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Coping with Drought in Village Economies: The Role of Polygyny *

Sylvain Dessy† Luca Tiberti‡ Marco Tiberti§ David Zoundi¶

Abstract

Rural communities in developing countries often experience growing-season droughts–a spatially covariant income shock disrupting mutual insurance mechanisms. These communities might leverage traditional practices such as polygyny to enhance economic resilience. This is particularly effective when co-wives come from geographically dispersed kinship networks, facilitating the inflow of financial support during droughts. Analyzing data from rural Mali, we exploit the quasi-random nature of droughts and variations in polygyny rates across communities. We control for time and community fixed effects and several observable correlates of drought potentially affecting polygyny. Results show that polygyny is linked with increased financial aid from distant kin during droughts, mitigating negative effects on crop yields. Additionally, polygyny prevalence remains unaffected by negative rainfall deviations, suggesting its role as a pre-established cultural strategy for managing income shocks. Hence, public policy aiming to phase out practices like polygyny for community survival must consider these cultural dimensions of resilience strategies.

Keywords: Village economies; Drought; Polygyny; Resilience strategy; Mali

JEL codes : C12, D12, J12, J13, O55

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†Department of Economics, CRREP, PEP, and CREATE, Université Laval, Quebec City, QC, Canada. sdes@ecn.ulaval.ca

‡Université Laval (Canada), University of Florence (Italy), PEP and CREATE. luca.tiberti@unifi.it

§Development Data Group, The World Bank, Rome, Italy. mtiberti@worldbank.org. Via Labicana, 110. 00184, Rome, Italy. +39 0677710245. Corresponding author.

¶Department of Economics and CRREP, Université Laval, Quebec City, QC, Canada. david-aime.zoundi.1@ulaval.ca

1 Introduction

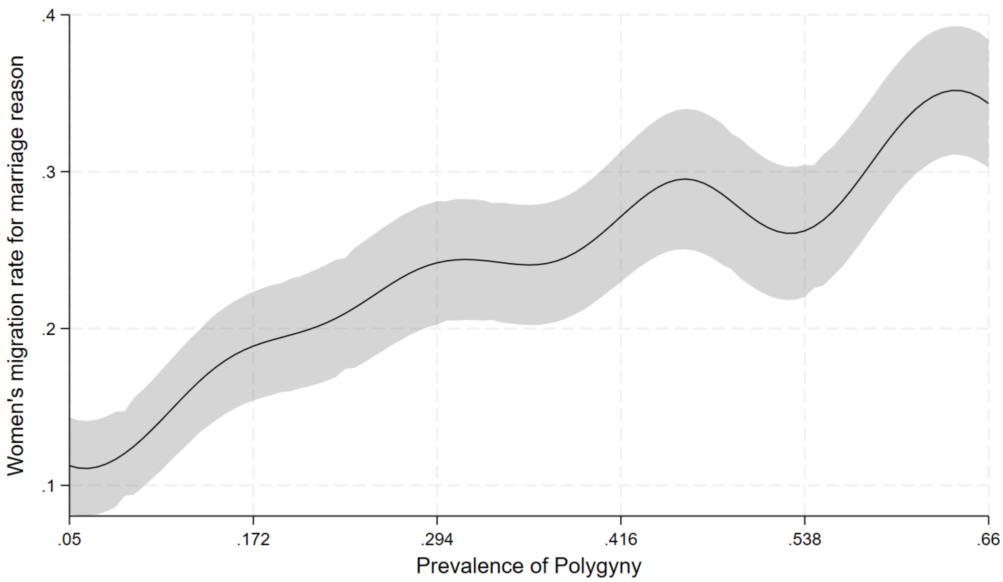
Economics explores allocating scarce resources to meet diverse needs, with modern economies often leaning on free markets to guide this allocation. This includes risk insurance markets, which are crucial for households to protect against uncertainties. However, risk insurance markets are either underdeveloped or absent in many rural settings, specifically village economies characterized by a heavy reliance on agriculture, limited formal risk management options, an imperfect agricultural labor market, and minimal division of labor (Rosenzweig and Stark, 1989; Barrett et al., 2010). Despite sometimes having community-based mutual risk-insurance arrangements, these village economies struggle with spatially covariant income shocks, such as growing-season droughts, which can undermine these traditional safety nets (Townsend, 1994; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007).

Research highlights that in response to these challenges, rural communities prone to adversities like droughts have developed coping strategies rooted in traditional customs and institutions (Daskon, 2010; Daskon and Binns, 2010; Daskon and McGregor, 2012; Karunarathne and Lee, 2019). Examples of these cultural practices, which are notably prevalent in areas susceptible to growing-season droughts, include marriage transfers (Anderson, 2007; Anderson and Bidner, 2015), migration for marriage (Rosenzweig and Stark, 1989), child fostering (Zimmerman, 2003; Akresh, 2009), child marriage (Corno et al., 2020), and polygyny (Rossi, 2019). Remarkably, while there has been a global decline in polygyny, including many parts of the developing world, the drought-prone Sahel subregion of Africa stands out for its high prevalence of this practice (Kramer, 2020). Yet, there needs to be a more formal investigation of whether this cultural practice supports community resilience in the Sahel subregion. Understanding the resilience benefits of these practices could shed light on why banning polygyny in this subregion has been met with significant local resistance (Tertilt, 2005), thus offering insights into more culturally sensitive and effective economic policies.

This paper provides new evidence on whether community-level polygyny buffers the negative effect of drought on crop yields in the context of a village economy. Our interest in the cultural practice of polygyny— the taking of several wives by a man (Rossi, 2019)— stems from several associated facts. First, even though polygyny is known to harm women (Ahinkorah, 2021b), increase fertility (Rossi, 2019), and has virtually disappeared in today's industrialized countries, it persists in sub-Saharan Africa (Tertilt, 2005; Rossi, 2019). Second, this cultural practice is most prevalent along the Sahel sub-region (Jacoby, 1995; Kramer, 2020), where rainfall is heavily concentrated in a minimal period of the year—in particular the July August summer monsoon period (Masih et al., 2014). This sub-region is also highly prone to the most prolonged and intense episodes of drought— a well-documented source of adverse income shock (Dinkelman, 2017; Kaur, 2019)—, and is home to smallholder farmers practicing rainfed agriculture (Clavel and Clavel, 2014).

We hypothesize that households in drought-prone communities leverage inflows of private transfer from non-local members of their extended kinship network as a coping mechanism following a negative shock (Yang and Choi, 2007). In such communities, having multiple wives originating from geographically dispersed kinship networks may allow male-headed households to diversify sources of non-local private transfer inflows to buffer covariant shocks' adverse effects on household welfare. For a polygynous man, each co-wife may be a potential source of non-local cash or in-kind transfers, through her non-local extended family of birth, particularly in communities where marriage is patrilocal. Indeed, Figure 1 below, drawn using DHS data, shows a positive correlation between the prevalence of polygyny and women's migration rates for marriage purposes.

Figure 1: *Polygyny prevalence and women's migration rate for marriage reasons*



Source: Authors elaboration based on DHS 2018.

This figure suggests that where the prevalence of polygyny is high, married women's pre-marital geographic origins are more diverse. Hence, our testable hypothesis is that drought increases the inflow of non-local transfers in highly polygynous rural communities.

In drought-prone agrarian communities, external resources raised through non-local private transfers inflows may be used to purchase drought-resilient inputs, hire labor, or diversify sources of income through engagement in off-farm activities —including producing and selling charcoal to urban markets and transporting livestock for sale in urban markets. The more polygynous a community, the higher the volume of non-local private transfer inflows it attracts, thus sparking intra-community economic transactions as a positive externality to all households, polygynous and non-polygynous. Indeed, with more resources in their hands in the form of non-local private transfer inflows, polygynous households may use these resources to hire extra labor to collect water from remote reservoirs, water their farm plots, spread fertilizers on them, or supply transportation services for charcoal and livestock producers, thus creating employment opportunities within the community.[1] Employment opportunities thus created may help non-polygynous households fund their resilience strategies. The more polygynous the community, the larger the positive externality non-local transfer inflows will generate to its member households, polygynous and non-polygynous. Hence, the relatively higher ability of more polygynous rural communities to buffer the adverse effects of drought crop yield, compared to less polygynous ones.

Based on the above arguments, we measure polygyny at the community level to identify its risk-insurance effect within communities in which it is highly prevalent. Given the slow-changing nature of the polygyny custom, a notable benefit of this community-level measurement of polygyny is that controlling for community-fixed effects is sufficient to overcome selection bias. Another positive side effect of measuring polygyny at the community level is that it enables us to correct for the tendency of standard household surveys to fail to adequately capture polygynous households when co-wives live in separate dwellings and thus are not connected under the same household (Beaman and Dillon (2012)). Indeed, as documented in Randall et al. (2011), not properly accounting

[1] Indeed, Hadley et al. (2007) find evidence in the rural Tanzanian region of Rukwa that, in periods of hardship, households from a predominantly monogamous ethnic group (the Pimbwe) supply cheap labor to households from the predominantly polygynous ethnic group (the Sukuma).

for this fact leads to misclassifying or misrepresenting polygynous (and monogamous) households.

We chose rural Mali as the setting of our empirical analysis for two reasons. First, Mali is a Sahelian country whose agriculture is predominantly rainfed (Birhanu, 2016), and drought is a transitory negative shock that affects agricultural productivity in the current year (Kaur, 2019). Second, Mali is a country besieged by frequent episodes of drought. Furthermore, it is located in the polygyny belt along the African Sahel region in sub-Saharan Africa (Jacoby, 1995) and has the second highest rate in the world of individuals living in polygynous households at 34% (Kramer, 2020). Interestingly, our rural Mali data show that about 95% of household heads co-reside with their spouse(s), with the remaining 5% residing in separate households. This pattern of family residence indicates the importance of measuring polygyny at the commune level in rural Mali to account for non-co-residing cowives.[2]

To identify the positive externality effect of commune-level polygyny in rural Mali, we regress household's crop yields on the interaction of the commune-level polygyny prevalence with drought, controlling for areas and year-fixed effects, household wealth, and polygyny's correlates. Our rural Mali's data come from two rounds of the *Enquête Agricole de Conjoncture Intégrée aux Conditions de Vie des Ménages (EAC-I)*, in combination with polygyny data from the *Fourth General Census of Population and Housing* (2009). We combine this data with meteorological data to analyze the interacting effect of commune-level polygyny and drought.

Several challenges confront our estimation of the buffering effect of community-level polygyny. First, there is a potential spatial correlation in the error term due to the tendency of drought and polygyny to be clustered in space. Although droughts can happen randomly over time, they often tend to be clustered across neighboring geographic units (Hsiang et al., 2011). Likewise, polygyny, as a cultural practice, is usually prevalent in geographic units that share similar cultural values.

Second, our drought series potentially exhibits serial correlation within each geographic unit. To simultaneously account for these sources of correlation, we follow Conley (1999) and Hsiang et al. (2011) in adjusting serial and spatial correlation standard

[2] Indeed, Mali's communes are sufficiently large geographic units that polygynous men with non-coresiding co-wives are highly likely to live within the same commune as all his wives, albeit in separate households, thus increasing the likelihood of these related households being misrepresented as monogamous households.

errors.

Third, the potential presence of spatial correlation due to omitted weather variables also threatens our identification strategy. We account for this problem by constructing a measure of drought during the agricultural season, using the Standardized Precipitation-Evapotranspiration Index (Vicente-Serrano et al., 2010; Miao and Popp, 2014; Harari and Ferrara, 2018).

Fourth, the potential presence of unobserved time-constant and time-varying factors can influence the relationship between our covariates of interest and crop yield, thus confounding our identified effect. We account for this problem by controlling for enumeration area (EA) fixed effects and time-variant household-level and community-level observables. The latter controls include household wealth, chemical fertilizers, area of cultivated land, labor applied per land area, various indicators of soil quality, and infrastructural factors such as proximity to the nearest road, border crossing, and district's capital town, along with household access to an irrigation system. Theoretically, the prevalence of polygyny in a locality could correlate with these attributes, potentially explaining several findings. Incorporating these attributes into our analysis strengthens our identification strategy. Additionally, identification of the resilience effect of community-level polygyny is obtained under the assumption that upon controlling for EA fixed effects and over a relatively short time (*i.e.*, 3 years),[3] differences across rural Mali's communes in the prevalence of polygyny are invariant to the agricultural yields reported by households. Nonetheless, we ran several robustness tests to increase confidence in our results, as they might be affected by the endogeneity of the polygyny prevalence. Specifically, when such identification challenge is due to differences in observable correlates of polygamy, we augmented the baseline specification by controlling for the interaction between (1) drought and time-variant controls, (2) polygyny prevalence and time-variant controls, and (3) drought and close correlates of polygyny like the ethnic groups (Desmet et al., 2017). Moreover, to verify whether polygyny prevalence over a short time span like ours is endogenous to rainfall levels in the starting period, we regressed the change in the commune polygyny rate between 2014 and 2017 on rainfall in 2014. Finally, we controlled for the time trends in polygyny and in proxies of soil

[3] According to the DHS STATcompiler –, the share of rural Malian men with one or more co-wives decreased from 47.6% in 1987 to 40.3% in 2018, that is, a 7.3 percentage points decrease over 31 years or a yearly average 0.24 percentage points decrease.

quality.

Fifth, even with the inclusion of all the controls mentioned above, not accounting for internal migration might be another potential threat to our identification strategy. Indeed, one may argue that internal migration creates a pathway for men wanting to have several wives to self-select into communities with a high prevalence of polygyny. However, in rural Mali— the setting of our empirical analysis— migration is rare. Indeed Hidrobo et al. (2022) find that between 2014 and 2016, men's migration to rural Mali occurred at an annual rate of merely 1.2%. This evidence has at least two important implications for our identification strategy. First, it assuages concerns about the potential selection bias, as men are unlikely to self-select into communes with a high prevalence of polygyny. Second, even if drought determines migration endogenously, this would not affect our estimation results.

After accounting for all the estimation challenges mentioned above, we find that, even though drought reduces crop yields in all affected rural communities, this adverse effect is lower in more polygynous than in less polygynous communes. This result is robust to various alternative specifications of the interaction between drought and commune-level polygyny.

Exploring the pathways of this buffering effect of polygyny prevalence, we find that, after drought, households living in highly polygynous communes receive non-local private transfers. This finding provides suggestive evidence that polygyny allows practicing households to leverage their larger non-local extended-family network as sources of external private transfer inflows they need to buffer the adverse effects of drought on their crop yields. Consistently with the previous result, the interaction of our drought variable with the prevalence of community-level polygyny positively affects the probability of a household using more fertilizers, spending more time in livestock activities, and engaging more in off-farm activities than those living in less polygynous communes. They also increase the family labor supply and spend more on hired labor.

The study reveals critical insights into how climate shocks like droughts impact socio-economic structures in drought-prone areas. Without strategies for resilience and adaptation, communities may continue to rely on polygyny. This practice helps them withstand income shocks, such as those caused by droughts. However, implementing solutions like irrigated agriculture and providing boreholes is essential. Without these, efforts to ban polygyny could meet with strong local opposition due to its role in community resilience. Given that this marriage practice increases fertility and intimate partner violence (Tertilt, 2005; Rossi, 2019; Ahinkorah, 2021a), any factor that causes it to persist, such as uninsured covariant risks, is likely to keep a drought-prone country into a high-fertility trap and higher gender inequality, in addition to undermining child human capital (Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Arthi and Fenske, 2018). Therefore, the design of effective public policy to eliminate this traditional practice must account for the cultural dimensions of economic resilience strategies in the affected communities.

This paper contributes to the literature on the effects of polygyny (Tertilt, 2005; Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Lawson et al., 2015; Arthi and Fenske, 2018; Rossi, 2019). Except for Lawson et al. (2015), the common denominator of contributions to this literature is that polygyny undermines development. It is harmful to women and children (Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Arthi and Fenske, 2018), and pushes fertility rates upward (Tertilt, 2005; Rossi, 2019). Lawson et al. (2015), in contrast, find that in certain environments, the costs of sharing a husband are offset by greater wealth, with polygynous households holding a significant advantage in terms of land and livestock. We contribute to this literature by providing evidence that a high prevalence of polygyny, by enabling households to leverage more expansive non-local extended family networks as a source of external private transfer inflows, is a cultural answer to climate shocks that threaten local livelihoods. It does so by allowing highly polygynous communities to be relatively more successful at buffering the adverse effects of droughts than the otherwise identical less polygynous communities.

Additionally, this paper contributes to the literature on risk-management strategies in village economies (Rosenzweig, 1988; Morduch, 1995; Platteau, 1997; Fafchamps and Lund, 2003; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007; Lange and Reimers, 2021). Most contributions to this literature analyze the buffering effects of community-based risk-sharing and self-insurance mechanisms. In particular, Kazianga and Udry (2006), Fafchamps and Gubert (2007), and Lange and Reimers (2021) all focus on the efficiency of community-based risk-sharing and risk-management mechanisms under covariant income shocks such as droughts. The consensus in this literature is that the presumed buffering effect of livestock breaks down in the context of droughts because the risks of crop failure and livestock loss are positively correlated when drought is the risk factor. We contribute to this literature by exploring the resilience effect of community-level polygyny following the occurrence of a negative aggregate income shock.

The paper is organized as follows. Section 2 reviews the literature on the causes of the disappearance of polygyny globally and its confinement to Sub-Saharan Africa. Section 3 presents the context and data. Section 4 lays out the framework for testing whether the prevalence of polygyny is a resilience mechanism against droughts. Section 5 reports the findings, and Section 6 investigates the mechanisms, while Section 7 concludes.

2 Community-Level Polygyny and Drought Risks

Polygyny —when a man marries multiple women— was a marriage institution in 80% of pre-industrial societies (Lawson et al., 2015). Today, this marriage institution has been outlawed throughout much of the world. In 2000, for example, the United Nations Human Rights Committee moved to ban this marriage institution.[4] Yet, it remains legal or generally accepted in 25 of the 46 countries comprising Sub-Saharan Africa (SSA), where the percentage of people living in polygynous households is highest globally, at 11% (Kramer, 2020).

2.1 On the Persistence of Polygyny in SSA: A Brief Literature Review

Given that the sex ratio in SSA has been near unity for decades (Jacoby, 1995), the reason why so many countries in this region still oppose the abolition of polygyny has been a matter of considerable debate. On the one hand, the literature has advanced our understanding of the forces driving its disappearance in the Western world (Jacoby, 1995; Gould et al., 2008), while also contributing evidence of its causal effect on multidimensional poverty in the developing world (Tertilt, 2005; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Arthi and Fenske, 2018). On the other hand, there is no consensus in this literature on why this marriage institution persists in Sub-Saharan Africa. For example, Jacoby (1995) argues that polygyny persists in SSA because women's comparative advantage in food production increases their value to men as husbands and household heads (Jacoby, 1995). However, Arthi and Fenske (2018) provides

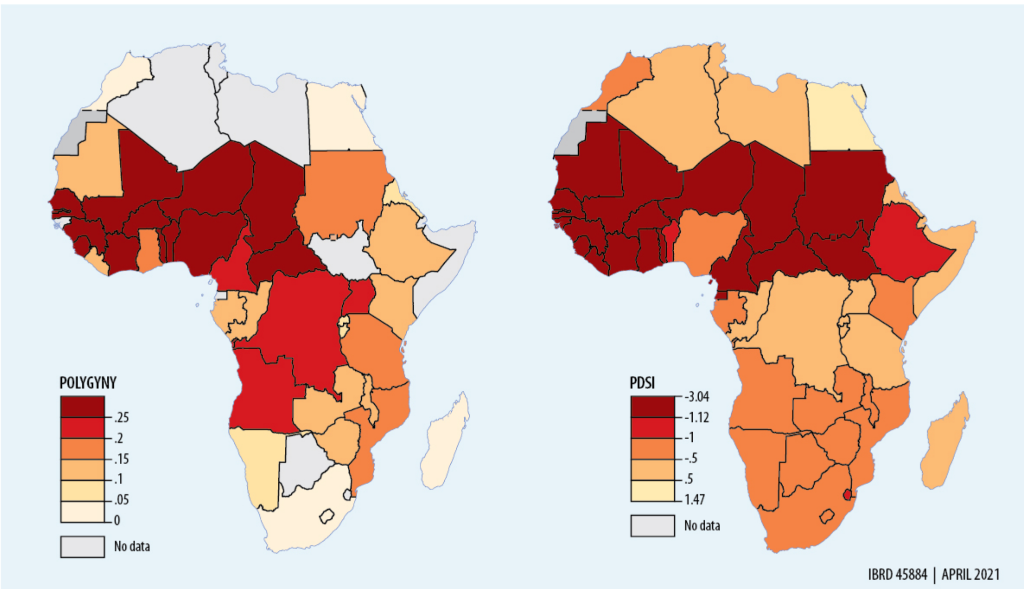
[4] See Human Rights Committee, General Comment 28, Equality of rights between men and women (article 3), U.N. Doc. CCPR/C/21/Rev.1/Add.10 (2000), available online at http://hrlibrary.umn.edu/gencomm/hrcom28.htm.

evidence that this cultural practice is least common in those parts of Sub-Saharan Africa where women have historically been most important in agriculture. This lack of consensus suggests that the socioeconomic forces contributing to the persistence of polygyny in SSA are still not well understood.

2.2 Are Drought-Prone Countries More Polygynous? A Visual Test

Interestingly, the drought-prone area of Sub-Saharan Africa —which stretches from Senegal on the Atlantic coast through parts of Mali, Burkina Faso, Niger, Nigeria, Chad, and Sudan to Eritrea on the Red Sea coast — almost coincides with the polygyny belt—stretching from Senegal to Tanzania. This positive correlation between areas prone to agricultural droughts and those where polygyny is prevalent is quite visible in Figure 2.

Figure 2: *Distribution of Polygyny and Drought in Africa*



Source: Authors elaboration based on DHS data (for polygyny) and Dai et al. (2004) (for drought – defined using the Palmer Drought Severity Index (PDSI), estimated as an average over the period 1968-2018).

The left panel of Figure 2, built using DHS data, shows the proportion of married women in polygynous unions. The right panel was built using Dai et al. (2004) and shows the Palmer Drought Severity Index (PDSI) at the country level, calculated over 50 years, from 1968 to 2018. It should be noted that a PDSI lower than -1 identifies drought episodes.

Countries like Burkina Faso, Mali, Senegal, Niger, and Nigeria, all of which are located in the western African part of the drought-prone Sahel region, report the highest proportions of women in polygynous marriages globally. A common characteristic of these countries is that their rural populations are highly dependent on rainfed production systems for their livelihoods and are highly drought-prone, making them vulnerable to agro-climatic conditions that predominantly affect rainfed production systems. Moreover, despite the high volatility of rainfed agriculture, which has been exacerbated by climate change, drought-prone sub-Saharan African countries appear to lag others in developing their irrigation sub-sector (Riddell et al., 2006). At the same time, the use of drought-resistant crop varieties among smallholder farmers also remains low (Frenken, 2005). All these factors heighten the risks of chronic food insecurity in drought-prone countries of Sub-Saharan Africa and raise the need for risk-management mechanisms as drought shocks become common occurrences due to climate change. Yet, despite the strong correlation between drought risks and the prevalence of polygyny, as shown in Figure 2, there has been limited interest in analyzing this relationship more closely. This paper is the first to examine this issue formally.

3 Context, Data, and Descriptive Statistics

We use Mali's data to test our hypothesis that polygyny enhances households' resilience after drought. Our data come from various sources, including the *Fourth General Census of Population and Housing (2009)*, the 2014 and 2017 *Enquête Agricole de Conjoncture Intégrée aux Conditions de Vie des Ménages (EAC-I)*, and climatological data.

3.1 Context

Mali is a landlocked, West African country located in the Sahel region and along the polygyny belt that stretches from Senegal to Tanzania (Jacoby, 1995). It is bordered on the north by Algeria, on the east by Niger and Burkina Faso, on the south by Côte d'Ivoire and Guinea, and on the west by Senegal and Mauritania. Mali is among the hottest countries in the world. Its two main geographic areas, North and South, each face different climatic conditions for agricultural production. The northern area is constantly threatened by desertification and population migration. The southern area, in contrast, is where the vast majority of its population is concentrated, deriving its livelihoods from rainfed subsistence agriculture and pastoralism.[5] About 65% of Mali's land area is desert

[5]FAO, 2017. Socio-economic context and role of agriculture. Mali Country Fact Sheet. Available online at http://www.fao.org/3/a-i7617e.pdf.

or semi-desert, which makes it particularly prone to droughts and increases its vulnerability to food price shocks. For example, in 2010, pastoral communities in northern Mali were affected by a food and nutrition crisis associated with a shortage of rainfall during the 2009 rainy season (Touré et al., 2012).

In Mali, agriculture accounts for more than 35% of GDP and 80% of livelihoods. Cotton is the main cash crop, while cereal grains (maize, millet, rice, and sorghum) constitute the main food crops. Animal husbandry contributes to 10% of the GDP and is the main resource for 30% of the population. The main constraints to agricultural production are low soil fertility, low and erratic rainfall exacerbated by climate change, and lack of irrigation infrastructure.[6]

In addition to the structural problems mentioned above, Mali also has one of the highest fertility rates in the world, at 5.9, tied for second with the Democratic Republic of Congo and behind Niger, which has a total fertility rate of 6.9 (World Bank, 2019). Over the years, the country has been experiencing a slow demographic transition due to the ongoing preference for large families, early childbearing, the lack of female education and empowerment, poverty, and extremely low contraceptive use.[7] Slowing Malis population growth by lowering its birth rate will be essential for poverty reduction, improving food security, and developing human capital and the economy. Yet, the country continues to be plagued by social factors known to increase total fertility. First, Mali ranks among the top five countries in the world, in terms of the prevalence of child marriage among married women aged $20-24$, with a prevalence of 54%, behind Niger (76%), the Central African Republic (68%), Chad (67%), and Bangladesh (59%).[8] Second, polygyny is legal in Mali, and 34% of individuals live in *polygynous households*, the second highest share globally, behind only Burkina Faso (36%). More precisely, according to the 2009 population Census, 20.2% of married people in Mali were in *polygynous unions* (Diamoutene, 2015). For married women, this proportion rises to 25.7%, while, for married men, it was 14.4%.

Figure A1, built using data from Mali's Fourth General Census of Population and Housing (2009), shows that polygyny is much more widespread in southern Mali, which

[6]FAO, 2017. Dual-purpose sorghum and cowpea intercropping in Mali. Available online at http://www.fao.org/agroecology/database/detail/en/c/1027957/.

[7]See CIA World Factbook, available online at https://www.cia.gov/the-world-factbook/.

[8]UNICEF global databases 2020, based on Multiple Indicator Cluster Surveys (MICS), Demographic and Health Surveys (DHS), and other national surveys.

is also where most of the country's population is concentrated. The population density in the northern regions of Tombouctou, Gao, Kidal, Taoudénit, and Ménaka is low. The prevalence of polygyny in southern Mali exceeds 45% in some communes. In the north, polygyny is relatively low compared to other regions – the highest prevalence is 15%. This could be explained by the fact that northern Mali is predominantly populated by ethnic groups (Sonrai 45% and Tuareg 32%) that pursue mainly nomadic pastoral livelihoods, including transhumance (Touré et al., 2012). Polygyny in Mali is also predominantly a rural phenomenon. Among married rural dwellers, 22.4% were in polygynous unions in 2009, while the corresponding figure in urban centers was lower, at 13.5%. The predominance of polygyny in rural areas is interesting because it suggests that rural life characteristics make this cultural practice more resilient.

All the above facts make Mali suitable for testing our main hypothesis: commune-level polygyny prevalence buffers crop yield losses due to drought.

3.2 Polygyny Data and Measurement

Our polygyny data are from the Fourth General Census of Population and Housing (2009). This census contains information on the demographics and socio-cultural characteristics of individuals and the communes in which they live. We use this information to construct our polygyny variable at the community level. In our data, we regroup households by commune—the smallest administrative unit in Mali—, distinguishing one commune from another based on its polygyny prevalence. We explained above the main advantages of measuring polygyny at the commune—instead of household— level. First, when polygyny is measured at the commune level, controlling for community-fixed effects helps to overcome selection bias. Second, as standard household surveys often fail to capture polygynous households when co-wives live in separate dwellings (Randall et al., 2011; Beaman and Dillon, 2012), measuring polygyny at the commune level allows us to correct this problem. Indeed, not properly accounting for this fact leads to misclassifying or misrepresenting polygynous (and monogamous) households Randall et al. (2011).

Our interest in commune-level polygyny stems from its hypothesized interaction with drought risk in communities dependent on rainfed agriculture for their livelihoods. For better comparability between low and high polygynous communities, we standardized our (commune-level) polygyny variable by subtracting it from its (country) mean and dividing by its (country) standard deviation (Iacobucci et al., 2016; Dalal and Zickar, 2012). This transformation does not change the interpretation of the coefficient of our interaction term (Allison, 1977).Thus, our results can be interpreted in units of standard deviation.

3.3 Main Outcome Data and Measurement

Our main data source is the *Enquête Agricole de Conjoncture Intégrée aux Conditions de Vie des Ménages* (EAC-I). We use EAC-I's 2014 and 2017 rounds (EAC-I 2014 and EAC-I 2017). EAC-I 2014 and EAC-I 2017 are nationally representative[9] multi-topic household surveys with a focus on agriculture. These surveys were implemented by Mali's Ministry of Agriculture under the Living Standards Measurement Study Integrated Surveys on Agriculture (LSMS-ISA) program.[10] It contains detailed information on the socioeconomic characteristics of farm households, as well as about the crop production activities (type and quantity of fertilizers, pesticides, seeds, credit, etc.). Information is collected at the level of the cultivated plots (area, soil quality, etc.), as well as on the seasonal crops produced (quantity harvested, area on which the crop was harvested, etc.). The EAC-I also contains crucial GPS information that allows us to identify enumeration areas that are exposed to local rainfall shocks.

For each edition of the survey, households were visited twice: the same households interviewed on the first visit were re-interviewed on the second visit, and the visits were planned to match the timing of the post-planting (between August and October) and post-harvest (November and February, with 82 percent of households being interviewed in January) periods of the 2014/15 and 2017/18 agricultural rainy seasons. Households interviewed in the EAC-I 2014 differ from those interviewed in the EAC-I 2017. However, the same Enumeration Areas (EA) were visited during these two surveys. Combining the EAC-I rounds and excluding the urban areas to focus on the rural population, we obtain a final sample of 4,008 farm households (1,961 in 2014 and 2,047 in 2017[11]). Since

[9] The sample covers all regions and areas (urban and rural) except the region of Kidal, excluded for security reasons from the sample.

[10] The Living Standards Measurement Study Integrated Surveys on Agriculture (LSMS-ISA) provides financial and technical support to Sub-Saharan African governments in designing and implementing multi-topic, national, panel household surveys with a strong focus on agriculture. The EAC-I data and documentation are publicly available at https://microdata.worldbank.org/index.php/catalog/lsms.

[11] EAC-I 2017 sample is restricted to the sample of households that received the full questionnaire. For a description of the sample and the questionnaire distribution, see the Basic Information Document of

our main specification is at the household-crop level, the total number of observations is 10,663 (5,550 in 2014 and 5,113 in 2017).[12]

Our main variable of interest is crop yield, which we define as the ratio of crop output value reported by the household over the area occupied by the crop on the plot. One of the main advantages of the EAC-I data is that the plot size is measured by GPS. This avoids measurement errors that lead to biased results. We aggregate crop yield at the household-crop level. Our data indicate that crop yield does not vary according to the extent to which polygyny is practiced in the commune. Indeed, as shown in Table 1, crop yield (in inverse hyperbolic sine) is around 11.9 LCU for both households in communes with below and above the median polygyny's prevalence.

3.3.1 Data and Measurement for Mechanisms' Outcomes

This sub-section presents the variables we use as the mechanism of our results. Descriptive results of these variables are reported in Table 1 and are shown by households living in communes with below and above the median polygyny's prevalence.[13]

(i) Non-Local Private Transfer Inflows

We define non-local private transfer inflows as all cash or in-kind transfers received by a household residing in a given commune in the past year from non-residents of the commune. Indeed, the questionnaire allows for distinguishing the origin from where the private transfers were sent. On average, about 10% of non-local private transfers were sent from the same locality, 30% from the capital city Bamako, 18% from elsewhere in Mali, 20% from elsewhere in Africa, 13% from France, and the remaining share from other places. We excluded private transfers from the same locality because our hypothesis is that households would receive transfers from other localities to buffer the consequences of covariant shocks like drought. Separate analyses use transfers from the same community to further corroborate our hypothesis. In addition, in our econometric analyses, we provided different definitions of non-local private transfer inflows, including (a) all cash transfers, (b) cash and in-kind non-food transfers, and (c) all cash and in-kind transfers. Finally, we specify our private transfer variable in two ways, first, as a binary

EAC-I 2017 at https://microdata.worldbank.org/index.php/catalog/3409.

[12] 427 observations have been omitted due to lack of information on production and/or outliers on production, yields, acreage, etc.

[13] It would be interesting to test the mediating role of polygyny on household welfare, as a direct mechanism of our results. However, only EAC-I 2014 survey collected data on household expenditure.

indicator equal to 1 if a household reported receiving non-local non-local private transfers and 0 otherwise. Second, as a continuous variable measuring the amount of money received as a non-local private transfer.

(ii) Farm Inputs

Farm inputs have a major role in contributing to crop yield. Therefore, in investigating mechanisms likely to drive the effect of polygyny on households' resilience to drought, we explore the effect of commune-level polygyny on households' use of chemical fertilizers, improved seeds, and on-farm labor.

We measure fertilizers as the inverse hyperbolic sine transformation of the expenditure on fertilizers used on on-farm plots during the agricultural season. Table 1 shows that households living in communes with above the median polygyny prevalence spend significantly more on fertilizers than households in low-polygyny communes, which increases agricultural labor productivity in the former compared to the latter (Boserup, 1985; Jacoby, 1995).

Similarly, improved seeds are the inverse hyperbolic sine transformation of the expenditure in improved seeds used on farm plots during the agricultural season. Among the households in our sample, the expenditure on improved seeds is significantly higher in low-polygyny communes (Table 1).

Polygyny can also influence crop yield through the use of the labor force. In fact, polygyny increases fertility (Rossi, 2019), which tends to increase the size of the household's labor force. Labor is defined in our analysis as the sum of the total days worked (for soil preparation, seeding, weeding, crop treatment, and protection, harvesting, and threshing) by family members and hired workers on the farm. Table 1 shows that in our sample, the average number of days of labor employed for crop activities is 374.96 days, and it is significantly higher in high-polygyny communes than in low-polygyny communes (419.04 and 312.99 days, respectively).

(iii) Livestock activities

The detailed information on livestock ownership and production included in the EAC-I is used to construct the total value of production and the costs associated with livestock activities. Table 1 shows that there is no significant difference in this variable between households living in low and high-polygyny communes. Livestock sales contribute to family food security by providing financial resources that can be used directly to obtain food or to develop and improve the family's production system (Schiere and Katere, 2001). As part of our exploration of mechanisms, we also test the combined effect of weather shock and commune-level polygyny on animal husbandry, measured as days of work in livestock activities by household members. If we look at the whole sample, households in low-polygyny communes spend more days in animal husbandry than households in high-polygyny communes. This counter-intuitive result is explained by the fact that households in low-polygyny communes are more likely to be involved in livestock activities. However, if we exclude the households not involved in such activities, we find that the households in high-polygyny communes spend more days in animal husbandry than households in low-polygyny communes (not shown here).

(iv) Off-Farm Activities

As for animal husbandry, off-farm activities are household income sources. For example, polygynous households (usually with many children) may send one or more of their children (daughters) to the city to do domestic work. The income earned from these children's labor could be used to buy fertilizers or to modernize the family's agricultural production system. We construct two off-farm variables to test this mechanism. The first variable is the value of income from off-farm activities. The second outcome is the number of off-farm work days household members spend. While there is no significant difference in off-farm income, households in low-polygyny communes spend more days in off-farm activities than households in high-polygyny communes. However, the same argument for animal husbandry holds here. Households in high-polygyny communes are less likely to be involved in off-farm activities. Indeed, if we consider only the households involved in off-farm activities, we find that the households in high-polygyny communes spend more days in such activities than households in low-polygyny communes (not shown here).

3.4 Drought Data

Following Harari and Ferrara (2018), Miao and Popp (2014) and Vicente-Serrano et al. (2010), we use the Standardized Precipitation-Evapotranspiration Index (SPEI) to construct a measure of droughts. Our SPEI data are from the SPEI Global Drought Monitor. The SPEI Global Drought Monitor provides information on drought on a global scale. The SPEI time scales provided range from 1 to 48 months, and the SPEI calibration period for our data is from January 1950 to December 2019.

Our SPEI value is observed during Mali's 2014 and 2017 rainy seasons (June-October). We use GPS information from EAC-I data to match each EA to the SPEI grid cell and calculate rainfall shocks at the EA level. Drought occurs if and only the SPEI value is below -1.5, which captures severe to extreme droughts (Vicente-Serrano et al., 2010). Interestingly, the SPEI index accounts for the joint effects of precipitation, potential evaporation, and temperature. This measure then allows controlling for weather variables strongly correlated with rainfall. This index is, therefore, less susceptible to omitted (weather) variable threats.

In Mali, rains are brought seasonally by monsoon winds that feed the lower layers of the atmosphere with water vapor (Jean, 1985). In recent years, climatic droughts seem almost endemic in Mali. Figure A2 reports the spatial frequency of drought occurrences in Mali EA based on the SPEI in 2017. In 2014 cumulative rainfall was normal or above normal throughout Mali (*i.e.*, no severe to extreme drought occurred in 2014), while in 2017, 12.6% of the EA experienced drought episodes (285 households, and 839 observations at the household-crop level).

4 Empirical Strategy

In this section, we discuss our empirical model. We use a linear fixed-effect regression model to provide evidence that commune-level polygyny prevalence buffers crop yield losses induced by agricultural droughts. The unit of observation for crop yield is the household crop. We specify the following baseline regression model:

$$Q_{chijt} = \beta_1 Drought_{it} + \beta_2 Drought_{it} \times Poly_j + \beta_3 X_{hijt} + e_h + \rho_c + \eta_t + \lambda_i + \epsilon_{hijt}, \quad (1)$$

The dependent variable Q_{chijt} is the natural logarithm of crop c's yields for a household h living in EA i (located in commune j) at time t. X_{hijt} is a vector of household head and farm characteristics, including head's sex, household size, the ratio of female household members, the ratio of household members aged 0-15, use of chemical fertilizers, area of cultivated land, labor applied per ha (person-day of labor), and quintile of households wealth index. $Drought_{it}$ is a time-varying variable measuring drought occurrence at EA i in year t; $Poly_j$ measures polygyny prevalence in commune j. We include e_h and ρ_c to control for household ethnic group and crop-specific invariant effects, respectively, EA fixed effects λ_i to account for the potential correlation between unobserved time-invariant factors at the EA level and polygyny prevalence, and year η_t fixed effects to account for year effect. ϵ_{chijt} is a zero-mean error, which captures the effect of unobserved factors that influence crop yield. Robust standard errors are clustered at the EA level.

The effect of drought on crop yield is captured by the parameter β_1 (drought), which we expect to be negative. $\beta_2 \times Poly_j$ represents the effect of droughts on crop yield in more polygynous communes. The overall effect of drought on crop yield in more polygynous communes depends on the extent of polygyny prevalence in those communes. Conditional on household wealth and EA and year-fixed effects, this overall effect is equal to $\beta_1 + \beta_2 \times Poly_j$. Therefore, when:

$$\beta_2 > 0, \text{polygyny prevalence buffers crop yield losses,} \tag{2}$$

$$\beta_2 = 0, \text{ it has no effect,} \tag{3}$$

$$\beta_2 < 0, \text{it exacerbates crop yield losses.} \tag{4}$$

The sign of β_2 cannot be determined theoretically because it depends on the extent to which commune-level polygyny prevalence creates mutual insurance opportunities.

4.1 Identification Challenges and Methodological Issues

Upon controlling for geographic and time-fixed effects, identification of the drought effect and the mediating role of polygyny relies on the variation of droughts across time and communes and the variation in polygyny prevalence across communes. While the identification of drought is quite standard in the literature (e.g., Kaur, 2019; Corno et al., 2020), it is worth discussing the challenges that might affect the identification of the mediating role of polygyny and how we address them. The main concern is that commune-level polygyny prevalence may be endogenous.

Differences due to observable correlates of polygamy: Communes with a high proportion of polygynous households may have different characteristics (geographic, cultural, infrastructural, etc.) than less polygynous communes. This could affect crop yield and their resilience to drought events. For example, if most polygynous communes are located in more fertile areas, households living in these areas will tend to have higher crop yields than households living in less polygynous communes. Or, if communes with higher polygynous rates are located closer to a rural market, a road, or a town or are more likely to have access to irrigation systems, we can presume that such locations have more off-farm work opportunities for households or are less dependent on rainfall, therefore allowing them to better diversifying their revenues and making them more resilient to climate shocks. In addition, based on Jacoby (1995)'s findings, communities with higher polygyny rates are expected to be wealthier and to show larger average household size and manpower (to which polygyny contributes), higher use of production inputs and technology, and more productive assets. Hence, we could (wrongly) attribute the yield differential to the impact of polygyny prevalence. First of all, we address this potential threat to identification using EA fixed effects. These EA-level fixed effects capture average differences in geographic, economic, and cultural factors that do not vary over time. Second, we control for various time-variant household and community characteristics that can be correlated with polygyny prevalence, such as household wealth and other baseline controls X_{hijt} included in equation 1, access to irrigation systems and production inputs, and several community-level infrastructural factors. Nevertheless, differences between communities with different levels of polygyny incidence might drive our key result. To further strengthen the validity of our results, we perform the following analyses:

- Polygyny's effect may still differ with respect to basic household and community characteristics. To account for this issue, and following Heath et al. (2020), we specify an alternative empirical model similar to the baseline model, except for the addition of the interaction of polygyny prevalence with each control variable. The underlying regression equation is written as follows:

$$\begin{aligned} Q_{chijt} =& \beta_1 Drought_{it} + \beta_2 Drought_{it} \times Poly_j + \\ &+ \beta_3 X_{hijt} \times Poly_j + e_h + \rho_c + \eta_t + \lambda_i + \epsilon_{chijt} \end{aligned} \tag{5}$$

- The mediating role of polygyny can be driven by observables that differ between high and low polygyny communities. Based on the t-test results reported in Table 1, we augmented the baseline specification by adding the interaction between drought and the X_{hijt} that statistically differ between communities with below and above the median polygyny rates. These X^*_{hijt} are household size, use of chemical fertilizers, area of cultivated land, and labor applied per hectare. Specifically, the following specification is estimated:

$$Q_{chijt} = \beta_1 Drought_{it} + \beta_2 Drought_{it} \times Poly_j + \\ + \beta_3 Drought_{it} \times X^*_{hijt} + e_h + \rho_c + \eta_t + \lambda_i + \epsilon_{chijt} \quad (6)$$

- Moreover, the buffering effect of the commune-level polygyny prevalence may be a reflection of the effect of its correlates. To address this issue, we control for the interaction between drought and household ethnicity — a predictor of ethnicity-level traditional customs (Desmet et al., 2017):

$$Q_{chijt} = \beta_1 Drought_{it} + \beta_2 Drought_{it} \times Poly_j + \beta_3 Drought_{it} \times e_h \\ + \beta_4 X_{hijt} \times Poly_j + e_h + \rho_c + \eta_t + \lambda_i + \epsilon_{chijt} \quad (7)$$

Rainfall deviations could affect commune polygyny rates: Over a short period of time covered by our data set (2014 and 2017), and based upon the slow-changing nature of cultural practices like polygyny, we can reasonably assume that polygyny prevalence in a commune is not affected by omitted time-variant variables. Nonetheless, one could argue that areas that experienced different rainfall levels in 2014 exhibited differential changes in polygyny from 2014 to 2017. Should such a pattern be observed, concerns may arise had polygyny increased after favorable rainfall, as this could potentially underpin observed correlations between enhanced economic resilience and greater use of inputs in higher-polygyny areas. To verify if this concern is found, we used EAC-I 2014/EAC-I 2017 to construct the delta of the commune polygyny level between 2014 and 2017 and regressed it on SPEI in 2014 and its interaction with the 2014 value of commune polygyny. As shown in Table A1, we do not find any statistically significant relationship. Nevertheless, our main measure of polygyny is built on an external data source and, more importantly, refers to the year 2009, so independent of the shocks observed in our study period.

Time trend in polygyny and soil quality: Finally, our results may be affected by the time trend of polygyny's prevalence and soil quality. We interact both variables with the year indicator to account for these potential confounders.

Spatial Correlation: A serious problem confronting our estimates is the potential presence of spatial correlation in the error term due to the tendency of both droughts and polygyny to be clustered in space. Although droughts can happen randomly over time, they often tend to be clustered across neighboring geographic units (Hsiang et al., 2011).

Likewise, polygyny, as a cultural practice, is often clustered in geographic units that share similar livelihoods and cultural values (Lawson et al., 2015). To account for this problem, we adjust the standard errors using the method developed by Conley (1999) and Hsiang et al. (2011). In particular, we correct standard errors by allowing for spatial correlation across the EAs within a radius of 52 km (the median distance across EAs) and serial correlation.

Furthermore, there is the potential presence of spatial correlation due to omitted weather variables (Auffhammer et al., 2013). To account for this problem, we rely on a measure of drought during the agricultural season, using the Standardized Precipitation-Evapotranspiration Index (Vicente-Serrano et al., 2010; Miao and Popp, 2014; Harari and Ferrara, 2018).

5 Results

This section presents and discusses the estimation results of our various regression specifications. We also discuss the results of robustness checks and the mechanisms.

5.1 Baseline Estimation Results

The results of our baseline model are reported in Table 2. We start with a parsimonious specification where we control only for the year, EA, crop, and ethnicity fixed effects (see column 1). Column 2 of Table 2 – our baseline – reports the results of our first specification (Equation 1). Drought reduces crop yield in rural Mali. This is consistent with the fact agriculture is predominantly rainfed. Column 2 indicates that drought occurring in the current agricultural season (t) reduces crop yields by 63.18%.

Table 2 also shows that interacting drought and polygyny prevalence positively affects crop yields, implying that commune-level polygyny buffers loss of crop yields induced by drought at the commune level. In other words, in communes that experienced drought episodes, a one standard deviation increase in the commune-level prevalence of polygyny within a given rural commune fully mitigates its adverse effect on crop yields (as reported by the equality test in the table). The higher polygyny prevalence in a commune, the stronger its mitigating effect on drought. These results indicate that polygyny prevalence acts as a coping mechanism against agricultural droughts. They are consistent with the literature (Akresh et al., 2012; Damon and McCarthy, 2019), suggesting that polygyny increases crop yields. Column 3 of Table 2 reports the results of the second specification (Equation 5), *i.e.*, that controls for the interaction between polygyny prevalence and time-variant characteristics. Moreover, column 4 shows the results of the baseline specification augmented by the interaction terms between drought and control variables that are statistically different between communities with below and above the median polygyny's prevalence rates (Equation 6). The coefficients of interest are statistically significant for all specifications and are qualitatively the same.

Finally, our results are unaffected when we account for spatial correlation across EAs (column 5), cultural correlates of polygyny — by interacting drought with household ethnic identity (column 6) — and for time trends of polygyny's prevalence (column 7) and of soil quality (column 8), and possible socio-economic and structural correlates of polygyny (column 9). Indicators of soil quality include nutrient availability, nutrient retention capacity, rooting conditions, oxygen availability to roots, excess salts, toxicity, and workability (constraining field management) (for column 8), while infrastructural factors are the proximity to the border crossing, nearest road, and district's capital town, along with household access to an irrigation system (for column 9).

5.2 Heterogeneous Effect by the level of Polygyny and by Crop Type

We have just shown that polygyny prevalence in a commune affected by drought mitigates crop failure, thereby buffering the loss of livelihoods among households residing in that commune. In this subsection, we explore whether such a buffering effect is linear and investigate the types of crops that provide a pathway for polygyny prevalence to buffer yield loss against the adverse effect of droughts.

Quartile of polygyny prevalence: As stressed earlier, the mutual insurance mechanism can materialize only if polygyny is sufficiently large in a commune. If its prevalence is too low, the wage rate for hired labor would likely be too low to allow monogamous households to make the needed investment to enhance crop yield against drought. In other words, the buffering effect would result only in communes with a sufficiently large incidence of polygyny. To test this assumption, we define polygyny quartiles. The average prevalence of polygyny in each quartile is 14.4% in the first quartile, 20.9% in the second quartile, 24.9% in the third quartile, and 32.1% in the fourth quartile. Consistent with this argument, we find that only the coefficient of the interaction between drought and the fourth quartile of polygyny prevalence is statistically significant (see column (10) of Table 2).

Type of crops: We divide crops in our sample into care-intensive crops and care-saving crops. In contrast to care-saving crops, care-intensive crops are labor-intensive as they require significant care during the growth cycle. We use the classification of care-intensive crops and care-saving crops provided by Guirkinger et al. (2015). According to this classification, rice, cotton, maize, and vegetables are care-intensive crops. In contrast, sorghum, millet, fonio, and niebe are care-saving crops.

Crops such as sorghum, millet, fonio, and niebe are traditional crops prevalent in the Sahel region, including Mali. By contrast, cotton, rice, and maize are cultivated in many other geographic areas worldwide, including in developed countries where drought-resistant varieties have been developed (Tirado and Cotter, 2010). The availability of drought-resistant cotton, rice, and maize seeds in the international market can enhance the adaptation of rural households in the Sahel region, where droughts are a recurrent phenomenon. Moreover, there is also evidence in Sub-Saharan Africa that inter-cropping maize with a legume tree— small tree, shrub, or undershrub — helps soil hold water longer than in maize monocultures (Makumba et al., 2006). Such inter-cropping also yields a double dividend, particularly for farm households engaged in animal husbandry, as legume trees are an important component of the fodder resources for livestock. According to the Food and Agriculture Organization (FAO), the fodder value of their leaves and fruits is very high. For example, in arid and semi-arid zones, such as the Sahel, legume trees provide the largest part of the protein supply during the driest months (Devendra, 1992). The above-mentioned facts suggest that for Mali's farmers, switching to care-intensive crops such as maize and rice may be an effective adaptation strategy to recurrent droughts in the country.

Table A2 reports the results of our estimations. Column 1 reports the estimation results for care-saving crops, and column 2 those of care-intensive crops. Table A2 shows that the buffering effect of polygyny prevalence is entirely driven by the care-intensive crops. The coefficient of drought-polygyny interaction is positive and statistically significant for care-intensive crops but not for care-saving crops.

6 Mechanisms

Our results suggest that community-level polygyny can mitigate the adverse effects of drought on crop yields. In particular, the interaction of commune-level polygyny and drought is positive and statistically significant. A logical question, therefore, is: what are the underlying mechanisms?

The literature on climate shocks outlines several resilience strategies for farmers living in drought-prone agricultural communities. This includes the use of modern agricultural inputs (e.g., drought-resistant seeds and drought-tolerant fertilizers), intercropping, diversification of sources of income (including off-farm work), and the use of hired labor (Schiere and Katere, 2001; Gitz et al., 2012). However, leveraging these resilience strategies requires farming households to access economic resources. Interestingly, the literature on risk management in village economies finds that community-based risk-sharing mechanisms break down in the presence of spatially covariant risks such as droughts (Townsend, 1994; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007). Indeed, multiple sources and types of risk affecting rural households have been documented in village economies (Townsend, 1995; Fafchamps et al., 1998; Kazianga and Udry, 2006), and their response to these risks analyzed both at the individual (Rosenzweig, 1988; Morduch, 1995) and community (Platteau, 1997; Fafchamps and Lund, 2003; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007) levels. Two significant findings emerge from this literature. First, risks related to recurrent shocks are widespread in the developing world, making them one of the largest contributors to rural poverty. Second, existing community-based risk-management arrangements are helpful strategies for coping with idiosyncratic shocks but are largely inefficient in the face of systemic covariant shocks such as droughts. Moreover, while households holding non-liquid assets such as livestock might have been viewed as a buffer of this type of shock, evidence rejects this hypothesis (Fafchamps and Lund, 2003; Kazianga and Udry, 2006; Lange and Reimers, 2021). These findings suggest that households in village economies must have access to external sources of risk insurance to cope effectively with droughts. In this context, the struggle to survive may induce farming households to harness traditional institutions to access external sources of cash to enhance livelihood resilience.

In this subsection, we perform two tasks. First, we test whether more polygynous communities attract more inflows of non-local private cash transfers than their less polygynous counterparts. The underlying idea is that to the extent that marriage is patrilocal,[14] married women may be migrants from different geographic areas (Rosenzweig and Stark, 1989), thus becoming potential sources of non-local private transfers for their marital households. Indeed, Figure 1 built from DHS data shows a positive correlation between polygyny prevalence in a community and the share of married women who migrated into this community. Therefore, a man living in an environment prone to ecological stress that threatens livelihood may resort to polygyny as risk insurance to increase the probability of receiving non-local private cash transfers in the event of a drought. If so, one would expect communities with a high prevalence of polygyny to be recipients of more non-local private transfers when drought occurs than those with a lower prevalence of it. Second, we test whether drought induces more polygynous communes to adopt the resilience strategies discussed above compared to less polygynous but otherwise similar communes.

Here, we outline our empirical strategy for testing if a high polygyny prevalence in a commune increases non-local private transfer inflows received by the community, the use of commercial farm inputs, and involvement in off-farm activities. More specifically, we test whether, compared to their less polygynous counterparts, highly polygyny communes receive more non-local private cash transfers, spend more on fertilizers, and hire labor when exposed to drought. Furthermore, to test whether drought induces households in more polygynous communes to engage in off-farm activities than their counterparts in less polygynous communes, we focus on participation in livestock activities (such as transporting livestock to selling points) and in non-agricultural work (such as transporting charcoal, wood, or water for drinking and other domestic use). The idea here is that because drought tends to induce livestock starvation, households may engage in "a fire sale" (Kazianga and Udry, 2006) or sell energy products and water, traveling to nearby cities to sell them. To do this, they may need to pay for transportation or hire extra workers to cater to their livestock, charcoal, wood, or water during the journey to the market. Thus, the more non-local private transfer inflows a community receives, the more opportunities for off-farm work within the community during drought.

To conduct these tests, we replicate the model in equation (1) by controlling for year

[14] Estimates based on the Murdock ethnographic atlas reveal that 100% of ethnic groups in Mali are patrilocal, i.e., newly married couples reside with or close the husband's parents.

and EA fixed effects for each outcome mentioned. Except for total and family labor, our data on the above-mentioned variables are left-censored as they have many zero values. If we ignore censoring, the effect of our explanatory variables would be underestimated. Therefore, we use the semiparametric method for censored estimation developed by (Honoré, 1992), which, unlike typical maximum likelihood estimators for censored variables, accounts for fixed effects in a consistent way. We estimate the following censored model:

$$Y^*_{hijt} = \beta_1 Drought_{it} + \beta_2 Drought_{it} \times Poly_j + \beta_3 X_{hijt} + e_h + \eta_t + \lambda_i + \epsilon_{hijt}, \quad (8)$$

with $Y_{hijt} = max\{0, Y^*_{hijt}\}$, and where Y_{hijt} represents the outcome mechanism, i.e., non-local private transfer inflows into the community, expenditure on fertilizers, improved seeds, and on-farm hired labor; on-farm total and hired labor in days; the value of production and costs from livestock activities and the days of work spent by household members in livestock activities; income from off-farm activities and days of work spent by household activities in off-farm activities for household h, Y^*_{hijt} represents their unobserved latent variables, and X_{hijt} variables are the heads sex, household size, area of cultivated land and quintile of households wealth index. In separate estimations, non-local private transfer inflows are also defined in a dichotomous way, identifying whether a household received such transfers or not; in such a case, a linear probability model with time and spatial fixed effects was used.

6.1 Does a High Polygyny Prevalence Increase Non-local Private Transfer Inflows During Drought?

In this section, we test whether highly polygynous communes can attract more non-local private transfers during drought years compared to their less polygynous counterparts.

To leverage the resilience strategies discussed above for livelihood resilience during drought, households must have access to external sources of economic resources. This includes money to buy fertilizers, hire labor, pay user fees for water access, or transport livestock. However, the issue is: to the extent, as the literature holds, community-based risk insurance mechanisms break down in the presence of covariant shocks such as drought and farm households do not have access to formal financial institutions for loans, how do they finance their resilience strategies identified above? Our test result provides the answer to this question.

We estimate equation (8) with continuous non-local private transfer inflows as the outcome (and a linear probability model when these non-local inflows are defined as a dichotomous variable). We specify our commune-level polygyny variable as a categorical variable corresponding to the first, second, third, and fourth quartiles of polygyny prevalence. The results of this estimation are reported in Table 3. We find that the coefficient of the interaction of drought with a given quartile of polygyny is positive and statistically significant only for the fourth quartile of polygyny. This result indicates that a high polygyny prevalence in a given community increases private transfer inflows during drought.

Finally, in columns 4 and 8 of Table 3, we define the outcome by including local private transfers but excluding non-local transfers in dichotomous and continuous indicators, respectively. As expected, we found no significant effect of the interaction between drought and higher quartiles of polygyny. These results strengthen the hypothesis that polygyny, through an extended and beyond-the-commune family network, serves as a coping strategy in case of drought.

6.2 Does a High Polygyny Prevalence Increase Resilience Effort during Drought?

The results of our different estimations are reported in Tables 4, 5, and 6. We separate the estimation results of polygyny's effects on households' resilience strategies into three groups: (i) farm inputs, (ii) diversification of income sources from livestock, and (iii) off-farm activities.

(i) Farm inputs

In Table 4, we present the test results for the hypothesis that more polygynous communes can leverage improved crop variety and use fertilizers as a resilience strategy. Starting with intermediate farm inputs, we find drought has no statistically significant effect on household expenditures on either chemicals (Column 1) or improved seeds (Column 2). The result in Column 2 was expected because agricultural drought takes place after seeds have been bought and planted (Li et al., 2013). However, compared to less polygynous communes, households in more polygynous communes increase their fertilizer expenditures in response to drought (Column 1). This is expected because the use of drought-resistant fertilizer enhances crop recovery from drought. We don't expect polygyny to play a role in improved seed use in the event of drought because their purchase and use usually precede drought (Li et al., 2013), and our results in Column (2) of Table 4 concur.

Regarding the use of labor, we find that drought decreases expenditures on hired labor. However, compared to households living in communes with a lower prevalence of polygyny, households living in more polygynous communes spend more on hired labor when a drought occurs. In addition, drought decreases the number of days of farm work by roughly 328 for total labor used and by roughly 241 for family labor. However, compared to their counterparts from less polygynous communes, households in more polygynous communes increase their number of days of farm work by 193 days for total farm labor used and by 176 for family labor. This implies that polygyny buffers the negative effect of drought on a household's farm labor productivity.

(ii) Diversification through farmers' involvement in livestock production

Diversification of income sources is also a well-documented resilience strategy in drought-prone rural regions Wan et al. (2016). By diversification of income sources, we mean the addition to the household's farm income of earnings from off-farm work. This includes households' simultaneous involvement in crop production, animal husbandry, non-agricultural employment, and non-local private transfer inflows.

Here, we explore whether polygyny prevalence influences a household's ability to diversify between farm work and livestock production. Results of this estimation are reported in Table 5. We find that households in more polygynous communes increase the value of production from livestock activities after a drought compared to households living in less polygynous communes (Column 1). In addition, they also increase expenditures on inputs for livestock activities, including expenditures on hired labor (Column 2).[15] Finally, we also find that drought increases participation in livestock activities among children aged $12-18$ (Column 3). However, relative to less polygynous communes, drought in more polygynous communes increases family labor supply among adult individuals—i.e., individuals aged $18-60$ (Column 5).

These findings suggest that more polygynous communities are able to leverage di-

[15]Our data do not allow for the disaggregation of household expenditures between hired labor and other inputs into livestock activities. Such disaggregation is available only for the 2017 round of data. According to data from that round, expenditures on hired labor amounted to about 25% of the total expenditures on livestock inputs.

versification as a resilience strategy compared to less polygynous ones.

(iii) Diversification through participation in non-agricultural work

Another potential mechanism through which the prevalence of polygyny can enhance farm households' resilience to drought is the diversification into non-agricultural employment. Non-agricultural activities can flourish in rural areas if and only if there is a local market for non-agricultural goods. Such activities may include using wheeled carts pulled by horses or donkeys for long-distance transport of charcoal, wood, livestock, or water for drinking and other domestic use (Starkey, 2004). We test this mechanism by estimating the effect of the interaction between drought and polygyny prevalence on farm households' participation in non-agricultural employment.

Table 6 reports the results of this estimation. First, we find that drought decreases income from off-farm activities among farm households (Column 1). More importantly, relative to their less polygynous counterparts, more polygynous rural farming communes increase participation in off-farm activities in response to drought (Column 2), particularly among active adults (Column 4). Because the prevalence of polygyny determines the volume of non-local private transfer inflows into the community, our results indicate that such inflows create employment opportunities within it, allowing transactions involving non-agricultural goods to take place during the drought. Hence the diversification of income sources in such communities compared to their less polygynous counterparts.

7 Conclusion

This paper extends the literature on risk coping in village economies by analyzing the buffering effect of commune-level polygyny prevalence on crop yield losses induced by droughts. We study the interacting effect of commune-level polygyny prevalence and drought episodes in the context of rural Mali—a drought-prone country located on the polygyny belt in the West African Sahel region.

We demonstrate that highly polygynous communities are relatively more effective at buffering drought's adverse effect on crop yields because they use more commercial inputs, hire more farm labor, and diversify their sources of income during drought. We identify the buffering effect of polygyny prevalence resulting from polygynous households' comparative advantage at diversifying external sources of non-local private transfer inflows– a form of risk insurance against drought. We argue that these private transfer inflows have a trickle-down effect going from polygynous households to non-polygynous ones residing in the same community, for example, through the creation of non-agricultural employment opportunities locally.

Our study reveals intriguing insights into how vulnerability to aggregate income shocks like droughts raises the significance of culture as a source of economic resilience strategies for affected communities. Notably, in the absence of public intervention to enhance the transition from rainfed to irrigated agriculture and to provide formal risk management options in drought-prone regions, communities may continue to rely on polygyny. Such interventions may help them withstand income shocks, such as those caused by droughts. Without this structural transformation of agriculture, efforts to eliminate polygyny could meet with strong opposition due to its role in community resilience.

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Table 1: *Descriptive statistics*

	Whole sample		**Commune polygyny rate**				
			Below median		Above median		
	mean	std dev	mean	std dev	mean	std dev	ttest
Household-crop level	**Obs. 10,474**		**Obs. 5,193**		**Obs. 5,281**		
Yield value(LCU, 2014 prices)[a]	11.8988	0.0278	11.9147	0.0434	11.8816	0.0344	
Yield, value (LCU, 2014 prices)	275,716	30,430	288,542	20,883	261,877	59,125	
Commune level	**Obs. 537**		**Obs. 305**		**Obs. 232**		
Standardized commune polygymy[b]	0.3800	0.9400	-0.2300	0.6300	1.1700	0.6300	***
Commune polygymy, rate	0.2300	0.0700	0.1800	0.0500	0.2900	0.0500	***
Household level	**Obs. 3,941**		**Obs. 2,119**		**Obs. 1,822**		
Drought (0,1) (SPEI<-1.5)	0.0723	0.0054	0.0398	0.0058	0.1052	0.0082	***
Household size	12.1735	0.1777	10.6289	0.2028	12.9764	0.2408	***
Share of female members	0.4871	0.0032	0.4880	0.0042	0.4863	0.0039	
Share of members aged 0-15	0.5185	0.0036	0.5124	0.0054	0.5225	0.0047	
Wealth Index	2.5617	0.0297	2.6039	0.0367	2.5437	0.0361	
Chemical fertilizers use (0,1)	0.3623	0.0114	0.2663	0.0148	0.4177	0.0138	***
Cultivated area (Ha)[a]	2.2059	0.0229	1.9119	0.0306	2.2517	0.0280	***
On farm labor per hectare (person-day)	4.7143	0.0254	4.8456	0.0343	4.7273	0.0320	**
Total expenditure for chemicals (LCU, 2014 prices)[a]	3.4929	0.1196	2.7373	0.1428	3.9625	0.1517	***
Total expenditure for improved seeds (LCU, 2014 prices)[a]	1.5587	0.1066	1.6645	0.1390	1.1469	0.0979	***
Total expenditure for hired labor for crop activities (LCU, 2014 prices)[a]	4.1318	0.1054	4.4744	0.1439	3.7566	0.1387	***
Total days of labor worked (family, hired, exchanged labor) for crop activities	374.9604	12.0771	312.9918	15.1954	419.0449	16.1906	***
Total days of family labor for crop activities	333.4410	11.8395	268.5688	14.9539	354.9505	12.7398	***
Total value of production from livestock activities (LCU, 2014 prices)[a]	6.6651	0.1042	6.6336	0.1427	6.7535	0.1531	
Total expenditure for livestock activities (LCU, 2014 prices)[a]	8.9098	0.0992	8.8242	0.1427	9.0184	0.1349	
Off farm income (LCU, 2014 prices)[a]	4.04047	0.1278	4.0003	0.1762	4.0917	0.1567	
Total days in livestock activities (family)	0.3500	0.0200	0.4100	0.0400	0.2900	0.0300	**
Total days in off-farm activities (family)	0.3700	0.0300	0.4200	0.0400	0.3200	0.0300	**
Total income (from all sources) (LCU, 2014 prices)	692,411	23,973	611,466	29,539	795,652	39,770	***
Non-local private transfers received (0,1)	0.2515	0.0096	0.2434	0.0141	0.2616	0.0128	
Non-local private transfers received (LCU, 2014 prices)[a]	3.0893	0.1211	2.9938	0.1784	3.2109	0.1572	

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: [a] In inverse hyperbolic sine. [b] Its mean is not 0 and its s.d. is not 1 because we standardized the polygyny rate variable using the full original sample and not just the sample used for our analyses. Non-local private transfer inflows include all cash or in-kind transfers a household residing in a given commune received in the past year from non-residents of the commune. LCU stands for Local Currency Unit that, in the case of Mali, is FCFA.

Table 2: *The effect of drought on crop yield*

Yield (inverse hyperbolic sine)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Drought_t$	-0.8501***	-0.6318***	-0.5489***	-1.7085*	-0.6318***	-0.7712***	-0.5951***	-0.6516***	-0.6444***	-0.7623***
	(0.2296)	(0.1869)	(0.1980)	(0.9164)	(0.2256)	(0.2097)	(0.1918)	(0.2004)	(0.1753)	(0.1623)
$Drought_t \times Polygyny$	0.7120***	0.6175***	0.5041***	0.5935***	0.6175***	0.5817***	0.5226***	0.6463***	0.6170***	
	(0.1894)	(0.1641)	(0.1778)	(0.1498)	(0.1722)	(0.1674)	(0.1951)	(0.1714)	(0.1382)	
$Drought_t \times Polygyny$ *(2nd quartile)*										0.5628
										(0.4493)
$Drought_t \times Polygyny$ *(3rd quartile)*										0.2764
										(0.3044)
$Drought_t \times Polygyny$ *(4th quartile)*										1.1284***
										(0.2731)
$Test: Drought_t + Drought_t \times Polygyny = 0$	-0.1389	-0.0143	-0.0448	-1.1150	-0.0143	-0.1895	-0.0724	-0.0053	-0.0274	0.3661
	(0.1737)	(0.1603)	(0.1632)	(0.8950)	(0.1889)	(0.1604)	(0.1723)	(0.1611)	(0.1512)	(0.2357)
Additional controls	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ethnic FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Crop FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls × polygyny	N	N	Y	N	N	N	N	N	N	N
Additional controls × drought	N	N	N	Y	N	N	N	N	N	N
Spatial correlation	N	N	N	N	Y	N	N	N	N	N
Ethnic × droughts	N	N	N	N	N	Y	N	N	N	N
Year × polygyny	N	N	N	N	N	N	Y	N	N	N
Year × soil quality	N	N	N	N	N	N	N	Y	N	N
Infrastructure controls	N	N	N	N	N	N	N	N	Y	N
Observations	10,474	10,474	10,474	10,474	10,474	10,474	10,474	10,474	10,474	10,474
R-squared	0.3110	0.3354	0.3384	0.3357	0.1601	0.3372	0.3357	0.3368	0.3362	0.3355

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are: head's sex (1=female), household size, ratio of female household members, ratio of household members aged 0-15, use of chemical inputs such as fertilizers, area of cultivated land, labor applied per ha (person-day of labor), and quintile of households wealth index. In column (5) we account for spatial correlation across the EAs within a radius of 52 km (the median distance across the EAs) by following Conley (1999). The correlate of polygyny is the household ethnic identity. In column (8) we account for the interaction of year and soil quality. Soil quality is represented by the following variables computed at the EA level: nutrient availability, nutrient retention capacity, rooting conditions, oxygen availability to roots, excess salts, toxicity, and workability (constraining field management). In column (9), infrastructure controls include the average distance (in km) to the nearest border crossing, to the nearest road, and to the district's capital town (all measured at the EA level), and whether the household has access to an irrigation system in a given plot. In column (10), the equality test is in the 4th quartile.

Table 3: *Mechanism: effect of drought on the inflows of private transfers*

	Inflows, received or not (1/0)				Inflows, amount (inv. hyp. sine)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Drought_t \times Polygyny$ *(1st quartile)*	-0.2151**	-0.2147**	-0.2073**	-0.0255*	-2.1307**	-2.3356**	-2.2854**	-0.2740*
	(0.1073)	(0.1074)	(0.1057)	(0.0138)	(0.9216)	(0.9847)	(0.9933)	(0.1548)
$Drought_t \times Polygyny$ *(2nd quartile)*	0.2463	0.3055	0.3107	0.0580	2.3578	3.3035	3.3949	0.6297
	(0.1766)	(0.2211)	(0.2195)	(0.0356)	(1.8501)	(2.4317)	(2.4250)	(0.3896)
$Drought_t \times Polygyny$ *(3rd quartile)*	0.2207*	0.2064	0.1551	-0.0094	1.7846	1.8252	1.2996	-0.0715
	(0.1341)	(0.1369)	(0.1470)	(0.0256)	(1.4048)	(1.4756)	(1.6860)	(0.786)
$Drought_t \times Polygyny$ *(4th quartile)*	0.2586*	0.2594*	0.2298*	-0.0071	2.6857**	2.8102**	2.5067*	-0.0552
	(0.1368)	(0.1389)	(0.1389)	(0.0314)	(1.3496)	(1.4128)	(1.4369)	(0.3613)
Additional controls	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y	Y	Y	Y
Ethnic FE	Y	Y	Y	Y	Y	Y	Y	Y
Mean outcome	0.2503	0.2541	0.2637	0.0214	3.0791	3.1242	3.2392	0.2408
Observations	3,955	3,955	3,955	3,953	3,955	3,955	3,955	3,953
R-squared	0.3613	0.3629	0.3727	0.2773	0.3758	0.3780	0.3869	0.2601

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are head's sex (1=female), household size, area of cultivated land, and quintile of households wealth index. The outcomes in columns (1)-(3) and (5)-(7) include inflows of non-local private transfers, by which we mean all cash or in-kind transfers a household residing in a given commune received in the past year from non-residents of the commune. In columns (1) and (4), such inflows include all cash transfers; in (2) and (5), they include cash and in-kind non-food transfers; in (3) and (6), they include all cash and in-kind transfers. In columns (4) and (8), outcomes are defined using private transfers from the same locality, and they both include all cash transfers.

Table 4: *Mechanism: effect of drought on farm inputs*

	Expenditure (inverse hyperbolic sine)			Farm labor (total days)	
	Chemicals	Improved seeds	Hired labor	Full	Household
	(1)	(2)	(3)	(4)	(5)
$Drought_t$	-1.0137	1.3704	-1.5505**	-327.8468***	-241.2039**
	(1.4530)	(4.1306)	(0.7440)	(93.1938)	(104.5518)
$Drought_t \times Polygyny$	4.8953***	2.1209	1.5679**	193.2482***	176.2878**
	(1.1894)	(2.7393)	(0.7298)	(71.2649)	(76.6808)
Additional controls	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y
Ethnic FE	Y	Y	Y	Y	Y
Mean outcome	3.1387	1.1812	4.0910	372.9484	315.0768
Observations	3,941	3,941	3,941	3,941	3,941
R-squared	–	–	–	0.6048	0.6990

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are head's sex (1=female), household size, area of cultivated land, and quintile of households wealth index. Labor is defined as the total number of days worked on the farm at the household level. 'Full' does not distinguish between household and hired labor. In columns (1), (2), and (3), the censored model presented in Eq. 8 is used. Columns (4) and (5) are estimated through the linear probability model described by Eq. 1.

Table 5: *Mechanism: Effect of drought on livestock activity*

	livestock value	livestock costs	days of family work in livestock activities		
			age ∈ [12, 60]	age ∈ [12, 18]	age ∈]18, 60]
	(1)	(2)	(3)	(4)	(5)
$Drought_t$	-0.5164	-0.9511	0.6092	2.2278*	-0.3923
	(0.8665)	(1.0037)	(1.2453)	(1.3417)	(1.3389)
$Drought_t \times Polygyny$	1.5691**	1.6065*	1.4045	0.0224	1.9134*
	(0.6306)	(0.8593)	(1.1256)	(1.1201)	(0.9784)
Additional controls	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y
Ethnic FE	Y	Y	Y	Y	Y
Mean outcome	6.6339	8.8170	0.3228	0.1832	0.2564
Observations	3,228	3,229	3,645	2,784	3,641

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: FE = fixed effects. Standard errors are clustered at the EA level. All outcomes are transformed in the inverse hyperbolic sine. Livestock value is the value of production from livestock activities. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are the head's sex (1=female), household size, and the households wealth index quintile. Livestock value is the total value of production from livestock activities. The censored model presented in Eq. 8 is used for all columns.

Table 6: *Mechanism: Effect of drought on off-farm activity*

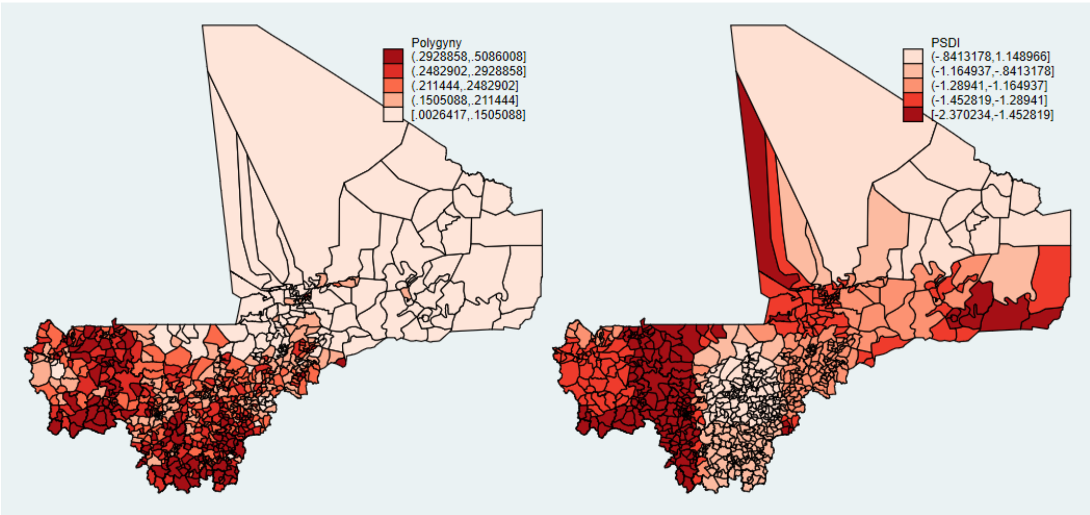
	Off-farm income	days of family work in off-farm activities		
		age ∈ [12, 60]	age ∈ [12, 18]	age ∈]18, 60]
	(1)	(2)	(3)	(4)
$Drought_t$	-2.5359**	0.9766	0.2695	0.8435
	(1.1909)	(0.8143)	(1.7123)	(0.7717)
$Drought_t \times Polygyny$	-0.0310	2.2801**	1.1119	2.0825*
	(1.0594)	(1.1307)	(2.1620)	(1.1011)
Additional controls	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
EA FE	Y	Y	Y	Y
Ethnic FE	Y	Y	Y	Y
Mean outcome	4.1242	0.3763	0.1289	0.3468
Observations	3,955	3,644	2,784	3,641

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: FE = fixed effects. Standard errors are clustered at the EA level. All outcomes are transformed in the inverse hyperbolic sine. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are head's sex (1=female), household size, and quintile of households wealth index. The censored model presented in Eq. 8 is used for all columns.

Annex A

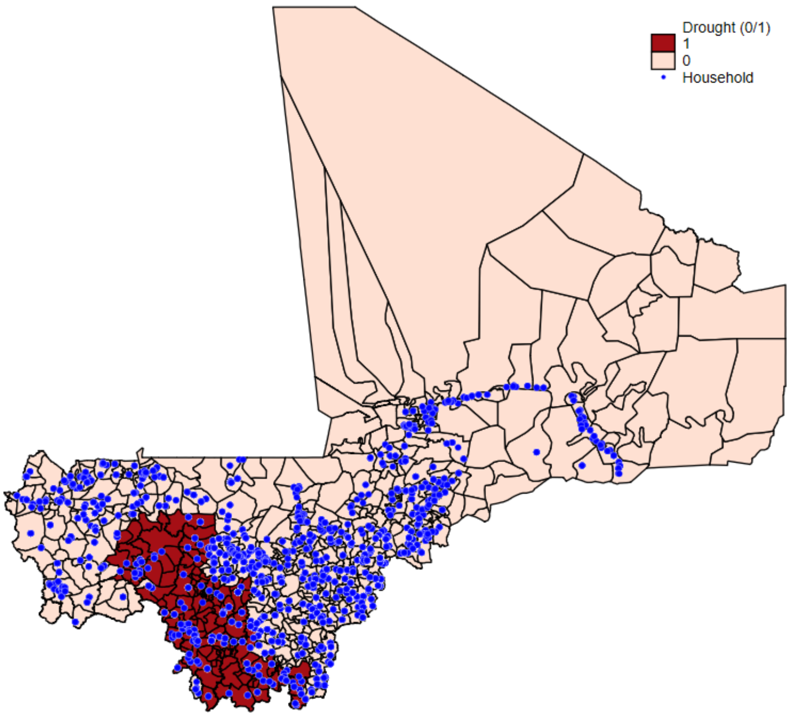
Figures

Figure A1: *Historical distribution of Polygyny's Prevalence and PDSI by Commune*



Source: Authors elaboration based on Mali's Fourth General Census of Population and Housing (2009) (for polygyny's prevalence) and Dai et al. (2004) (for drought – defined using the Palmer Drought Severity Index (PDSI), estimated as an average over the period 1968-2018).

Figure A2: *Distribution of Droughts in 2017*



Source: Authors elaboration based on EAC-I 2017 and SPEI Global Drought Monitor.

Tables

Table A1: *Correlation between SPEI in 2014 and the differential of polygyny between 2014 and 2017*

	$\Delta(Poly_{2017} - Poly_{2014})$
$SPEI_{2014}$	-0.0298
	(0.0688)
$Poly_{2014}$	-0.6272***
	(0.1183)
$Poly_{2014} \times SPEI_{2014}$	0.2205
	(0.1365)
Mean outcome	-0.0615
Observations	148
R-squared	0.4633

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: Standard errors are clustered at the grid level. The outcome is defined as the difference between the grid polygyny rates in 2017 and 2014.

Table A2: *The effect of drought on crop yields care-saving crops vs. care-intensive crops*

Yield (inverse hyperbolic sine)	care-saving crops (1)	care-intensive crops (2)
$Drought_t$	-0.1561	-0.7218***
	(0.2697)	(0.2468)
$Drought_t \times Polygyny$	0.1705	0.7808***
	(0.2860)	(0.2230)
Test :		
$Drought_t + Drought_t \times Polygyny = 0$	0.0144	0.0589
	(0.2163)	(0.2201)
Additional controls	Y	Y
Year FE	Y	Y
EA FE	Y	Y
Ethnic FE	Y	Y
Crop FE	Y	Y
Observations	4,512	5,785
R-squared	0.3675	0.3136

Source: Authors elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are head's sex (1=female), household size, the ratio of female household members, the ratio of household members aged 0-15, use of chemical fertilizers, area of cultivated land, labor applied per ha (person-day of labor), and quintile of households wealth index.