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DIFFERENTIATED GEOGRAPHY OF INSECURITY-RELATED AGRICULTURAL LOSSES IN ATACORA, ALIBORI AND BORGOU (NORTHERN BENIN)

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ABSTRACT

Armed violence spreading from the Sahel since 2021 has reached the farming systems of northern Benin, but we know little about where agricultural losses are heaviest and why. This study measures them at household level in three departments. A multisectoral survey interviewed 350 households in Alibori (116), Atacora (110) and Borgou (124) between 29 August and 4 September 2026: hosts, internally displaced persons (IDPs) and refugees. Fourteen binary indicators covering production, land, productive capital and markets were averaged into an agricultural loss index (ALI) running from 0 to 1. The index is 0.413 in Borgou, against 0.297 in Alibori and 0.297 in Atacora, and the average household reports 4.6 of the 14 losses. The gap is driven by land dispossession (45% of households in Borgou, 12% in Atacora and 7% in Alibori), by fields destroyed during violence and by productive assets lost. The share of households with an index above 0.5 is 35.5% in Borgou against 6.9% in Alibori and 10.0% in Atacora ($\chi^2 = 40.1$, $p < 0.001$). Market disruption is more evenly spread. Within departments, Kalalé stands out, and mean ALI is higher for refugees (0.383) than for hosts (0.288). A Kitagawa decomposition shows that 91% of the Borgou–Alibori gap comes from differences within status groups and only 9% from the mix of statuses. Territory matters more than the legal situation of the household. Responses should therefore be designed by commune and by type of loss: land security in Kalalé, livestock and equipment replacement, and market support in the departments where it is the main loss.

Keywords: Agricultural Losses; Insecurity; Geography of Conflict; Land Dispossession; Northern Benin; Displacement

1 INTRODUCTION

Since 2021 the northern departments of Benin have been drawn into the expansion of armed groups from the Sahel towards the coastal states [1,2]. Attacks on defence forces and civilians, kidnappings, explosive devices and cattle theft are concentrated along the borders with Burkina Faso, Niger and Nigeria and around the Pendjari and W protected areas [3]. Displacement tracking recorded 42,409 IDPs in the north in March 2026, and refugees and asylum seekers

from Burkina Faso, Niger and Togo have also settled in the three departments [4]. The people affected are mostly farmers and herders, so the damage falls on food crops, cotton, livestock and the markets that sell them.

The literature on conflict and agriculture shows that violence cuts output through several routes: destruction of crops and assets, loss of access to land, and disruption of markets and inputs [5,6]. Insurgent attacks have also been tied to higher food insecurity [7], and household resilience falls after exposure to violence [8]. What these studies rarely give is a geography. Losses are not spread evenly across a region at war, and the places where they pile up are rarely the places that make the headlines. In northern Benin the three departments have different farming systems, different border contexts and different types of displaced populations, and one would expect them to be hit differently.

This paper describes that geography. It asks three questions. How large are agricultural losses in each department, and what are they made of? How do they vary between communes and with distance from the border? How much of the gap between departments reflects who lives there (hosts, IDPs or refugees) and how much reflects place? We expect territory to matter more than status.

2 MATERIAL AND METHODS

2.1 Study area

The study covers the departments of Alibori, Atacora and Borgou (Figure 1). Alibori (cotton, maize, cattle) borders Niger and Nigeria and contains the W National Park. Atacora (food crops, shea, cattle) borders Burkina Faso and Togo and contains the Pendjari National Park. Borgou is a larger and more central department, and its commune of Kalalé borders Nigeria and Niger and hosts large refugee settlements. Thirteen communes were reached by the survey; their sample sizes are very unequal, from 2 households in Coby and Péhunco to 124 in Kalalé and 81 in Matéri.

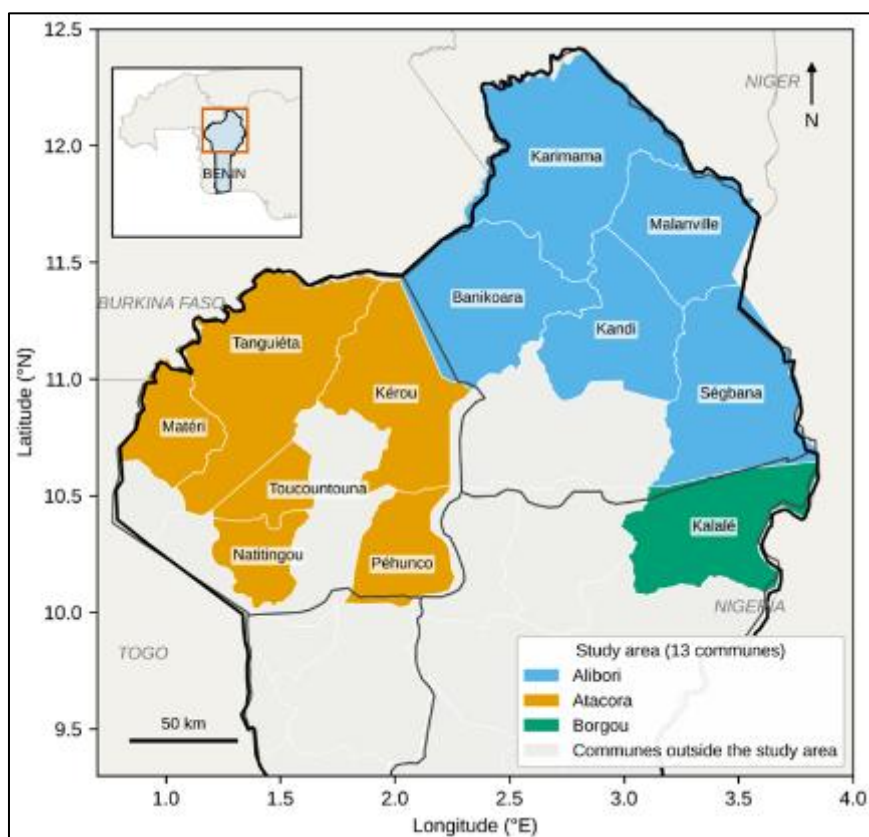


Figure 1: Study area: departments of Alibori, Atacora and Borgou and surveyed communes. Boundaries: geoBoundaries [9].

2.2 Data

Data come from the multisectoral needs assessment of the Benin Red Cross [4]. A KoboCollect questionnaire covering demography, displacement, shelter, food security, livelihoods, livestock and protection was administered to household heads or their representatives with informed consent. The sample has 350 households, shared among the departments in proportion to the number of people affected: 116 in Alibori, 110 in Atacora and 124 in Borgou. Status was recorded

in three groups (Table 1). The margin of error on a proportion of 0.5 is about ± 5.2 points for the whole sample and between ± 8.9 and ± 9.3 for each department.

Table 1: Sample by department and household status, n (%)

Group	Alibori	Atacora	Borgou	All
Host families	50 (43.1)	42 (38.2)	45 (36.3)	137 (39.1)
Internally displaced persons	36 (31.0)	23 (20.9)	31 (25.0)	90 (25.7)
Refugees and asylum seekers	30 (25.9)	45 (40.9)	48 (38.7)	123 (35.1)
Farming households	76 (65.5)	77 (70.0)	103 (83.1)	256 (73.1)
Georeferenced households	61 (52.6)	68 (61.8)	104 (83.9)	233 (66.6)
Total households	116	110	124	350

Source: household survey, Benin Red Cross, 2026. Georeferenced households are those whose location was recorded and could be mapped, which is the basis of the distance analysis.

2.3 Agricultural loss index

Fourteen binary indicators were grouped into four dimensions: production losses (crops destroyed, cash crops destroyed, fields destroyed during violence), land losses (loss of access to farmland, dispossession, access hindered by insecurity), productive capital losses (livestock stolen or killed, livestock dispossessed, equipment destroyed, means of production destroyed or dispossessed) and market and input disruption (markets stopped, rising prices, harder access, access to inputs hindered). The value of each dimension is the share of its indicators reported by a household or group, and the ALI is the unweighted mean of the four dimensions:

$$ALI_g = (1/4) \sum_{d=1}^4 [(1/k_d) \sum_j p_{gj}] \quad (1)$$

where p_{gj} is the proportion of households in group g (department, commune, status or distance class) reporting loss j , and k_d is the number of indicators in dimension d . The index goes from 0 (no loss reported) to 1 (all losses reported by all households). Households with an index above 0.5 are called high-loss households.

2.4 Statistical analysis

Differences between departments were tested with Pearson's χ^2 test on the 3×2 table of each indicator. When an expected count fell below 5, the p value was obtained by a Monte-Carlo permutation test with 20,000 draws. To separate the effect of status composition from the effect of place, the difference in mean ALI between two departments was decomposed following Kitagawa [10]:

$$ALI_A - ALI_B = \sum_s (w_{As} - w_{Bs}) \cdot (ALI_{As} + ALI_{Bs})/2 + \sum_s (ALI_{As} - ALI_{Bs}) \cdot (w_{As} + w_{Bs})/2 \quad (2)$$

where w_{As} is the share of status s in department A . The first term is the composition component, the second the rate component. Computations were done in Python (pandas, SciPy). Mean ALI values by status and distance class are taken from the grouped survey summaries, so inference on them is limited to these decompositions and to descriptive comparison.

3 RESULTS AND DISCUSSION

3.1 Scale and composition of losses

Households report on average 4.6 of the 14 losses, and the ALI is 0.338 for the whole sample. Borgou stands apart at 0.413, against 0.297 in Alibori and 0.297 in Atacora, which are identical to the third decimal. The share of high-loss households (ALI above 0.5) is 44 of 124 in Borgou (35.5%), against 11 of 110 in Atacora (10.0%) and 8 of 116 in Alibori (6.9%); the difference is highly significant ($\chi^2 = 40.1$, $df = 2$, $p < 0.001$).

Table 2: Agricultural loss indicators (% of households) and dimension scores (0–1) by department

Indicator	Alibori (n = 116)	Atacora (n = 110)	Borgou (n = 124)	p
PRODUCTION LOSSES	0.302	0.352	0.465	–
Food crops destroyed or damaged	34.5	40.0	41.9	0.475 ns
Cash crops destroyed or damaged	34.5	39.1	43.5	0.356 ns
Fields destroyed during violence	21.6	26.4	54.0	< 0.001 ***
LAND LOSSES	0.351	0.361	0.524	–
Loss of access to farmland	47.4	42.7	51.6	0.397 ns
Land dispossessed	6.9	11.8	45.2	< 0.001 ***
Access to land hindered by insecurity	50.9	53.6	60.5	0.303 ns
PRODUCTIVE CAPITAL LOSSES	0.144	0.123	0.278	–
Livestock stolen or killed	22.4	23.6	46.0	< 0.001 ***
Livestock dispossessed	1.7	1.8	6.5	0.069 ns
Farm or fishing equipment destroyed	20.7	9.1	14.5	0.049 *
Means of production destroyed or dispossessed	12.9	14.5	44.4	< 0.001 ***
MARKET AND INPUT DISRUPTION	0.390	0.355	0.383	–
Markets stopped functioning	32.8	42.7	53.2	0.006 **
Rising market prices	56.0	39.1	47.6	0.039 *
Harder access to markets	22.4	15.5	15.3	0.269 ns
Access to inputs or markets hindered by insecurity	44.8	44.5	37.1	0.387 ns
ALI	0.297	0.297	0.413	–

p: Pearson χ^2 test (3 × 2); permutation test for livestock dispossessed (expected count < 5). *** p < 0.001; ** p < 0.01; * p < 0.05; ns: not significant. Dimension rows give the mean of the indicators of the dimension. Source: household survey, Benin Red Cross, 2026.

Table 2 and Figure 2 show what the losses are made of. Land is the heaviest dimension everywhere (0.415 overall), followed by production (0.375) and market disruption (0.376). Productive capital losses are the lightest (0.185). The department differences come from specific indicators. Land dispossession is 45% in Borgou, 12% in Atacora and 7% in Alibori; fields destroyed during violence reach 54% in Borgou against 26% and 22%; and livestock stolen or killed affects 46% of households in Borgou against 22% in the other two. Means of production destroyed or dispossessed follow the same pattern (44% against 15% and 13%). All four differences are significant at p < 0.001. In contrast, crop destruction, loss of access to farmland and land access hindered by insecurity do not differ significantly between departments: about half of all households lose access to land and 55% say insecurity hinders it, wherever they live.

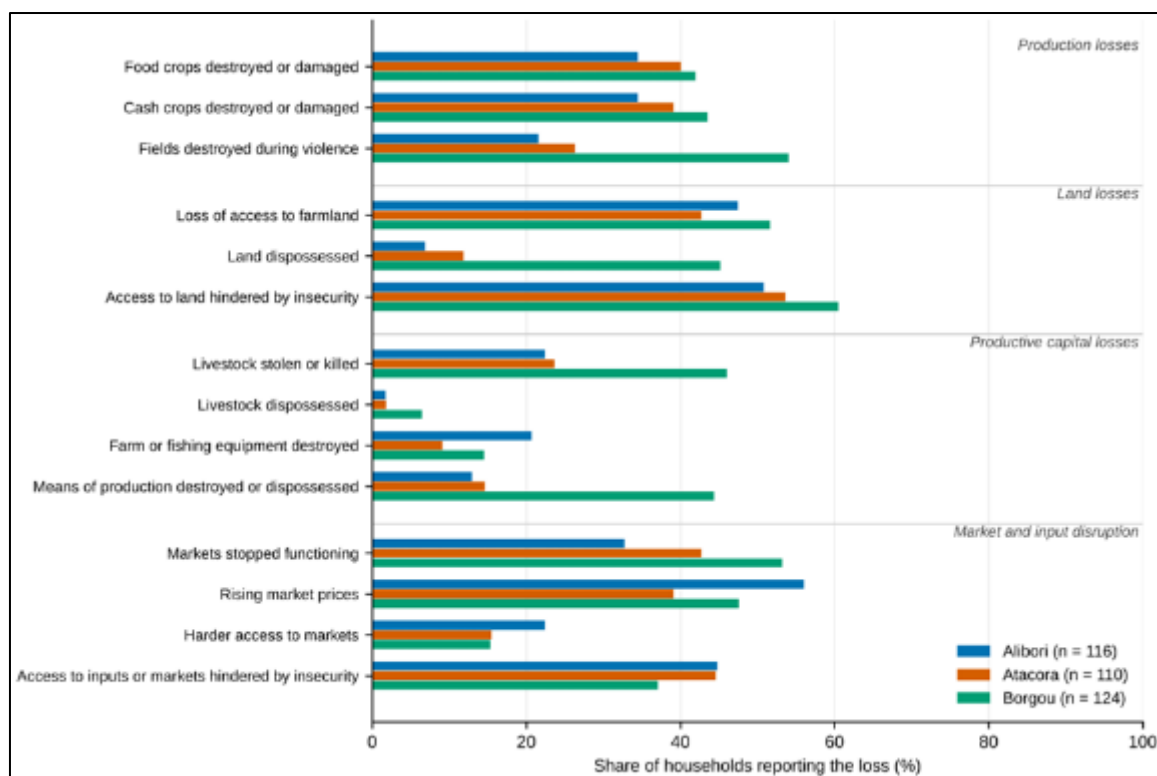


Figure 2: Share of households reporting each loss, by department.

Market disruption is different. Markets stopped functioning more often in Borgou (53%) and Atacora (43%) than in Alibori (33%, $p = 0.006$), while rising prices were reported most in Alibori (56% against 39% and 48%, $p = 0.039$). Alibori also has the highest rate of equipment destruction (21% against 9% in Atacora, $p = 0.049$), which fits with a cotton basin where inputs and tools are a visible target. Market and input disruption is the dimension on which the departments are closest (0.390, 0.355 and 0.383), which suggests a regional effect of border closures and general insecurity rather than local violence. This agrees with reports from Nigeria, where insurgency raised food insecurity mostly through market and access channels [7].

3.2 A commune effect inside the departments

Figure 3 gives the ALI and its dimensions for the thirteen communes. Kalalé (Borgou) has the highest index (0.413) and is also the largest subsample (124 households). Cobly (0.409) and Kérou (0.371) in Atacora follow, then Karimama, Ségbana, Banikoara and Tanguiéta at 0.31 to 0.33. Matéri (0.292) and Malanville (0.280) are close to the national average, and Kandi (0.095), Toucountouna (0.163) and Natitingou (0.240) are the least affected. Communes with fewer than 10 households in the sample (Cobly, Péhunco, Natitingou, Tanguiéta, Toucountouna, Kandi) are marked on the figure and were not interpreted: their values only show that the survey touched them.

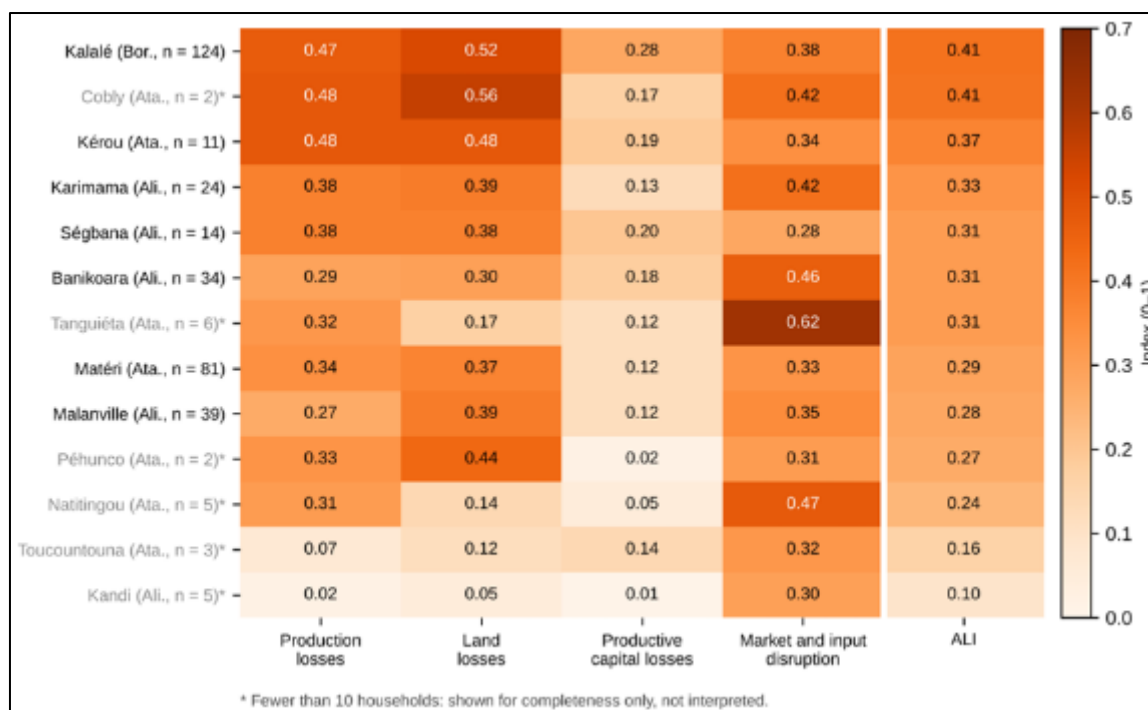


Figure 3: Agricultural loss index and its dimensions by commune (n = households; * fewer than 10 households).

Two points are worth making. First, the commune ranking cuts across the department ranking: Banikoara and Karimama in Alibori score higher than Matéri in Atacora, and Kérou in Atacora scores well above the Alibori communes. The department average hides this variation. Second, the communes at the top combine high land losses (0.52 in Kalalé, 0.56 in Cobly) with high production losses (0.47 and 0.48), and Kalalé is the only one that combines them with high capital losses (0.28). Banikoara has the highest market score (0.46) among the larger subsamples, in line with its place in the cotton chain. The communes with larger samples (Kalalé, Matéri, Banikoara, Malanville) are the only ones for which these figures are reasonably stable at this sample size. Qualitative work from the same assessment points to the same places: herders in Kalalé describe seasonal conflicts that turn into land seizures, and key informants in Alibori mention cattle theft along the Niger and Nigeria borders [11,12].

3.3 Distance to the border

Households were grouped by their distance to the nearest international border (Figure 4). In the whole sample the ALI is 0.314 within 10 km, rises to 0.382 at 10 to 25 km, is 0.362 at 25 to 50 km and drops to 0.271 beyond 50 km. The relationship is therefore not monotone: the first 10 km are not the worst. The profile differs by department. In Alibori, the index grows slowly from 0.298 to 0.327 over the first 50 km and falls to 0.191 beyond. In Atacora it is almost flat (0.264 to 0.300). In Borgou it peaks at 10 to 25 km (0.508) and is still 0.400 at 25 to 50 km, and there are no households beyond 50 km. The Borgou peak is the one that matters: it probably reflects the weight of Kalalé in the Borgou sample. Distance classes carry no sample sizes in the grouped summaries and the curves are descriptive.

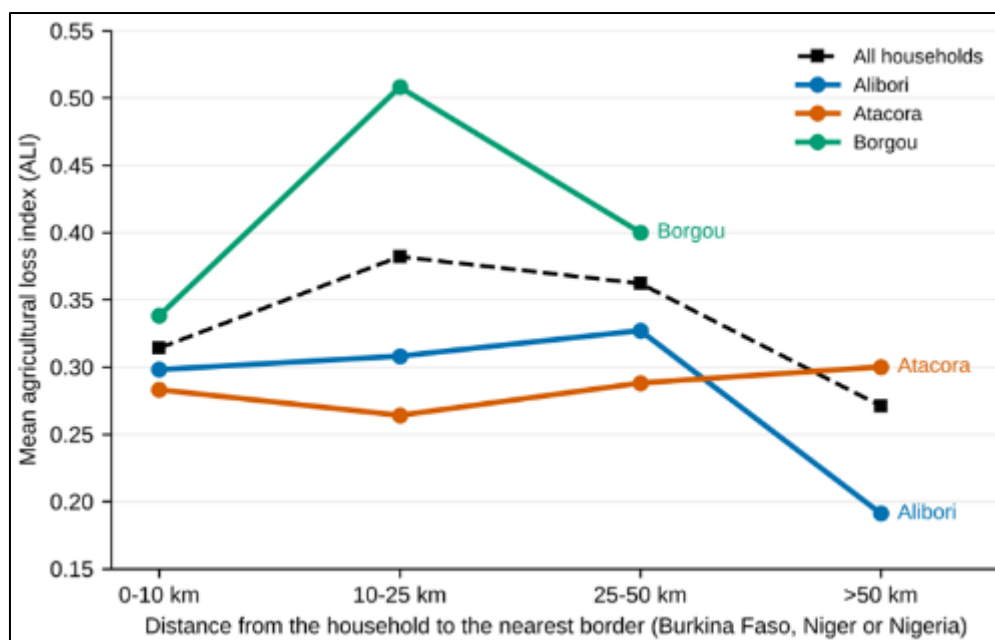


Figure 4: Mean agricultural loss index by distance to the nearest border and department.

3.4 Status and place

Mean ALI rises from hosts (0.288) to IDPs (0.352) and refugees and asylum seekers (0.383). Figure 5 shows that the gradient holds in Borgou (0.313 for hosts, 0.427 for IDPs, 0.496 for refugees) but is much flatter in Alibori (0.275 to 0.323) and Atacora (0.278 to 0.320). The refugee figure for Borgou is the highest of all nine department-status cells. A refugee household in Borgou has a much higher index than one in Alibori, and a host household in Borgou (0.313) has a loss index close to a refugee household in the other departments.

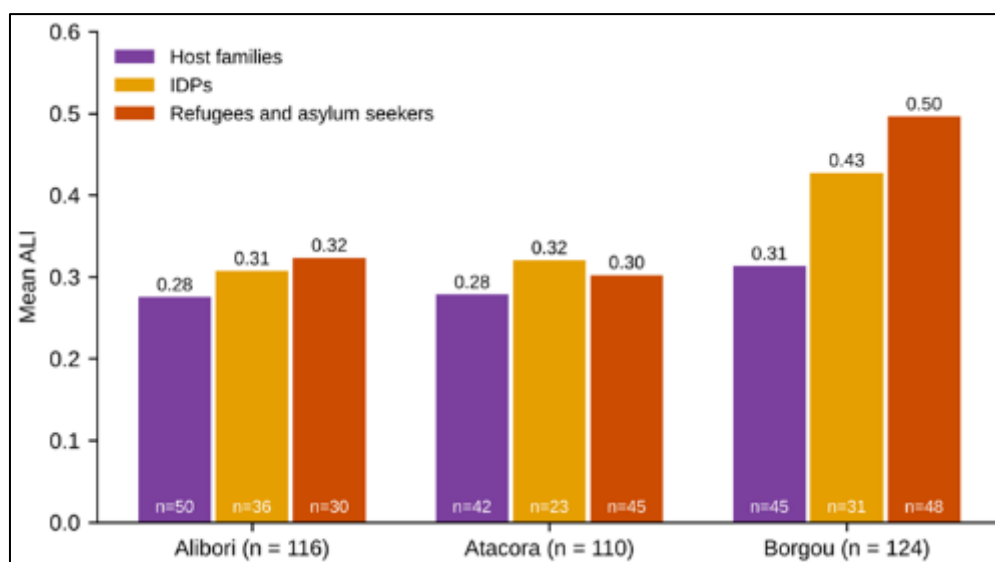


Figure 5: Mean agricultural loss index by department and household status (n = households).

The Kitagawa decomposition (Table 3) quantifies this. Borgou's ALI is 0.115 above Alibori's and 0.116 above Atacora's. In both comparisons the composition term is very small (0.010 and 0.001): Borgou does not stand out because it hosts more refugees. Almost all the difference (0.105 and 0.115) is a rate effect, meaning that households of the same status lose more in Borgou. Status explains little of the geography. Refugees are indeed worse off than hosts everywhere, which fits findings on displaced populations elsewhere [13], but the place where a household lives sets the size of its losses more than the status it holds.

Table 3: Kitagawa decomposition of the difference in mean ALI between departments

Comparison	Difference	Composition	% of difference	Rate	% of difference
Borgou vs Alibori	0.115	0.010	9.1	0.105	90.9
Borgou vs Atacora	0.116	0.001	0.8	0.115	99.2

Composition: effect of the status mix (hosts, IDPs, refugees). Rate: effect of differences in ALI within status groups. Source: authors' calculations from the survey summaries.

3.5 Mechanisms

The pattern of losses points to different mechanisms. Land dispossession, destruction of fields and loss of means of production, which are concentrated in Borgou, involve a transfer of rights or a deliberate act against an identifiable owner, and fit the accounts of seasonal and communal conflicts in Kalalé gathered in the focus groups [11]. Livestock theft is the clearest case of an armed-group economy, and it is also the form of loss that falls most on herders of Alibori and Atacora who live near the parks. Market effects are common to the three departments. Rising prices and closed markets follow from border restrictions and from the cost of moving goods, and they reach households that never saw an attack. Land access hindered by insecurity (55% overall) and loss of access to farmland (47%) sit in between: they are widespread, probably because fear and military restrictions keep farmers out of border fields, and they are not specific to any department.

3.6 Implications

Three implications follow. First, aid planned by department would miss the contrasts that matter. Kalalé would need land-rights mediation and security of tenure, with restitution of seized plots where this is possible. Second, replacement of livestock and equipment, and protection of herding routes, should be tied to the communes where theft and destruction are reported. Third, market measures (price monitoring, safe transport, input credit) fit all three departments and could be run at regional scale. Targeting by status alone would not help, since the status of a household accounts for very little of the geography of its losses.

Limitations

Four limits apply. The sample is modest (350 households), so department estimates carry margins of about ± 9 points and commune subsamples go down to 2 households; commune results are descriptive and the small ones are not interpreted. The indicators are binary, equally weighted and self-reported, and the index does not measure the value of losses. Mean ALI by status and by distance class come from grouped summaries, so tests of difference between those groups were not run. Finally, the survey is cross-sectional and cannot separate losses caused by armed groups from those caused by other conflicts or by climate shocks.

4 CONCLUSION

Agricultural losses linked to insecurity in northern Benin are not spread evenly. Borgou, and within it the commune of Kalalé, stands out through land dispossession, destroyed fields and lost productive capital, with an ALI of 0.413 against about 0.297 in Alibori and Atacora and 35% of households above 0.5. Market disruption is the common thread across the three departments. Differences in the status mix hardly explain the gap, since 91% of it comes from differences within status groups. Place matters more than status. Agricultural recovery and protection programmes should therefore be planned by commune and by type of loss, with land security as the priority in Borgou. Future work should use microdata to model the determinants of loss with regression, map hotspots at finer scale, and follow the same households over time.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

We, the authors, declare that we have no conflicts of interest.

Statement of informed consent

Informed consent was obtained from all respondents prior to the interviews.

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