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# **Rural Demography, Public Services, and Land Rights in Africa**

**A Village-Level Analysis in Burkina Faso**

**Margaret McMillan**

**William A. Masters**

**Harounan Kazianga**

**Development Strategy and Governance Division**

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## **AUTHORS**

**Margaret McMillan, International Food Policy Research Institute**  
Deputy Division Director, Development Strategy and Governance Division  
[m.macmillan@cgiar.org](mailto:m.macmillan@cgiar.org)

**William A. Masters**  
Tufts University  
[william.masters@tufts.edu](mailto:william.masters@tufts.edu)

**Harounan Kazianga**  
Oklahoma State University  
[harounan.kazianga@okstate.edu](mailto:harounan.kazianga@okstate.edu)

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## **ABSTRACT**

This paper uses historical census data from Burkina Faso to characterize local demographic pressures associated with internal migration into river valleys after onchocerciasis eradication, combined with a new survey of village elders to document change over time and differences across villages in local public goods provision, market institutions, and land use rights. We hypothesize that higher local population densities are associated with more public goods and with a transition from open-access to regulated land use. Controlling for province or village fixed effects, we find that villages' variance in population associated with proximity to rivers is closely correlated with higher levels of infrastructure, markets, and individual land rights, as opposed to familial or communal rights. Responding to population growth with both improved public services and private property rights is consistent with both scale effects in public good provision and changes in the scarcity of land.

**Keywords:** Africa, demography, institutions

## **ACKNOWLEDGMENTS**

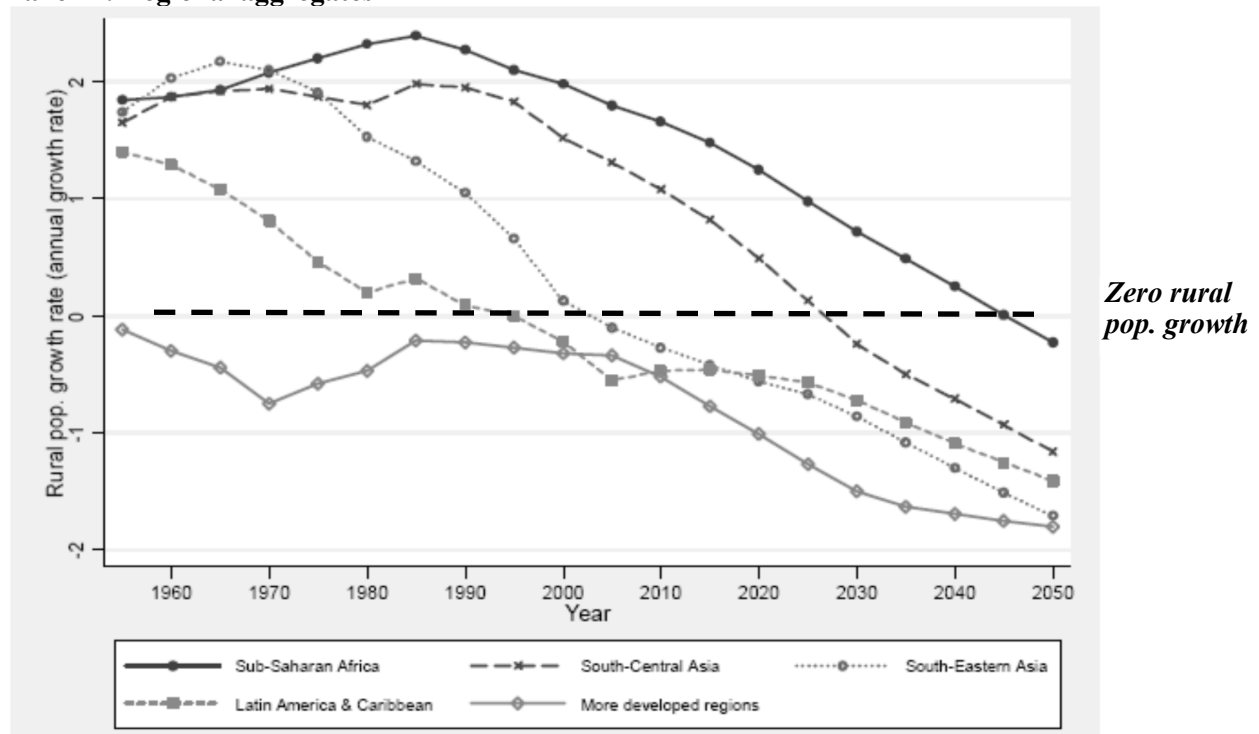
We are grateful to the National Bureau of Economic Research (NBER) African Successes Project for financial support, and we thank Moussa Kabore and colleagues in the Direction de la Prospective et des Statistiques Agricoles et Alimentaires of Burkina Faso for survey implementation, Jose Castillo for research assistance, and Jun Folledo of IFPRI for Geographic Information System calculations. The paper was much improved by valuable suggestions from Will Dow and other participants at the Zanzibar Conference of the NBER African Successes Project, August 3–5, 2011, as well as by comments from Rohini Pande and Remi Jedwab.

## 1. INTRODUCTION AND MOTIVATION

An unusual factor in Africa's twentieth-century agricultural development was a relatively low initial level of average population density coupled with unusually high rates of rural population growth over the past 30 years. As shown Panel A in Figure 1.1, Africa's year-to-year rate of rural population growth rose above that of Asia around 1975 and peaked in 1990; only recently has it fallen below the highest levels ever seen in other regions. All regions have seen a rise and then fall in their annual rates of rural population growth, but in the post-1975 period, Africa's growth rate rose more recently and reached a higher level for a longer time than that of other regions.

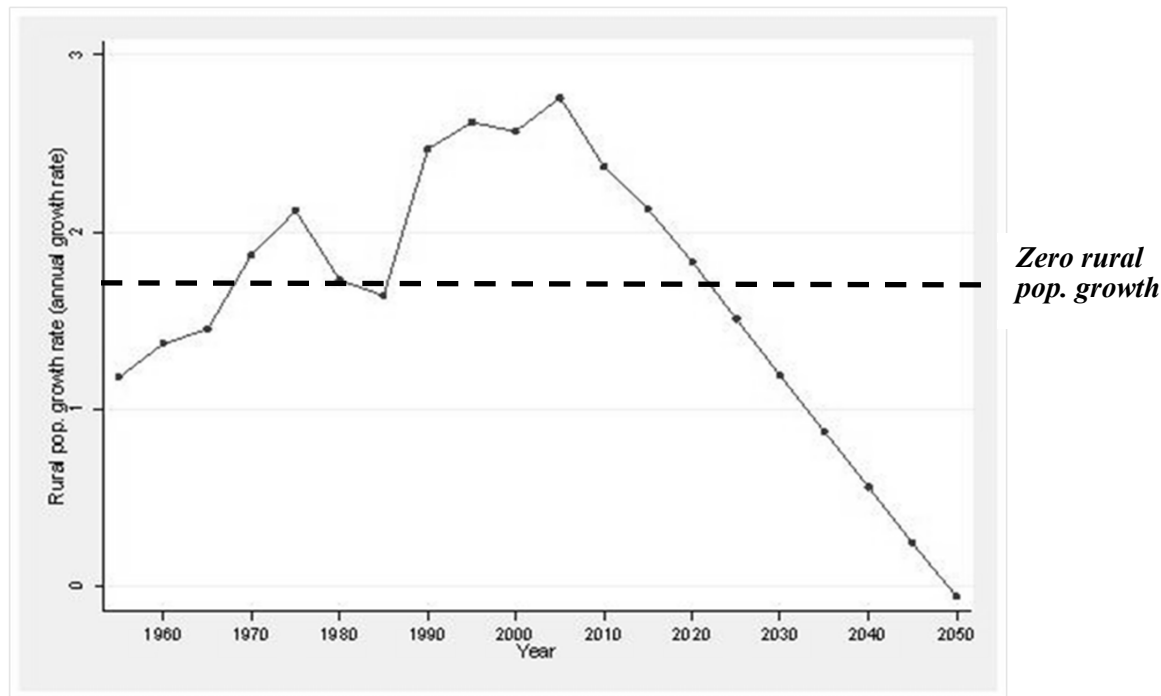
**Figure 1.1—Past and projected rural population growth, by region and country (1950–2050)**

**Panel A: Regional aggregates**



Source: Calculated from UN Population Projections (United Nations 2011).

## Panel B: Burkina Faso



Source: Calculated from UN Population Projections (United Nations 2011).

This paper investigates the link between rural population and the local institutions and infrastructure needed for market development in agriculture. We use spatial differences in settlement patterns and migration exposure to test how rural public goods and land use rights have responded to demographic change. Our central hypothesis is that recent increases in rural population densities are associated with a wider spread of rural infrastructure, public services, and local marketplaces, as well as with a transition from open-access to regulated land use, including stronger individual property rights and more reliance on the rule of law to adjudicate disputes.

Our data come from Burkina Faso, a landlocked West African country of about 13 million people. As shown in Panel B of Figure 1.1, from 1950 to 2005, Burkina Faso's rural population growth rate rose even more dramatically than that of Africa as a whole (shown in Panel A of Figure 1.1), to a peak above 2.5 percent per year. Burkina's rural population growth rate is projected to decline rapidly in the coming decades, but will remain well above zero until the absolute size of the urban population becomes large enough for the annual growth of towns and cities to absorb each year's increase in the country's entire population. Figure 1.1 (Panel B) shows that rapid growth in Burkina Faso's rural population was not uniform in time, with a temporary reversal in the 1980s that may have been associated with migration to Cote d'Ivoire or other factors, followed by a burst of catch-up growth and downward projections until urbanization is sufficient to achieve zero rural population growth around 2050.

Historically, Burkina Faso has had large movements of rural people to its own cities and a large migration to coastal Cote d'Ivoire after colonization. A large number of those migrants later returned, including many who were forcibly repatriated following civil unrest in Cote d'Ivoire starting in the late 1990s. In addition, starting in the 1970s, the donor-funded Onchocerciasis Control Program quickly eradicated river blindness, leading to large population movements into river valleys. These demographic shocks affected villages across Burkina Faso in different ways depending on the location of the villages, creating unusual variance in subsequent rural population density with which to study the impact of rural demography on local institutions and infrastructural investments.

We hypothesize that changes in rural population growth change the payoffs from collective action, making it relatively more urgent to develop market infrastructure and institutions. This hypothesis

follows Boserup (1965), who argued that rising rural population densities not only create incentives for farm-level adoption of more input-intensive techniques and *induced invention* of new technologies in response to factor scarcity, as suggested by Hicks (1932), but also induce institutional changes to allocate newly scarce natural resources more efficiently. A link between rural population density and rural public goods could also be due to political pressures or indivisibilities and scale effects in the provision of infrastructure and institutions. Both relative-price and scale effects could be subject to time lags, leading rural population growth to have a Malthusian effect in the short run, even as it facilitates the institutional and technological innovations needed for later agricultural productivity growth.

Modern analyses of how population density and factor scarcity affect agricultural development were pioneered by Hayami and Ruttan (1971) for the United States and Japan, and were tested in a large subsequent literature, such as Olmstead and Rhode (1993). Only a few of these papers (for example, Lin 1995) focused on the emergence and adoption of institutions; most, such as Kazianga and Masters (2002, 2006), asked how institutions affect technology adoption. Focusing on rural demography also expands on our other previous work regarding the role of environmental factors in economic growth (Masters and McMillan 2001) and African policy choices (McMillan 2001, McMillan and Masters 2003). In this paper, we use within-country variation in village size and access to public services, infrastructure, and property rights to test how the public sector has responded to rural demographic change.

Our focus on the specific challenge of *rural* population growth for agricultural development follows Johnston and Kilby (1975), among others. Most of the development economics literature concerned with demography has focused either on demographic transitions in the population as a whole (including the demographic *drag* or dividend from age structure, emphasized by Bloom and Williamson [1998]) or on the structural transformation from farm to nonfarm employment in terms of output and employment shares (including the *growth bonus* associated with shifting from a low productivity to a high productivity sector, as in Temple [2005]). Focusing on demographic conditions within rural areas addresses a distinctive aspect of Africa's postindependence economic decline; it also provides the grounds for optimism about the future, as rural infrastructure and institutions adapt to higher levels of population density and the speed of further demographic change slows down.

The motivation for our approach begins with an economic view of rural demography. Simple accounting ensures that each locality's rural population growth is its natural increase (births minus deaths, which in turn are determined by age structure as well as age-specific mortality and fertility), plus or minus each year's net migration to urban or other rural areas. From an economic point of view, however, both fertility and migration are choice variables, and mortality may also be influenced by investment in health. Given this endogeneity, identification of a potentially causal effect of demography requires an exogenous shock to rural population size that occurs with sufficient speed and magnitude to induce a measurable societal response.

Our study design takes advantage of Burkina Faso's unusual demographic history, which includes two large waves of exogenous migration into specific rural areas from the 1970s. One wave flowed southwest out of the Central Plateau toward rivers in the Volta Valley, where it converged with another wave returning from Cote d'Ivoire. We use three rounds of census data from 1985, 1996, and 2006 to capture the resulting variation in village population, and we compare that to variance in institutions and infrastructure as recalled by focus group interviews of village elders.

Our work contributes to an important gap in the literature on institutions and economic development identified by Pande and Udry (2006, 352), who argued that "the research agenda identified by the institutions and growth literature is best furthered by the analysis of much more micro-data than has typically been the norm in this literature". Specifically, we study both spatial and temporal variation in rural public services and property rights, focusing on diversity across villages in a setting, with wide variation in exposure to clearly exogenous demographic shocks. The closest antecedent is probably Grimm and Klasen (2008), who tested for endogenous adoption of land titles at the village level in Sulawesi, Indonesia. Our surveys include land rights and also consider a wide range of other institutions, public services, and infrastructure used for market exchange. Methodologically, our use of focus groups to obtain village-level recall data on the location and availability of public services and land rights follows

Chattopadhyay and Duflo (2004), building on a long tradition of participatory surveys in rural areas (for example, Chambers 1994). This approach allows us to ask about many different types of public services as seen from the villagers' points of view.

This paper aims only to demonstrate the value of villagers' recall data in establishing stylized facts about how rural public services and land rights vary across space and time. In future work, this type of data could also be used to analyze causal effects of public services and institutions on economic outcomes. For example, Besley (1995) and others found evidence that institutions significantly affect investment outcomes in rural Africa; Pande and Udry (2006) provided a summary of these studies. In Burkina Faso, Kazianga and Masters (2002) found that stronger cropland tenure was associated with more intensive soil and water conservation. Our approach to changes in village-level infrastructure and institutions are also relevant to the mechanisms by which large-scale public health interventions influence economic development, as in Acemoglu and Johnson (2007), Bleakley (2007), and Cutler et al. (2010).

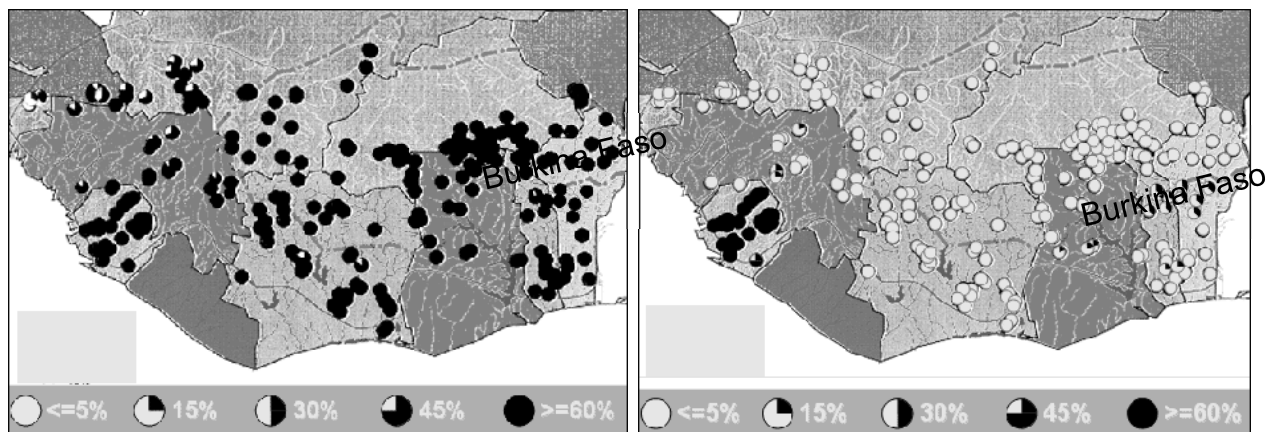
In the next section, we describe the major exogenous population shifts that might permit identification of how changes in rural demography affect public goods provision. We then turn to our empirical strategy and a description of our data. In section four we present and discuss our results. Section five concludes.

## 2. HISTORICAL BACKGROUND

Since its independence in 1960, Burkina Faso has experienced two major policy-induced changes in settlement patterns. The first began in 1974, when the Onchocerciasis Control Program (OCP) was launched by the World Bank to control river blindness in seven West African countries: Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali, Niger, and Togo. The second occurred from the late 1990s until 2002, when up to one million Burkinabe returned from Cote d'Ivoire to escape violence and a suspension of immigrants' rights in that country. Since our ability to draw a causal link between population growth and institutional change hinges on these two events, we describe them in more detail below.

The OCP is widely considered to be among the most successful public health programs ever launched in Sub-Saharan Africa. Onchocerciasis, or *river blindness* is primarily a rural disease that affects Sub-Saharan Africa more than anywhere else in the world. The disease is spread through bites from black flies of the genus *Simulium*, which transmit the larvae of a filarial worm, *Onchocerca volvulus*. The worms multiply only in the human body, where they cause debilitating symptoms that include blindness; the worms are transmitted only by the black fly, which lives in proximity to fast-moving rivers. The OCP was a multilateral effort that initially covered 11 countries, including Burkina Faso. The program involved weekly aerial treatment and ground-level treatment of black fly breeding grounds. Annual drug treatments offered immediate relief from the symptoms and elimination of nearly all offspring of the adult worm.

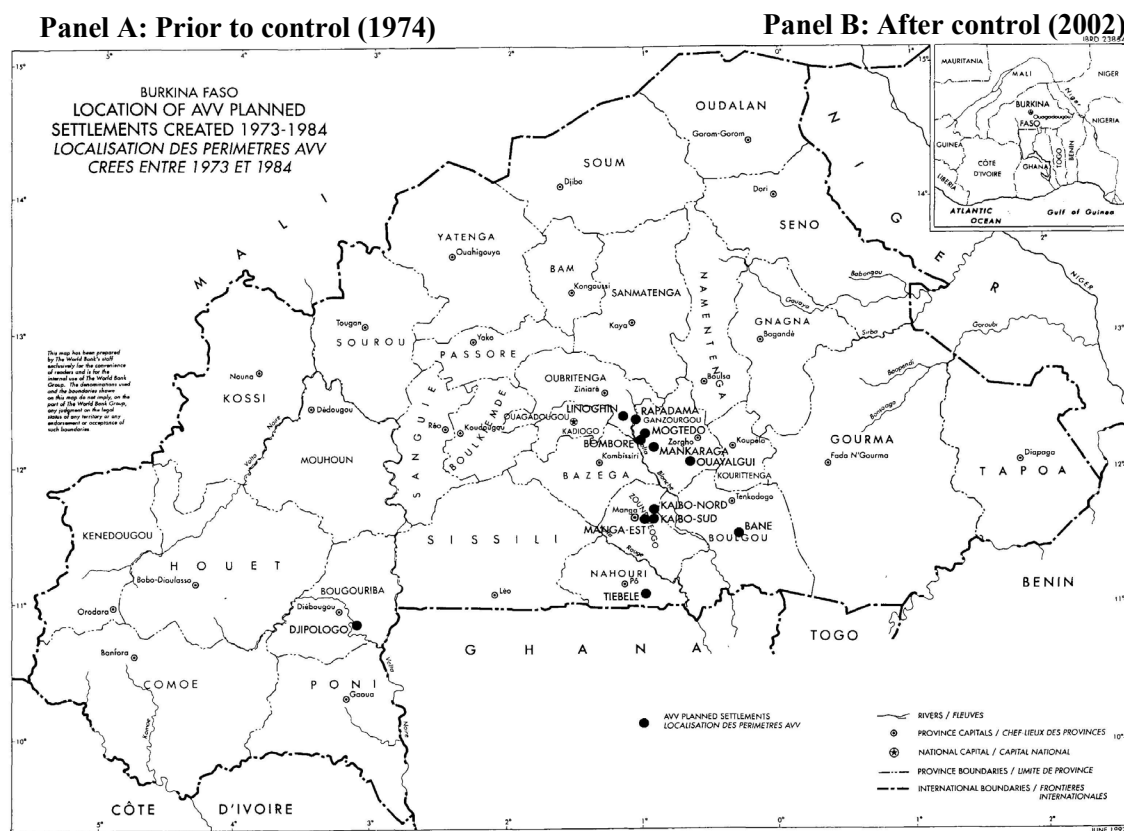
**Figure .2.1—Estimated onchocerciasis prevalence in West Africa**



Source: WHO, Onchocerciasis Control Programme ([www.who.int/apoc/onchocerciasis/ocp](http://www.who.int/apoc/onchocerciasis/ocp)).

Figure 2.1 provides a map of onchocerciasis prevalence in and around Burkina Faso prior to the OCP and afterward. Prevalence rates were recorded at above 60 percent of surveyed people living in the lower Volta River valley before the OCP. The OCP almost completely eradicated the disease in target countries but left prevalence rates unchanged in Sierra Leone. Eradication was incomplete in Guinea, Togo, and Benin. Today, the disease is no longer considered a threat in the original control zone, which has consequently attracted in-migration from other rural areas.

**Figure 2.2—Location of planned settlements associated with onchocerciasis control, 1973–1984**



Source: McMillan, Nana, and Savadogo 1993.

Anticipating in-migration to newly attractive river valleys, the government of Burkina Faso created a special national agency—the Volta Valley Authority (AVV)—and gave the agency control of 75 percent of the targeted river basins. Figure 2.2 shows these locations and the *planned* villages to which it provided financial and institutional support. However, the pace of spontaneous settlement soon outgrew the ability of the AVV to finance and create sufficient numbers of sponsored settlements. As a result, there were sizable intra- and interregional migration flows, as documented by McMillan, Nana, and Savadogo (1992), typically from the drier northeast and central plateau to lower-altitude river valleys, leading to the actual pattern of interregional migration illustrated in Figure 2.3.

**BURKINA FASO**  
**AGRICULTURAL AND TRANSHUMANT**  
**MIGRATION PATTERNS**  
**FLUX MIGRATOIRE ET TRANSHUMANCE**

This map has been prepared by the World Bank staff exclusively for the convenience of readers and is for the internal use of the World Bank Group. The denominations used and the boundaries shown on this map do not imply, on the part of the World Bank Group, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

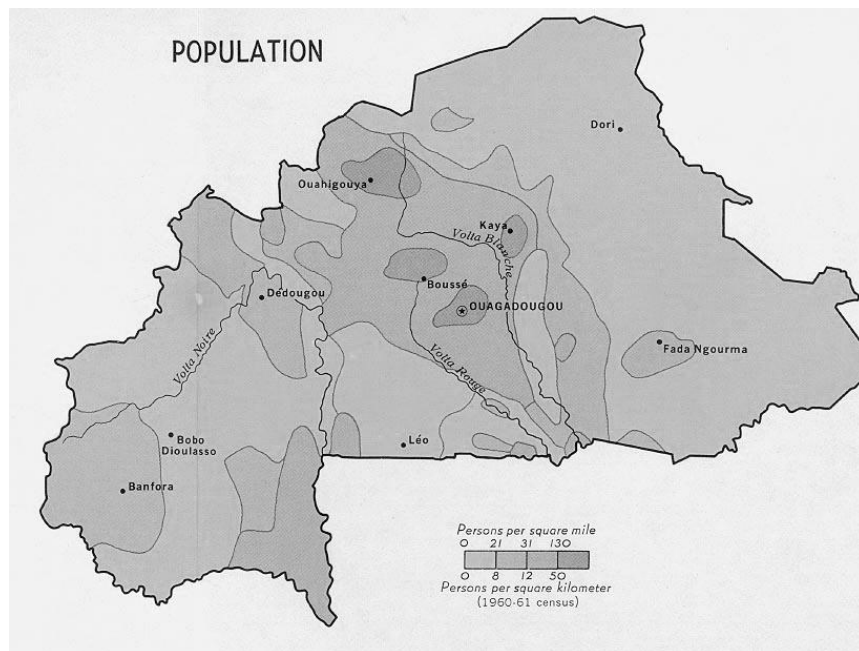
**LEGEND:**

- MIGRATORY MOVEMENTS AND TRANSHUMANCE:  
FLUX MIGRATOIRES ET TRANSHUMANCE:
- HEAVY IMMIGRATION AREAS  
ZONE A FORTE IMMIGRATION
- WEAK IMMIGRATION AREAS  
ZONE A FAIBLE IMMIGRATION
- "HOME" SENDING AREAS  
ZONE DE DEPART
- PEOPLE  
HOMME
- LIVESTOCK  
BETAIL
- NATIONAL CAPITAL  
CAPITALE NATIONALE
- PROVINCE CAPITALS  
CAPITALES PROVINCIALES
- INHABITANTS PER KM<sup>2</sup>  
HABITANTS PAR KM<sup>2</sup>
- PROVINCE BOUNDARIES  
LIMITES DE PROVINCES
- INTERNATIONAL BOUNDARIES  
FRONTIERES INTERNATIONALES

**KILOMETERS** 0 20 40 60 80

Figure 2.3 documents the pattern of human migration that occurred in the late 1970s and 1980s. The arrows in the figure originate in the area of out-migration and the direction of movement. Dashed arrows indicate net human migration, whereas solid arrows indicate the path of transhumant (seasonal) livestock movements, which formed travel corridors for migrants. The shading in the figure indicates how heavy the degree of net settlement was by province. This pattern of rural-to-rural migration reflected the economic opportunities opened up by river blindness control in the lower parts of the Volta River valleys, relative to the extreme poverty experienced in high-density, higher-altitude areas, which had less disease pressure prior to the OCP. Figure 2.4 illustrates how during colonial times, population had accumulated upstream in the Central Plateau, leaving the downstream segments of the three Volta River valleys with extremely low population densities. Some of population movement toward these downstream river valleys was planned as part of the OCP; however, by 1983, more than 80 percent of the increase in cultivated land in Burkina's river basins could be attributed to spontaneous settlers (McMillan et al. 1993).

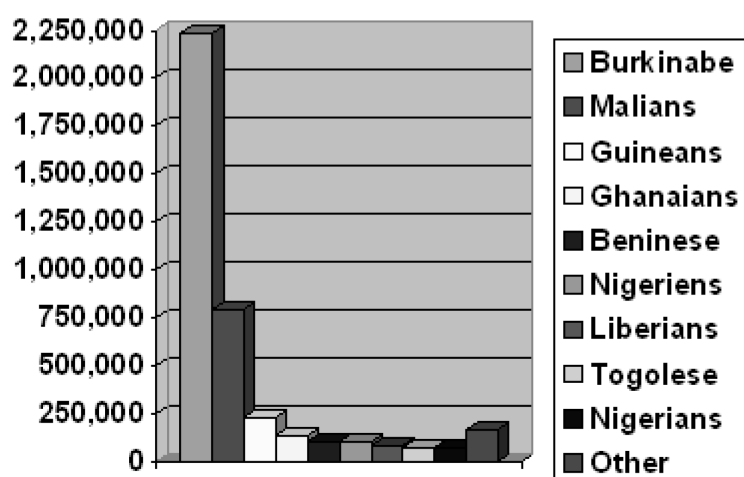
**Figure 2.4—Population density in Burkina Faso, 1960–61**



Source: University of Texas at Austin.

Also notable and of particular importance for our study is that the lower parts of the Volta River valleys, which attracted heavy in-migration, are relatively accessible from Cote d'Ivoire. The domestic migration triggered by the OCP was therefore compounded by repatriation of migrants from Cote d'Ivoire, who converged on the same newly habitable provinces in southern Burkina Faso. Some of this return migration from Cote d'Ivoire could have happened as early as the mid-1980s due to changes in cocoa prices that made migration to Cote d'Ivoire less profitable than it once had been. Repatriation then accelerated sharply in the 1990s due to political changes in Cote d'Ivoire. After the death of the autocratic ruler Felix Houphouët-Boigny in 1993, his successor, Henri Konan Bédié, introduced the concept of "Ivorian-ness" in 1995, allegedly to deny Ivorian citizenship to his main political rival, Alassane Ouattara, thereby excluding Ouattara from office. Bédié insisted that Ouattara, a Muslim from the north of the country, was Burkinabe. Subsequently, attacks on people of foreign descent became increasingly widespread (Human Rights Watch 2001). By that time, more than one-quarter of Cote d'Ivoire's population consisted of immigrants who had arrived since independence, of whom the overwhelming majority had come from Burkina Faso. As shown in Figure 2.5, the Cote d'Ivoire census of 1998 identified about 2.25 million Burkinabe living in Cote d'Ivoire, which was close to 20 percent of Burkina's total population at that time. Four decades of peace and stability in Cote d'Ivoire came to an abrupt end on December 24, 1999, when the military, under the leadership of General Robert Guéï, overthrew the elected government of Konan Bédié in the country's first coup d'état. Although the coup was ostensibly prompted by soldiers' unhappiness over pay and conditions, it soon became apparent that like Bédié, General Guéï was also ready to incite ethnic and religious rivalries in order to remove political opposition. Continuing the theme of *Ivorian-ness*, Guéï introduced even stricter eligibility requirements for the 2000 presidential elections, once again excluding Ouattara on the basis of his alleged links with Burkina Faso.

**Figure 2.5—Foreign population in Cote d'Ivoire by nationality, 1998 census**



Source: IRIN News 2002.

Though exact numbers are difficult to come by, it is estimated that between 1999 and 2002, hundreds of thousands of Burkinabe were repatriated as a result of political unrest and worsening economic conditions in Cote d'Ivoire. They returned by rail, road, and on footpaths. Because of a lack of data, it is impossible to determine exactly where all of these emigrants decided to settle. But it is unlikely that many of them went back to the same impoverished Central Plateau they had originally fled. It is much more likely that these emigrants settled in the OCP river basins closer to Cote d'Ivoire, as suggested by McMillan et al. (1993).

### 3. EMPIRICAL STRATEGY, DATA, AND DESCRIPTIVE STATISTICS

Our evidence on village-level access to public services, infrastructure, and institutions comes from a novel survey conducted for this project by the Burkina Faso Office of Agricultural Statistics in January through June 2010. This survey asked groups of village elders to discuss and describe the history of the facilities around them, recording the date of any changes in the distance to each kind of facility and any changes in property rights arrangements. From those underlying observations, we constructed a time-varying index of the village's proximity to public services, public infrastructure, religious services, and markets, as well as time-varying indicators of property rights over land. We combined these indexes with population estimates for each village from the Burkina Faso national censuses of 1985 1996, and 2006 to test whether cross-sectional and time-series variance in population size could help explain variance in the provision of public services, infrastructure, market institutions, and property rights. To help identify a causal effect of demographic change on our outcome variables, we used the exogenous pressures on population described in the previous section.

The survey instrument is provided in the appendix. It was administered by experienced enumerators employed for Burkina's annual agricultural survey, the structure of which is designed to accommodate new survey modules. The enumerators began by assembling a focus group of village elders and officials, who were asked a series of detailed questions regarding various types of public services, infrastructure, and institutions available to them. For each type of public-sector amenity, the enumerators asked how far villagers had to travel to reach the nearest point of service, at present and in previous years, along with the date of any change in that distance. The section on property rights did the same for institutions—for example, by posing the following question: Can land be sold in your village? If the group agreed that the answer to this question is yes, then the interviewer asked: Since when could land be sold in your village? Questions posed in this way allow us to construct time-varying indexes over multiple amenities from the point of view of the villagers themselves. Our results focus on two kinds of variables: travel distances to public services or infrastructure and categorical indicators of land use rights, both as reported for each census year.

The travel distances to collective amenities are grouped into four categories: (1) *Public Services and Utilities*, defined as the administrative office used to register births, any savings and loan facility, any fixed-line telephone, or any mobile phone reception; (2) *Public Infrastructure*, defined as a road that is accessible by truck all year, a road accessible by truck seasonally, a bus stop, a primary school, a secondary school, or a health center; (3) *Religious Services*, defined as any church, mosque, or temple; and (4) *Markets*, defined as any market with storage facilities, any livestock market, or a private shop. These are all the distances for which our group interview technique elicited unambiguous agreement in at least 700 of the 730 villages. Other questions, such as distance to water wells, bridges, and electricity supplies, elicited agreement less often, perhaps because those amenities are less salient to villagers' lives or their use is more varied among respondents. The distances to collective amenities were then aggregated in each of three ways. First, we considered the distance one must travel to have access to *all* the services in a given category—that is, the distance associated with the farthest one. Second, we considered the average distance to all the services in the group—that is, the arithmetic mean of each distance. Finally, we considered the distance to *any* of the listed services—that is, the minimum distance among them.

Categorical indicators of land rights address three kinds of land use. First, we asked whether use rights over cropland are undefined or held by individuals, families, or the community. Then we asked whether cropland had ever been rented or sold, which we took to indicate the presence of a land market. Finally, we asked whether villagers recognize a formal authority that regulates access to pasture land, forests, and potentially cropland.

Our sample of villages consisted of 747 sites that had previously been selected by the Office of Agricultural Statistics for the office's nationally representative agricultural survey, which has been conducted annually since the early 1990s. In this context, villages are very small, averaging about 1,500 people. Their boundaries can change somewhat from decade to decade, as some households enter or split

off to form new settlements associated with the village. Our final dataset consisted of 730 villages whose recorded names are the same across all three censuses and our new survey and which are at a correctly recorded Geographic Information System (GIS) location. We used year and region fixed effects for each of Burkina's 45 provinces in order to focus on spatial variation across villages within relatively small administrative units, as well as village fixed effects to control for time-invariant village characteristics not included in our dataset.

Table 3.1 presents the proportion of all observations within each category of property right, as reconstructed for the census years of 1985, 1996, and 2006. For example, rights over cropland are not defined in 14.4 percent of village-year observations, implying a complete absence of rule of law over this resource. Of the observations, 10 percent involved cropland rights controlled by communal authorities, almost 60 percent had cropland rights held by families, and almost 16 percent reported cropland rights held by individuals. Descriptive statistics on all variables as used in the regressions are provided in Table 3.2; they are provided separately for each year to reveal the time trends. Public services have become more closely available and property rights more tightly regulated in more recent years. In addition, note that the average population of all surveyed villages grew from 1985 to 1996, but then fell in 2006. There is likely to have been systematic undercounting of the rural population in 2006, which is why the Burkina government is planning a new census several years ahead of its decennial schedule.

**Table 3.1—Property rights and land use across sample villages in Burkina Faso (n = 2,076)**

| <b>Land Rights</b>                                                       | <b>Percentage of observations in sample</b> |
|--------------------------------------------------------------------------|---------------------------------------------|
| <i>Rights over cropland</i>                                              |                                             |
| Not defined                                                              | 14.4                                        |
| Communal                                                                 | 10.0                                        |
| Familial                                                                 | 59.9                                        |
| Individual                                                               | 15.7                                        |
| <i>Existence of sales or rental of cropland</i>                          |                                             |
| None                                                                     | 92.4                                        |
| At least one sale or rental has occurred                                 | 7.7                                         |
| <i>Role of traditional authorities in solving cropland conflict</i>      |                                             |
| None                                                                     | 63.8                                        |
| Some                                                                     | 36.2                                        |
| <i>Role of elected authorities involved in solving cropland conflict</i> |                                             |
| None                                                                     | 81.9                                        |
| Some                                                                     | 18.1                                        |
| <i>Demarcation and regulation of pasture land</i>                        |                                             |
| No delimited pasture land                                                | 71.7                                        |
| Pasture land delimited, access not regulated                             | 22.9                                        |
| Pasture land delimited, access regulated by tax or quota                 | 5.4                                         |
| <i>Demarcation and regulation of forest land</i>                         |                                             |
| No delimited forest land                                                 | 70.1                                        |
| Forest land delimited, access not regulated                              | 15.9                                        |
| Forest land delimited, access regulated by tax or quota                  | 14.0                                        |

Source: Authors' calculations.

Notes: Results shown are from village elders' responses to questions asked in local languages, translated by local enumerators from the French questionnaire reproduced in the appendix to this paper. Items shown are from questionnaire Sections VIII (for cropland), IX (for pasture land), and X (for forest land).

**Table 3.2—Mean and standard deviations for all variables**

| Year | <b>Proximity of farthest source (km)</b><br><b>(Distance to farthest site in each set)</b> |                 |                    |         | <b>Proximity to all sources (km)</b><br><b>(Average distance to all services)</b> |                 |                    |         | <b>Proximity to closest source (km)</b><br><b>(Distance to closest site in each set)</b> |                 |                    |         |
|------|--------------------------------------------------------------------------------------------|-----------------|--------------------|---------|-----------------------------------------------------------------------------------|-----------------|--------------------|---------|------------------------------------------------------------------------------------------|-----------------|--------------------|---------|
|      | Public Services                                                                            | Public Infrast. | Religious Services | Markets | Public Services                                                                   | Public Infrast. | Religious Services | Markets | Public Services                                                                          | Public Infrast. | Religious Services | Markets |
| 1985 | 35.348                                                                                     | 35.458          | 9.274              | 12.832  | 26.915                                                                            | 14.662          | 6.321              | 8.585   | 18.351                                                                                   | 3.566           | 3.536              | 4.855   |
|      | [1.206]                                                                                    | [1.239]         | [0.518]            | [0.790] | [0.779]                                                                           | [0.482]         | [0.360]            | [0.432] | [0.607]                                                                                  | [0.308]         | [0.299]            | [0.269] |
| 1996 | 35.635                                                                                     | 28.053          | 7.465              | 12.735  | 25.055                                                                            | 11.532          | 4.726              | 7.811   | 15.115                                                                                   | 1.817           | 2.328              | 3.788   |
|      | [1.137]                                                                                    | [0.977]         | [0.409]            | [0.741] | [0.708]                                                                           | [0.374]         | [0.267]            | [0.384] | [0.533]                                                                                  | [0.209]         | [0.230]            | [0.251] |
| 2006 | 32.151                                                                                     | 20.955          | 5.218              | 11.455  | 19.681                                                                            | 8.099           | 3.036              | 6.11    | 8.596                                                                                    | 0.501           | 1.16               | 1.975   |
|      | [1.005]                                                                                    | [0.771]         | [0.331]            | [0.611] | [0.543]                                                                           | [0.278]         | [0.194]            | [0.276] | [0.415]                                                                                  | [0.083]         | [0.138]            | [0.176] |

| Year | <b>Land ownership rights</b> |          |          | <b>Land markets</b> | <b>Regulated access to land for:</b> |         |         | <b>Population</b><br>(1000s) | <b>Distance (km) to:</b><br><b>Nearest river</b> |
|------|------------------------------|----------|----------|---------------------|--------------------------------------|---------|---------|------------------------------|--------------------------------------------------|
|      | Individual                   | Familial | Communal |                     | Pasture                              | Forest  | Crop    |                              |                                                  |
| 1985 | 0.41                         | 0.665    | 0.1      | 0.056               | 0.152                                | 1.353   | 2.75    | 1.6                          | 65.986                                           |
|      | [0.018]                      | [0.018]  | [0.011]  | [0.009]             | [0.013]                              | [0.024] | [0.033] | [0.058]                      | [1.782]                                          |
| 1996 | 0.423                        | 0.671    | 0.099    | 0.064               | 0.186                                | 1.44    | 2.751   | 1.682                        | 66.876                                           |
|      | [0.019]                      | [0.018]  | [0.011]  | [0.009]             | [0.015]                              | [0.027] | [0.034] | [0.059]                      | [1.818]                                          |
| 2006 | 0.453                        | 0.669    | 0.104    | 0.107               | 0.24                                 | 1.516   | 2.786   | 1.396                        | 66.336                                           |
|      | [0.018]                      | [0.017]  | [0.011]  | [0.011]             | [0.016]                              | [0.029] | [0.033] | [0.091]                      | [1.777]                                          |

Source: Authors' calculations.

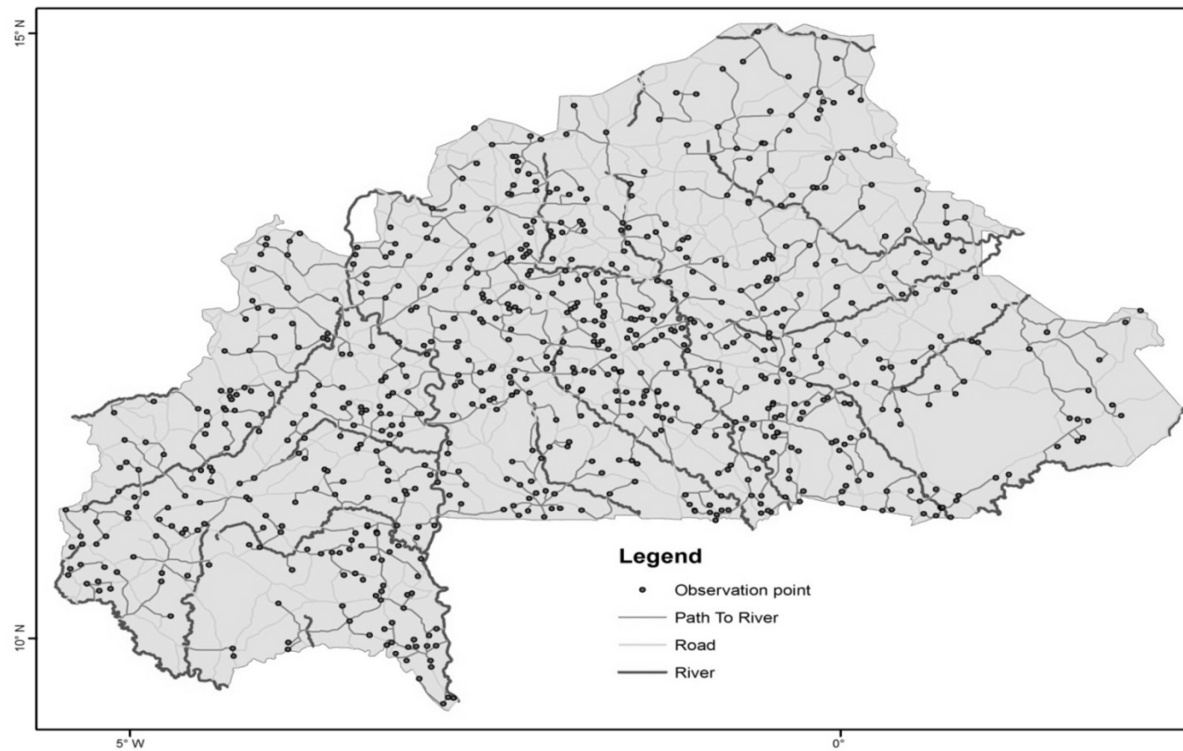
Notes: Standard deviations are in brackets. Proximity measures refer to travel distances from the village to reach the closest site offering one or more of each set of collective resources: **Public Services** and Utilities (defined as the administrative office used to register births, any savings and loan facility, any fixed-line telephone, any mobile phone reception); **Public Infrastructure** (defined as a road that is accessible by truck all year, a road accessible by truck seasonally, a bus stop, a primary school, a secondary school, and a health center); **Religious Services** (any church, mosque, or temple); and **Markets** (any open-air food market, livestock market, or private shop). Specific wording of each question is reproduced in the appendix; from the questionnaire as a whole, we retained only those proximity questions that more than 700 of the 730 villages were unable to answer unambiguously. Population is computed from the Burkina Faso national censuses for 1985, 1996, and 2006. Distances to nearest river are straight lines calculated from latitude and longitude geocodes.

To overcome endogeneity between a village's amenities and its population size, we instrumented the village's population by its straight-line distance to any river from which onchocerciasis could have been eradicated. We expect distance to the river to be inversely correlated with population size in all survey years (1985, 1996, and 2006), as households moved into the river valleys after 1974. To account for time-varying migration and population growth, as well as differences in enumeration and the quality of each census, we interacted distance to river with period dummies to allow for differential effects over time. The advantage of using this instrument to proxy for demographic factors associated with river blindness control is that it is *clean* and not influenced by administrative boundaries or ex post classifications that might drive correlations with infrastructure, public services, or land use. This strategy does have some disadvantages, of course: Distance to rivers may turn out to be a weak instrument for population size. In addition, it may not be valid to exclude distance to river from our main regression if infrastructure, public services, and land rights are correlated with distance to rivers independently of the influence of that distance on population size. As a result, we may not be able to interpret our estimated coefficients on instrumented population as a causal effect of population change alone. The coefficients and significance levels, even in our instrumental variable (IV) regressions, remain correlations that could confound the effects of population size with other features of proximity to rivers that might repel or attract people and also influence infrastructure, public services, and land rights.

One way to test the degree to which exogenous Onchocerciasis Control Program (OCP) treatment made river valleys newly attractive to people, as well as whether the resulting demographic change was associated with any political response in terms of infrastructure, public services, and land rights, is to split the sample into treatment and placebo regions. Inside treatment regions, the OCP made village locations nearer river valleys newly attractive after 1974. In the placebo regions, the relative attractiveness of proximity to rivers did not change. To demarcate the OCP-treated regions shown in Figures 2.1, 2.2, and 2.3, we use the province boundaries shown in Figure 2.3 around the shaded, migrant-receiving areas. These provinces contained land that became newly attractive over time, presumably because the black flies that transmit onchocerciasis were eliminated after 1974.

The empirical strategy we used results in a set of two-stage least squares (2SLS) regressions, asking whether demographic changes associated with the attractiveness of a village's proximity to rivers are correlated with the spread of rural public services, infrastructure, and market institutions serving that village (Figure 3.1). Our paper does not identify the mechanism by which more populated villages might obtain more rural public services, infrastructure, or market institutions; instead, our goal is to test whether our new type of data can reveal an informative relationship, exploiting an unusual natural experiment in the relative attractiveness of village locations across Burkina Faso.

**Figure 3.1—Location of surveyed villages and rivers used for IV estimation**



Source: Authors' calculations.

Notes: Village locations are drawn from authors' survey data; river locations and paths from villages to rivers are calculated from IFPRI file data. Roads and travel paths are shown for illustration purposes only; data used for hypothesis tests are straight-line distances from the village to the closest river and travel distance to nearest point in Cote d'Ivoire (at the lower-left of the map shown).

## 4. ESTIMATING EQUATIONS AND RESULTS

Our estimation begins with a set of descriptive ordinary least squares (OLS) regressions showing the correlations between village-level population and public infrastructure or institutions, controlling for year and province fixed effects, using the following specification:

$$I_{jkt} = \alpha + \beta P_{jt} + \delta X_j + \gamma_t + \varepsilon_{jkt}, \quad (1)$$

Where  $I$  is our measure of infrastructure or institution of type  $k$  serving village  $j$  at time  $t$  from the survey data, and  $P$  is our measure of the total population in village  $j$  at year  $t$  from the census data, and  $\gamma$  are time dummies.  $X$  controls for province fixed effects, and in robustness tests, it also controls for the ethnic composition of village population. Our hypothesis is that that  $\beta > 0$ , as larger populations facilitate the provision of public goods and market institutions due either to relative scarcities, as in Boserup (1965), or to indivisibilities at the relevant scale of population size.

Estimates of regression (1) are shown in Table 4.1, where  $X$  controls only for province fixed effects. Columns 1–12 all concern the presence of public services. In columns 1–4, the dependent variable is the maximum distance one must travel to have access to all amenities in each category. In columns 5–8, the dependent variable is the average distance one must travel to access any amenity in each category, and in columns 9–12, the dependent variable is the minimum distance one must travel to access at least one of the amenities. Both the distances and the village population are expressed in natural logs, so that the coefficients can be interpreted as elasticity's. We find that larger villages have closer amenities in 11 of the 12 regressions; the one exception is column 2, where only the time trend is significant.

Columns 13–19 refer to land rights. The dependent variable takes the value of 1 if our respondents report that this type of land use rights is used in the village; otherwise, it is 0. Because our model contains province or village fixed effects, we estimate the relationship between population and land rights using a linear probability model. Coefficients can be interpreted as the change in the probability that a certain type of land right exists when the natural log of population increases by 1. In a larger village, land ownership is less likely to be familial (as opposed to individual or communal); however, the more important correlation is with the presence of land market transactions: having a larger village population by 1 log point is associated with a 1.9 percent higher probability of having had land transactions.

Table 4.2 repeats the diagnostic OLS regression with additional controls for the number of land chiefs who participated in the group interview, as well as the number of ethnic groups and number of clans reported to be present in the village, as a crude approximation of the village's social fragmentation, which might influence political cooperation and collective action for public goods provision (for example, Alesina and La Ferrara 2005). The correlation between population size and access to public goods is usually, but not always, robust to these controls. Estimated coefficients on population size are somewhat smaller when controlling for ethnic diversity and number of land chiefs, but contrary to some hypotheses, the more diverse villages actually have more public infrastructure than do the less diverse ones. In the absence of any clear identification strategy regarding fragmentation, however, this paper focuses on the main relationship concerning total population size.

**Table 4.1—OLS regression results for public infrastructure and institutions on village-level population**

|            | <u>Proximity of farthest source (km)</u> |                      |                      |                      | <u>Proximity to all sources (km)</u> |                      |                      |                      | <u>Proximity to Closest Source (km)</u> |                      |                      |                      |
|------------|------------------------------------------|----------------------|----------------------|----------------------|--------------------------------------|----------------------|----------------------|----------------------|-----------------------------------------|----------------------|----------------------|----------------------|
|            | Services<br>(1)                          | Infrastr.<br>(2)     | Religion<br>(3)      | Markets<br>(4)       | Services<br>(5)                      | Infrastr.<br>(6)     | Religion<br>(7)      | Markets<br>(8)       | Services<br>(9)                         | Infrastr.<br>(10)    | Religion<br>(11)     | Markets<br>(12)      |
| Population | 0.064***<br>[0.024]                      | 0.013<br>[0.025]     | 0.226***<br>[0.031]  | 0.211***<br>[0.032]  | 0.067***<br>[0.021]                  | 0.070***<br>[0.021]  | 0.217***<br>[0.026]  | 0.234***<br>[0.028]  | 0.128***<br>[0.031]                     | 0.154***<br>[0.020]  | 0.187***<br>[0.023]  | 0.316***<br>[0.024]  |
| Y=1996     | -0.064<br>[0.054]                        | 0.175***<br>[0.055]  | 0.125*<br>[0.069]    | -0.015<br>[0.072]    | 0.016<br>[0.048]                     | 0.187***<br>[0.046]  | 0.161***<br>[0.060]  | 0.043<br>[0.062]     | 0.177***<br>[0.058]                     | 0.290***<br>[0.052]  | 0.210***<br>[0.055]  | 0.185***<br>[0.058]  |
| Y=2006     | 0.040<br>[0.051]                         | 0.487***<br>[0.055]  | 0.509***<br>[0.068]  | 0.085<br>[0.071]     | 0.261***<br>[0.046]                  | 0.539***<br>[0.041]  | 0.526***<br>[0.058]  | 0.238***<br>[0.061]  | 1.093***<br>[0.065]                     | 0.595***<br>[0.046]  | 0.486***<br>[0.052]  | 0.640***<br>[0.055]  |
| Constant   | -3.643***<br>[0.164]                     | -3.261***<br>[0.174] | -3.175***<br>[0.219] | -3.275***<br>[0.225] | -3.477***<br>[0.144]                 | -2.907***<br>[0.142] | -2.878***<br>[0.189] | -3.248***<br>[0.194] | -3.428***<br>[0.208]                    | -1.793***<br>[0.147] | -2.066***<br>[0.175] | -3.283***<br>[0.175] |
| Observ.    | 2,040                                    | 2,068                | 1,960                | 2,043                | 2,040                                | 2,068                | 1,960                | 2,043                | 2,040                                   | 2,068                | 1,960                | 2,043                |
| R-squared  | 0.005                                    | 0.039                | 0.051                | 0.022                | 0.022                                | 0.069                | 0.069                | 0.041                | 0.146                                   | 0.096                | 0.070                | 0.121                |

|              | <u>Land ownership rights</u> |                      |                   | <u>Land</u>         | <u>Regulated access</u> |                     |                     |
|--------------|------------------------------|----------------------|-------------------|---------------------|-------------------------|---------------------|---------------------|
|              | Individual<br>(13)           | Family<br>(14)       | Communal<br>(15)  | markets<br>(16)     | Pasture<br>(17)         | Forest<br>(18)      | Crop Land<br>(19)   |
| Inpopulation | 0.114<br>(0.062)             | -0.043***<br>(0.011) | 0.008<br>(0.007)  | 0.019***<br>(0.006) | 0.019<br>(0.011)        | 0.033<br>(0.027)    | -0.030<br>(0.021)   |
| year==1996   | 0.012<br>(0.027)             | 0.010<br>(0.025)     | -0.003<br>(0.016) | 0.007<br>(0.013)    | 0.030<br>(0.020)        | 0.089**<br>(0.037)  | -0.003<br>(0.047)   |
| year==2006   | 0.037<br>(0.027)             | -0.004<br>(0.025)    | 0.006<br>(0.016)  | 0.056***<br>(0.014) | 0.085***<br>(0.021)     | 0.152***<br>(0.038) | 0.031<br>(0.047)    |
| Constant     | 0.511***<br>(0.083)          | 0.973***<br>(0.078)  | 0.043<br>(0.053)  | -0.077*<br>(0.039)  | 0.088<br>(0.062)        | 1.584***<br>(0.119) | 2.765***<br>(0.150) |
| Observations | 2,076                        | 2,076                | 2,076             | 2,076               | 2,076                   | 2,076               | 2,076               |
| R-squared    | 0.002                        | 0.007                | 0.001             | 0.012               | 0.008                   | 0.010               | 0.000               |

Sources: Authors' calculations.

Notes: Population and distance measures are in logs, with proximity defined as its additive inverse ( $-\log[\text{distance}]$ ), so that coefficients can be read as elasticities and a positive coefficient implies closer facilities. The regression also controls for 45 province dummies (not shown). Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

**Table 4.2—OLS regression results for public infrastructure and institutions on village-level population and diversity**

|                    | Proximity of farthest source (km) |                      |                      |                      | Proximity to all sources (km) |                      |                      |                      | Proximity to Closest Source (km) |                      |                      |                      |
|--------------------|-----------------------------------|----------------------|----------------------|----------------------|-------------------------------|----------------------|----------------------|----------------------|----------------------------------|----------------------|----------------------|----------------------|
|                    | Services<br>(1)                   | Infrastr.<br>(2)     | Religion<br>(3)      | Markets<br>(4)       | Services<br>(5)               | Infrastr.<br>(6)     | Religion<br>(7)      | Markets<br>(8)       | Services<br>(9)                  | Infrastr.<br>(10)    | Religion<br>(11)     | Markets<br>(12)      |
| Population         | 0.057**<br>(0.026)                | 0.022<br>(0.027)     | 0.177***<br>(0.032)  | 0.183***<br>(0.035)  | 0.057**<br>(0.023)            | 0.065***<br>(0.022)  | 0.176***<br>(0.028)  | 0.208***<br>(0.029)  | 0.097***<br>(0.032)              | 0.143***<br>(0.021)  | 0.169***<br>(0.025)  | 0.297***<br>(0.025)  |
| # of land chiefs   | -0.004<br>(0.006)                 | -0.018**<br>(0.007)  | 0.016*<br>(0.010)    | 0.046***<br>(0.010)  | -0.004<br>(0.005)             | 0.002<br>(0.008)     | 0.016**<br>(0.008)   | 0.043***<br>(0.008)  | 0.018<br>(0.017)                 | 0.018***<br>(0.007)  | 0.020***<br>(0.007)  | 0.027***<br>(0.008)  |
| # of ethnic groups | 0.024**<br>(0.011)                | 0.015<br>(0.010)     | 0.048***<br>(0.010)  | 0.010<br>(0.012)     | 0.029***<br>(0.010)           | 0.029***<br>(0.007)  | 0.043***<br>(0.009)  | 0.020*<br>(0.010)    | 0.055***<br>(0.010)              | 0.026***<br>(0.005)  | 0.035***<br>(0.006)  | 0.040***<br>(0.008)  |
| # of clans         | 0.001<br>(0.003)                  | -0.004<br>(0.003)    | 0.016***<br>(0.003)  | 0.018***<br>(0.004)  | 0.002<br>(0.003)              | -0.001<br>(0.002)    | 0.013***<br>(0.002)  | 0.016***<br>(0.003)  | 0.008**<br>(0.004)               | 0.007***<br>(0.002)  | 0.005***<br>(0.002)  | 0.013***<br>(0.002)  |
| year==1996         | -0.072<br>(0.057)                 | 0.184***<br>(0.057)  | 0.139*<br>(0.073)    | -0.008<br>(0.077)    | 0.012<br>(0.051)              | 0.198***<br>(0.048)  | 0.171***<br>(0.063)  | 0.048<br>(0.066)     | 0.188***<br>(0.060)              | 0.285***<br>(0.055)  | 0.208***<br>(0.059)  | 0.189***<br>(0.061)  |
| year==2006         | 0.027<br>(0.053)                  | 0.516***<br>(0.057)  | 0.527***<br>(0.071)  | 0.070<br>(0.076)     | 0.250***<br>(0.047)           | 0.560***<br>(0.047)  | 0.536***<br>(0.061)  | 0.230***<br>(0.064)  | 1.061***<br>(0.068)              | 0.592***<br>(0.048)  | 0.477***<br>(0.055)  | 0.663***<br>(0.057)  |
| Constant           | -3.705***<br>(0.174)              | -3.344***<br>(0.185) | -3.193***<br>(0.228) | -3.372***<br>(0.236) | -3.552***<br>(0.152)          | -3.009***<br>(0.150) | -2.902***<br>(0.197) | -3.372***<br>(0.202) | -3.551***<br>(0.217)             | -1.901***<br>(0.153) | -2.156***<br>(0.185) | -3.472***<br>(0.179) |
| Observations       | 1,810                             | 1,835                | 1,728                | 1,813                | 1,810                         | 1,835                | 1,728                | 1,813                | 1,810                            | 1,835                | 1,728                | 1,813                |
| R-squared          | 0.013                             | 0.048                | 0.094                | 0.048                | 0.036                         | 0.087                | 0.109                | 0.075                | 0.170                            | 0.120                | 0.092                | 0.170                |

**Table 4.2—Continued**

|                    | Land ownership rights |                      |                     | Land                 | Regulated access     |                      |                     |
|--------------------|-----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|---------------------|
|                    | Individual<br>(13)    | Family<br>(14)       | Communal<br>(15)    | Markets<br>(16)      | Pasture<br>(17)      | Forest<br>(18)       | Cropland<br>(19)    |
| Population         | 0.020<br>(0.012)      | -0.051***<br>(0.012) | 0.003<br>(0.008)    | 0.020***<br>(0.006)  | 0.013<br>(0.009)     | -0.046**<br>(0.018)  | -0.033<br>(0.023)   |
| # of land chiefs   | 0.011***<br>(0.004)   | 0.011***<br>(0.003)  | -0.003*<br>(0.002)  | -0.006**<br>(0.003)  | 0.004<br>(0.005)     | -0.022***<br>(0.006) | 0.001<br>(0.006)    |
| # of ethnic groups | 0.004<br>(0.004)      | -0.011***<br>(0.004) | 0.005*<br>(0.003)   | 0.013***<br>(0.003)  | -0.008***<br>(0.003) | 0.014**<br>(0.006)   | -0.005<br>(0.007)   |
| # of clans         | -0.007***<br>(0.001)  | 0.006***<br>(0.001)  | 0.003***<br>(0.001) | -0.004***<br>(0.001) | -0.001<br>(0.001)    | 0.006***<br>(0.002)  | -0.001<br>(0.002)   |
| year==1996         | 0.018<br>(0.028)      | 0.011<br>(0.026)     | -0.003<br>(0.018)   | 0.006<br>(0.014)     | 0.030<br>(0.022)     | 0.091**<br>(0.039)   | 0.002<br>(0.049)    |
| year==2006         | 0.042<br>(0.028)      | -0.009<br>(0.026)    | 0.005<br>(0.018)    | 0.052***<br>(0.015)  | 0.086***<br>(0.023)  | 0.153***<br>(0.041)  | 0.033<br>(0.049)    |
| Constant           | 0.527***<br>(0.088)   | 1.001***<br>(0.082)  | 0.040<br>(0.058)    | -0.077*<br>(0.041)   | 0.103<br>(0.066)     | 1.593***<br>(0.127)  | 2.823***<br>(0.158) |
| Observations       | 1,843                 | 1,843                | 1,843               | 1,843                | 1,843                | 1,843                | 1,843               |
| R-squared          | 0.022                 | 0.026                | 0.019               | 0.039                | 0.013                | 0.026                | 0.001               |

Source: Authors' calculations.

Notes: Population and distance measures are in logs, with proximity defined as its additive inverse ( $-\log[\text{distance}]$ ), so that coefficients can be read as elasticities and a positive coefficient implies closer facilities. The regression also controls for 45 province dummies (not shown). Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Finding significant coefficients in these OLS regressions is not surprising, as people could choose to locate in villages with closer access to public institutions and services, or both could be caused by something else. To overcome endogeneity, we use instrumental variables for population, so that the only variation in village population used in our second-stage regression is associated with distance to rivers and changes over time.

The first-stage regression of our two-stage least squares (2SLS) system is specified as follows:

$$P_{jt} = \alpha_0 + \alpha_1 R_j + \alpha_2 T_t R_j + \alpha_3 T_t + \alpha_4 M_j + \epsilon_j, \quad (2)$$

where  $R$  is the log of geographic distance to the nearest river in village  $j$ ,  $T$  are year dummies for 1996 and 2006, and  $M$  is controls imposed through province or village fixed effects. When using the resulting predicted village populations, the coefficient estimate from equation (1) could be interpreted as a causal effect of population size only if a village's distance to rivers had no other channel of influence on the provision of public services and land rights. Our goal in this paper is simply to test whether such a link exists; if so, the mechanism could be addressed in future work.

Any correlation between a village's population and its distance to rivers might vary over time, so the first-stage regression includes time dummies and interaction terms. The Onchocerciasis Control Program (OCP) started in 1974, and our observations are from 1985, 1996, and 2006, so we expect that distance to rivers might be most important for population in the earlier years. We also expect that distance to rivers might matter more in the regions where OCP had been active. Therefore, we divide the sample between villages in the treatment provinces and villages in placebo regions, where this shock did not occur.

First-stage results are shown in Table 4.3. Columns 1–3 use province fixed effects for the country as a whole and then for the placebo and treatment regions only. Columns 4–6 do the same but using village fixed effects. The point estimates in row 1 indicate that villages farther from rivers are significantly smaller: a 1 percent increase in travel time to a river reduces village population size by 0.247 percent. The magnitude of this effect is roughly twice as large for villages in the Volta Valley region as it is for villages outside this region. The interaction terms in rows 4 and 5 indicate that the influence of distance to river on population size did not diminish significantly between 1985 and 1996; thus, the difference between treatment and control group persists. In 2006, however, the coefficient on the interaction term is positive and significant for the entire sample and is driven by the treatment group. Taken together, the point estimates on distance to river of  $-0.312$  and distance to river interacted with the year dummy for 2006 of  $+0.27$  imply that in 2006, a 1 percent increase in the distance to a river reduced the population size by 0.047 percent in the treatment villages. This result is consistent with our expectation that the size of the effect would diminish over time. Beneath each column, we provide an F-statistic on the joint significance of all instruments. The null hypothesis that the instruments are jointly irrelevant in the regression can be rejected at the 1 percent level for all cases. In addition, the F-statistics meet the rule of thumb cut-off suggested by Stock and Yogo (2005) in five of six cases (all but the last column), which is an indication of the explanatory power of our instruments.

**Table 4.3—First-stage regression results for IV estimation**

| Variables             | (1)<br>All<br>Provinces | (2)<br>Non-Volta Regions | (3)<br>Volta Valley<br>Regions | (4)<br>All<br>Provinces | (5)<br>Non-Volta Regions | (6)<br>Volta Valley<br>Regions |
|-----------------------|-------------------------|--------------------------|--------------------------------|-------------------------|--------------------------|--------------------------------|
| log distance to river | -0.247***<br>[0.041]    | -0.183***<br>[0.057]     | -0.312***<br>[0.059]           |                         |                          |                                |
| year==1996            | -0.111<br>[0.244]       | -0.324<br>[0.368]        | 0.030<br>[0.330]               | -0.165<br>[0.231]       | -0.297<br>[0.373]        | -0.089<br>[0.293]              |
| year==2006            | -0.896***<br>[0.242]    | -0.687*<br>[0.369]       | -1.107***<br>[0.324]           | -0.916***<br>[0.255]    | -0.733*<br>[0.411]       | -1.109***<br>[0.324]           |
| distanceX1996         | 0.053<br>[0.060]        | 0.082<br>[0.088]         | 0.038<br>[0.084]               | 0.066<br>[0.057]        | 0.077<br>[0.089]         | 0.067<br>[0.075]               |
| distanceX2006         | 0.174***<br>[0.060]     | 0.079<br>[0.089]         | 0.265***<br>[0.082]            | 0.179***<br>[0.063]     | 0.090<br>[0.099]         | 0.267***<br>[0.082]            |
| Constant              | 7.942***<br>[0.164]     | 7.885***<br>[0.236]      | 8.023***<br>[0.230]            | 6.975***<br>[0.029]     | 7.160***<br>[0.038]      | 6.815***<br>[0.043]            |
| Observations          | 2,076                   | 959                      | 1,117                          | 2,076                   | 959                      | 1,117                          |
| R-squared             | 0.189                   | 0.143                    | 0.217                          | 0.489                   | 0.452                    | 0.513                          |
| F-Stat Inst           | 19.20                   | 10.82                    | 11.79                          | 12.44                   | 10.67                    | 6.602                          |

Source: Authors' calculations.

Notes: Dependent variable for all columns is log of village population size; columns 1–3 control for 45 province dummies (not shown), and columns 4–6 control for village fixed effects (so distance to river is dropped). Distance measures are in logs. Distance to nearest river is straight-line distance, to capture flight time needed by the black flies that carry onchocerciasis from the river to peoples' homes. Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 4.4a–f report our instrumental variable (IV) estimates, using the same sequence of regressions as shown in Table 4.1, which used OLS. Below each column of Table 4.4, we report the 2SLS regression’s Hansen J-statistic and the associated p-value. The p-values are generally well above 0.10, indicating that we cannot reject the null hypothesis that our excluded instruments are uncorrelated with the error term in most instances.

It is notable that the IV coefficients on village population are generally larger and more significant than the OLS estimates in Table 4.1. A potential explanation is that the OLS estimates reflect the average population effect on the outcomes variables (for example, Card 1995, 2001). On the other hand, the IV estimates reflect the effect of population in villages where the instruments induced population changes (Imbens and Angrist 1994).

Table 4.4a shows our basic result with province fixed effects for the entire country. Variation in a village’s population associated with proximity to rivers is positively associated with having more public services, infrastructure, religious facilities, and markets, as well as more individual land rights (as opposed to familial or communal), more land rental or sale transactions, and regulated access to forest land. The only unexpected coefficient is in column 19, which shows less-regulated access to cropland; however, that is only weakly significant and arises in the context of column 13, which indicates that rights are more likely to be vested in individuals than in families or communal authorities.

Table 4.4b shows the same regression with village fixed effects. Coefficients for public services, religious facilities, and land regulations are no longer significant, but the coefficients on infrastructure, markets, individual land rights, and land markets remain large and significant. These amenities show the strongest link to village population changes over this 20-year period, controlling for common national time trends and any time-invariant characteristics of the villages other than their population.

Tables 4.4c and 4.4d show the corresponding pair of results for the Volta Valley region only, first with province and then with village fixed effects. Here, coefficients are generally larger, but significance levels are sometimes smaller, perhaps due to the smaller sample size. With village fixed effects, two of the three infrastructure variables, as well as individual land ownership rights and land markets, remain significantly linked to instrumented population size.

Tables 4.4e and 4.4f show the relevant results for the villages outside our treatment region. This is a type of placebo regression, although in this case, we do not expect the link between population and public services to disappear entirely. Indeed, in these non-treatment villages, the coefficients on instrumented population remain significant for religious facilities and a few other amenities when using province fixed effects, although even these become insignificant when village fixed effects are used.

**Table 4.4a—IV regression results for infrastructure and institutions on predicted village population, with province fixed effects**

|                | <u>Proximity of farthest source (km)</u> |                  |                 |                | <u>Proximity to all sources (km)</u> |                  |                 |                | <u>Proximity to closest source (km)</u> |                   |                  |                 |
|----------------|------------------------------------------|------------------|-----------------|----------------|--------------------------------------|------------------|-----------------|----------------|-----------------------------------------|-------------------|------------------|-----------------|
|                | Services<br>(1)                          | Infrastr.<br>(2) | Religion<br>(3) | Markets<br>(4) | Services<br>(5)                      | Infrastr.<br>(6) | Religion<br>(7) | Markets<br>(8) | Services<br>(9)                         | Infrastr.<br>(10) | Religion<br>(11) | Markets<br>(12) |
| Inpopulation   | 0.273*                                   | 0.320*           | 1.026***        | 0.665***       | 0.390**                              | 0.696***         | 0.912***        | 0.735***       | 0.973***                                | 0.697***          | 0.594***         | 0.959***        |
|                | [0.163]                                  | [0.172]          | [0.194]         | [0.223]        | [0.152]                              | [0.160]          | [0.167]         | [0.197]        | [0.219]                                 | [0.160]           | [0.143]          | [0.182]         |
| year==1996     | -0.082                                   | 0.150***         | 0.059           | -0.065         | -0.013                               | 0.135**          | 0.108*          | -0.008         | 0.101                                   | 0.247***          | 0.190***         | 0.128**         |
|                | [0.056]                                  | [0.056]          | [0.072]         | [0.070]        | [0.051]                              | [0.053]          | [0.062]         | [0.062]        | [0.070]                                 | [0.054]           | [0.055]          | [0.062]         |
| year==2006     | 0.083                                    | 0.556***         | 0.715***        | 0.184**        | 0.332***                             | 0.681***         | 0.712***        | 0.350***       | 1.281***                                | 0.719***          | 0.614***         | 0.789***        |
|                | [0.058]                                  | [0.064]          | [0.092]         | [0.085]        | [0.055]                              | [0.062]          | [0.079]         | [0.076]        | [0.085]                                 | [0.065]           | [0.066]          | [0.077]         |
| Observations   | 2,040                                    | 2,068            | 1,960           | 2,043          | 2,040                                | 2,068            | 1,960           | 2,043          | 2,040                                   | 2,068             | 1,960            | 2,043           |
| # of prov.     | 45                                       | 45               | 45              | 45             | 45                                   | 45               | 45              | 45             | 45                                      | 45                | 45               | 45              |
| Hansen J-stat. | 2.067                                    | 8.224            | 5.624           | 0.0629         | 3.947                                | 8.279            | 4.655           | 0.0820         | 7.047                                   | 2.193             | 1.064            | 1.062           |
| Prob HJS       | 0.356                                    | 0.0164           | 0.0601          | 0.969          | 0.139                                | 0.0159           | 0.0975          | 0.960          | 0.0295                                  | 0.334             | 0.587            | 0.588           |

|                | <u>Land ownership rights</u> |                |                  | <u>Land</u>            | <u>Regulated access</u> |                |                  |
|----------------|------------------------------|----------------|------------------|------------------------|-------------------------|----------------|------------------|
|                | Individual<br>(13)           | Family<br>(14) | Communal<br>(15) | <u>Markets</u><br>(16) | Pasture<br>(17)         | Forest<br>(18) | Cropland<br>(19) |
| Inpopulation   | 0.119**                      | -0.150**       | 0.074            | 0.081**                | 0.224***                | 0.113          | -0.078*          |
|                | [0.051]                      | [0.064]        | [0.046]          | [0.032]                | [0.071]                 | [0.106]        | [0.341]          |
| year==1996     | 0.006                        | 0.019          | -0.007           | 0.002                  | 0.013                   | 0.073**        | 0.028            |
|                | [0.023]                      | [0.023]        | [0.016]          | [0.011]                | [0.022]                 | [0.035]        | [0.043]          |
| year==2006     | 0.066**                      | -0.028         | 0.020            | 0.069***               | 0.133***                | 0.185***       | -0.031           |
|                | [0.027]                      | [0.026]        | [0.018]          | [0.014]                | [0.025]                 | [0.041]        | [0.048]          |
| Observations   | 2,076                        | 2,076          | 2,076            | 2,076                  | 2,076                   | 2,076          | 2,076            |
| # of prov.     | 45                           | 45             | 45               | 45                     | 45                      | 45             | 45               |
| Hansen J-stat. | 0.456                        | 1.503          | 1.204            | 2.274                  | 3.042                   | 1.008          | 0.965            |
| Prob HJS       | 0.796                        | 0.472          | 0.548            | 0.321                  | 0.218                   | 0.604          | 0.617            |

Source: Authors' calculations.

Notes: HJS = Hansen J-statistic. First-stage results are shown in column 3 of Table 4.3. Population and proximity measures are in logs. All regressions control for 45 province dummies (not shown). Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

**Table 4.4b—IV regression results for infrastructure and institutions on predicted village population, with village fixed effects**

|                    | <u>Proximity of farthest source (km)</u> |                     |                     |                    | <u>Proximity to all sources (km)</u> |                     |                     |                     | <u>Proximity to closest source (km)</u> |                     |                     |                     |
|--------------------|------------------------------------------|---------------------|---------------------|--------------------|--------------------------------------|---------------------|---------------------|---------------------|-----------------------------------------|---------------------|---------------------|---------------------|
|                    | Services<br>(1)                          | Infrastr.<br>(2)    | Religion<br>(3)     | Markets<br>(4)     | Services<br>(5)                      | Infrastr.<br>(6)    | Religion<br>(7)     | Markets<br>(8)      | Services<br>(9)                         | Infrastr.<br>(10)   | Religion<br>(11)    | Markets<br>(12)     |
| Inpopulation       | 0.106<br>[0.292]                         | 0.777**<br>[0.398]  | 0.103<br>[0.267]    | 0.701**<br>[0.337] | 0.300<br>[0.247]                     | 0.387<br>[0.252]    | 0.025<br>[0.218]    | 0.564**<br>[0.272]  | 0.491<br>[0.378]                        | 0.980**<br>[0.402]  | 0.191<br>[0.207]    | 0.556***<br>[0.201] |
| year==1996         | -0.035<br>[0.045]                        | 0.273***<br>[0.063] | 0.144***<br>[0.044] | -0.070<br>[0.053]  | 0.069*<br>[0.039]                    | 0.252***<br>[0.039] | 0.182***<br>[0.036] | 0.005<br>[0.043]    | 0.264***<br>[0.057]                     | 0.237***<br>[0.061] | 0.240***<br>[0.035] | 0.159***<br>[0.046] |
| year==2006         | -0.001<br>[0.061]                        | 0.317***<br>[0.094] | 0.411***<br>[0.079] | 0.196**<br>[0.084] | 0.189***<br>[0.055]                  | 0.446***<br>[0.057] | 0.479***<br>[0.065] | 0.316***<br>[0.067] | 0.984***<br>[0.089]                     | 0.794***<br>[0.107] | 0.525***<br>[0.066] | 0.712***<br>[0.080] |
| Observations       | 2,027                                    | 2,066               | 1,936               | 2,033              | 2,027                                | 2,066               | 1,936               | 2,033               | 2,027                                   | 2,066               | 1,936               | 2,033               |
| Number of villages | 692                                      | 704                 | 670                 | 694                | 692                                  | 704                 | 670                 | 694                 | 692                                     | 704                 | 670                 | 694                 |
| Hansen J-stat.     | 1.524                                    | 0.00170             | 0.0243              | 0.00699            | 0.920                                | 0.0217              | 0.0223              | 0.0152              | 0.0416                                  | 0.766               | 0.0732              | 0.0348              |
| Prob HJS           | 0.217                                    | 0.967               | 0.876               | 0.933              | 0.337                                | 0.883               | 0.881               | 0.902               | 0.838                                   | 0.382               | 0.787               | 0.852               |

|                    | <u>Land ownership rights</u> |                  |                    | <u>Land</u>         |                     | <u>Regulated access</u> |                   |
|--------------------|------------------------------|------------------|--------------------|---------------------|---------------------|-------------------------|-------------------|
|                    | Individual<br>(13)           | Family<br>(14)   | Communal<br>(15)   | Markets<br>(16)     | Pasture<br>(17)     | Forest<br>(18)          | Cropland<br>(19)  |
| Inpopulation       | 0.053**<br>[0.025]           | 0.005<br>[0.020] | -0.023*<br>[0.014] | 0.044**<br>[0.022]  | -0.034<br>[0.067]   | -0.125<br>[0.130]       | -0.034<br>[0.072] |
| year==1996         | 0.015**<br>[0.007]           | 0.004<br>[0.003] | 0.003<br>[0.003]   | 0.012<br>[0.008]    | 0.033***<br>[0.010] | 0.101***<br>[0.020]     | 0.013<br>[0.012]  |
| year==2006         | 0.052***<br>[0.015]          | 0.007<br>[0.005] | 0.001<br>[0.002]   | 0.041***<br>[0.013] | 0.075***<br>[0.017] | 0.136***<br>[0.031]     | 0.023<br>[0.016]  |
| Observations       | 2,076                        | 2,076            | 2,076              | 2,076               | 2,076               | 2,076                   | 2,076             |
| Number of villages | 705                          | 705              | 705                | 705                 | 705                 | 705                     | 705               |
| Hansen J-stat.     | 1.793                        | 0.0201           | 0.210              | 0.0298              | 0.596               | 0.00628                 | 0.786             |
| Prob HJS           | 0.181                        | 0.887            | 0.647              | 0.863               | 0.440               | 0.937                   | 0.375             |

Source: Authors' calculations.

Notes: HJS = Hansen J-statistic. First-stage results are shown in column 1 of Table 4.3. Population and proximity measures are in logs. All regressions control for village fixed effects.

Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

**Table 4.4c—IV regression results for infrastructure and institutions on village population, with province fixed effects, in Volta Valley only**

|                | <u>Proximity of farthest source (km)</u> |                     |                     |                     | <u>Proximity to all sources (km)</u> |                     |                     |                     | <u>Proximity to closest source (km)</u> |                     |                     |                     |
|----------------|------------------------------------------|---------------------|---------------------|---------------------|--------------------------------------|---------------------|---------------------|---------------------|-----------------------------------------|---------------------|---------------------|---------------------|
|                | Services<br>(1)                          | Infrastr.<br>(2)    | Religion<br>(3)     | Markets<br>(4)      | Services<br>(5)                      | Infrastr.<br>(6)    | Religion<br>(7)     | Markets<br>(8)      | Services<br>(9)                         | Infrastr.<br>(10)   | Religion<br>(11)    | Markets<br>(12)     |
| Inpopulation   | 0.406**<br>[0.181]                       | 0.396**<br>[0.196]  | 0.653***<br>[0.193] | 0.667***<br>[0.247] | 0.478***<br>[0.166]                  | 0.704***<br>[0.171] | 0.633***<br>[0.169] | 0.759***<br>[0.220] | 0.979***<br>[0.229]                     | 0.816***<br>[0.160] | 0.532***<br>[0.161] | 1.167***<br>[0.209] |
| year==1996     | -0.143*<br>[0.083]                       | 0.165*<br>[0.086]   | 0.058<br>[0.098]    | -0.113<br>[0.104]   | -0.071<br>[0.077]                    | 0.109<br>[0.079]    | 0.123<br>[0.086]    | -0.054<br>[0.094]   | 0.029<br>[0.104]                        | 0.158**<br>[0.078]  | 0.234***<br>[0.081] | 0.054<br>[0.100]    |
| year==2006     | 0.073<br>[0.074]                         | 0.574***<br>[0.082] | 0.613***<br>[0.102] | 0.137<br>[0.097]    | 0.303***<br>[0.069]                  | 0.619***<br>[0.078] | 0.656***<br>[0.089] | 0.305***<br>[0.089] | 1.172***<br>[0.106]                     | 0.560***<br>[0.077] | 0.634***<br>[0.077] | 0.737***<br>[0.101] |
| Observations   | 1,103                                    | 1,114               | 1,044               | 1,107               | 1,103                                | 1,114               | 1,044               | 1,107               | 1,103                                   | 1,114               | 1,044               | 1,107               |
| # of prov.     | 23                                       | 23                  | 23                  | 23                  | 23                                   | 23                  | 23                  | 23                  | 23                                      | 23                  | 23                  | 23                  |
| Hansen J-stat. | 2.734                                    | 9.640               | 10.30               | 1.568               | 5.298                                | 10.49               | 10.03               | 2.028               | 5.429                                   | 1.923               | 4.974               | 1.330               |
| Prob HJS       | 0.255                                    | 0.00807             | 0.00579             | 0.457               | 0.0707                               | 0.00527             | 0.00665             | 0.363               | 0.0662                                  | 0.382               | 0.0832              | 0.514               |

|                | <u>Land ownership rights</u> |                   |                   | <u>Land</u>            | <u>Regulated access</u> |                     |                   |
|----------------|------------------------------|-------------------|-------------------|------------------------|-------------------------|---------------------|-------------------|
|                | Individual<br>(13)           | Family<br>(14)    | Communal<br>(15)  | <u>Markets</u><br>(16) | Pasture<br>(17)         | Forest<br>(18)      | Cropland<br>(19)  |
| Inpopulation   | 0.226***<br>[0.080]          | -0.044<br>[0.064] | 0.053<br>[0.053]  | 0.026***<br>[0.012]    | 0.233***<br>[0.069]     | 0.073<br>[0.121]    | -0.080<br>[0.104] |
| year==1996     | -0.016<br>[0.035]            | 0.014<br>[0.031]  | -0.014<br>[0.025] | 0.005<br>[0.013]       | 0.005<br>[0.032]        | 0.092*<br>[0.052]   | 0.035<br>[0.055]  |
| year==2006     | 0.076**<br>[0.034]           | 0.003<br>[0.029]  | 0.007<br>[0.023]  | 0.053***<br>[0.014]    | 0.119***<br>[0.030]     | 0.192***<br>[0.050] | 0.060<br>[0.053]  |
| Observations   | 1,117                        | 1,117             | 1,117             | 1,117                  | 1,117                   | 1,117               | 1,117             |
| # of prov.     | 23                           | 23                | 23                | 23                     | 23                      | 23                  | 23                |
| Hansen J-stat. | 2.158                        | 0.307             | 0.906             | 1.542                  | 4.172                   | 0.825               | 0.0377            |
| Prob HJS       | 0.340                        | 0.858             | 0.636             | 0.463                  | 0.124                   | 0.662               | 0.981             |

Source: Authors' calculations.

Notes: HJS = Hansen J-statistic. First-stage results are shown in column 2 of Table 4.3. Population and proximity measures are in logs. All regressions control for 45 province dummies (not shown). Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Table 4.4d—IV regression results for infrastructure and institutions on village population, with village fixed effects, in Volta Valley only**

|                    | <u>Proximity of farthest source (km)</u> |                     |                     |                    | <u>Proximity to all sources (km)</u> |                     |                     |                     | <u>Proximity to closest source (km)</u> |                     |                     |                     |
|--------------------|------------------------------------------|---------------------|---------------------|--------------------|--------------------------------------|---------------------|---------------------|---------------------|-----------------------------------------|---------------------|---------------------|---------------------|
|                    | Services<br>(1)                          | Infrastr.<br>(2)    | Religion<br>(3)     | Markets<br>(4)     | Services<br>(5)                      | Infrastr.<br>(6)    | Religion<br>(7)     | Markets<br>(8)      | Services<br>(9)                         | Infrastr.<br>(10)   | Religion<br>(11)    | Markets<br>(12)     |
| Inpopulation       | -0.171<br>[0.267]                        | 0.629**<br>[0.312]  | -0.337<br>[0.278]   | 0.197<br>[0.208]   | -0.292<br>[0.217]                    | -0.294<br>[0.198]   | -0.174<br>[0.225]   | 0.268<br>[0.187]    | 0.004<br>[0.278]                        | 0.741***<br>[0.272] | 0.055<br>[0.203]    | 0.753**<br>[0.302]  |
| year==1996         | -0.048<br>[0.067]                        | 0.352***<br>[0.087] | 0.181**<br>[0.073]  | -0.037<br>[0.057]  | 0.060<br>[0.055]                     | 0.289***<br>[0.054] | 0.226***<br>[0.059] | 0.024<br>[0.051]    | 0.206***<br>[0.069]                     | 0.181***<br>[0.069] | 0.308***<br>[0.055] | 0.127*<br>[0.076]   |
| year==2006         | 0.019<br>[0.052]                         | 0.490***<br>[0.068] | 0.433***<br>[0.077] | 0.094**<br>[0.045] | 0.238***<br>[0.047]                  | 0.537***<br>[0.040] | 0.516***<br>[0.064] | 0.262***<br>[0.040] | 1.098***<br>[0.065]                     | 0.553***<br>[0.073] | 0.569***<br>[0.060] | 0.711***<br>[0.076] |
| Observations       | 1,096                                    | 1,113               | 1,032               | 1,102              | 1,096                                | 1,113               | 1,032               | 1,102               | 1,096                                   | 1,113               | 1,032               | 1,102               |
| Number of villages | 374                                      | 380                 | 358                 | 376                | 374                                  | 380                 | 358                 | 376                 | 374                                     | 380                 | 358                 | 376                 |
| Hansen J-stat.     | 0.753                                    | 0.508               | 0.000555            | 1.304              | 0.258                                | 1.105               | 0.0108              | 1.473               | 0.706                                   | 1.515               | 0.303               | 0.123               |
| Prob HJS           | 0.386                                    | 0.476               | 0.981               | 0.253              | 0.612                                | 0.293               | 0.917               | 0.225               | 0.401                                   | 0.218               | 0.582               | 0.725               |

|                    | <u>Land ownership rights</u> |                   |                   | <u>Land</u>            | <u>Regulated access</u> |                     |                     |
|--------------------|------------------------------|-------------------|-------------------|------------------------|-------------------------|---------------------|---------------------|
|                    | Individual<br>(13)           | Family<br>(14)    | Communal<br>(15)  | <u>Markets</u><br>(16) | Pasture<br>(17)         | Forest<br>(18)      | Cropland<br>(19)    |
| Inpopulation       | 0.048**<br>[0.026]           | 0.005<br>[0.021]  | -0.013<br>[0.009] | 0.043***<br>[0.018]    | 0.012<br>[0.059]        | -0.097<br>[0.120]   | -0.058<br>[0.084]   |
| year==1996         | 0.018<br>[0.013]             | 0.007<br>[0.005]  | 0.002<br>[0.003]  | 0.012<br>[0.011]       | 0.040***<br>[0.015]     | 0.122***<br>[0.031] | 0.031<br>[0.022]    |
| year==2006         | 0.062***<br>[0.013]          | 0.008*<br>[0.005] | 0.004<br>[0.003]  | 0.046***<br>[0.010]    | 0.100***<br>[0.015]     | 0.180***<br>[0.027] | 0.060***<br>[0.020] |
| Observations       | 1,116                        | 1,116             | 1,116             | 1,116                  | 1,116                   | 1,116               | 1,116               |
| Number of villages | 380                          | 380               | 380               | 380                    | 380                     | 380                 | 380                 |
| Hansen J-stat.     | 1.209                        | 0.0574            | 0.333             | 0.220                  | 2.118                   | 0.0483              | 0.648               |
| Prob HJS           | 0.271                        | 0.811             | 0.564             | 0.639                  | 0.146                   | 0.826               | 0.421               |

Source: Authors' calculations.

Notes: HJS = Hansen J-statistic. First-stage results for this regression are not shown. Population and proximity measures are in logs. All results control for village fixed effects. Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Table 4.4e—IV regression results for infrastructure and institutions on village population, with province fixed effects, outside Volta Valley (placebo regression)**

|                | Proximity of farthest source (km) |                     |                     |                   | Proximity to all sources (km) |                     |                     |                  | Proximity to closest source (km) |                     |                     |                     |
|----------------|-----------------------------------|---------------------|---------------------|-------------------|-------------------------------|---------------------|---------------------|------------------|----------------------------------|---------------------|---------------------|---------------------|
|                | Services<br>(1)                   | Infrastr.<br>(2)    | Religion<br>(3)     | Markets<br>(4)    | Services<br>(5)               | Infrastr.<br>(6)    | Religion<br>(7)     | Markets<br>(8)   | Services<br>(9)                  | Infrastr.<br>(10)   | Religion<br>(11)    | Markets<br>(12)     |
| Inpopulation   | -0.085<br>[0.307]                 | 0.136<br>[0.316]    | 1.600***<br>[0.474] | 0.317<br>[0.430]  | 0.123<br>[0.281]              | 0.609*<br>[0.317]   | 1.312***<br>[0.389] | 0.413<br>[0.366] | 0.996**<br>[0.473]               | 0.313<br>[0.336]    | 0.576**<br>[0.265]  | 0.413<br>[0.322]    |
| year==1996     | -0.039<br>[0.073]                 | 0.114<br>[0.071]    | 0.119<br>[0.116]    | -0.015<br>[0.092] | 0.038<br>[0.065]              | 0.162**<br>[0.065]  | 0.135<br>[0.095]    | 0.037<br>[0.079] | 0.186**<br>[0.094]               | 0.323***<br>[0.073] | 0.149**<br>[0.072]  | 0.165**<br>[0.076]  |
| year==2006     | -0.025<br>[0.129]                 | 0.472***<br>[0.141] | 0.984***<br>[0.224] | 0.098<br>[0.199]  | 0.275**<br>[0.118]            | 0.720***<br>[0.139] | 0.879***<br>[0.186] | 0.273<br>[0.169] | 1.421***<br>[0.199]              | 0.770***<br>[0.149] | 0.574***<br>[0.131] | 0.652***<br>[0.148] |
| Observations   | 937                               | 954                 | 916                 | 936               | 937                           | 954                 | 916                 | 936              | 937                              | 954                 | 916                 | 936                 |
| # of prov.     | 22                                | 22                  | 22                  | 22                | 22                            | 22                  | 22                  | 22               | 22                               | 22                  | 22                  | 22                  |
| Hansen J-stat. | 1.285                             | 1.696               | 0.379               | 2.857             | 1.093                         | 0.882               | 0.444               | 1.538            | 2.559                            | 1.703               | 0.810               | 1.014               |
| Prob HJS       | 0.526                             | 0.428               | 0.827               | 0.240             | 0.579                         | 0.643               | 0.801               | 0.463            | 0.278                            | 0.427               | 0.667               | 0.602               |

Source: Authors' calculations.

Notes: HJS = Hansen J-statistic. First-stage results for this regression are not shown. Population and proximity measures are in logs. All regressions control for 45 province dummies (not shown). Robust standard errors are in brackets, and asterisks indicate significance levels at \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

So far, we have shown that variance in village population is robustly correlated with the provision of local public services, private markets, and individual property rights. The link is particularly clear when instrumenting population by proximity to rivers, especially within the Volta Valley, where the OCP shock occurred. This correlation between village population and public amenities could be driven by various possible mechanisms, to be investigated in future work, including scale economies in the public sector and the relative scarcity of natural resources.

Whatever mechanisms are involved, the magnitude by which larger villages obtain more public services and have more access to private markets and individual land rights is economically significant. The order of magnitude can be described by a comparison of the time trends sweeping Burkina Faso as a whole, driven by national policy and other changes. The point estimates of elasticities reported in Table 4.4a give us the effect of a 1 percent increase in village population, which we can compare to the effect of time associated with our dummy variables for 1996 and 2006. For example, using column 2 for proximity to every item of public infrastructure (including the farthest), villages that are 1 percent larger in terms of population size have infrastructure that is 0.32 percent closer. In contrast, the time trend for new infrastructure projects improved proximity by 16 percent and 74 percent from 1985 to 1996 and to 2006, respectively. Over a 10-year period, village population is likely to increase by much more than 1 percent. For example, using the average rural population growth rate of 2 percent, village population would increase by 25 percent. The implied reduction in travel distance to public infrastructure is  $0.32 * 25$  percent, or 8 percent. Alternatively, a doubling of village size is roughly equivalent to a decade or two of time trend for most of the variables we consider.

## 5. CONCLUSION

This paper uses variance in rural demography associated with proximity to rivers in Burkina Faso to test whether villages with larger populations obtain closer provision of public services, public infrastructure, religious facilities, and markets, and whether they have more market-oriented property rights over land use. Our data on infrastructure and institutions come from a survey of village elders, which was designed to document change over time and differences across villages. We find strong links among larger rural population, more local public goods provision, and individual property rights, controlling for either province or village fixed effects and time trends.

One feature of our study is to demonstrate the use of village elders' recall data in constructing time-varying indexes of local infrastructure and institutions. This involves asking about villagers' access to specific amenities, and then aggregating those responses into indexes that capture variations in public amenities from the point of view of the villagers. The correlations we find demonstrate the potential significance of this approach as a way to overcome the limited availability of other ways of measuring variation in public services, infrastructure, and institutions over time and space.

In the particular setting of rural Burkina Faso, we find that variance in village population size is significantly correlated with village-level access to infrastructure, markets, and individual land rights. These public amenities are clearly of great importance for rural development. Future work using our data or similar new surveys elsewhere could further document how village infrastructure and institutions are responding to Africa's extraordinary demographic changes, as well as explore the economic mechanisms behind these important political changes.

## APPENDIX: SURVEY QUESTIONNAIRE

**BURKINA FASO**  
Ministère de l'Agriculture de l'Hydraulique et des Ressources Halieutiques

### DIRECTION GENERALE DE LA PROMOTION DE L'ECONOMIE RURALE

Direction de la Prospective et des Statistiques Agricoles et Alimentaires

#### ENQUETE COMMUNAUTAIRE

| N° | Eléments d'identification                   | Nom | Code          |
|----|---------------------------------------------|-----|---------------|
| 1  | Région                                      |     | _ _ _         |
| 2  | Province                                    |     | _ _ _         |
| 3  | Commune                                     |     | _ _ _         |
| 4  | Type de localité<br>1 = urbain<br>2 = rural |     | _ _           |
| 5  | Village / secteur                           |     | _ _ _ _       |
| 6  | Latitude                                    |     | _ _ _ _ _ _ _ |
| 7  | Longitude                                   |     | _ _ _ _ _ _ _ |

Nom du contrôleur : \_\_\_\_\_|\_C\_|\_|\_|\_|

Date de l'interview : |\_|\_|\_|\_|\_|\_|\_|\_|\_|\_|  
Jour mois année

Nom et visa du superviseur : \_\_\_\_\_

Date de contrôle : |\_|\_|\_|\_|\_|\_|\_|\_|\_|\_|  
Jour mois année

Résultat du contrôle : .....|\_|\_|\_|  
(1= aucun problème ; 2= questionnaire corrigé ; 3= questionnaire repris)

Nom et prénom(s) de l'agent de saisie A : \_\_\_\_\_|\_|\_|\_|\_|

Nom et prénom(s) de l'agent de saisie B : \_\_\_\_\_|\_|\_|\_|\_|

A combien d'années remonte l'établissement du village :..... |\_|\_|\_|\_|\_|

Le Village est-il un village de colonie : (1=Oui ; 0=Non) :..... |\_|\_|

## I. IDENTITE DES REpondANTS

| N°  | Catégorie                                                    | Nombre pour chaque catégorie |       | TOTAL* |
|-----|--------------------------------------------------------------|------------------------------|-------|--------|
|     |                                                              | Homme                        | Femme |        |
| I.1 | Autorités gouvernementales/Représentants de l'administration | _ _ _                        | _ _ _ | _ _ _  |
| I.2 | Chefs de village                                             | _ _ _                        | _ _ _ | _ _ _  |
| I.3 | Délégués CVD                                                 | _ _ _                        | _ _ _ | _ _ _  |
| I.4 | Chefs de terre                                               | _ _ _                        | _ _ _ | _ _ _  |
| I.5 | Chefs religieux (Imam, Pasteur, Prêtre....)                  | _ _ _                        | _ _ _ | _ _ _  |
| I.6 | Responsables de Groupements/Associations                     | _ _ _                        | _ _ _ | _ _ _  |
| I.7 | TOTAL*                                                       | _ _ _                        | _ _ _ | _ _ _  |

\* A compléter après l'interview avec le groupe

## II. COMPOSITION ACTUELLE DES COMMUNAUTES DU VILLAGE

| N°   | Questions                                                                                    | Réponse |
|------|----------------------------------------------------------------------------------------------|---------|
| II.1 | Nombre approximatif d'autochtones revenus de la Côte d'Ivoire à cause de la crise ivoirienne | _ _ _ _ |
| II.2 | Nombre approximatif d'immigrants venant d'ailleurs                                           | _ _ _ _ |
| II.3 | Nombre de groupes ethniques dans la communauté du village                                    | _ _ _   |
| II.4 | Nombre de clans dans le village                                                              | _ _ _   |

## III. POPULATION DU VILLAGE

NB : Pour cette partie, l'enquêteur devra se rendre à la préfecture ou à la mairie de la localité

| N°    | Questions                                                         | Réponse       |
|-------|-------------------------------------------------------------------|---------------|
| III.1 | Existence des documents du recensement de 2006<br>(1=Oui ; 0=Non) | _             |
| III.2 | Population totale en 2006                                         | _ _ _ _ _ _ _ |

|        |                                                                   |       |                      |
|--------|-------------------------------------------------------------------|-------|----------------------|
| III.3  | Population de plus de 15 ans                                      | Homme | <input type="text"/> |
| III.4  |                                                                   | Femme | <input type="text"/> |
| III.5  | Population de moins de 15 ans                                     | Homme | <input type="text"/> |
| III.6  |                                                                   | Femme | <input type="text"/> |
| III.7  | Existence des documents du recensement de 1996<br>(1=Oui ; 0=Non) |       | <input type="text"/> |
| III.8  | Population totale en 1996                                         |       | <input type="text"/> |
| III.9  | Population de plus de 15 ans                                      | Homme | <input type="text"/> |
| III.10 |                                                                   | Femme | <input type="text"/> |
| III.11 | Population de moins de 15 ans                                     | Homme | <input type="text"/> |
| III.12 |                                                                   | Femme | <input type="text"/> |
| III.13 | Existence des documents du recensement de 1985<br>(1=Oui ; 0=Non) |       | <input type="text"/> |
| III.14 | Population totale en 1985                                         |       | <input type="text"/> |
| III.15 | Population de plus de 15 ans                                      | Homme | <input type="text"/> |
| III.16 |                                                                   | Femme | <input type="text"/> |
| III.17 | Population de moins de 15 ans                                     | Homme | <input type="text"/> |
| III.18 |                                                                   | Femme | <input type="text"/> |

#### IV. VISITE D'UN OFFICIEL DE LA VULGARISATION AGRICOLE

| N°   | Questions                                                                                                           | Réponse              |
|------|---------------------------------------------------------------------------------------------------------------------|----------------------|
| IV.1 | Quand a été la première visite d'un vulgarisateur à votre communauté ?<br>(Inscrire l'année ou xxxx si jamais)      | <input type="text"/> |
| IV.2 | Quand est-ce que la vulgarisation de proximité (ancienne formule) a cessé ?<br>(Inscrire l'année ou xxxx si jamais) | <input type="text"/> |
| IV.3 | Quand est-ce que la vulgarisation nouvelle formule a commencé? (Inscrire l'année ou xxxx si jamais)                 | <input type="text"/> |
| IV.4 | Quand a été la dernière visite d'un vulgarisateur à votre communauté ?<br>(Inscrire l'année ou xxxx si jamais)      | <input type="text"/> |

|      |                                                                                                            |                      |
|------|------------------------------------------------------------------------------------------------------------|----------------------|
| IV.5 | Combien de visites avez vous reçus au cours des 12 derniers mois ?<br>(Inscrire l'année ou xxxx si jamais) | <input type="text"/> |
|------|------------------------------------------------------------------------------------------------------------|----------------------|

## V. INFRASTRUCTURES CENTRALES : DISTANCES ET CHANGEMENTS

| N°         | Questions                                                                                                 | Réponse              |                       |
|------------|-----------------------------------------------------------------------------------------------------------|----------------------|-----------------------|
|            |                                                                                                           | Distance (en km)     | Année d'établissement |
| <b>V.1</b> | <b>Distance entre le village et l'administration centrale (pour les registres des naissances)</b>         |                      |                       |
| V.1.1      | La situation actuelle                                                                                     | <input type="text"/> | <input type="text"/>  |
| V.1.2      | La situation précédente                                                                                   | <input type="text"/> | <input type="text"/>  |
| V.1.3      | La situation antécédente                                                                                  | <input type="text"/> | <input type="text"/>  |
| <b>V.2</b> | <b>Distance entre le village et la route praticable par car ou camion toute l'année</b>                   |                      |                       |
| V.2.1      | La situation actuelle                                                                                     | <input type="text"/> | <input type="text"/>  |
| V.2.2      | La situation précédente                                                                                   | <input type="text"/> | <input type="text"/>  |
| V.2.3      | La situation antécédente                                                                                  | <input type="text"/> | <input type="text"/>  |
| <b>V.3</b> | <b>Distance entre le village et la route praticable par car ou camion seulement une partie de l'année</b> |                      |                       |
| V.3.1      | La situation actuelle                                                                                     | <input type="text"/> | <input type="text"/>  |
| V.3.2      | La situation précédente                                                                                   | <input type="text"/> | <input type="text"/>  |
| V.3.3      | La situation antécédente                                                                                  | <input type="text"/> | <input type="text"/>  |
| <b>V.4</b> | <b>Distance entre le village et l'arrêt d'autocar/taxi brousse rural</b>                                  |                      |                       |
| V.4.1      | La situation actuelle                                                                                     | <input type="text"/> | <input type="text"/>  |
| V.4.2      | La situation précédente                                                                                   | <input type="text"/> | <input type="text"/>  |
| V.4.3      | La situation antécédente                                                                                  | <input type="text"/> | <input type="text"/>  |
| <b>V.5</b> | <b>Distance entre le village et le bureau des caisses populaires</b>                                      |                      |                       |
| V.5.1      | La situation actuelle                                                                                     | <input type="text"/> | <input type="text"/>  |
| V.5.2      | La situation précédente                                                                                   | <input type="text"/> | <input type="text"/>  |
| V.5.3      | La situation antécédente                                                                                  | <input type="text"/> | <input type="text"/>  |
| <b>V.6</b> | <b>Distance entre le village et la localité avec distribution d'électricité</b>                           |                      |                       |

|            |                                                                           |                      |                      |
|------------|---------------------------------------------------------------------------|----------------------|----------------------|
| V.6.1      | La situation actuelle                                                     | <input type="text"/> | <input type="text"/> |
| V.6.2      | La situation précédente                                                   | <input type="text"/> | <input type="text"/> |
| V.6.3      | La situation antécédente                                                  | <input type="text"/> | <input type="text"/> |
| <b>V.7</b> | <b>Distance entre le village et la localité avec le téléphone fixe</b>    |                      |                      |
| V.7.1      | La situation actuelle                                                     | <input type="text"/> | <input type="text"/> |
| V.7.2      | La situation précédente                                                   | <input type="text"/> | <input type="text"/> |
| V.7.3      | La situation antécédente                                                  | <input type="text"/> | <input type="text"/> |
| <b>V.8</b> | <b>Distance entre le village et la localité avec la téléphonie mobile</b> |                      |                      |
| V.8.1      | La situation actuelle                                                     | <input type="text"/> | <input type="text"/> |
| V.8.2      | La situation précédente                                                   | <input type="text"/> | <input type="text"/> |
| V.8.3      | La situation antécédente                                                  | <input type="text"/> | <input type="text"/> |

## VI. MARCHES VILLAGEOIS

| N°          | Questions                                                       | Réponse                                                                                                   |                                                                                                                              |                              |
|-------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>VI.1</b> | <b>FREQUENCE DU MARCHE GENERAL</b>                              |                                                                                                           |                                                                                                                              |                              |
|             |                                                                 | <b>Distance (en km)</b>                                                                                   | <b>Fréquence</b><br>1 = chaque jour<br>2 = tous les 3 jours<br>3 = tous les 4 jours<br>4 = chaque semaine<br>5 = occasionnel | <b>Année d'établissement</b> |
| VI.1.1      | La situation actuelle                                           | <input type="text"/>                                                                                      | <input type="text"/>                                                                                                         | <input type="text"/>         |
| VI.1.2      | La situation précédente                                         | <input type="text"/>                                                                                      | <input type="text"/>                                                                                                         | <input type="text"/>         |
| VI.1.3      | La situation antécédente                                        | <input type="text"/>                                                                                      | <input type="text"/>                                                                                                         | <input type="text"/>         |
| <b>VI.2</b> | <b>TYPE DE SOURCE POUR ACCES A L'EAU DANS LE MARCHE GENERAL</b> |                                                                                                           |                                                                                                                              |                              |
|             |                                                                 | <b>Type de source d'eau</b><br>1 = robinet<br>2 = borne fontaine<br>3 = forage<br>4 = puits<br>5 = aucune | <b>Année d'établissement</b>                                                                                                 |                              |

|             |                                                     |                                                                                                                     |                                                                                                                               |
|-------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| VI.2.1      | La situation actuelle                               | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                  | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.2.2      | La situation précédente                             | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                  | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.2.3      | La situation antécédente                            | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                  | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VI.3</b> | <b>HANGARS DANS LE MARCHE GENERAL</b>               |                                                                                                                     |                                                                                                                               |
|             |                                                     | <b>Type de hangar</b><br>1 = individuel<br>2 = collectif<br>3 = aucun                                               | <b>Année d'établissement</b>                                                                                                  |
| VI.3.1      | La situation actuelle                               | <input type="text"/> - <input type="text"/>                                                                         | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.3.2      | La situation précédente                             | <input type="text"/> - <input type="text"/>                                                                         | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.3.3      | La situation antécédente                            | <input type="text"/> - <input type="text"/>                                                                         | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VI.4</b> | <b>ACCES A L'ELECTRICITE DANS LE MARCHE GENERAL</b> |                                                                                                                     |                                                                                                                               |
|             |                                                     | <b>Disponibilité</b><br>1 = permanente<br>2 = une partie de la journée<br>3 = aucune                                | <b>Année d'établissement</b>                                                                                                  |
| VI.4.1      | La situation actuelle                               | <input type="text"/>                                                                                                | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.4.2      | La situation précédente                             | <input type="text"/>                                                                                                | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.4.3      | La situation antécédente                            | <input type="text"/>                                                                                                | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VI.5</b> | <b>FRAIS (NIVEAU DES TAXES DE MARCHE GENERAL)</b>   |                                                                                                                     |                                                                                                                               |
|             |                                                     | <b>Période</b><br>1 = chaque jour<br>2 = chaque semaine<br>3 = chaque mois<br>4 = chaque année<br>5 = chaque marché | <b>Année d'établissement</b>                                                                                                  |
| VI.5.1      | La situation actuelle                               | <input type="text"/>                                                                                                | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.5.2      | La situation précédente                             | <input type="text"/>                                                                                                | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VI.5.3      | La situation antécédente                            | <input type="text"/>                                                                                                | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VI.6</b> | <b>FREQUENCE DU MARCHE A BETAIL</b>                 |                                                                                                                     |                                                                                                                               |
|             |                                                     | <b>Distance (en km)</b>                                                                                             | <b>Fréquence</b><br>1 = chaque jour<br>2 = tous les 3 jours                                                                   |
|             |                                                     |                                                                                                                     | <b>Année d'établissement</b>                                                                                                  |

|        |                          |                      |                                                                                    |                      |
|--------|--------------------------|----------------------|------------------------------------------------------------------------------------|----------------------|
|        |                          |                      | <i>3 = tous les 4 jours</i><br><i>4 = chaque semaine</i><br><i>5 = occasionnel</i> |                      |
| VI.6.1 | La situation actuelle    | <input type="text"/> | <input type="text"/>                                                               | <input type="text"/> |
| VI.6.2 | La situation précédente  | <input type="text"/> | <input type="text"/>                                                               | <input type="text"/> |
| VI.6.3 | La situation antécédente | <input type="text"/> | <input type="text"/>                                                               | <input type="text"/> |

## VII.INFRASTRUCTURE DU VILLAGE

| N°           | Questions                                                                                                  | Réponse              |                      |                       |
|--------------|------------------------------------------------------------------------------------------------------------|----------------------|----------------------|-----------------------|
|              |                                                                                                            | Distance             | Nombre               | Année d'établissement |
| <b>VII.1</b> | <b>Distance entre le village et les boutiques pour achat des provisions divers (sel, thé, sucre, etc.)</b> |                      |                      |                       |
| VII.1.1      | La situation actuelle                                                                                      | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.1.2      | La situation précédente                                                                                    | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.1.3      | La situation antécédente                                                                                   | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| <b>VII.2</b> | <b>Distance entre le village et les puits collectifs pour l'eau potable</b>                                |                      |                      |                       |
| VII.2.1      | La situation actuelle                                                                                      | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.2.2      | La situation précédente                                                                                    | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.2.3      | La situation antécédente                                                                                   | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| <b>VII.3</b> | <b>Distance entre le village et le puits à grand diamètre</b>                                              |                      |                      |                       |
| VII.3.1      | La situation actuelle                                                                                      | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.3.2      | La situation précédente                                                                                    | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.3.3      | La situation antécédente                                                                                   | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| <b>VII.4</b> | <b>Distance entre le village et le forage collectif pour l'eau potable</b>                                 |                      |                      |                       |
| VII.4.1      | La situation actuelle                                                                                      | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.4.2      | La situation précédente                                                                                    | <input type="text"/> | <input type="text"/> | <input type="text"/>  |
| VII.4.3      | La situation antécédente                                                                                   | <input type="text"/> | <input type="text"/> | <input type="text"/>  |

|              |                                                                                        |                      |                      |                      |
|--------------|----------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|
| <b>VII.5</b> | <b>Distance entre le village et le Barrage collectif</b>                               |                      |                      |                      |
| VII.5.1      | La situation actuelle                                                                  | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| VII.5.2      | La situation précédente                                                                | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| VII.5.3      | La situation antécédente                                                               | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| <b>VII.6</b> | <b>Pont routier construit par le village</b>                                           |                      |                      |                      |
| VII.6.1      | La situation actuelle                                                                  |                      | <input type="text"/> | <input type="text"/> |
| VII.6.2      | La situation précédente                                                                |                      | <input type="text"/> | <input type="text"/> |
| VII.6.3      | La situation antécédente                                                               |                      | <input type="text"/> | <input type="text"/> |
| <b>VII.7</b> | <b>Passage piétonnier construit par le village</b>                                     |                      |                      |                      |
| VII.7.1      | La situation actuelle                                                                  |                      | <input type="text"/> | <input type="text"/> |
| VII.7.2      | La situation précédente                                                                |                      | <input type="text"/> | <input type="text"/> |
| VII.7.3      | La situation antécédente                                                               |                      | <input type="text"/> | <input type="text"/> |
| <b>VII.8</b> | <b>Magasin (utilisable) de coopérative agricole, d'ONG ou de Groupement Villageois</b> |                      |                      |                      |
| VII.8.1      | La situation actuelle                                                                  |                      | <input type="text"/> | <input type="text"/> |
| VII.8.2      | La situation précédente                                                                |                      | <input type="text"/> | <input type="text"/> |
| VII.8.3      | La situation antécédente                                                               |                      | <input type="text"/> | <input type="text"/> |

## VIII.DROITS FONCIERS SUR LES TERRES DE CULTURE

| N°            | Questions                                                                                                                             | Réponse                                           |                                     |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------|
| <b>VIII.1</b> | <b>Type de droit appliquée pour les terres de culture</b><br>(si la réponse est non, mettre des croix à année de début d'application) |                                                   |                                     |
|               |                                                                                                                                       | <b>Type de droit appliquée</b><br>(1=Oui ; 0=Non) | <b>Année de début d'application</b> |
| VIII.1.1      | Propriété individuelle                                                                                                                | <input type="text"/>                              | <input type="text"/>                |
| VIII.1.2      | Propriété collective-familiale                                                                                                        | <input type="text"/>                              | <input type="text"/>                |
| VIII.1.3      | Propriété collective-communautaire                                                                                                    | <input type="text"/>                              | <input type="text"/>                |
| <b>VIII.2</b> | <b>Location, vente et prêts de terres de culture</b><br>(si la réponse est non, mettre des croix à année de début d'application)      |                                                   |                                     |

|               |                                                                                                                                                                         |                                                                                                                                                                              |                                     |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
|               |                                                                                                                                                                         | <b>Possibilité de transaction</b><br>(1=Oui ; 0=Non)                                                                                                                         | <b>Année de début d'application</b> |
| VIII.2.1      | Est-ce que la terre peut-être louée ?                                                                                                                                   | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| VIII.2.2      | Est-ce que la terre peut-être vendue ?                                                                                                                                  | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| VIII.2.3      | Est-ce que la terre peut-être prêtée ?                                                                                                                                  | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| <b>VIII.3</b> | <b>Est-ce qu'il y a des terres de culture qui ont été louées ?</b><br>(si non à la question VIII.2.1, mettre des croix dans les bacs et passer à la question suivante)  |                                                                                                                                                                              |                                     |
|               |                                                                                                                                                                         | <b>Location de terre</b><br>(1=Oui ; 0=Non)                                                                                                                                  | <b>Année de début d'application</b> |
| VIII.3.1      | Louées à une personne autochtone                                                                                                                                        | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| VIII.3.2      | Louées à une personne étrangère                                                                                                                                         | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| <b>VIII.4</b> | <b>A qui devrait-on demander permission pour louer ses terres?</b><br>(cette question devra être toujours posée quelque soit la réponse de la question précédente)      |                                                                                                                                                                              |                                     |
|               |                                                                                                                                                                         | <b>Personnes ressources</b><br>1 = chef de famille<br>2 = chef de terre<br>3 = conseil élu par la communauté<br>4 = conseil élu par le gouvernement<br>5 = aucune permission | <b>Année de début d'application</b> |
| VIII.4.1      | La situation actuelle                                                                                                                                                   | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                           | <input type="text"/>                |
| VIII.4.2      | La situation précédente                                                                                                                                                 | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                           | <input type="text"/>                |
| VIII.4.3      | La situation antécédente                                                                                                                                                | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                           | <input type="text"/>                |
| <b>VIII.5</b> | <b>Est-ce qu'il y a des terres de culture qui ont été vendues ?</b><br>(si non à la question VIII.2.2, mettre des croix dans les bacs et passer à la question suivante) |                                                                                                                                                                              |                                     |
|               |                                                                                                                                                                         | <b>Ventes de terre</b><br>(1=Oui ; 0=Non)                                                                                                                                    | <b>Année de début d'application</b> |
| VIII.5.1      | Vendues à une personne autochtone ?                                                                                                                                     | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| VIII.5.2      | Vendues à une personne étrangère?                                                                                                                                       | <input type="text"/>                                                                                                                                                         | <input type="text"/>                |
| <b>VIII.6</b> | <b>A qui devrait-on demander permission pour vendre ses terres?</b><br>(cette question devra être toujours posée quelque soit la réponse de la question précédente)     |                                                                                                                                                                              |                                     |
|               |                                                                                                                                                                         | <b>Personnes ressources</b><br>1 = chef de famille<br>2 = chef de terre<br>3 = conseil élu par la communauté<br>4 = conseil élu par le gouvernement<br>5 = aucune permission | <b>Année de début d'application</b> |
| VIII.6.1      | La situation actuelle                                                                                                                                                   | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                           | <input type="text"/>                |

|                |                                                                                                                                                                                                       |                                                                                                                                                                                                    |                                                                                                          |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| VIII.6.2       | La situation précédente                                                                                                                                                                               | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VIII.6.3       | La situation antécédente                                                                                                                                                                              | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VIII.7</b>  | <b>Est-ce qu'il y a des terres de culture qui ont été prêtées ?</b><br>(si non à la question VIII.2.3, mettre des croix dans les bacs et passer à la question suivante)                               |                                                                                                                                                                                                    |                                                                                                          |
|                |                                                                                                                                                                                                       | <b>Prêts de terre</b><br>(1=Oui ; 0=Non)                                                                                                                                                           | <b>Année de début d'application</b>                                                                      |
| VIII.7.1       | Prêtées à une personne autochtone                                                                                                                                                                     | <input type="text"/>                                                                                                                                                                               | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VIII.7.2       | Prêtées à une personne étrangère                                                                                                                                                                      | <input type="text"/>                                                                                                                                                                               | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VIII.8</b>  | <b>A qui devrait-on demander permission pour prêter ses terres?</b><br>(cette question devra être toujours posée quelque soit la réponse de la question précédente)                                   |                                                                                                                                                                                                    |                                                                                                          |
|                |                                                                                                                                                                                                       | <b>Personnes ressources</b><br>1 = chef de famille<br>2 = chef de terre<br>3 = conseil élu par la communauté<br>4 = conseil élu par le gouvernement<br>5 = aucune permission                       | Année de début d'application                                                                             |
| VIII.8.1       | La situation actuelle                                                                                                                                                                                 | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VIII.8.2       | La situation précédente                                                                                                                                                                               | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VIII.8.3       | La situation antécédente                                                                                                                                                                              | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VIII.9</b>  | <b>A qui devrait-on s'adresser pour résoudre un conflit foncier pour l'usage des terres de culture?</b>                                                                                               |                                                                                                                                                                                                    |                                                                                                          |
|                |                                                                                                                                                                                                       | <b>Personnes ressources</b><br>1 = chef de terre<br>2 = chef ou conseil élu par la communauté<br>3 = chef ou conseil nommé par le gouvernement<br>4 = autre type d'autorité<br>5 = aucune autorité | Année de début d'application                                                                             |
| VIII.9.1       | La situation actuelle                                                                                                                                                                                 | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VIII.9.2       | La situation précédente                                                                                                                                                                               | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| VIII.9.3       | La situation antécédente                                                                                                                                                                              | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                 | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>VIII.10</b> | <b>Quelles sont les modes de propriété des terres de pâturages dans cette communauté</b><br>(s'il n'existe pas de terre de pâturage, mettre des croix dans les bacs et passer à la question suivante) |                                                                                                                                                                                                    |                                                                                                          |
|                |                                                                                                                                                                                                       | <b>Personnes ressources</b><br>1 = propriété individuelle<br>2 = propriété collective-familiale<br>3 = propriété collective-lignagère<br>4 = propriété collective-communautaire                    | <b>Année de début d'application</b>                                                                      |

|                |                                                                                                                                                                              |               |                                     |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------------|
|                |                                                                                                                                                                              | 5 = autre     |                                     |
| VIII.10.1      | La situation actuelle                                                                                                                                                        | _ _ -_ _ -_ _ | _ _ _ _ _                           |
| VIII.10.2      | La situation précédente                                                                                                                                                      | _ _ -_ _ -_ _ | _ _ _ _ _                           |
| VIII.10.3      | La situation antécédente                                                                                                                                                     | _ _ -_ _ -_ _ | _ _ _ _ _                           |
| <b>VIII.11</b> | <b>Combien de pistes à bétail y a-t-il dans le village</b><br><i>(s'il n'existe pas de pistes à bétail, mettre des croix dans les bacs et passer à la question suivante)</i> |               |                                     |
|                |                                                                                                                                                                              | <b>Nombre</b> | <b>Année de début d'application</b> |
| VIII.11.1      | La situation actuelle                                                                                                                                                        | _ _           | _ _ _ _ _                           |
| VIII.11.2      | La situation précédente                                                                                                                                                      | _ _           | _ _ _ _ _                           |
| VIII.11.3      | La situation antécédente                                                                                                                                                     | _ _           | _ _ _ _ _                           |

## IX.DROITS FONCIERS POUR LES TERRES DE PATURAGE

| N°          | Questions                                                                                                                                                                                                                         | Réponse                                                            |                              |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------|
| <b>IX.1</b> | <b>Existe-t-il des terres réservées pour le pâturage ?</b><br><i>(si la réponse est non pour une situation donnée, mettre des croix à année d'établissement)</i>                                                                  |                                                                    |                              |
|             |                                                                                                                                                                                                                                   | <b>Existence de pâturage</b><br>(1=Oui ; 0=Non)                    | <b>Année d'établissement</b> |
| IX.1.1      | La situation actuelle                                                                                                                                                                                                             | _ _                                                                | _ _ _ _ _                    |
| IX.1.2      | La situation précédente                                                                                                                                                                                                           | _ _                                                                | _ _ _ _ _                    |
| IX.1.3      | La situation antécédente                                                                                                                                                                                                          | _ _                                                                | _ _ _ _ _                    |
| <b>IX.2</b> | <b>Quelles sont les voies d'accès aux pâturages ?</b><br><i>(si la réponse est 2 (tout autre piste), mettre des croix à année d'établissement)</i>                                                                                |                                                                    |                              |
|             |                                                                                                                                                                                                                                   | <b>Voies d'accès</b><br>1= pistes à bétail<br>2 = tout autre piste | <b>Année d'établissement</b> |
| IX.2.1      |                                                                                                                                                                                                                                   |                                                                    |                              |
| IX.2.2      | La situation actuelle                                                                                                                                                                                                             | _ _                                                                | _ _ _ _ _                    |
| IX.2.3      | La situation précédente                                                                                                                                                                                                           | _ _                                                                | _ _ _ _ _                    |
|             | La situation antécédente                                                                                                                                                                                                          | _ _                                                                | _ _ _ _ _                    |
| <b>IX.3</b> | <b>Quels moyens existent pour limiter l'accès aux terres de pâturages ?</b><br><i>(si la réponse est non pour une situation donnée à la question IX.1, mettre des croix dans la situation correspondante à cette question ci)</i> |                                                                    |                              |
|             |                                                                                                                                                                                                                                   | <b>Moyens de paiement</b><br>1= paiement d'une taxe                | <b>Année d'établissement</b> |

|             |                                                                         |                                                                                                                                                                                                                                        |                                                                                                                               |
|-------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
|             |                                                                         | <i>par animal</i><br><i>2 = paiement d'un autre type de taxe</i><br><i>3 = contrôle du nombre d'animaux</i><br><i>4 = accès illimité pour autochtones</i><br><i>5 = accès illimité pour résidents</i><br><i>6 = aucune restriction</i> |                                                                                                                               |
| IX.3.1      | La situation actuelle                                                   | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                                                     | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| IX.3.2      | La situation précédente                                                 | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                                                     | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| IX.3.3      | La situation antécédente                                                | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                                                     | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| <b>IX.4</b> | <b>Qui est responsable pour gérer l'accès aux terres de pâturages ?</b> |                                                                                                                                                                                                                                        |                                                                                                                               |
|             |                                                                         | <b>Personnes ressources</b><br><i>1 = chef de terre</i><br><i>2 = chef ou conseil élu par la communauté</i><br><i>3 = chef ou conseil nommé par le gouvernement</i><br><i>4 = autre type d'autorité</i><br><i>5 = aucune autorité</i>  | <b>Année d'établissement</b>                                                                                                  |
| IX.4.1      | La situation actuelle                                                   | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                                                     | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| IX.4.2      | La situation précédente                                                 | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                                                     | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |
| IX.4.3      | La situation antécédente                                                | <input type="text"/> - <input type="text"/> - <input type="text"/>                                                                                                                                                                     | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |

## **X.DROITS D'UTILISATION DES FORETS (POUR LE BOIS, LES FRUITS, LA CHASSE ETC.)**

| N°    | Questions                                                                                                                                                                                                             | Réponse                                |                                                                                                                              |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| X.1   | Existe-t-il des forêts dans votre communauté ?<br><i>(si la réponse est non pour une situation donnée, mettre des croix à année d'établissement)</i>                                                                  |                                        |                                                                                                                              |
|       |                                                                                                                                                                                                                       | Existence de forêts<br>(1=Oui ; 0=Non) | Année d'établissement                                                                                                        |
| X.1.1 | La situation actuelle                                                                                                                                                                                                 | <input type="checkbox"/>               | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| X.1.2 | La situation précédente                                                                                                                                                                                               | <input type="checkbox"/>               | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| X.1.3 | La situation antécédente                                                                                                                                                                                              | <input type="checkbox"/>               | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |
| X.2   | Est-ce qu'il existe des moyens pour limiter l'accès aux forêts ?<br><i>(si la réponse est non pour une situation donnée à la question X.1, mettre des croix dans la situation correspondante à cette question ci)</i> |                                        |                                                                                                                              |

|            |                                                                  |                                                                                                                                                                                                                                                                                                                 |                                      |
|------------|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
|            |                                                                  | <b>Moyens de paiement</b><br><i>1 = paiement d'une taxe par unité de bois</i><br><i>2 = paiement d'une taxe par autre moyen</i><br><i>3 = contrôle direct des entrées et sorties</i><br><i>4 = accès illimité pour autochtones</i><br><i>5 = accès illimité pour résidents</i><br><i>6 = aucune restriction</i> | <b>Année d'établissement</b><br><br> |
| X.2.1      | La situation actuelle                                            | - -                                                                                                                                                                                                                                                                                                             |                                      |
| X.2.2      | La situation précédente                                          | - -                                                                                                                                                                                                                                                                                                             |                                      |
| X.2.3      | La situation antécédente                                         | - -                                                                                                                                                                                                                                                                                                             |                                      |
| <b>X.3</b> | <b>Qui est responsable de la gestion de l'accès aux forêts ?</b> |                                                                                                                                                                                                                                                                                                                 |                                      |
|            |                                                                  | <b>Personnes ressources</b><br><i>1 = chef de terre</i><br><i>2 = chef ou conseil élu par la communauté</i><br><i>3 = chef ou conseil nommé par le gouvernement</i><br><i>4 = autre type d'autorité</i><br><i>5 = aucune autorité</i>                                                                           | <b>Année d'établissement</b><br><br> |
| X.3.1      | La situation actuelle                                            | - -                                                                                                                                                                                                                                                                                                             |                                      |
| X.3.2      | La situation précédente                                          | - -                                                                                                                                                                                                                                                                                                             |                                      |
| X.3.3      | La situation antécédente                                         | - -                                                                                                                                                                                                                                                                                                             |                                      |

## **XI. INFRASTRUCTURE D'EDUCATION ET DE SANTE**

| N°          | Questions                                                                                            | Réponse  |                       |
|-------------|------------------------------------------------------------------------------------------------------|----------|-----------------------|
|             |                                                                                                      | Distance | Année d'établissement |
| <b>XI.1</b> | <b>Distance entre le village et l'école primaire la plus fréquentée par les enfants du village</b>   |          |                       |
| XI.1.1      | La situation actuelle                                                                                |          |                       |
| XI.1.2      | La situation précédente                                                                              |          |                       |
| XI.1.3      | La situation antécédente                                                                             |          |                       |
| <b>XI.2</b> | <b>Distance entre le village et l'école secondaire la plus fréquentée par les enfants du village</b> |          |                       |

|             |                                                                                                       |                      |                      |
|-------------|-------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| XI.2.1      | La situation actuelle                                                                                 | <input type="text"/> | <input type="text"/> |
| XI.2.2      | La situation précédente                                                                               | <input type="text"/> | <input type="text"/> |
| XI.2.3      | La situation antécédente                                                                              | <input type="text"/> | <input type="text"/> |
| <b>XI.3</b> | <b>Distance entre le village et le centre de santé le plus fréquenté par la population du village</b> |                      |                      |
| XI.3.1      | La situation actuelle                                                                                 | <input type="text"/> | <input type="text"/> |
| XI.3.2      | La situation précédente                                                                               | <input type="text"/> | <input type="text"/> |
| XI.3.3      | La situation antécédente                                                                              | <input type="text"/> | <input type="text"/> |

## **XII.INFRASTRUCTURE RELIGIEUSES**

| N°           | Questions                                                                                      | Réponse              |                       |
|--------------|------------------------------------------------------------------------------------------------|----------------------|-----------------------|
|              |                                                                                                | Distance             | Année d'établissement |
| <b>XII.1</b> | <b>Distance entre le village et l'église la plus fréquentée par la population du village</b>   |                      |                       |
| XII.1.1      | La situation actuelle                                                                          | <input type="text"/> | <input type="text"/>  |
| XII.1.2      | La situation précédente                                                                        | <input type="text"/> | <input type="text"/>  |
| XII.1.3      | La situation antécédente                                                                       | <input type="text"/> | <input type="text"/>  |
| <b>XII.2</b> | <b>Distance entre le village et la mosquée la plus fréquentée par la population du village</b> |                      |                       |
| XII.2.1      | La situation actuelle                                                                          | <input type="text"/> | <input type="text"/>  |
| XII.2.2      | La situation précédente                                                                        | <input type="text"/> | <input type="text"/>  |
| XII.2.3      | La situation antécédente                                                                       | <input type="text"/> | <input type="text"/>  |
| <b>XII.3</b> | <b>Distance entre le village et le temple le plus fréquenté par la population du village</b>   |                      |                       |
| XII.3.1      | La situation actuelle                                                                          | <input type="text"/> | <input type="text"/>  |
| XII.3.2      | La situation précédente                                                                        | <input type="text"/> | <input type="text"/>  |
| XII.3.3      | La situation antécédente                                                                       | <input type="text"/> | <input type="text"/>  |

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