

Agricultural households' adaptation to weather shocks in Sub-Saharan Africa: implications for land-use change and deforestation

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ONLINE APPENDIX

Appendix A. Synthesis of coping and adaptation strategies used by households in Sub-Saharan Africa in the face of weather shocks and climate variability

Table A1. Anticipatory adaptation practices (ex-ante)

Practices	Description	References
Diversification of income sources	Diversifying income with non-farm or off-farm activities. It involves changes in labor allocation, and might involve migrations. Common off-farm activities include the gathering of non-timber forest products (NTFP), petty trade, etc. In the case of a migration, the emigrated family member(s) can send remittances to the family.	Ellis, 2008; Osbahr <i>et al.</i> , 2008; Paavola, 2008; Dillon <i>et al.</i> , 2011; Angelsen <i>et al.</i> , 2014; Wunder <i>et al.</i> , 2014
Income skewing	Re-allocation of resources to one or several activities with lower returns but lower risks.	Dercon, 2002
Migration	<ul style="list-style-type: none"> - Permanent migration and resettlement of the entire household, or only of some household members - Regular seasonal migration of household members 	Corbett, 1988; Osbahr <i>et al.</i> , 2008; Paavola, 2008; Dillon <i>et al.</i> , 2011
Agricultural diversification	<ul style="list-style-type: none"> - Diversification of crops, intercropping, halting of monoculture production, use of crops with different agronomic and physiological characteristics (time to maturity, etc.) - Diversification of agricultural practices (fallow times, rotations...) - Spatial diversification: division of the exploitation in plots with different attributes (crops, practices), taking advantage of landscape diversity (topography, soils, climate...) – this practice requires land and labor - Transition to crop-livestock mixed systems. This can be seen as a diversification strategy but might also be an integration strategy (use of one activity's byproducts as an input for the 	Reenberg and Paarup-Laursen, 1997; Osbahr <i>et al.</i> , 2008; Bezabih and Sarr, 2012; Mapfumo <i>et al.</i> , 2014; Thornton and Herrero, 2014; Wunder <i>et al.</i> , 2014; Yegbemey <i>et al.</i> , 2017; Veljanoska, 2018

	<p>other activity).</p> <ul style="list-style-type: none"> - Diversification through the addition of trees. It may provide food, income, and ecosystem services for crop and livestock activities – it might require labor, skills and knowledge, as well as equipment. 	
Other agricultural practices	<ul style="list-style-type: none"> - Use of crops or varieties better adapted to droughts, high temperatures, and even waterlogging. This can lead to a change in the main crop, or to the introduction of new crops. New crops might as well be ancient varieties. - Addition of trees / agroforestry - it offers protection from strong winds, shading, runoff control, fodder sources, etc. - Relocation of crops to less exposed and better adapted lands, or even relocation of the farm – it requires access to land - Change in the agricultural calendar (sowing date, etc.), and choice of short-maturing varieties - Soil conservation, and water conservation and harvesting techniques / climate-smart agriculture - Irrigation – it might be financially costly, but allows dry season farming, and growing fruits and vegetables - Increase in crop spacing to avoid plant competition for water - Seedling covering (plastic or other cover) - Expansion/extensification (decrease in fallow time, conversion of fallow or of new land) - Turning back to / increase of subsistence farming - Intensification 	<p>Brou, 2005; Thomas <i>et al.</i>, 2007 ; Paavola, 2008; Bryan <i>et al.</i>, 2009 Di Falco and Veronesi, 2013; Mapfumo <i>et al.</i>, 2014; Thornton and Herrero, 2014; Elum <i>et al.</i>, 2017; Yegbemey <i>et al.</i>, 2017; Partey <i>et al.</i>, 2018; Antwi-Agyei <i>et al.</i>, 2018</p>
Practices specific to livestock rearing	<ul style="list-style-type: none"> - Use of breeds better adapted to droughts and high temperatures - Diversification through diversified herd composition, herd splitting in different places, transition to mixed crop-livestock systems - Reduction in herd size, or halting of livestock rearing 	<p>Silvestri <i>et al.</i>, 2012; Tibbo and van de Steeg, 2013; Mapfumo <i>et al.</i>, 2014; Thornton and Herrero, 2014</p>

	<ul style="list-style-type: none"> - Diversification of feed sources, finding more resistant feed sources (to both drought conditions and waterlogging), change in feeding regime - Relocation of herds to less exposed or better adapted zones (in terms of climate, vegetation, feed sources). 	
Participation in / development of kinship networks	Such networks are based on reciprocity, to benefit from donation, lending, help, trading of food, labor, money, or other elements in case of shock (e.g. exchange of labor against food). It is a form of risk pooling, and can be done with family, friends, neighbors, or between communities and villages.	Corbett, 1988; Dercon, 2002; Osbahr <i>et al.</i> , 2008; Wunder <i>et al.</i> , 2014
Constitution of buffer stocks	Stocks of food, harvest, NTFP. Form of informal insurance.	Corbett, 1988; Kazianga and Udry, 2006; Wunder <i>et al.</i> , 2014
Constitution of asset stocks	Livestock is particularly being used for saving purposes. Most often, it is smallstock (e.g. poultry) as it is less expensive and easier to resell, but it depends on numerous factors among which culture, religion, wealth, and location.	Corbett, 1988; Dercon, 2002; Kazianga and Udry, 2006 ; Wunder <i>et al.</i> , 2014

Table A2. Coping responses to weather shocks (ex-post)

Practices	Description	References
Asset sales	Sales of assets acquired for saving purposes in the first place, such as smallstock or jewelry, and sales of productive assets later if the shock is severe, for instance cattle, farm, land (distress sales).	Corbett, 1988; Kazianga and Udry, 2006; Osbahr <i>et al.</i> , 2008; Smucker and Wisner, 2008; Silvestri <i>et al.</i> , 2012; Wunder <i>et al.</i> , 2014
Search of alternative income sources	Through off-farm work, natural product harvesting, handicraft, etc. Such practice might take the form of temporary migration. The emigrated family member(s) can send remittances. The migration also alleviates pressure on the consumption needs of the family. More generally, this practice implies a reallocation of production factors, notably labor.	Corbett, 1988; Smucker and Wisner, 2008; Dillon <i>et al.</i> , 2011; Silvestri <i>et al.</i> , 2012; Mapfumo <i>et al.</i> , 2014; Wunder <i>et al.</i> , 2014; Noack <i>et al.</i> , 2019
Natural products harvesting	For consumption or sale to make up for poor harvests (fuelwood, construction wood, fodder, NTFP, etc.). This practice might already take place in normal times but even more following a shock. Some studies report an increase in charcoal production (for cash income) after a shock.	Corbett, 1988; Angelsen and Wunder, 2003; Smucker and Wisner, 2008; Woittiez <i>et al.</i> , 2013; Gautier <i>et al.</i> , 2016; Noack <i>et al.</i> , 2019
Purchase of food or construction materials	The income from migration (remittances), or from other sources (asset sales, NTFP sales, off-farm work) can be used for this purpose.	Osbahr <i>et al.</i> , 2008; Silvestri <i>et al.</i> , 2012
Use of kinship networks	To get food, livestock, labor, seeds, or work. However, in the case of a severe or lasting shock this solution might be inefficient as the whole community is affected.	Corbett, 1988; Osbahr <i>et al.</i> , 2008; Silvestri <i>et al.</i> , 2012 ; Gautier <i>et al.</i> , 2016
Change in the intensity of use of the labor force	Household members work longer hours, harder, and children might be taken out of school to be used as additional labor.	Wunder <i>et al.</i> , 2014

Economical behavior	Reduced expenditures and consumption, rationing. Constitution of food stocks (crops, wild foods) if the shock is thought to last.	Corbett, 1988; Silvestri <i>et al.</i> , 2012 ; Gautier <i>et al.</i> , 2016
Change in diet	Consumption of different food	Silvestri <i>et al.</i> , 2012
Migration	- Temporary migration to look for work - Distress migration (permanent)	Corbett, 1988; Osbahr <i>et al.</i> , 2008; Dillon <i>et al.</i> , 2011; Gray and Mueller, 2012; Gautier <i>et al.</i> , 2016
Taking a loan	Use of credit from merchants or moneylenders. Interest rates might be high.	Corbett, 1988; Gautier <i>et al.</i> , 2016
Responses for livestock rearing	- Relocation of the herd and/or mobility to find areas with more feed and water resources, or with a more appropriate vegetation and climate. This can lead to grazing in protected areas, common pool resources, government areas. - Buying fodder and water - Selling animals - pastoralists are less inclined to kill or sell their animals after a shock compared to other farmers for whom livestock can be considered more as savings rather than as productive assets.	Ifejika Speranza, 2010; Mapfumo <i>et al.</i> , 2014; Gautier <i>et al.</i> , 2016
Focus on livestock (rather than crops)	Reduce investment in agriculture / cessation of cropping activities to focus on livestock management.	Thomas <i>et al.</i> , 2007
Finding temporary agricultural land	Especially if the land was damaged or flooded.	Takasaki <i>et al.</i> , 2004; Liswanti <i>et al.</i> , 2011
Other practices	Soil conservation and water management conservation practices, delaying planting / replanting.	Berman <i>et al.</i> , 2014

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