimental approach – comparing changes in the participant and non-participant group. The differences-in-differences model estimates causal inference by controlling for group-level and temporal fixed-effects. This paper will first present the difference-in-differences results estimating the causal impact of a homogenous treatment effect, validating the Anukulan project theory of change. This study then uses an ex-post difference-in-means estimation to study differentiated treatment effects based on market intensity, given that classification is built off of household self-selection into the Collection Centers and Distillation Units during the course of program intervention. For the purpose of this study, the households within the treatment group have been disaggregated into two categories, participants of high market intensity interventions (users of Collection Centres and/or Distillation Units) and participants of low market intensity interventions (non users), as depicted in the 4-box matrix in Figure 1.

Figure 1: Matrix of the disaggregation of the treatment group in Low and High market intensity sub-groups



Quantitative data was collected through structured questionnaires administered across all of the project districts. The baseline and endline samples were purposively taken from the same 10 project VDCs (out of the 86 VDCs/Municipalities covered by the project) and the same 10 control VDCs. The total sample sizes for the surveys were 600 households of which 300 were treatment and 300 were control. Market intensity was determined ex-post after the completion of the endline household survey and therefore sampling was not originally powered to stratify results along market intensity. Nonetheless, using the identification presented in Figure 1 the endline treatment group is evenly distributed with 40% of endline treatment households classified as high market intensity and the reaming 60% as low market intensity. Further, the results hold fairly consistently across districts meaning market intensity classification does not appear to be driven by district-level effect (with the exception of Dadeldhura district which has only low market intensity households).

2.2. ***SHARP***

The Self-evaluation and Holistic Assessment of climate Resilience for farmers and Pastoralists (SHARP) digital tool is a holistic assessment of household resilience based on farmers' perceived priorities and understanding of their farm and household. It was developed by the FAO to strengthen the capacity of smallholders to produce sustainably in the context of climate change by supporting evidence-based decision-making at household, community and project level [12]. The tool is designed to collect objective information on smallholders resilience across all dimensions of the farm and household, while a incorporating the concerns and interests of farmers related to climate resilience.

In SHARP, resilience is defined as 'the capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the ability to adapt, learn and transform' [12]. A household and its farm system are considered resilient when they have characteristics that allow them to absorb, cope and overcome shocks and crises. As such, SHARP seeks to identify whether households' economic, social, environmental and agronomic characteristics indicate that the households are well equipped to face small and big shocks and stresses, as well as overall changes in long term patterns. Given the interrelated and unpredictable nature of shocks and stresses, SHARP considers that households should aim to become more resilient in general, and not towards a specific type of shocks, e.g. climate-related ones. However, specific indicators of climate resilience are also measured, seeking to assess the households' ability to survive, recover from, and even thrive in changing climatic conditions.

The resilience indicators' framework developed by Cabell and Oleofse [13] was used to determine and score the characteristics of the household in terms of their contribution to the overall resilience of the household. The framework identifies 13 properties (or indicators) of a resilient system which can be applied to understand the resilience level of any agro-ecosystem. The indicators were identified following a broad review of existing literature and can therefore be applied across contexts and systems. In the context of SHARP, the 13 indicators where use to understand how to rate the responses given to the assessment. For instance in Table 2, when looking at a market aspects of the farm system, the third indicator shows that well-connected households and markets are more resilient than isolated ones. This framework provides the theoretical basis on which the SHARP assessment of household resilience was built.

Table 2. Indicators for assessing the resilience of agro-ecosystems.

Indicator	Definition	Implications
1. Socially self organized	The social components of the agro-ecosystem are able to form their own configuration based on their own needs and desires	Systems that exhibit greater level of self organization need fewer feedbacks introduced by managers or foreign actors, and have greater intrinsic adaptive capacity
2. Ecologically self-regulated	Ecological components self-regulate via stabilizing feedback mechanisms that send information back to the controlling elements	A greater degree of ecological self-regulation can reduce the amount of external inputs required to maintain a system, such as nutrients, water, and energy
3. Appropriately connected	Connectedness describes the quantity and quality of relationships between system elements	The level of connectivity provides a certain degree of diversity, flexibility and autonomy to the system
4. Functional and response diversity	Functional diversity represents the variety of ecosystem services that components provide to the system; response diversity is the range of responses of these components to environmental change	Diversity buffers against perturbations (insurance / risk diversification) and provides seeds of renewal following disturbance
5. Optimally redundant	Critical components and relationships within the system are duplicated in case of failure	Also called response diversity; redundancy may decrease a system's efficiency, but it gives the system multiple backups, increases buffering capacity, and provides seeds of renewal following disturbance

6. Spatial and temporal heterogeneity	Patchiness across the landscape and changes through time	Like diversity, spatial heterogeneity provides seeds of renewal following disturbance; through time, it allows patches to recover and restore nutrients
7. Exposed to disturbance	The system is exposed to discrete, low-level events that cause disruptions without pushing the system beyond a critical threshold	Frequent, small-scale disturbances can increase system resilience and adaptability in the long term by promoting natural selection and novel configurations during the phase of renewal; described as 'creative destruction'
8. Coupled with local natural capital	The system functions as much as possible within the means of the local available natural resource base and ecosystem services	Responsible use of local resources encourages a system to live within its means; this creates an agro-ecosystem that recycles waste, relies on healthy soil, and conserves water
9. Reflective and shared learning	Individuals and institutions learn from past experiences and present experimentation to anticipate change and create desirable futures	The more people and institutions can learn from the past and from each other, and share that knowledge, the more capable the system is of adaptation and transformation
10. Globally autonomous and locally interdependent	The system has relative autonomy from exogenous (global) control and influences and exhibits a high level of cooperation between individuals and institutions at the more local level	A system cannot be entirely autonomous but it can strive to be less vulnerable to forces that are outside its control; local interdependence can facilitate this by encouraging collaboration and cooperation rather than competition
11. Honours legacy	The current configuration and future trajectories of systems are influenced and informed by past conditions and experiences	Also known as path dependency, this relates to the biological and cultural memory embodied in a system and its components
12. Builds human capital	The system takes advantage of and builds resources that can be mobilized through social relationships and membership in social networks	Human capital includes: constructed (economic activity, technology, infrastructure), cultural (individual skills and abilities), social (social organizations, norms, formal and informal networks) endowments
13. Reasonably profitable	The segments of society involved in agriculture are able to make a livelihood from the work they do without relying too heavily on subsidies or secondary employment	Being reasonably profitable allows participants in the system to invest in the future; this adds buffering capacity, flexibility, and builds wealth that can be tapped into following release

Source: Adapted from Cabell and Oleofse [13].

Based on this theoretical framework, the SHARP assessment is built as a survey made of a set of 40 modules - each composed of a subset of questions - exploring different aspects of the farm system and spanning the agronomic, environmental, social, economic and governance dimensions of the household's livelihood. The combination of the 13 resilience indicators and the 40 modules across five domains - agricultural practices, environmental, social, economic factors, and governance - ensures a holistic overview of household farm-scale climate resilience. In particular, the assessment works under the assumption that social features of households and communities strongly affect their capacity to respond to changes, including climatic ones [14]. Out of the 40 modules, 20 are mandatory to ensure that the assessment provides a holistic representation of resilience of that particular farm system. The other 20 modules are optional and can be included depending on the assessment needs. The modular structure allows the survey to be customized to fit local context and project goals.

At module level, the assessment combines quantitative and factual information on respondents' resources, practices and knowledge, combined with their qualitative perceptions of the adequacy and importance of the specific aspect of their farm system assessed in the module . This mixed method approach is used as an attempt to capture people's priorities rather than relying uniquely on experts' objective appraisal [15]. The first

component of each SHARP module - the "technical resilience" component - explores resources,practices andknowledge and its socio-economic and biophysical environment to assess the resilience of the household based on the characteristics or behaviours in that aspect, for instance land management or access to markets. For each aspect assessed, a first score is calculated based on the 13 principles of resilience and expert review. In the second component of each module - known as adequacy component - respondents are asked to assess their own capacity to respond to change in that aspect. A fixed scoring system is then used to rate the response, assigning a higher resilience score when the farmer assess their adaptive capacity in that aspect as high. The technical resilience and the adequacy component are added to create the compound score (max 20 points) and it is used to categorize resilience in three levels: low (< 7), mid (7-12) and high (>12). Through the self-assessed importance component, the last component, farmers assess the importance or priority of that specific aspect for their livelihood. For each module, the three scores are combined to create a ranking of resilience priorities based on both an experts' assessment and farmers' own perception of their strengths and weaknesses. As shown in the example given in Table 3, the overall relative resilience score per module is therefore obtained by summing the scores for each component.

Table 3. Ranking of resilience priorities based on a sub-question of the 'access to markets module'. Underlined an exemplification of the scores and the priority ranking.

Module	Aspect measured	Technical resilience score (0-10) (a)	Adequacy score (0-10) (b)	Compound score (0-20)	Importance score (0-10) (c)	Resilience priority score (0-30)
		Question	Question		Question	
31. Access to markets	People receive a fair price / treatment	Would you say that most of the products you sold in the last 12 months were paid on time?	To what extent do the conditions in which you sell your agricultural products help you provide enough income to meet the needs of your household and agricultural activities?	$R = (a + b)$	Would improving the conditions to sell your agricultural products contribute to improving your household food security and revenues?	$R = (a + b + c)$
		Scale	Scale	Ranking of modules for resilience building	Scale	Ranking of modules based on this resilience priority score
		Yes, all of them=10 Yes, most of them=7 **<u>Only about half=5</u>** No=0	Not at all = 0, **<u>A little = 2.5</u>**, Average =5, A lot =7.5, Completely =10	R=5+2.5 R=7.5	Not at all = 10, A little = 7.5, Average, =5, **<u>A lot =2.5</u>**, Very = 0	$R = 5 + 2.5 + 2.5$ $R = 10$

SHARP is administered via a digital application. After data is collected, the information is automatically analysed through the tablet or web application providing respondents with a quick assessment of their resilience module by module. All collected data are sent to a central server for aggregate data analysis. The assessment can be used to highlight priorities to plan project interventions during formulation and the beginning of the implementation phase, as well as for monitoring and evaluation of intervention activities.

2.2.1. ***SHARP version for market system development interventions***

The SHARP version developed for the MERIT project has been specifically adapted to capture the effect of market system development interventions upon household resilience. This is something that has not been done

before and the project will offer the first opportunity to test its sensitiveness and applicability to explore the link between market access and household resilience in the project intervention area.

The SHARP tool was adapted using a multi-pronged methodology. First, the SHARP team trained iDE staff on the SHARP methodology and introduced the SHARP application. The training was followed by discussions among both teams, and the local project team, to co-develop an adapted SHARP MERIT version. The newly developed SHARP tool has strengthened pre-existing modules related to input and output markets, orientation of productive activities and farm inputs sources, These will constitute the base for analyzing the effect of market system-related interventions on household resilience. In addition, all modules and sub-questions were reviewed to ensure adaptation to the local context, in terms of agro-biodiversity, livelihood activities and cultural characteristics.

The next iteration will see the version piloted in the project area to ensure the survey is well-tailored to the Vietnamese communities.This process start with training the enumerators to ensure that key concepts of resilience and specific questions are well understood and that they can be explained in local language.

3.Findings and considerations

3.1. *Anukulan Resilience Analysis and Market Intensity Results*

Table 4 presents the results of the Anukulan difference-in-differences analysis to estimate the causal impact of the project intervention on household level resilience. As evident in the table, baseline differences between treatment and control households are not statistically significant confirming that difference-in-differences analysis is an appropriate estimation model. Further, differences between treatment and control households at endline, and between treatment households over time, are statistically significant at the 0.1% significance level indicating the Anukulan project had a significant impact on treatment households.

The analysis shows that treatment households increased their ACRI score by 1.7 points due to project intervention, which is a doubling of their baseline score. The share of treatment households who had an ACRI score of three or higher, and were thus classified as 'resilient', increased by 64 percentage points from baseline. These results confirm that the Anukulan project had causal impact and significantly improved treatment households' resilience as measured by the ACRI. The validation of the project intervention permits further ex-post analysis on treatment group market segmentation.

Table 4: Anukulan Resilience Difference-in-Differences Analysis

		Baseline	Endline	*Difference*
Anukulan Composite Resilience Index Score (out of 5, higher is better)	Treatment	1.6	3.4	*1.8* ***
	Control	1.8	1.9	*0.1*
	Difference	*-0.2*	*1.5* ***	*1.7* ***
Share of Resilient Households (ACRI score of 3 or higher)	Treatment	21%	82%	*61%* ***
	Control	28%	25%	*-3%*
	Difference	*-7%*	*57%* ***	*64%* ***

* = p < 0.05; ** = p < 0.01; *** = p < 0.001

Table 5 presents the ex-post difference-in-means analysis comparing control households to Anukulan treatment household outcomes with different market intensities at project endline. Households who engaged in high market intensity activities, utilizing market Collection Centers and/or Distillation Units as part of the commercial pocket approach, had significantly higher ACRI scores and share of households considered resilient. High market intensity households increased their ACRI score by 0.3 points. Given that the difference-in-differences analysis showed a 1.7 increase in treatment households' ACRI score from baseline, a difference of 0.3 points accounts for 17% of that overall gain. Similarly, 88% of high market intensity households achieved resilient

status compared to only 78% of low market intensity households. The statistically significant findings that households with fuller participation in market based interventions saw even higher gains on resilience outcome measures affirms that market system development interventions promoted under Anukulan are an effective measure to improve household level resilience.

Table 5: Anukulan resilience measures at endline, by market reach

	High Market Intensity	Low Market Intensity	Control	Stat Sig Difference
Anukulan Composite Resilience Index Score (out of 5, higher is better)	3.6	3.3	1.9	(LMI v. Control) *** (HMI v. Control) *** **(HMI v. LMI) ***
Share of Resilient Households (ACRI score of 3 or higher)	88%	78%	25%	(LMI v. Control) *** (HMI v. Control) *** **(HMI v. LMI) ***
ACRI sub-indicators				
Households with early warning notice	77%	62%	39%	(LMI v. Control) *** (HMI v. Control) *** **(HMI v. LMI) ****
Households with access to improved water source less than 30 minutes away	63%	58%	74%	(LMI v. Control) *** (HMI v. Control) *
Households using six or more climate smart agriculture technologies	97%	69%	3%	(LMI v. Control) *** (HMI v. Control) *** **(HMI v. LMI) *****
Households with sufficient dietary diversity	79%	75%	33%	(LMI v. Control) *** (HMI v. Control) ***
Households above $1.25 a day poverty threshold	59%	55%	38%	(LMI v. Control) *** (HMI v. Control) ***

* = p < 0.05; ** = p < 0.01; *** = p < 0.001

The sub-indicator analysis presented in Table 5 illuminates the primary drivers of different resilience outcomes for high versus low market households. ACRI sub-indicators of improved water source access, sufficiently diverse diets, and rates of poverty incidence do not have statistically significant differences between high and low market intensity households. It is the households' access to early warning notices and most notably the share of households using climate smart technologies that is driving the difference in ACRI scores overall. These findings align with Anukulan theory of change as the project has more direct influence over the rate and quantity of climate-smart technologies introduced in the market via the commercial pocket approach. Other sub-indicator measures such as dietary diversity and poverty incidence are more indirectly impacted through different intervention channels.

3.2. ***SHARP/MERIT considerations***

The finalized SHARP/MERIT version will support the assessment of resilience in the project area through a similar disaggregation conducted in the Anukulan analysis. A composite SHARP resilience index will be used to assess the differences for households disaggregated by the degree of market system intervention intensity the household participated in. The degree will be proxied by considering the ability and adequacy to access input and output markets.

3.3. ***ACRI and SHARP/MERIT Methodological Comparison***

Following the application of the ACRI and the initial development of the SHARP/MERIT version, the authors identified the respective challenges, strengths and limitations of the two approaches, which are presented in Table 6. It is important to note that, as the SHARP/MERIT version is piloted, additional learnings will be gathered around its applicability and use with the objective of better understanding the impact of market development interventions upon household resilience.

Table 6. Methodological comparison between the ACRI and SHARP

	ACRI	SHARP/MERIT
Resilience quantification	Resilience score thresholded as binary measure of resilience	Resilience scores based on modules and indicators
Challenges	Predicting household self-selection in market based activities ex-ante Determining the right sub-indices mix and threshold cut-offs ex-ante project intervention	Comprehensive survey requiring high intensity field work Need for careful adaptation of the survey to the specific context
Strengths	Straightforward and easy to build off other indicators contextualized to a specific project Low intensity fieldwork and survey enumeration when built into project M&E processes Data collected can be combined with other tools and analyses, including focus group discussions for validation of assessment, and geographically located data	The combination of technical knowledge on resilience with people's perceptions can allow for a participatory resilience measurement and building Customizable tablet-based application for highest contextualization Initial analysis of resilience at household level are available immediately after completion of app survey Data collected can be combined with other tools and analyses, including focus group discussions for validation of assessment, and geographically located data
Limitations	Externally imposed definition Binary threshold does not capture the range of possible contributions from individual sub-indices	Needs deep understanding of the communities to better contextualize the results

4.Conclusion

While the availability of frameworks and indicators for the measurement of resilience has steadily increased in recent years, their application to specifically capture the effect of market system development interventions upon household resilience is still limited.

This paper shares insights and analysis from the use of two alternative methodologies in two project contexts and findings at different stages of their development and application.

The ACRI proved useful to further understand characteristics of resilience following market interventions under Anukulan, where a difference-in-difference analysis found that the project significantly and causally increased ACRI scores and resilience binary measures. Main considerations for its use and findings include:

- Determining market participation ex-ante is problematic as with market systems interventions households can choose to self-select in or out, limiting the ability to apply a market analysis framework at baseline. Ex-post market analysis can be strengthened through advanced matching techniques to construct a panel data set for quasi-experimental analysis
- Nonetheless, ex-post difference-in-means testing shows that households with higher participation in Anukulan's market based intervention had significantly higher ACRI scores and share of resilient households

While at the development stage, the SHARP/MERIT tool has been found useful:

- Before any project activity, as a baseline assessment, for the comprehensive analysis of resilience, including as a participatory methods for results validation and interventions planning to build resilience
- Along the project, as monitoring and evaluation tool, to track implementation of activities and assess the project outcomes and results
- In case of interest in comparing resilience at different scales (e.g. communities, regions, countries, type of farming system, household head) and across contexts (as it captures socio-cultural, political context and ecosystem characteristics)

Finally, a tool, such as SHARP, could potentially help clarify the drivers for success in improved Anukulan resilience, further unpacking the causal pathway of individual drivers of resilience and capturing qualitative data.

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References

[1] World Bank; International Monetary Fund. (2013): *Global Monitoring Report 2013: Rural-Urban Dynamics and the Millennium Development Goals*. Washington, DC: World Bank.
[2] Alkire, A., Conconi, A., Seth, S. (2014): *Multidimensional Poverty Index 2014: Brief Methodological Note and Results*, Oxford Poverty and Human Development Initiative, University of Oxford.
[3] World Bank (2008): *Agriculture for Development*. World Development Report 2008.
[4] DFID. (2005): *Making market systems work better for the poor (M4P): an introduction to the concept*.
[5] Leavy, J., Boydell, E., McDowell, S., Sladkova, B., (2018): *Resilience Results. Braced Final Evaluation. Synthesis Report*. ODI.
[6] ADB. (2009): Building Climate Resilience in the Agriculture Sector of Asia and the Pacific.
[7] Kuhl, L. (2018): *Potential contributions of market-systems development initiatives for building climate resilience*. World Development, 108, 131-144
[8] Rose, R. Bui, T. Nicoletti, C. (2016): *iDE Vietnam - SDC Evaluation Report.* https://s3.amazonaws.com/www.ideglobal.org/files/public/iDE-R_VN_ImpactEvaluation_SDC.pdf?mtime=20170427210745
[9] Rose, R. Nega, M. Gelanew, B. (2017). *Innovations for Rural Prosperity Ethiopia - Evaluation Report.* https://s3.amazonaws.com/www.ideglobal.org/files/public/iDE-R_ET_iQ_ImpactEvaluation_IRP.pdf?mtime=20171221200103
[10] Swindale, A., Bilinsky, P. (2006): *Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2)*. Washington, D.C.: FHI 360/FANTA.
[11] Bahadur, A.V., Peters, K., Wilkinson, E., Pichon, F., Gray, K., Thomas, T., (2015): *The 3As: Tracking resilience across BRACED*. ODI.
[12] Choptiany, C., Graub, B., Phillips, S., Colozza, D., Dixon, D., (2015): *Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP)*. FAO.
[13] Cabell, J. F., Oelofse. M. (2012): *An indicator framework for assessing agroecosystem resilience*. Ecology and Society 17(1): 18
[14] Smit, B., Pilifosova, O. (2003): *Adaptation to climate change in the context of sustainable development and equity*. Sustainable Development, 8(9): 9.
[15] Schipper, E. L. F., Langston, L., (2015): *A comparative overview of resilience measurement frameworks*. ODI.