**Lack of crucial information exacerbates barriers to mitigating human–﻿elephant conflicts in rural Kenya**

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Supplementary Material 1 Survey distributed to 206 respondents in six villages in the Kasigau Wildlife Corridor, Kenya.

Community Survey

# Farming

How many acres do you currently use for crop farming?

Have you had any formal farming educational training (other than family)?

◯ Yes

◯ No

If yes, what type of training?

How many years have you been farming?

What types of crops do you plant? (Check all that apply)

* Maize (Mahindi)
* Green Grams (Pojo)
* Cow Peas (Kunde)
* Ground Nuts (Njugu)
* Sorghum (Mtama)
* Other (please specify)
* Other (please specify)

Are you interested in planting diﬀerent types of crops that what you normally plant?

◯ Yes

◯ No

◯ Unsure

 If yes, what types of plants are you interested in planting?

 What do you feel is the main reason for your crop losses? (Please choose one)

◯ Drought

◯ Elephants

◯ Other wildlife

◯ Pests (wadudu)

◯ Disease

◯ Bad seeds

◯ Other (please specify)

How many acres do you believe are lost?

Do you irrigate your crops in some way?

◯ Yes

◯ No

If yes, what type of irrigation do you use?

How often does drought aﬀect your harvest per season? (Select one)

* Never
* Sometimes
* Every Season
* I Don’t Know

If you had other ways to earn money, would you still continue to farm? (Select One)

* Definitely Not
* Maybe Not
* I Don't Know
* Possibly So
* Definitely

Would you be interested in planting rough lemon as a way to earn income?

◯ Yes

◯ No

◯ Unsure

Crop Raiding

Do animals crop raid your farm(s)? (Check One)

* Often
* Sometimes
* Never
* I don't know

If yes, please list the animal(s) that come to your farm

Which animal do you believe comes to your farm the most often?

How many acres of your crops do you believe elephants normally damage in a typical season?

During a good harvest season (crops are present), how many times per week do elephants visit your farm?

Do elephants visit your farm during the day?

◯ Yes

◯ No

◯ Sometimes

Have you ever actively chased elephants from your farm?

◯ Yes

◯ No

If you have actively chased elephants, did you use any tools? For example, were you waving a torch or making noise or something else?

If yes, how many times per week do you chase elephants away during the height of the crop raiding season?

Have you ever harmed or attempted to harm elephants when they came to your farm? (These answers will NOT be shared with authorities)

◯ Never

◯ Once

◯ Several Times

◯ Regularly

◯ All the Time

 Do you use methods to prevent crop raiding by wildlife on your farm?

◯ Yes

◯ No

If yes, what type methods do you use?

Have you ever received information on methods to prevent crop raiding?

◯ Yes

◯ No

If yes, what type of information on methods to prevent crop raiding?

Have you ever received instructions on how to build deterrent fences?

◯ Yes

◯ No

If yes, what types of deterrent(s)?

If you were given information about ways to prevent crop raiding how likely is it you would be able to invest in and build deterrent methods?

* I would definitely be able build deterrent methods
* I would possibly be able to build deterrent methods
* I am unsure if I would be able to build deterrent methods
* I would definitely not build deterrent methods

If no, please tell us why would you not be able to purchase or construct deterrent methods.

Have you ever tried to contact authorities about elephants or other wildlife on your farm?

◯ Once

◯ 1-2 times

◯ 3+ times

◯ No

If yes, who did you attempt to contact? (List All)

If you had enough income to support your family, would you still feel angry at elephants when they crop raid?

◯ I would not feel angry anymore

◯ I Don't know

◯ I would still feel a little angry

◯ I would still be very angry

Is there anything else you would like to share concerning your feelings about elephants and crop raiding?

# Elephants

How much do you fear elephants?

◯ Not at all

◯ A little bit

◯ Unsure

◯ Somewhat afraid

◯ Very afraid

Have you ever been injured by an elephant?

◯ Yes

◯ No

Have you ever received information on how to safely live with elephants?

◯ Yes

◯ No

If yes, what type of information did you receive and from whom?

Have you ever received information about the role of elephants in the environment?

◯ Yes

◯ No

If yes, what type of information did you receive and from whom?

# Environment, Wildlife and Climate Change

Do you believe that climate change has negatively aﬀected your life?

◯ Not at all

◯ Somewhat

◯ I don't know

◯ Very much

 How do you believe climate change has aﬀected you? (Check all that apply)

* I don't believe climate change has aﬀected me
* The temperatures are hotter
* There are less rains/more drought
* The crops are unpredictable
* There is more flooding
* There are more pests
* Animals come more often to crop raid
* I don't know
* Other (please specify)

Do you believe your household benefits from the preservation of wildlife? (Choose One)

◯ Yes, a lot

◯ Somewhat

◯ No, not at all

◯ Not sure

How do you believe your household benefits from wildlife? (Check all that apply)

* I don't believe my household benefits from wildlife
* Wildlife brings jobs to the community
* I enjoy watching or seeing wildlife
* I understand that healthy wildlife is important to the ecosystem
* I understand that preserving wildlife is important for tourism for the

 Kenyan economy

* I don't know
* Other (please specify)

How do you feel about wildlife authorities and your relationship with them? (Check One)

* I am not happy with the authorities
* I am slightly unhappy with authorities
* I do not know
* I am slightly pleased with authorities
* I am very happy with authorities
* I do not have a relationship with wildlife authorities

Which authorities have you had a relationship with concerning wildlife? (Check all that apply)

* Kenya Wildlife Service
* Wildlife Works
* Kenyan Police
* Other
* I have never contacted wildlife authorities

Have you ever visited a National Park?

◯ Yes

◯ No

Would you be willing to introduce new techniques that improve crop yields on your farm (s)?

◯ Yes

◯ No

◯ Unsure

Do you have a way to bring products that you want to sell to a market?

◯ Yes

◯ No

◯ Doesn't apply to me

What is your main means of income?

If you have other means of income, please describe here.

Have you ever visited Tsavo East or Tsavo West National Parks?

◯ Yes

◯ No

# Livelihood

Have you ever learned about other ways to earn money than farming? (Please check one)

◯ I have never heard about other ways

◯ I have heard a little bit about other ways

◯ I do not know

◯ I have heard a lot about other ways

Have you ever received information about new agricultural techniques that could increase your crop yields? (Please Check One)

◯ I have never heard about new techniques

◯ I have heard a little bit about new techniques

◯ I do not know

◯ I have heard a lot about new techniques

# Personal & Household Information

NAME

If you would like to be contacted for future surveys, please list your phone number

What year were you born?

Village of origin

Gender

◯ Male

◯ Female

Which ethnic community are you from?

How many people in your household?

 What is the highest level of education you have received?

Supplementary Table 1 Breakdown of the gender and number of survey respondents in each of the participating villages in surveys distributed to farmers in rural villages in the Kasigau Wildlife Corridor, Kenya.

|  |  |  |  |
| --- | --- | --- | --- |
| Village | Men | Women | Total per village |
| Buguta | 15 | 14 | 29 |
| Bungule | 18 | 17 | 35 |
| Itinyi  | 12 | 25 | 37 |
| Kisimenyi | 17 | 17 | 34 |
| Makwasenyi | 21 | 14 | 35 |
| Miasenyi | 13 | 23 | 36 |
| Totals | 96 | 110 | 206 |

Supplementary Material 2 Information on data cleaning and modification for analysis.

For education level responses, college, university, or any type of technical certificates were grouped into the term ‘tertiary’. Likewise, questions 4 (What type of information on methods to prevent crop raiding did you receive?) and 6 (what types of deterrent(s) fence information did you receive?) were grouped into general deterrents and fencing deterrent categories, respectively. For question 2, the types of deterrents used were grouped into the categories of rudimentary fencing, making noise, using torches (flashlights), burning fires, guarding, solar lights along fencing, cloths and oil, planting chili peppers, and Kasaine metal strip fences. Any type of deterrent that had ≤ 3 answers except for Kasaine metal strip fences, a method developed and introduced locally) was grouped into a miscellaneous category as some farmers used completely novel methods. For question 6, the deterrents were grouped into either traditional or modern categories, with traditional methods being burning fires, guarding, making noise, chasing elephants, using scarecrows, waving a torch (flashlight), soaking rags with oil, or erecting rudimentary fencing made of wood, trees or barbed wire. Modern deterrents were considered any type of solar or electric lighting, electric fencing, beehive fences or beekeeping, Kasaine metal strip fences, or intercropping with chili peppers (alternative crops). Although other modern methods exist, no others were mentioned by respondents. The 4-point Likert-scale responses to question 7 were lumped into ‘yes’ (Definitely and Possibly) and ‘no’ (I am unsure and Definitely not) categories. A follow-up question not used in our analysis (because the majority of respondents noted ‘making noise’ as a tool) inquired of those responding ‘yes’ to question 10 (Have you ever actively chased elephants from your farm?) regarding what tools were used. Perhaps misunderstanding the question, 24 respondents provided a tool they chased elephants with, even though they said no to the initial question 10. Therefore, these 24 answers were changed to yes.

 For each of the four hypotheses, we developed a priori models (Table 2 in main text). Any respondents with missing answers to relevant questions were excluded from model analyses so that model comparisons had equal sample sizes, resulting in different samples sizes for each hypothesis. For the deterrent-use hypothesis, the yes/no answer from Q1 was used as the dependent variable (n = 189), and we analyzed models 1–23 (Table 2). To determine which types of deterrents were used by farmers, we used Q2 and categorized responses as traditional or modern. In the deterrent-exposure hypothesis on villagers that received information on any types of deterrents from an outside source and more specifically on deterrent fencing, the yes/no answers to Q5 (n = 189) were used as the dependent variable, and we considered the null model (1), a model with just education level (3), and a model that was a linear combination of all of the remaining non-open-ended variables (24; Table 2). We separated the deterrent-exposure hypothesis into two parts because of the economic difference related to these two types of information: any types of deterrents (A) or specifically deterrent fences (B), which commonly require more financial investment and are often modern deterrents. Questions 4 (n = 46) and 6 (n = 24) asked respondents what types of deterrent information they received. The economic-barriers hypothesis used Q7 as the dependent variable and was analyzed with models 1–9, 12, 13, 15, and 17–23 (Table 2): all single variable models and all models including any combination with education level as a variable (n = 98). Because the tertiary education category had a low sample size, samples with that response were excluded when testing the economic-barriers hypothesis.

Supplementary table 2 The different types of deterrents on which farmers had received information, with categorized responses from questions 4 and 6 (see Table 2 in the main text).

|  |  |  |
| --- | --- | --- |
| Question | Type of deterrent method | No. of farmers |
| Q4. Any deterrents (n = 42) | Barbed wire fence | 3 |
|  | Beekeeping | 6 |
|  | Chasing elephants | 2 |
|  | Digging trenches | 1 |
|  | Electric fences | 2 |
|  | Fencing (basic, non-specific) | 8 |
|  | Guarding overnight | 3 |
|  | Help from Kenya Wildlife Service  | 2 |
|  | Planting chili peppers | 4 |
|  | Making noise | 4 |
|  | Planting hedges or trees | 3 |
|  | Pouring gasoline around farm perimeter (not ignited) as an olfactory deterrent  | 1 |
|  | Using torches (flashlights) | 3 |
| Q6. Fencing deterrents (n = 22) | Barbed wire | 6 |
|  | Beehive fences | 1 |
|  | Electric fences | 6 |
|  | Solar or other lights | 3 |
|  | Thorny branches | 5 |
|  | Tree | 1 |

Supplementary table 3 Types of deterrents used by farmers; where there were less than four responses for a deterrent type (except for Kasaine fences, a locally created deterrent), these were grouped into the miscellaneous category, all of which were traditional deterrent types (n = 114).

|  |  |
| --- | --- |
| Type of deterrent | Quantity |
| Fencing (using rudimentary supplies) | 29 |
| Making noise  | 15 |
| Torch (flashlight) | 14 |
| Burning fires | 12 |
| Guarding | 12 |
| Solar lights on fencing | 8 |
| Cloths and oil | 6 |
| Planting peppers | 4 |
| Kasaine metal strip fences | 3 |
| Miscellaneous | 11 |

Supplementary table 4 Results of binomial generalized linear models for the deterrent-use hypothesis, evaluating which farmers were using deterrents based on demographic variables (n = 189). Model descriptions are presented in Table 2 in the main text. For each model, the table shows the Akaike information criterion adjusted for small sample sizes (AICc), the difference in AICc from the best-performing model (ΔAICc), the adjusted pseudo-*r*2 value, the Akaike weight (*wi*), log-likelihood (LL) and the number of variables (k).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Intercept | AICc | ∆AICc | Adj r2 | *wi* | LL | k |
| 12 | -0.93 | 253.71 | 0.00 | 0.07 | 0.36 | -121.69 | 5 |
| 15 | -1.54 | 255.05 | 1.33 | 0.07 | 0.19 | -121.29 | 6 |
| 6 | -0.04 | 255.55 | 1.84 | 0.04 | 0.14 | -125.74 | 2 |
| 17 | -1.09 | 256.30 | 2.59 | 0.07 | 0.10 | -120.84 | 7 |
| 10 | -0.05 | 257.61 | 3.90 | 0.03 | 0.05 | -125.74 | 3 |
| 18 | -1.55 | 257.97 | 4.26 | 0.06 | 0.04 | -120.58 | 8 |
| 14 | -0.18 | 258.07 | 4.36 | 0.04 | 0.04 | -124.93 | 4 |
| 21 | -1.22 | 258.59 | 4.87 | 0.06 | 0.03 | -120.89 | 8 |
| 16 | -0.11 | 260.17 | 6.45 | 0.03 | 0.01 | -124.92 | 5 |
| 22 | -1.29 | 261.94 | 8.23 | 0.05 | 0.01 | -120.35 | 10 |
| 3 | -0.69 | 262.19 | 8.47 | 0.02 | 0.01 | -130.03 | 4 |
| 1 | 0.18 | 262.50 | 8.79 | 0 | 0.00 | -130.24 | 1 |
| 9 | -1.36 | 263.28 | 9.56 | 0.02 | 0.00 | -126.47 | 5 |
| 5 | 0.35 | 263.44 | 9.72 | <0.00 | 0.00 | -129.69 | 2 |
| 4 | 0.32 | 264.13 | 10.41 | <0.00 | 0.00 | -130.03 | 2 |
| 2 | 0.07 | 264.50 | 10.78 | -0.01 | 0.00 | -130.22 | 2 |
| 19 | -1.21 | 264.85 | 11.13 | 0.01 | 0.00 | -126.19 | 6 |
| 13 | -0.73 | 265.85 | 11.92 | 0.01 | 0.00 | -126.59 | 6 |
| 7 | 0.16 | 265.69 | 11.98 | -0.01 | 0.00 | -129.78 | 3 |
| 20 | -1.04 | 266.61 | 12.89 | 0.01 | 0.00 | -126.00 | 7 |
| 11 | 0.11 | 267.77 | 14.05 | -0.01 | 0.00 | -129.77 | 4 |
| 8 | 0.24 | 269.22 | 15.51 | -0.01 | 0.00 | -128.38 | 6 |
| 23 | -1.47 | 261.28 | 17.56 | 0.04 | 0.00 | -119.25 | 15 |

Supplementary Table 5 Results of binomial generalized linear models for the economic-barriers hypothesis, evaluating demographic factors of villagers who said they definitely could implement deterrents (n = 98). Model descriptions and terms are presented in Table 2 in the main text.

| Model | Intercept | AICc | ∆AICc | Adj r2 | *wi* | LL | k |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 6 | 1.12 | 119.24 | 0.00 | 0.03 | 0.39 | -57.56 | 2 |
| 1 | 0.87 | 121.09 | 1.85 | 0.00 | 0.16 | -59.52 | 1 |
| 12 | 2.12 | 122.29 | 3.05 | 0.02 | 0.09 | -56.93 | 4 |
| 4 | 1.13 | 122.62 | 3.38 | <-0.00 | 0.07 | -59.25 | 2 |
| 2 | 1.20 | 122.98 | 3.75 | -0.01 | 0.06 | -59.43 | 2 |
| 5 | 0.84 | 123.15 | 3.91 | -0.01 | 0.06 | -59.51 | 2 |
| 3 | 1.95 | 123.82 | 4.59 | -0.01 | 0.04 | -58.78 | 3 |
| 15 | 2.83 | 124.05 | 4.82 | 0.01 | 0.04 | -56.70 | 5 |
| 7 | 0.41 | 124.17 | 4.93 | -0.01 | 0.03 | -58.96 | 3 |
| 9 | 2.65 | 125.52 | 6.28 | -0.01 | 0.02 | -58.54 | 4 |
| 8 | 1.10 | 126.09 | 6.86 | 0.01 | 0.01 | -56.58 | 6 |
| 17 | 1.87 | 126.43 | 7.19 | <0.00 | 0.01 | -56.75 | 6 |
| 13 | 1.52 | 127.12 | 7.89 | -0.02 | 0.01 | -58.23 | 5 |
| 19 | 2.89 | 127.25 | 8.01 | -0.02 | 0.01 | -58.30 | 5 |
| 21 | 3.13 | 127.87 | 8.64 | <-0.00 | 0.01 | -56.31 | 7 |
| 18 | 2.64 | 128.18 | 8.94 | -0.01 | 0.00 | -56.47 | 7 |
| 20 | 2.89 | 129.46 | 10.23 | -0.03 | 0.00 | -58.27 | 6 |
| 22 | 2.94 | 132.44 | 13.20 | -0.02 | 0.00 | -56.20 | 9 |
| 23 | 3.91 | 137.50 | 18.26 | 0.01 | 0.00 | -52.22 | 14 |