

Supplementary materials

Supplementary material A. Semi-structured questionnaires.

Note that focus-group discussions were used to create a list of ten items wealthy households commonly own in each study area, and thus lists were not the identical. The lists in questions 15 and 16 of the questionnaire were modified according to responses in the focus group discussions. For example, in Mount Kilimanjaro it was noted that onion farming was not a main livelihood in the villages studied, and therefore, the question about decreased yields (onion) was not asked to respondents in Mount Kilimanjaro.

Part 1. General information

1. Village name
2. Household composition (adults M and F)
3. Household composition (children)
4. Owner of house
5. Owner of farm
6. Farm size (ha)
7. List animals your household has
8. Does your household have any of these items? Tractor / Cow) / >5 ha land / >6 children / Motorbike / Car / Television / Radio / Mobile phone / Cement house with metal roof / Grinder / Car / Shop / Water pump / Farm
9. Does your household belong to a farmer association? If yes, which one
10. Which activities are important to your household?
11. Have you heard of the term climate change, and can you explain what it means?
12. If so, who explained this phenomenon to you?
13. How do you determine when to sow your seeds?
14. Compared to when you were a teenager and started farming, which of the following climatic changes have you noticed in your village? Increased temperatures (dry season)/ Increased temperatures (rainy season)/ Reduced rainfall (long rains)/ Late start long rains/ More dry spells (long rains)/ More showers (dry season)/ More extreme floods/ More extreme droughts/ Fewer foggy days/ Less frost/ Increased wind (rainy season)/ Fewer hailstorms/ Reduced stream flow (rainy season)/ More landslides (rainy season)/ More soil erosion (rainy season)
15. Compared to when you were a teenager and started farming, which of the following impacts changes have you noticed in your village? Lower yields (maize)/ Lower yields (beans)/ Lower yields (coffee)/ Lower yields (banana)/ Lower yields (potatoes) / Lower yields (onions) / Increased pests/diseases (maize) / Increased pests/diseases (beans) / Increased pests/diseases (coffee)/ Increased pests/diseases (banana)/ Increase pests/diseases (potatoes) / Mango bears less fruit / Cows produce less milk / Cows have more diseases / Goats have more diseases / Pigs have more diseases / People are less healthy
16. Which of the following adaptation strategies have you used? Crop change (millet)/ Change to improved variety (maize)/ Change to improved variety (beans) / Change to improved variety (potatoes) / Change to improved variety (onions) / Change to improved variety (banana) / Change to improved variety (coffee) / Increased shade in coffee / Increased farm size / Changed farm location (near stream) / Increased irrigation / Sow seeds earlier / Sow seeds later / Sow seeds twice (if they die) / Increased use soil conservation / Increased use fertiliser / Increased use pesticide / Increased use veterinary care (cows) / Increased use veterinary care (goats) / Increased use veterinary care (pigs) / Increased use feed (cows) / Increased use feed (goats) / Increased use feed (pigs) / Diversify: sell firewood / Diversify: NTFPs (hunting, honey) / Diversify: labour / Diversify: started rearing animals / Diversify: vegetable/fruit production / Diversify: trading animal products/ Diversify: small business / Diversify: tourism

Supplementary material B. Wealth groups

Mount Kilimanjaro - Respondents were pooled by wealth group (poor, average, wealthy) based on a wealth index created from ten asset indicators (Córdova, 2008; Berman et al., 2014). The ten assets considered were: tractor (2% of the respondents), >5 cows (6%), >5 ha land (14%), >6 children (29%), motorbike (30%), car (32%), Tv (75%), radio (97%), mobile phone (98%), cement house with metal roof (99%). Assets which were owned by < 25% of the households (tractor, > 5 cows, >5 ha land) were weighted 0.25 greater than those more commonly found. Table B1 displays main characteristics of each wealth group created. All respondents owned the house they lived in. Notably, in Mount Kilimanjaro only nine households were female-headed (no husband or male relative living in the household) and these included rich, average, and poor households. Only one respondent had never followed primary school.

Table B1. Main characteristics of each wealth group in Mount Kilimanjaro.

Wealth group	Frequency	Adult's house	Farm (ha)	Animals	Main activities	Key items
Poor	n=19	2.6	2.3	63%	70% farming (2% farmed coffee)	No car, motorbike, or television
Average	n=82	2.9	2.3	87%	60% farming (8.5% farmed coffee)	Car, motorbike, or television
Rich	n=49	3.1	3.4	90%	56% farming (22% farmed coffee)	Television and car, or television and motorbike

Udzungwa Mountains - Respondents were pooled by wealth group (poor, average, wealthy) based on a wealth index created from ten asset indicators (Córdova, 2008; Berman et al., 2014). The ten assets considered were: tractor (1% of the respondents), grinder (1%), car (2.5%), shop (4.6%), motorbike (15%), water pump (20%), television (27%), cement house with metal roof (27%), radio (45%), owner of their farm (96%). Assets which were owned by < 25% of the households (tractor, grinder, car, shop, motorbike and water pump) were weighted 0.25 greater than those more commonly found. Table B2 displays main characteristics of each wealth group created. All (except 4) respondents owned the house they lived in. Notably, only 20 households were female-headed (no husband, or male relative living in the household) and these included equal numbers of average and poor households. Twelve respondents had never followed primary school (10 of which were females).

Table B2 Main characteristics of each wealth group in the Udzungwa Mountains.

Wealth group	Frequency	Adults	Farm (ha)	Animals	Main activities	Key items
Poor	n=64	3.7	2.5	40%	60% farming (18% animal rearing)	No radio
Average	n=58	3.9	3.9	55%	60% farming (18% animal rearing)	Radio
Rich	n=28	4.2	6	50%	60% farming (20% animal rearing)	Motorbike and television, or motorbike and pump

Supplementary material C. Village elevation analysis

In each mountain, similar numbers (37 or 38) of respondents were interviewed in each village. We computed percent of respondents in each village who reported each climatic change, impact, or adaptation strategy (see Tables D1 and D2).

Table C1. Climatic changes, impacts and adaptation strategies as reported by percentage of respondents in each village studied in Mount Kilimanjaro. Only variables with at least a 15% difference across villages are shown in the table.

	Foo (1694m)	Kokirie Mamba (1630m)	Uparo (1426m)	Mudio (1083m)
<i>Climatic changes and impacts</i>				
More showers (dry season)	74	98	92	36
More extreme floods	13	80	3	14
More extreme droughts	3	88	8	14
Less frost	94	100	92	29
Increased wind (rainy season)	13	85	97	43
More landslides (rainy season)	0	88	42	48
More soil erosion (rainy season)	65	98	28	81
Lower yields (banana)	29	85	53	57
Lower yields (beans)	94	98	64	98
Increased pests/diseases (banana)	100	100	61	98
Mango bears less fruit	100	100	56	98
<i>Adaptation strategies</i>				
Change to improved variety (coffee)	0	24	8	19
Increased shade in coffee	6	24	8	14
Increased irrigation	87	12	3	79
Increased use soil conservation	32	90	100	98
Increased use fertiliser	100	78	17	95
Increased use pesticide	97	71	31	93
Diversify: sell firewood	0	15	0	36
Diversify: labour	32	7	17	24
Diversify: vegetable/fruit production	42	17	3	86
Diversify: trading animal products	39	56	50	88
Diversify: labour	48	7	0	0

Table C2. Climatic changes, impacts and adaptation strategies as reported by percentage of respondents in each village studied in the Udzungwa Mountains. Only variables with at least a 15% difference across villages are shown in the table.

	Ilula (1370m)	Udekwa (1013m)	Msosa (596m)	Mtandika (570m)
<i>Climatic changes and impacts</i>				
More showers (dry season)	89	86	58	81
More extreme floods	55	97	92	84
Increased temperatures (rainy season)	66	89	68	92
Increased wind (rainy season)	63	100	92	70
More soil erosion (rainy season)	47	76	45	59
Lower yields (potatoes)	53	51	0	0
Lower yields (onions)	53	3	68	92
Increased pests/diseases (potatoes)	92	81	0	0
Increased pests/diseases (onions)	92	3	97	95
Cows produce less milk	84	78	0	0
Cows have more diseases	87	86	0	0
<i>Adaptation strategies</i>				
Change to improved variety (potatoes)	26	0	0	0
Change to improved variety (onions)	5	3	68	84
Change to improved variety (beans)	97	62	74	92
Increased farm size	71	59	29	27
Increased use fertiliser	89	54	82	100
Increased use pesticide	89	62	87	97
Increased use veterinary care (pigs)	66	8	0	3

Supplementary material D. Gender analysis

Within each study site, equal numbers of male and female respondents were interviewed. Within each mountain paired t-tests were used to assess significant differences between genders, at $P < 0.05$. Overall, there were no significant differences across genders, for neither climatic changes, impacts nor adaptation responses (see Table C1 and C2).

Table D1. Climatic changes and impacts as reported by percentage of respondents of each gender within each study site. Kili: Mount Kilimanjaro, Udz: the Udzungwa Mountains, F: female, M: male.

	Kili-F (%)	Kili-M (%)	Udz-F (%)	Udz-M (%)
Increased temperatures				
Increased temperatures (dry season)	100	100	99	96
Increased temperatures (rainy season)	100	100	71	85
Changes in rainfall patterns				
Reduced rainfall (long rains)	96	99	100	100
Late start long rains	98	93	100	100
More dry spells (long rains)	96	99	99	98
More showers (dry season)	78	70	81	77
Hazards, fog and wind				
More extreme floods	36	21	90	75
More extreme droughts	36	24	99	94
Fewer foggy days	99	100	84	83
Less frost	80	71	100	96
Increased wind (rainy season)	69	53	86	78
Fewer hailstorms	100	96	100	100
Reduced stream flow (rainy season)	95	96	83	89
More landslides (rainy season)	49	43	6	2
More soil erosion (rainy season)	66	70	62	52
Impacts in biological domain				
Lower yields (maize)	93	96	99	95
Lower yields (beans)	83	96		
Lower yields (coffee)	95	87		
Lower yields (banana)	58	59		
Lower yields (potatoes)			20	31
Lower yields (onions)			55	53
Increased pests/diseases (maize)	95	97	97	99
Increased pests/diseases (beans)	90	97		
Increased pests/diseases (coffee)	96	94		
Increased pests/diseases (banana)	88	93		
Increased pests/diseases (potatoes)			36	49
Mango bears less fruit	89	89	77	78
Cows produce less milk	100	97	35	46
Cows have more diseases	98	99	38	48
Goats have more diseases			88	88
Pigs have more diseases			38	53
People are less healthy	93	96	90	77

Table D2. Adaptation strategies as reported by percentage of respondents of each gender within each study site. Kili: Mount Kilimanjaro, Udz: Udzungwa Mountains, F: female, M: male.

	Kili-F (%)	Kili-M (%)	Udz-F (%)	Udz-M (%)
Crop change (millet)				
Change to improved variety			9	15
Change to improved variety (maize)	99	99	99	99
Change to improved variety (beans)	96	97	81	81
Change to improved variety (potatoes)			4	9
Change to improved variety (onions)			41	40
Change to improved variety (banana)	99	93		
Change to improved variety (coffee)	16	11		
Increased shade in coffee	14	14		
Increased farm size			52	42
Changed farm location (near stream)			61	68
Increased irrigation	8	7	81	81
Sow seeds later	90	93		
Sow seeds earlier			91	79
Sow seeds twice (if they die)	98	99	88	88
Increased use soil conservation	85	80	75	75
Increased use fertiliser	65	81	78	84
Increased use pesticide	68	79	83	85
Increased use veterinary care (cows)	86	90		
Increased use veterinary care (goats)			13	14
Increased use veterinary care (pigs)			13	25
Increased use feed (cows)	84	90		
Diversify: sell firewood	16	11	14	7
Diversify: NTFPs (hunting, honey)	1	0		
Diversify: labour	14	26	33	38
Diversify: started rearing animals	81	86	35	33
Diversify: vegetable/fruit production	33	43	1	4
Diversify: trading animal products	59	61	0	2
Diversify: small business	10	14	36	22
Diversify: tourism			0	1