

Decentralising Climate Funds (DCF)



Self-Assessed Resilience and its Correlation to Specific Indicators

Near East Foundation consortium under the Building Resilience and
Adaptation to Climate Extremes and Disasters (BRACED) programme



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Section 1. Introduction

The Decentralizing Climate Funds (DCF) project supports locally-led adaptation to climate change in Senegal and Mali. The project seeks to build resilience by enabling communities to manage local climate adaptation funds and to identify and implement public good investments that support adaptation strategies.

Resilience is a multidimensional concept. To assess whether our approach and investments enhance resilience, we must first find a way to operationalize the concept into measurable components. In the context of the Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) program, the British Department for International Development (DfID) has provided guidelines on operationalizing the concept for monitoring and evaluation (M&E), namely through a Key Performance Indicator 4 (KPI4) and associated guidance documents.

The KPI4 guidance document¹ describes a vision of what resilience looks like and dimensions that are possible to measure. Box 1 summarizes the key elements of KPI4. Also central to the BRACED programme M&E is the idea of the “Three As” (3As), meaning the ability to adapt to, anticipate, and absorb climate extremes and disasters. The 3As provide an analytical lens for evaluating project outcomes.

The Decentralizing Climate Funds (DCF) Consortium used KPI4 content as a guide to formulate the project’s baseline and endline evaluations. It provided our monitoring and evaluation team with a series of indicators that we were able to adapt to ask meaningful questions of households in Kaffrine, Senegal and Mopti, Mali. The objective of the monitoring and evaluation exercise is to assess whether our efforts have enhanced resilience.

The DCF Consortium team developed a survey instrument to measure resilience and potentially identify changes over time in household resilience, guided by the core KPI4 elements (Box 1). We asked heads of household questions about measures that are potentially correlated with resilience and collected responses to indicators proposed in the KPI4 document to capture elements of the concept of resilience.

In addition, we directly asked household heads to conduct a self-assessment of their household’s resilience. We asked households in the baseline survey to assess their household’s resilience in the current year on a Likert scale from weak (1) to strong (5) in terms of resilience. DCF conducted earlier qualitative work (Resilience assessments) in the project communities to investigate appropriate ways of expressing the concept of resilience in local

¹ See DfID KPI 4: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/328254/BRACED-KPI4-methodology-June2014.pdf

Box 1: KPI 4 categories of indicators to measure resilience

1. **Assets**, including physical and financial assets, food and seed reserves, and other assets that can be deployed or realised during times of hardship to help people absorb losses, and recover from stresses and shocks. Debt could be considered as a negative asset.
2. **Access to services**, including water, electricity, early warning systems, public transport, and knowledge and information that helps people plan for, cope with and recover from stresses and shocks, and how vulnerable these services are themselves to shocks and stresses.
3. **Adaptive capacity**, including factors that specifically enable people to anticipate, plan for and respond to changes (for example by modifying or changing current practices and investing in new livelihood strategies). The ability to adapt to changes in any of the other dimensions listed here might also be included.
4. **Income and food access**, including the vulnerability to shocks and stresses of income sources and food supplies (including food prices/ability to purchase or otherwise access food, and the vulnerability of food supply chains to local and remote shocks and stresses).
5. **Safety nets**, including access to formal and informal support networks, emergency relief, and financial mechanisms such as insurance.

(KPI 4 guidelines, page 11, extracted from a longer list)

languages, and these local language translations were used in the household surveys.

We present in this working paper a preliminary investigation of how households' measures of self-assessed resilience correlate with the key indicators that have been proposed to capture the multiple dimensions of the concept of resilience.

The data presented are from sites that were selected based on community characteristics that are representative of the overall study area. In Mali, we stratified communities by size (large, medium, or small), distance to a weekly market (far or near), and according to different administrative sub-areas (Koro, Mopti, and Douentza). In Kaffrine, we stratified communities by three agro-ecological zones (northern bordering the Ferlo, central peanut

basin, southern more humid zone) for each of four different administrative sub-areas (Malem Hodar, Kougheul, Kaffrine, and Mbirkelane).

After this brief introduction, this working paper provides a summary of the literature on the concept of resilience in dryland Sub-Saharan Africa. The third section introduces the study area and summarizes the field work associated with the baseline survey. Section 4 provides summary information on the resilience ranking results and a closely associated concept related to food security. In section 5, we turn to empirical results that test whether there are significant statistical differences between households grouped by responses to the self-assessed resilience measure.

Section 2. Literature on the Concept of Resilience

In current development discourse the concept of resilience has become prominent. It is related to, but different from, concepts of well-being (most closely associated with poverty measures) and vulnerability (most closely associated with variability in income over time). Resilience, as defined in the literature on the overall BRACED program, can apply to individuals, households, communities, systems, and ecosystems. Here, “resilience to climate shocks and stresses (that may be intensifying as a result of climate change) is considered to be a composite attribute possessed by each individual, that represents their ability to anticipate, avoid, plan for, cope with, recover from and adapt to (climate related) shocks and stresses. Improved resilience means that an individual is better able to maintain or improve their well-being despite being exposed to shocks and stresses.” (DfID, 2014, p.5)

The U.S. Agency for International Development (USAID) defines resilience as “the ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth” (2012, 2015). Their framework is premised on the relationships among resilience, vulnerability, and inclusive growth. It anticipates results from enhanced resilience, such as increased adaptive capacity, improved ability to address and reduce risk, and improved social and economic conditions of vulnerable populations, that will meet the long term goal of reducing humanitarian need. (p. 5).

The World Bank’s “Concept Paper on the Economics of Resilience in the Drylands of Sub-Saharan Africa” (2013), identifies four key shocks to dryland production systems: climate, health, market, and conflict. Across these four shocks,

households may differ in: exposure to the risk, sensitivity to the shock, and capacity to cope with the shock. McPeak and Little (2017) apply the World Bank framework to investigate different types of shocks and determinants of vulnerability using panel data gathered northern Kenya and southern Ethiopia from 2000-2002, which covers a drought and drought recovery period. They stratify the analysis by livelihood groups, where the sample is divided by access to herd wealth and access to the cash economy at the time of the baseline survey in 2000. They illustrate how shocks impact subgroups in the sample differently, indicating there is heterogeneity in resilience across different livelihood categories in dryland areas.

Barrett and Constanas (2015) provide an overview of the concept of resilience as seen through the dynamic lens of poverty traps. They illustrate the importance of understanding the difference between a resilient outcome and a poverty trap. It is important to layer upon the concept of bouncing back following a shock the idea that the state to which one returns is desirable. In fact, McPeak and Little (2017) find a measure of ‘bouncing back to the income level before the shock’ is a misleading and unsatisfactory measure of household resilience, as impoverished households may return to a “poor” state faster than their more well-off counterparts – but remain highly vulnerable. Bouncing back to a common income or asset threshold provides more convincing results. Cisse and Barrett (2016) propose a conditional moments based resilience measure that is related to the Foster Greer Thorbeck family of poverty measures. The measure they propose uses data from current and past periods to forecast predictions of future resilience at the household level in a way that considers whether households bounce back to a level above a specified threshold.

Barrett and Santos (2015) present a livestock-based measure of future resilience based on predictions of future herd size from household survey data. They illustrate that livestock producers understand that their future outcomes are reliant on climate conditions. Household estimates of future outcomes are influenced by climate scenarios. That is, herders recognize that the existence of something like a steady state outcome for a future herd size that will be sustainable becomes increasingly difficult as rainfall regimes worsen.

The monitoring conducted by the DCF Consortium is predominantly centered on the change in resilience at the individual and household level. Although the focus is on the individual and household, it is important to recognize that the resilience at these levels also depends on the resilience of the community, systems, and ecosystems in which they live. The social context in which individuals live is a part of understanding the concept of resilience. This community level element will be analyzed in future analysis.

Section 3. The Study Area and Methodology

The DCF Consortium operates in Senegal's Kaffrine Region and Mali's Mopti Region. Kaffrine is situated in the 'peanut basin' of Senegal, with the northern reaches bordering the Ferlo agro-pastoral region and a southern border with the Gambia. Mopti region in Mali has areas of flood plain cultivation, nomadic grazing, settled rainfed cultivation, and important fishery resources. Both regions contain diverse ethnic groups and livelihood strategies.

We developed a baseline survey as part of our project monitoring and evaluation effort. Near the end of 2015, the Near East Foundation (NEF) in Mali and Innovations Environnement Développement Afrique (IED-Afrique) in Senegal hired and trained enumerators to conduct a baseline survey of households in our two study areas. NEF, International Institute for Environment and Development (IIED), and Syracuse University (SU) collaborated with in-country teams to draft, test, and field the household survey. A particular challenge was that, at the time we selected our sample, we did not know: 1) where there would be future community-prioritized project investments to

enhance resilience; or 2) what kinds of interventions would be selected by the communities. These challenges have been addressed in the endline survey design that was implemented in November 2017 and is currently being analyzed. Endline results will be presented in future documents; this document uses data from the baseline.

In each community that was selected to represent a particular production zone, we randomly selected households from a household roster (generally the tax list) obtained in the community from local leaders. Based on the population size, we developed a sampling interval from our desired sample size in the community. In Senegal, we specified 17 households per community and 12 total communities for a total of 204 households. In Mali, we specified 25 households per community in 16 communities for a total of 400 households. The total of 600 households was selected by conducting Minimal Detectable Effect calculations for household level data gathered for another project in the Senegal River Valley. The ratio between Mali and Senegal was based on the

difference in population size, comparing Kaffrine to Mopti using census data. Starting with a randomly-selected household within the sampling interval at the top of the list, we then selected households further down the list according to the size of the sampling interval, which was a function of the population size and the target sample size. Data were entered in the project offices in Senegal and Mali, and were transferred to NEF headquarters and SU for further analysis. This document presents preliminary results of this analysis.

A few methodological caveats are in order. One caveat is that there is methodological danger in taking variation in cross sectional data as representative of change over time for a given household. That is to say, elements we are drawing on from the KPI4 document are indicators proposed as measures of change in resilience over time at the household level. At the time of writing this document, however, we had only baseline data to work with. As such, this analysis considers

variation from the baseline data across households at a single point in time to evaluate the relationship between various KPI4 indicators and self-assessed resilience. We propose this analysis to explore different concepts of resilience and perhaps to inform future monitoring and evaluation. We are currently conducting and analyzing endline surveys that are part of the DCF project's monitoring and evaluation; once multiple observations on households are available we can conduct a full panel analysis and we may find different patterns.

Another methodological caveat, noted above, is that we had to define and field the baseline survey in advance of any project-funded investments in resilience. As communities were empowered to collectively identify and design investments in their communities, we did not know precisely where there would be investments or what communities would prioritize as resilience-enhancing public goods. For these reasons, we were not able to *ex ante* define treatment and control sites.

Section 4. Results

4.1 Measures of Resilience and Food Security

We set out in this study to examine resilience and measures that are correlated with resilience. On a five-point Likert scale, households ranked their own resilience on a scale from weak (1) to strong (5). The following figures presents the overall pattern of their responses.

The pattern skews leftward from a normal distribution, indicating that the average lies slightly below the conceptual midpoint of 3 (Figure 1).

Numerically, the overall mean is 2.5, whereas conceptually for the question it is 3.

Three interesting patterns emerge when we look at differences in the resilience ranking. First, there is spatial variation in the means that indicates there are site-specific influences on these rankings.² There is a geographic element that influences households when making the resilience self-assessment (Figure 2).

A second observation is that there is a gender dimension to these rankings. In each male-headed household we asked both the husband and wife to

Figure 1: Percent of households reporting different resilience self-assessment values

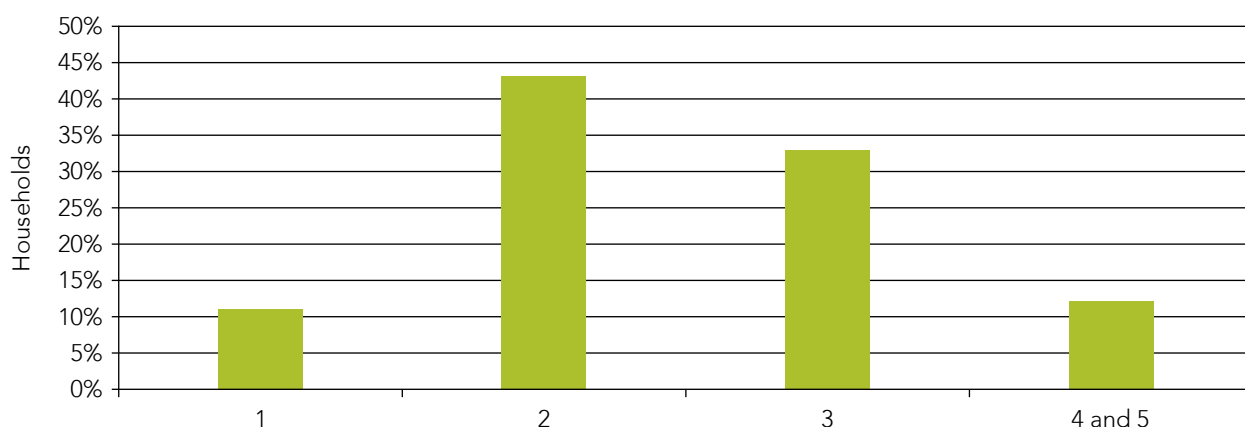
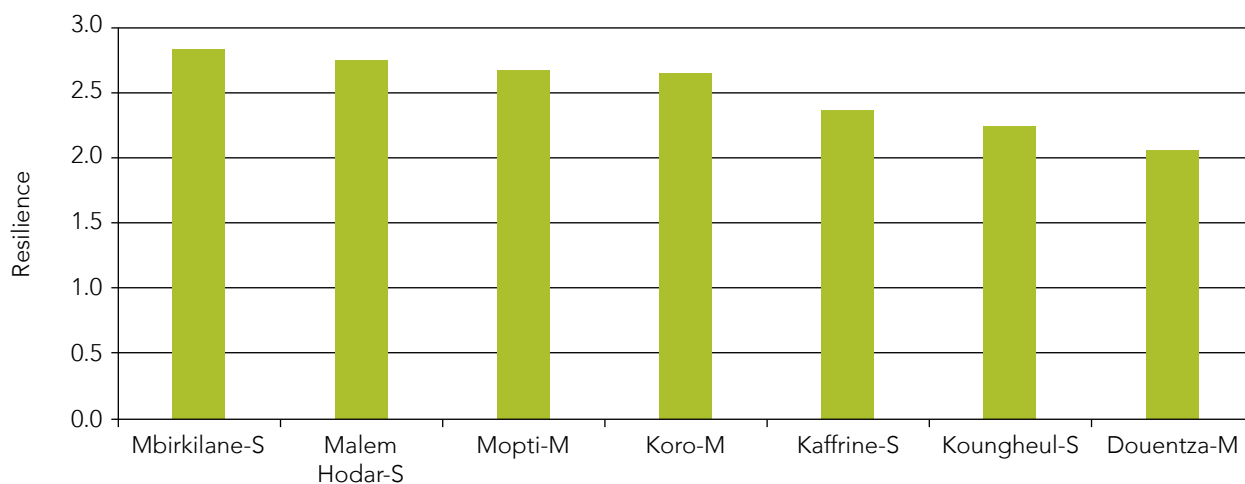


Figure 2: Average self-assessed resilience by study area, S=Senegal, M=Mali



² 13 of the 21 possible pairwise comparisons for difference in mean are statistically significant.

rank their resilience. The mean response from the male head of household (average 2.5) was higher than the female household respondents (average 2.2), which is significantly different ($p < 0.01$) using a paired t-test. If we contrast male and female-headed households, female heads of households rank their resilience (mean 2.1) significantly lower ($p < 0.05$) than male heads of households (mean 2.5).

A final contrast is evident when comparing households who cited their primary activity as 'farming' to those who ranked 'herding' first. The farming households' self-assessment averaged 2.5 while the herding households were significantly ($p < 0.01$) lower with an average of 2.0.

One measure in our study that merits heightened analysis is food security, as it is central to concepts of well-being, vulnerability, and resilience. Here we will focus attention on the relationship between the DCF resilience measures and a measure of food security. We asked respondents to report on how many food secure months their economic activities delivered in the past year. To see the correlation between this measure of food security and resilience, we sorted households by their resilience

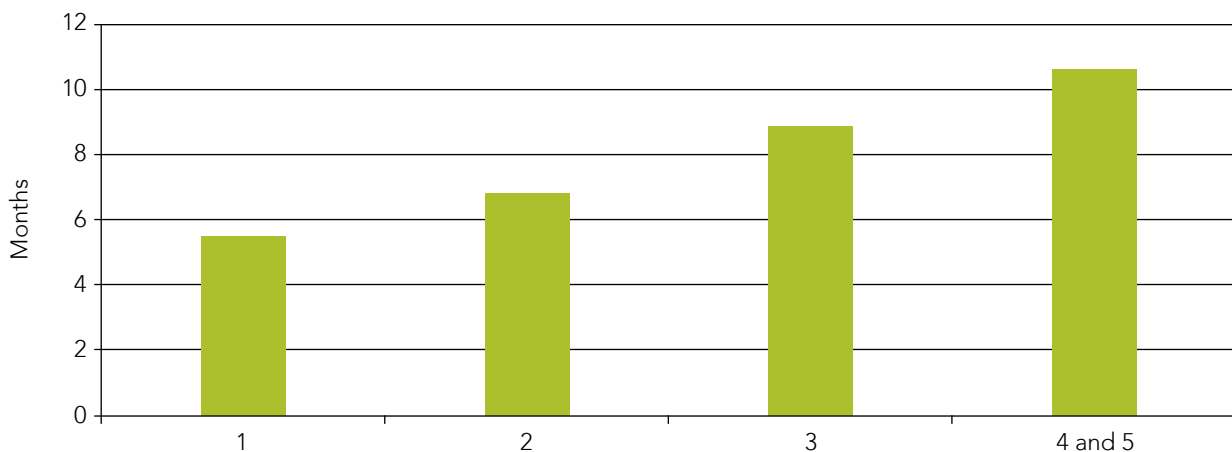
response and computed the mean number of food secure months for that subgroup. We combined responses of resilience self-assessment groups 4 and 5 as there are very few '5' responses. The following pattern emerges (t-statistics for significant difference in means by resilience assessment groups are presented for adjacent categories below).³

Table 1: t-test results for statistically significant differences in means for food security

t stats for difference in means	
1 and 2	-3.04
2 and 3	-9.09
3 and 4/5	-5.63

Food security is quite clearly correlated with the sense of resilience among the sampled households. The overall correlation between the resilience ranking and the food security measure is 0.52.

Figure 3: Mean months of food security (y-axis) for households sorted by resilience self-assessment (x-axis)



³Critical p-values for the t-distribution are 1.960 for a 5% level and 2.576 for a 1% level. T values above these thresholds will be in bold and more darkly shaded cells. The specification used in comparing the means has (lower resilience level mean-next higher resilience level mean) in the numerator.

4.2 Resilience correlates

4.2.1 Bivariate Analysis

The objective of this exercise is to establish correlation patterns between individuals' self-assessment of their household's resilience and other variables that KPI4 proposes to capture dimensions of resilience. While food security is central to resilience, as presented above, the resilience measure expands to other concepts as well.

Quite clearly, one dimension of understanding resilience is the degree to which a household is exposed to shocks. We asked respondents if they had experienced any of a set of shocks that are common in the study area (fire in the household, violent winds, locust invasion, brush fires, drought, floods, and an open ended 'other' option) over the past year. To represent shock experience, we add up how many of the six shocks listed were experienced by the household, and compute the average of this index for the different sub-groups sorted by resilience measures (Figure 4).

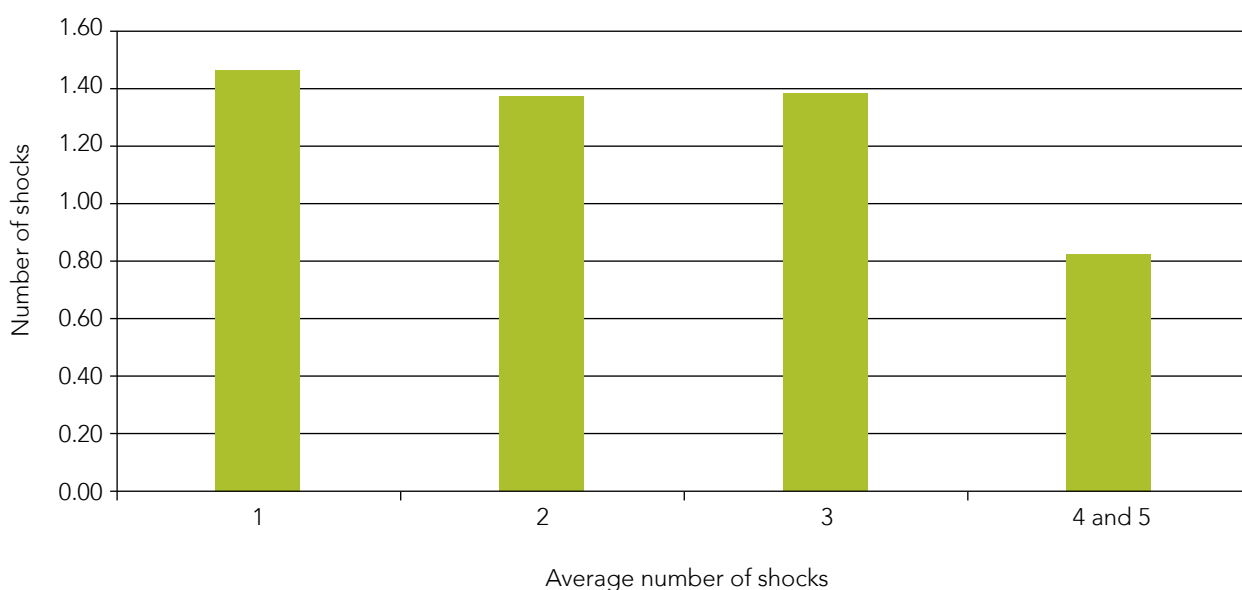
Table 2: t-test results for statistically significant differences in means for shocks

t-statistics for difference in means	
1 and 2	0.59
2 and 3	-0.13
3 and 4/5	4.48

The differences among the first three groups are not statistically significant. However, the group that self-assesses as 4 or 5 experienced significantly fewer shocks. It could be either that those who have not experienced a large number of shocks self-assess as more resilient or that those who are more resilient are able to reduce shock exposure. Further panel analyses should help us resolve this question as we gather additional information for monitoring and evaluation.

Some insights might be gained from a follow-up question in the baseline that was asked for each affirmative response to a shock experience to assess the degree to which the household was adversely impacted by the shock. Zero means not at all, 1 means slightly impacted, and 2 means strongly impacted. If the ability to avoid a shock

Figure 4: Average number of shocks (y-axis) experienced by households sorted by resilience self-assessment (x-axis)



is related to the ability to reduce the impact of a shock that is experienced, we might see a difference in shock impact across the resilience groups. However the responses to the follow up question do not differ in any systematic pattern across the four self-assessed resilience sub-groups describing shock impact. This suggests that the difference in the number of shocks experienced probably reflects differences in risk exposure, rather than difference in ability to cope with shocks. But, given the data we have, this conclusion is tentative.

Another element worth considering is the degree to which households have access to information that allows them to manage or avoid shocks. As an important part of the risk exposure lies with climate variability, we asked household heads if they had heard forecast information in the past year and, if so, from what source or sources. Figure 5 presents first overall access to forecast information by resilience sub-group, then after that a breakdown of what percent obtained it from different sources. In general, the groups ranking resilience at or

above 3 were more likely to report they had heard a forecast than those who report resilience below the midpoint of 3. The groups that experienced more shocks were less likely to have heard forecasts. Again, there is a challenge in interpretation, as it could be that those who are more resilient are better able to seek out information because of other attributes that impact resilience, such as wealth (a possible interpretation for the television pattern), or it is possible they heard forecasts and changed behavior to reduce risk exposure. We need additional data to tease this apart.

We next considered access to information, markets, and other inputs. Market information and markets are more accessible in the dry season than in the rainy season for all groups. The resilience sub-groups indicate that markets and market information are more accessible by those who have higher resilience rankings. Public services do not seem to vary much across resilience sub-groups in the rainy season, but group 1 is significantly lower in the dry season. This could reflect the more pronounced reliance on livestock by those in group

Figure 5: Percent of households in self-assessed resilience categories that reported obtaining forecast information and from what kinds of sources did they receive it

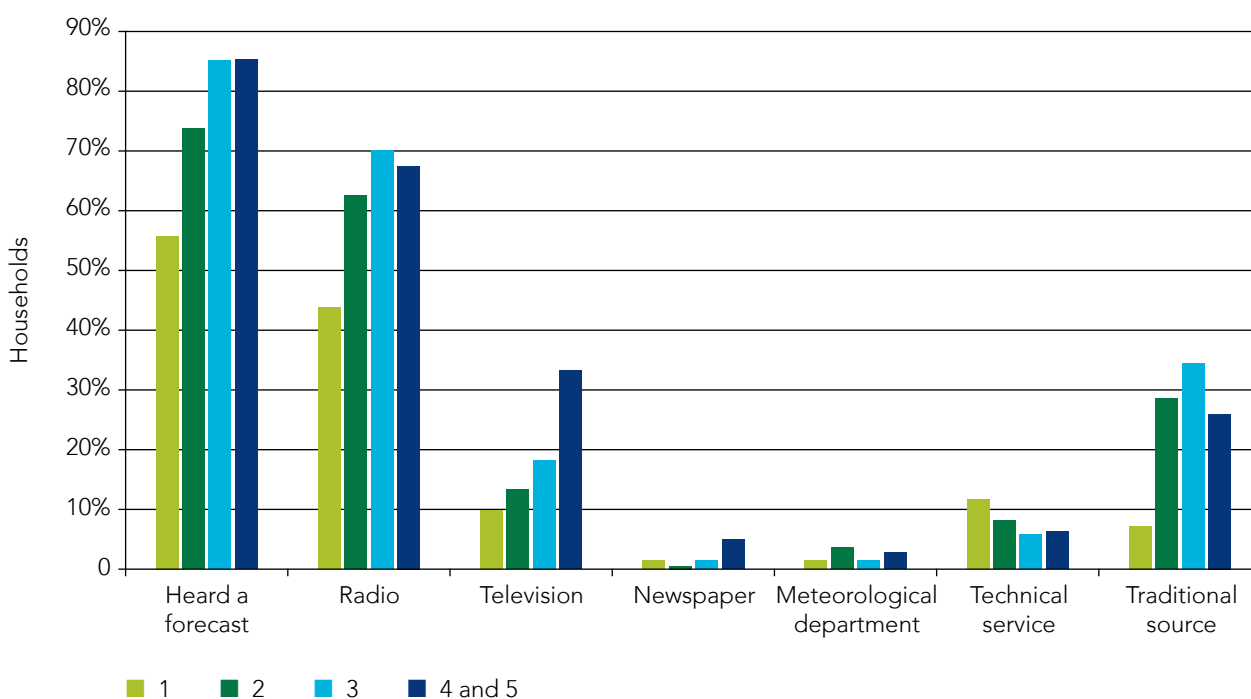


Table 3: t-test results for statistically significant differences in means for climate information

	Heard a forecast	From Radio	From Television	From a newspaper	Meteorological department	Technical Service	Traditional source
1 and 2	-2.68	-2.72	-0.75	0.45	-1.26	0.85	-4.99
2 and 3	-3.15	-1.76	-1.46	-0.72	1.59	0.87	-1.39
3 and 4/5	-0.06	0.45	-2.49	-1.37	-0.54	-0.14	1.44

Figure 6: Average on scale of 1 (very difficult to access) to 5 (very easy to access) for households in self-assessed resilience categories access to different items

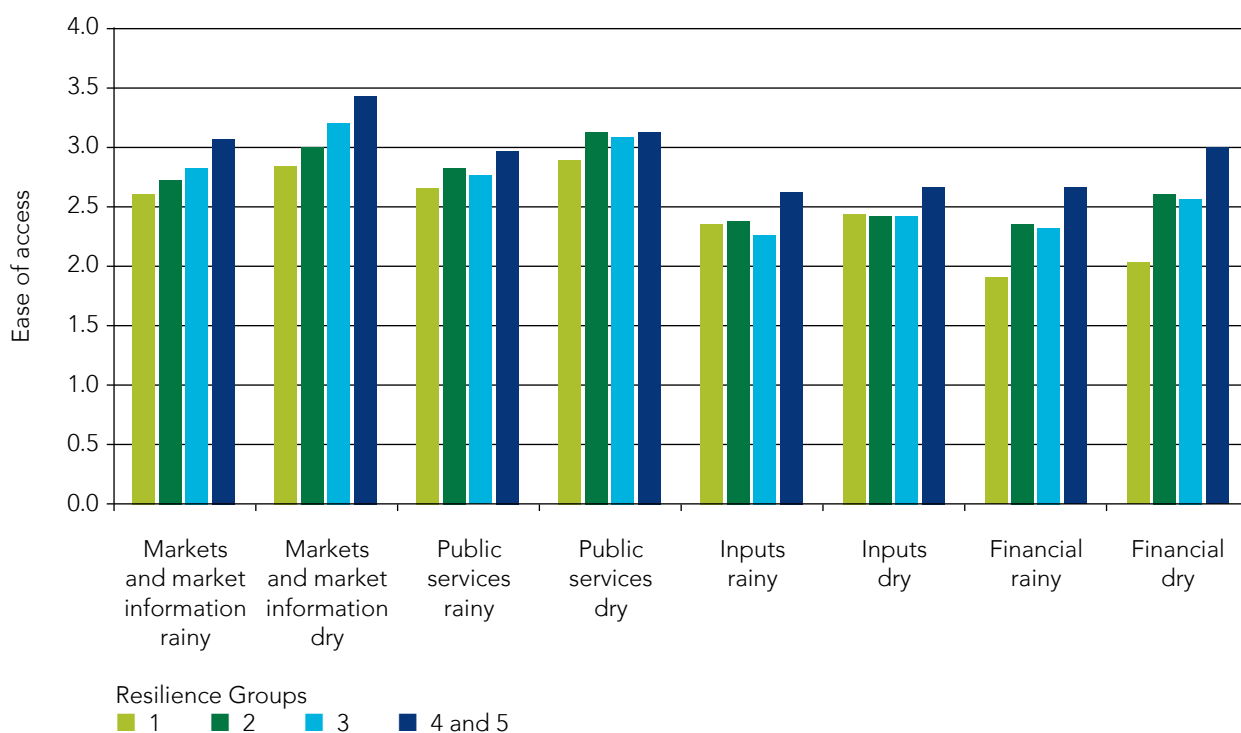


Table 4: t-test results for statistically significant differences in means for different items

	Markets and market information rainy	Markets and market information dry	Public services rainy	Public services dry	Inputs rainy	Inputs dry	Financial rainy	Financial dry
1 and 2	-0.81	-1.14	-1.31	-2.29	-0.30	0.14	-3.39	-4.10
2 and 3	-1.11	-2.53	0.66	0.54	1.48	0.09	0.37	0.39
3 and 4/5	-1.62	-1.85	-1.48	-0.41	-2.44	-1.69	-2.20	-3.10

one and their need for mobility in the dry season. In contrast, for inputs, the most resilient group is significantly higher than group 3. Inputs in this case is an average across three questions, inputs for cultivation, inputs for livestock raising, and inputs for fishing. Similarly, with financial access, there is a pretty clear pattern that, as the resilience ranking increases, ease of access to financial services also increases.

We also asked questions concerning access to managed production areas in the community, defined as managed cultivation zones, managed grazing zones, managed fishing zones, and managed non-wood product zones. This is related to, but different from, questions about natural resources, discussed below. The ease of access to each of these zones was ranked on a 5 point Likert scale from 1 (very difficult) to 5 (very easy). The mean is computed for each household for all production zones that they reported using for each season.

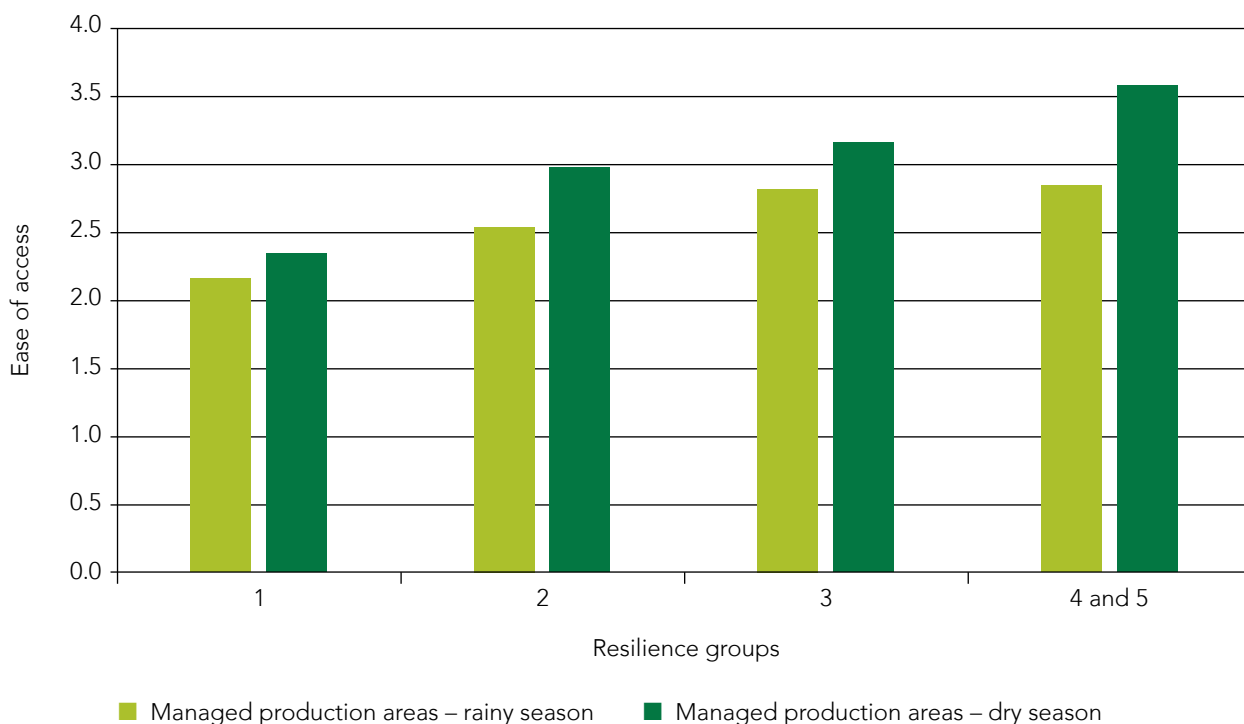
Table 5: t-test results for statistically significant differences in means in access to managed production areas

	Rainy season	Dry season
1 and 2	-3.46	-4.66
2 and 3	-3.47	-2.04
3 and 4/5	-0.23	-3.92

Clearly there is a seasonal aspect for all households as access is ranked higher in the dry season than the rainy season by all groups. For all but the contrast between groups 3 and 4/5 in the rainy season, the differences in the means are statistically significant. There is differential access to these production areas that is associated with the degree of self-assessed resilience.

A different pattern emerges when we turn to the question of access to community infrastructure that can be thought of as community assets. Nine items were named: collective grain storage facility, grain

Figure 7: Average ease of access to managed production areas (y-axis) on a scale of 1 (very difficult) to 5 (very easy) sorted by resilience groups (x-axis)



bank, protected dry season garden, vaccination park, livestock market, water point for livestock, migration corridor for livestock, fish ponds, and rainwater management infrastructure. For each of these, we asked first if there was such a facility in the community and, if there was, we followed up with a score of ease of access to the infrastructure or equipment in different seasons from 1 (very difficult) to 5 (very easy). To summarize the data, we added the number of 'yes' responses (no access to any of these 9 things = 0 up to a score of 9 if the household had access to all assets named). We then computed the average ease of access score for the dry season and rainy season, respectively, for any infrastructure / equipment identified as being present. Given the DCF project's intent to work with communities to identify and deliver public goods, these assets are examples of the kinds of investments that communities might select for funding, making this baseline information particularly important. Given the 'bell curve' hinted at in the graph, we will expand the group-wise

comparisons to go beyond just adjacent groups and contrast all subgroups with t-statistics.

Community assets were used more by those in the middle groups (self-assessed resilience of 2 or 3) than in the other groups. Looking at the individual categories, this is largely driven by livestock related infrastructure and equipment, with usage in the least resilient and most resilient groups lower than the middle two groups. We speculate that this could be because the least resilient households do not have livestock to make access an issue, while the most resilient may be invested in livelihood strategies other than livestock. Consistent with this interpretation, those who assess resilience to be 4 or 5 reported higher usage of collective grain storage facilities that are important for sedentary agriculture (84% of them said they had access) compared to the next highest group (group 3 with 51% reporting access).

Another area we might expect to influence resilience is access to natural resources. We asked

Figure 8: Number of community assets identified and average ease of access to these items in the rainy season and the dry season (y-axis), by resilience sub group (x-axis)

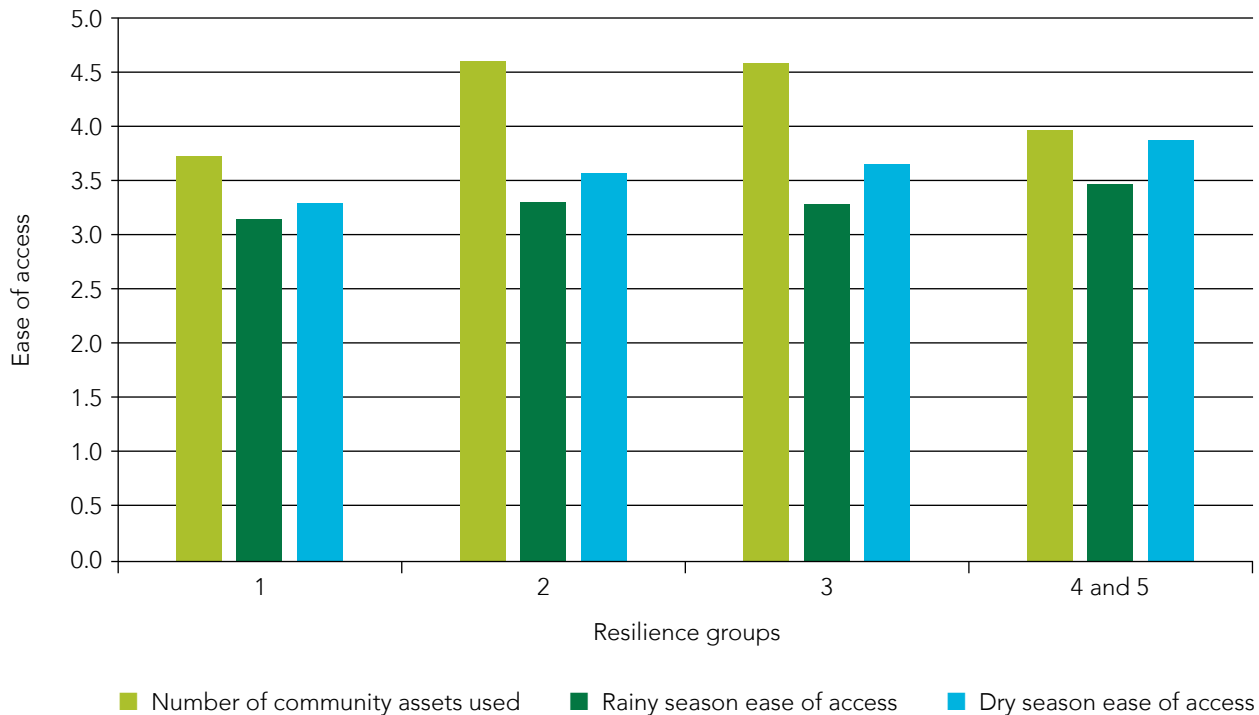


Table 6: t-test results for statistically significant differences in means in access to community assets

	Number of community assets used	Rainy ease of access	Dry season ease of access
1 and 2	-3.47	-1.25	-2.60
1 and 3	-3.25	-1.05	-3.35
1 and 4/5	-0.72	-2.36	-4.55
2 and 3	0.16	0.29	-1.35
2 and 4/5	2.64	-1.73	-3.29
3 and 4/5	2.44	-1.94	-2.28

the respondents questions about their reliance on natural resources, the existence and functioning of institutions of natural resources governance, and their sense of their household's influence on the management of collectively managed natural resources. Relevant resources were defined as inundated pastures, dryland pastures, rainy season pastures, dry season reserve pastures, rainfed agricultural fields, water bodies where fishing is possible, and forest resources. We again find more complex patterns in the responses to this question, so we will elaborate some of different kinds of natural resources.

First, we considered overall access to resources. Figure 9 reports the average number of the natural resource types (identified above) that were used by households sorted by self-assessed resilience score.

The mean total number of natural resources identified are very consistent across groups; none of the means are significantly different (see Table 6). There is some hint at an inverted "U" shape, but it is not yet possible to clearly state whether there is a similar phenomenon to what we saw for community infrastructure and equipment, discussed above. On average households rely on around 3.5 of the seven categories of natural resources identified. This suggests that project interventions in the domain of improving natural resources and natural resource management could have a direct effect on many households.

However, this overall pattern may mask differences within the category of natural resources, as it may be that households rely on different kinds of natural resources. Further, there may be differences in the institutional setting, degree of input into this governance system.

The table below presents selected types of natural resources that illustrate some of the patterns observed in the data. We have focused on reliance on particular kinds of natural resources, the presence of a management system for that natural resource and the degree to which the respondent feels their household has input into how this resource is managed. For each resource listed in Table 7, the shaded row reports the percent of households by resilience category who reported that they relied on the particular resource. The next row illustrates the percentage of households that identified the existence of a management system for that resource. The last row reflects the respondent's perception of the degree to which they have input in decisions about this management system (1 = weak, 2 = average, and 3 = elevated).

The pattern for dryland pastures is similar to the inverted U shape for the community assets results presented above, though the mean percent of respondents reporting access to such resources is not significantly different across resilience categories. However, those with low self-assessed resilience (Group 1) were significantly

Figure 9: Average number of natural resources types that households relied upon (y-axis) sorted by self-assessed resilience category (x-axis)

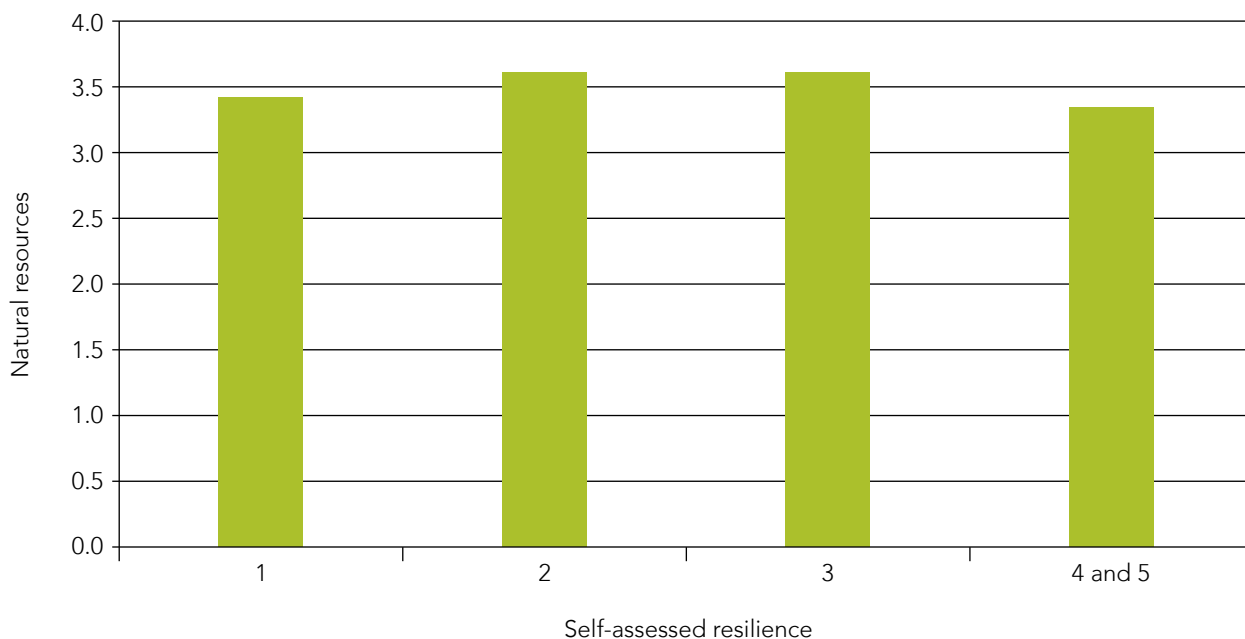


Table 7. Percentage of households reporting access to different kinds of natural resources; followed by the percentage of households with access who report that a management system exists for the specified type of natural resource and the degree to which they believe they have input into decisions about the management system (1 = weak, 2 = average, and 3 = elevated)

Resilience Self-Assessment Categories	1	2	3	4 and 5
Access to Natural Resources : Dry Pasture	54%	58%	60%	48%
Existence of Management System?	16%	52%	55%	68%
Degree of contribution?	1.43	1.49	1.85	2.12
Access to Natural Resources: Agricultural Land	96%	95%	96%	95%
Existence of Management System?	37%	66%	79%	69%
Degree of contribution?	1.46	1.70	1.70	1.96
Access to Natural Resources : Flooded pasture	22%	30%	29%	42%
Existence of Management System?	53%	81%	93%	88%
Degree of contribution?	1.38	1.33	1.38	1.39
Access to Natural Resources : Fishing waters	9%	11%	15%	40%
Existence of Management System?	100%	86%	69%	88%
Degree of contribution?	2.17	2.00	1.95	2.11

less likely to report that the resources they relied upon were accompanied by a functioning resource management system than those with higher self-assessed resilience (Groups 2, 3, and 4/5). Further insight is gained by contrasting household assessments (mean) of their degree of contribution to decisions made about managing this resource across resilience sub-groups. These are all significantly different, with higher resilience levels associated with greater involvement in management.

If we turn to the next natural resource of agricultural land we see a similar pattern in the data. Again, there is no statistically significant difference in the reliance on these resources, but there is a significant difference across resilience sub-groups in the frequency with which respondents reported the existence of a functioning management system and the degree to which respondents feel they contribute to the management of this resource.

These data suggest that the existence of a management system for shared resources and the household's contribution to decision-making about this system are positively associated with resilience. DCF efforts to support participatory management systems for natural resources and public goods investments could in this way potentially contribute to enhancing resilience.

In contrast, greater access to flooded pastures is associated with higher self-assessed resilience, significantly so for the highest group in contrast to the others. This is echoed in the findings for fishing areas. These results may reflect an important background for riverine communities, such as those in parts of both Kaffrine and Mopti. Riverine resources can offer critical sets of options to livelihood strategies that are not present in non-riverine settings; these results likely reflect the fact that people in communities with river access have more options to support themselves. When we consider the existence of management systems for inundated pastures, most comparisons across resilience groups are statistically significant. In contrast, none of the differences for degree of contribution to management are significant. Roughly the same pattern of significance holds for management and degree of contribution for

the fishing areas, though, in contrast to all other resource types, the presence of a functioning management system for fishing resources is most commonly reported by the least resilient sub-group. These data require further analysis.

We also asked respondents to identify any conflicts over these natural resources in the past year. With seven different natural resources identified in the questionnaire, the possible values for this index are zero (no conflict) up to 7 (conflict over each type of natural resource identified in the question). Notably, in some locations, respondents indicated there were multidimensional conflicts over sets of resources. For preliminary analysis, we simplified the indicator to a binary variable, where 0 represents no conflict and 1 represents resource-based conflicts of any kind. We find natural resource conflict of any kind incidence for group 1 = 7%, group 2=9%, group 3 = 14%, and group 4/5 =17%. The differences between group 4/5 and group 1 and group 2 are statistically significant at the 5% level. In Figure 10, we present a more elaborate average for the index, which allows for the possibility that households experienced more than one kind of conflict over the past year. The number on the y-axis is the average number of conflicts each household reported across the seven different kinds of natural resources in the past year, sorted by the resilience sub-group on the x-axis.

Intriguingly, the average number of conflicts is highest for the most resilient group. Further analysis of the spatial pattern of this data leads to a provocative implication. Households who experience more conflict are those who live in communities with sufficiently high-quality resources to support resilience – but also to merit contestation. Disproportionate to their weight in the sample, households who report high conflict are in sites with access to rivers. Generally, higher potential areas in the respective regions draw a convergence of different producer and ethnic groups, supporting diversity and reliability of livelihoods that underpin resilience, but also exposing users to resource-based conflicts. If this is the case, the association between resilience and the existence of functioning institutions for governance of shared resources, discussed above

Figure 10: Average number of natural resource conflicts (y-axis) per household for multiple natural resources, averages by resilience group (x-axis)

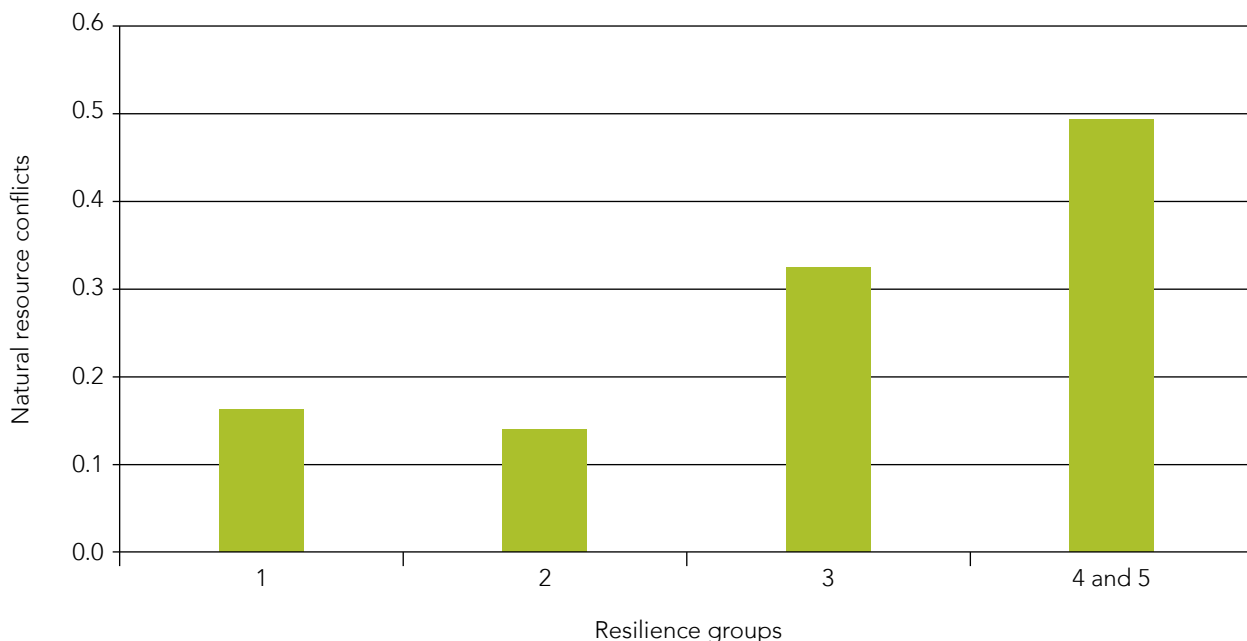


Table 8: t-test results for statistically significant differences in means use of and conflict over natural resources

	t stat number of natural resources	t stat number of natural resource conflicts
1 and 2	-0.84	0.20
1 and 3	-0.80	-1.28
1 and 4/5	0.30	-2.05
2 and 3	0.04	-2.39
2 and 4/5	1.58	-2.80
3 and 4/5	1.48	-1.20

and in Table 7, reflect both resource sustainability and conflict dimensions. Further data and analyses are needed to understand the dynamics at play here, but the existence of conflict and resilience may not be in opposition if institutions to manage conflict are in place.

We also investigated the number of different activities a household identified as part of their livelihood strategy. More resilient groups (with self-assessments of resilience at 4 or 5) had greater diversity in their livelihood activities (2.9 activities per household on average), compared to less

resilient households (self-assessed resilience of 1, 2, or 3), who reported significantly fewer activities (2.4 – 2.5 activities per household on average). There is no significant difference among the first three groups. We hope to further explore this interesting finding in further research.

Finally, we asked respondents about their degree of involvement in community decision making. The DCF project at times uses participatory methods to support communities to deliberate over resilience needs and to build capacities to prioritize, implement and manage public good

resilience investments. As such, it is important to have a sense of how involved people felt before the project began. We first asked respondents about their level of information on the role and activities in development efforts in their community. We then asked specific questions on the extent to which they were involved in development activities related to: information, participation, budgeting, and monitoring and evaluation. Responses were given on a 5-point scale, where 1 = non-existent, 3 = average, and 5 = very good.

Self-assessed resilience is clearly correlated with the degree to which people feel they are involved in community-level activities and decision-making. Across the spectrum of dimensions of involvement in community activities, increased resilience is matched by an increase in the sense of being involved. Here again, it is not possible to attribute causation – e.g., whether involvement leads to greater resilience, or whether involvement is a proxy for other attributes, such as wealth or social status, that are likely to support resilience as well as enhance involvement in community matters.

Figure 11: Degree of involvement in community development activities (y-axis) grouped by self-scored resilience on 1-5 scale (x-axis)

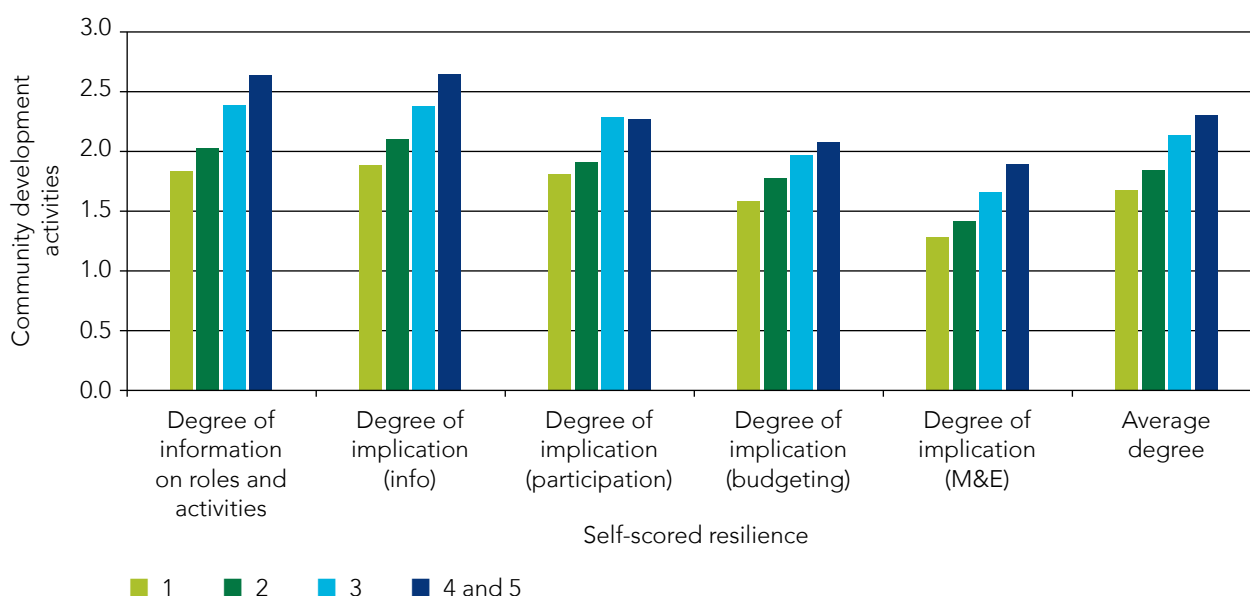


Table 9: t-test results for statistically significant differences in means for degree of involvement in community development activities

	Degree of information on roles and activities	Information	Participation	Budgeting	M&E	Average overall degree of implication
1 and 2	-1.438	-1.529	-0.729	-1.276	-1.116	-1.438
1 and 3	-3.941	-3.336	-2.991	-2.366	-3.141	-3.659
1 and 4/5	-4.493	-3.989	-2.278	-2.241	-3.480	-3.679
2 and 3	-3.784	-2.605	-3.241	-1.555	-2.672	-3.147
2 and 4/5	-4.184	-3.392	-2.086	-1.539	-3.071	-3.111
3 and 4/5	-1.625	-1.611	0.085	-0.497	-1.375	-1.082

4.2.2 Multivariate Analysis

As illustrated above, there are many correlates to self-assessed resilience rankings. It is possible that the correlates are themselves correlated, leading to the question of what is the independent impact of each of them on the resilience score. To control for these effects, we can turn to multiple regression. We can attempt to identify the impact of variation in a set of the measures identified above on the outcome of interest, the household's resilience self-assessment. As a contrast, we will present the resilience regression results next to results from a regression of the food security indicator (number of months of food security) on the same set of regressors used in the resilience regression.

Regression is conducted using Ordinary Least Squares regression. The constant is omitted to allow each site to have a dummy variable. Regressions were also conducted using Poisson and Negative Binomial models and generated qualitatively similar results to the OLS results. For the access questions that differ by rainy season and dry season we take the average of the seasonal values to compute average access to managed productive areas, community infrastructure, markets, public services, inputs, and financial services.

Geographical variables figure heavily into these results. For the most part, the dummy variables indicating which site the household is in are statistically significant; there are clearly covariate community level elements to both resilience self-assessments and food security.

However, there are other outcomes that are of interest to our understanding of resilience and food security.

- Household size is positively related to food security, perhaps indicating an issue of a labor constraint among smaller households. Note that household size is not significantly related to resilience ranking, though in the data set, households self-assessing resilience as 1 (mean household size of 4) are significantly smaller than households self-assessing 2 to 5 (mean household sizes around 6).
- The households that listed livestock as their primary livelihood activity are both significantly less resilient and have lower food security. This may indicate the long term process of cultivation expansion at the expense of livestock production, with access to pastoral resources becoming increasingly threatened.
- The number of livelihood activities a household undertakes has a positive relationship with both food security and resilience, potentially reflecting mitigation of risks through livelihood diversification and suggesting different dimensions related to household size and the ability to diversify labor.
- The number of shocks experienced by a household has a negative impact on both resilience and food security.
- Access to community managed production areas is positively related to both resilience and food security. This is important for us to understand as there appears to be some differential access to community managed production zones.
- There is a significant relationship between financial service access for both dependent variables.
- There is a significant positive relationship between infrastructure and food security.
- Contrary to original expectations, food security is positively associated with natural resource conflict which merits further examination.
- Finally, people who feel they are more involved with community-level development activities rank their resilience higher than those who feel less involved.
- Some of the variables for access to shared items (markets, public services, infrastructure) are not significant. We will explore this further in panel analysis when we are able to investigate how possible change in the access levels for a household impacts a change in their resilience and food security assessment.
- As a tentative first step, these preliminary analyses of cross-sectional data provide some information on what variables are related to resilience and food security in the study area and indicate our monitoring and evaluation design has the potential to be informative as we continue to interact with these communities.

Table 10: OLS Regression results for Resilience Self-Assessment and Household Food Security

	Resilience			Food Security		
	Beta	St. Error	Sig.	Beta	St. Error	Sig.
Douentza	0.7636	0.3428	**	0.0309	1.0701	
Koro	1.2548	0.3613	***	3.4975	1.1277	***
Mopti	1.1115	0.3635	***	1.4427	1.1346	
Kaffrine	1.0114	0.3458	***	3.6755	1.0793	***
Koungheul	1.1609	0.3294	***	5.4294	1.0283	***
Malem Hodar	1.4182	0.3320	***	4.3576	1.0362	***
Mbirkelane	1.3581	0.3461	***	2.0181	1.0804	*
Gender of Head of Household	0.1338	0.1457		-0.4158	0.4548	
Household size	0.0110	0.0119		0.1529	0.0372	***
Average age HH members	-0.0034	0.0038		-0.0030	0.0118	
Cultivation first	0.1297	0.1192		0.0896	0.3721	
Elevage first	-0.2731	0.1518	*	-0.8913	0.4740	*
Number of activities	0.1700	0.0393	***	0.5505	0.1227	***
Number of shocks	-0.1190	0.0334	***	-0.4617	0.1043	***
Forecast information	0.1660	0.0862	*	0.3543	0.2690	
Access managed productive areas	0.1247	0.0378	***	0.3890	0.1180	***
Access markets	0.0044	0.0512		0.0226	0.1598	
Access public services	0.0045	0.0522		0.1941	0.1629	
Access inputs	-0.0518	0.0427		0.1925	0.1334	
Access financial services	0.1047	0.0279	***	0.1568	0.0871	*
Number of community infrastructure	-0.0112	0.0229		0.2540	0.0716	***
Access infrastructure	0.0111	0.0489		0.1233	0.1527	
Number of natural resources	0.0310	0.0309		-0.0446	0.0964	
Natural resource conflicts	0.0562	0.0438		0.2978	0.1367	**
Average implication development	0.1268	0.0360	***	0.1192	0.1124	
R ²	0.92			0.92		

Is significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level.

Conclusion

Based on these preliminary analyses, patterns in our baseline data support the utility of many of the measurable variables suggested by the KPI4 guidelines as dimensions of resilience. We look forward to investigating how patterns seen in the cross sectional analysis will carry through to future longitudinal analysis. Endline surveys were fielded in November 2017 and are currently under analysis to further explore many of the issues raised in this report.

The correspondence between food security measures (a KPI4 variable) and resilience self-assessment indicates both the food security component and the larger resilience measures capture important elements of well-being. Similarly, livelihood diversity appears to be important; as noted in the regression results, the number of activities identified by the household was positively related to both resilience and food security.

The survey findings offer important observations for the DCF Project. The correspondence between access to public services and the resilience measures for the most part support the DCF objective of investing in public goods. It will be useful to develop our understanding of why the least resilient have more problems with access in the dry season; but it otherwise appears from these data that public services largely meet the non-exclusion condition of the public good definition. This stands in some contrast to the findings for access to inputs and in clear contrast with access to financial services. For these latter categories, it appears that the most resilient groups enjoy greater access than less resilient groups.

Both access to community managed productive areas and a household's degree of involvement in development activities seem to be linked to their resilience—and these findings are important for the DCF Project to keep in mind going forward. The finding that access to and use of community managed productive areas may vary across groups calls for us to pay attention to whether all members of the community can, in fact, access investments in community infrastructure that are conceived of as a public good.

Similarly – and perhaps unsurprisingly – baseline data reveal that some groups in the community feel they have more input into community decision making. Community engagement is integral to the DCF mechanism, and it will be interesting to evaluate this result with panel data collected after project implementation. In any case, this preliminary finding underscores that the project must ensure that processes and institutions established by the mechanism are truly accessible to all groups in the community.

Given the heavy reliance on natural resources in the project area, the DCF Project's investments in improving resource management seem well placed. Importantly, there appears to be a correlation between resilience and both the existence of a functioning management system for shared resources and the ability of the respondent to influence decisions taken by that management system. However, the varied access to and involvement in natural resources management decision-making reported by community members – particularly those who may be more vulnerable to climate shocks and extremes – is important to bear

mind when designing public goods investments in natural resource management.

These preliminary analyses also indicate a number of key points for follow-on investigation. These include:

- The gender difference in resilience self-assessments. We found that women's assessments of household resilience were lower than men's in the same household. However, in the regression analysis, the gender variable was not a significant. Some qualitative follow-up work could help develop our understanding of this result.
- Qualitative analyses may also be useful to develop insight into why those who focus on livestock as their primary economic activity feel less resilient than those who primarily focus on cultivation.
- Survey data show that experiencing shocks of various kinds are associated with a lower assessment of resilience. But it is unclear whether self-assessed resilience is associated with greater abilities to adapt to or avoid shocks or whether the "more resilient" households simply had not been exposed to certain risks. We anticipate being able to further develop insights into the meaning of this result as we move from cross sectional analysis to panel analysis.
- Access to information corresponds to self-assessed resilience, but we are unable to discern what drives this result. If better access to climate or market information can directly increase resilience, this supports an important message for development actors and governments

regarding extension of information. In contrast, if it is mainly those who possess other attributes associated with resilience (e.g., wealth, education, etc.) who are able to access and act on information to make decisions, then information alone might not be sufficient to enhance resilience among vulnerable populations.

- Finally, the natural resource conflict findings are at some level unexpected, but may be partially explainable by differences across sites and livelihood strategies noted above and beyond the measures used in the regression analysis. Individuals who experienced greater conflict appear to be those who are more resilient. This may suggest that they have more resources to contest or live in areas with varied resources that support both diversified livelihoods (correlated with resilience) and also that draw different producers and ethnic groups (who may compete for resources). Additional spatial analyses of these results and qualitative analyses would help elucidate this pattern.

Overall, our use of the KPI4 guidelines in developing our monitoring and evaluation strategy appears to be on the right track for our program objectives. Further, analysis of these data has led to some subtle and nuanced insights into different dimensions of resilience – and also indicated a number of areas for follow-up investigation. These findings will be helpful in future project activities, supporting both Project staff and community actors to be more fully aware of different dimensions of resilience, variability across different types of households, and how these aspects may impact the success of resilience investments.

References

Barrett, CB and M Constan (2014) "Towards a theory of resilience for international development applications.: *PNAS*. 111(40): 14625-30.

Barrett, CB and P Santos (2014) "The Impact of Changing Rainfall Variability on Resource Dependent Wealth Dynamics" *Ecological Economics* 105: 48-54.

Cisse, J and CB Barrett (2016) Estimating Development Resilience: a conditional moments-based approach. African Development Bank Group, Working Paper Number 236.

DfID (2011). Defining disaster resilience: A DfID approach paper. www.gov.uk.

DfID (2014). Methodology for reporting against KPI4 – number of people whose resilience has been improved as a result of project support. www.gov.uk.

McPeak, J. and P.D. Little (2017). "Applying the Concept of Resilience to Pastoral Household Data." *Pastoralism*.7:14

McPeak, J., P.D. Little, C. Doss. 2012. *Risk and Change in an African Rural Economy*. Routledge.

USAID (2012) Building Resilience to Recurrent Crisis. USAID: Washington

USAID (2015) *Market Systems for Resilience*. LEO report #6. USAID: Washington

World Bank (2013)"Concept Paper on the Economics of Resilience in the Drylands of Sub-Saharan Africa"

Organisations



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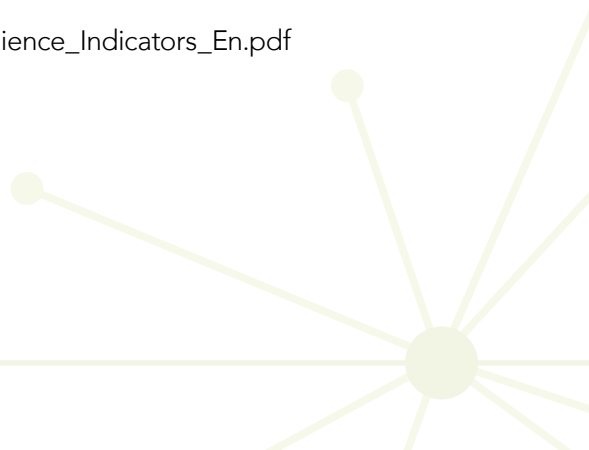
Published by Near East Foundation, December 2017

McPeak, J and Abdella, J (2017). Self-Assessed Resilience and its Correlation to Specific Indicators. NEF, New York.

www.near-east.org/download/materials_center/WorkingPaper_SA_Resilience_Indicators_En.pdf

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