Chapter 11

Rural populations faced with environmental hazards

African experiences

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Although the exact and experimental sciences (mathematics, climatology, oceanography, geomorphology) have a fundamental role to play in forecasting and in analysing the past and future climate, the same applies to the social sciences whose role is to shed light on the social and human dimensions of changes. One of the notions often used in social sciences with reference to this question is adaptation[1]—analysing how populations adapt to environmental changes and events (increasingly strong inter-annual variations in rainfall, soil fertility loss, scarcity of land, forest and water resources, etc.). Focus in the social sciences has been on the environment in the broad sense rather than what is strictly the climate in order to show how rural societies organise themselves and adapt to survive in contexts of uncertainty or risk.

In the first part of this chapter we describe the research work conducted on this question. We shall return to three results in social sciences: first the matching of the management of environmental resources and forms of social and family organisation in rural societies, then the fact that adaptation is an old feature of these societies and finally the complexity of forms of adaptation. We base the demonstration on research results in very varied areas of Africa—from Madagascar to the oases of the Sahara by way of West Africa (Senegal and Côte d'Ivoire).

The results of an original survey conducted in the administrative district of Djougou in Benin are then described. The economic and demographic strategies of a rural

1. A common term in social sciences and anthropology, the notion of adaptation is also used by the IPCC and politicians in the framework of climate change. There is a degree of consensus with regard to the needs to implement adaptation programmes and projects for adaptation to climate change by populations in the South.

population obliged to adapt to changing environmental, social or economic contexts are analysed at a 'micro' level. Stress is laid on the complexity of the link with environmental and social change.

The environment and adaptation of rural populations in Africa

Matching the management of environmental resources and forms of social and family organisation

Work in the social sciences on the relations between societies and the climate or the environment reveal 'matching' (JANTY, 2013) and 'intimacy' (PEYRUSAUBES, 2013) between the management of natural resources and forms of social and family organisation.

Water management in sub-Saharan oases is a clear illustration of the way in which populations have become organised for survival in spite of scarce resources. Oasis farmers have developed production techniques adapted to local conditions and also forms of social organisation that closely match these (GUILLERMOU, 1993). Oases require substantial labour for the maintenance of galleries and channels. This is restricting work with little reward. The labour handling irrigation network maintenance first consisted of slaves, then domestic staff or, failing this, younger sons (BADUEL, 1980). Water management thus means that oasis societies are based on a hierarchy of persons, within families as well. This production mode hides a true system of exploitation—especially of young people by their elders. The whole agricultural production system is compromised when there is a shortage of servile labour.

Water management is not possible without a consensus among the population as individuals are extremely dependent on each other. If certain channels are not maintained, the water supply to all the fields is called into question. A minimum of cohesion, cooperation and also sanctions are required for the irrigation system to last. In this context, individual persons are dependent on the extended family. The generations live together and the men—especially the older ones—give orders. Fertility is high, with a preference for male births, and marriage is endogamic, with a distinct preference for marriages between cousins (GASTINEAU, 2007). The mastery of water, a scarce resource, is the basis of social organisation in oases but the rules can be very different in environments where the availability of water is not a problem. Let us examine the example of rice growing in Madagascar where irrigation is also an important issue. BIED-CHARRETON (1970) described anarchic resource management in the Betafo region (Highlands): there was no collaboration between farmers (even between neighbours) and no regulations governing the sharing of water; canals running parallel to each other or crossing were even observed. Water management did not

govern social structure as has been seen in oases. In the Madagascan highlands, the availability and mobility of fields—rice fields—are the strong components of the natural environment in which the fabric of social organisation was built. Households have very small farm areas and so it was in their interest to be small. When the children marry they rapidly form a new household. The different generations do not live together, farms are individual, corresponding to a couple (OTTINO, 1998). Women inherit and add their fields to their husbands' farms. If a woman owns more land than her husband, the latter may move to his wife's village and not the opposite (BLANCHY, 2000). Marriages are exogamous. The relations between men and women and between generations are thus clearly different to those observed in Saharan oases.

The two examples—Saharan oases and the Madagascan Highlands—illustrate the strong matching of natural resources and forms of social and family organisation. They are also a reminder that while Africa has very diverse climates and natural resources the structures of families and societies are also very varied. The responses of individual persons, families and societies to environmental events will be able to take many forms and not be limited to just the agronomic aspect.

Adaptation: an old, ceaselessly renewed feature

We face a new environmental challenge today whose long and even short-term consequences for societies are difficult to predict. Nevertheless, we can use past experience to imagine what might be the political, social or demographic responses to the intensification of environmental events and shocks (drought, flooding and hurricanes for example).

Societies display different types of response to environmental shocks or events. The first, most visible, form of adaptation is migration to settle elsewhere. Such 'environmental' migration may be a response to unexpected and violent climatic events. Hurricanes and extremely heavy rainfall can causes massive population displacement (IOM, 2007). Such mobility in emergency situations is generally domestic. The populations do not go very far and often hope to return when the crisis is over.

Slow degradation of the environment with repeated climate shocks (such as droughts) can also cause population displacements. Mention can be made here of the Senegal groundnut basin where from the 1970s onwards a chronic decrease in rainfall and strong population growth led to an intensification of agricultural work that upset the agro-pastoral balance based on crop rotations and fallows—now abandoned. Decreased soil fertility and shortage of land have obliged the population to find solutions for survival, and especially seasonal migration which has become a true institution in this region (LERICOLLAIS, Ed., 1999).

Migration can thus form an integral part of practices for adaptation to environmental constraints. Studies have shown how deforestation and the over-exploitation of land have resulted in the lasting degradation of soil, especially in the cacao regions of Côte d'Ivoire, with farmers having to colonise new, more fertile land continuously

to ensure their crop production (Léonard, 1997; Ruf, 1991). A powerful pioneer front thus advanced from east to west in Côte d'Ivoire throughout the second half of the 20th century. The land colonisation strategies used by growers were based on social practices that favoured polygamy, high fertility and the use of labour from other parts of the country and from abroad (Guillaume *et al.*, ed., 1997). But at the time Côte d'Ivoire was a vast territory with very fertile primary forest and low population density[2].

However, an environmental shock or increasingly numerous climate events do not necessarily intensify migration flows. Migration is often considered as a last resort (Brucker *et al.*, 2012). What other adaptation approaches are possible?

Ivorian rice growers in confronted with increasingly marked inter-annual variations in rainfall have developed various adaptation strategies ranging from changes to the cropping calendar to crop diversification (cassava, maize, yam, etc.). New foodstuffs and dishes from other ethnic groups were thus added to their diet (Doumbia and Depieu, 2013). Farmers continuously revise their knowledge and practices to keep climate risks to a minimum and achieve better mastery of resources to ensure food security. Adaptations may be either endogenous or proposed by the state or private stakeholders. The farmers take them and use them, possibly modifying them to make them acceptable for their social and economic context.

The emergence of farms centred on the family unit consisting of a man, his wife/wives and their children is considered as one of the structuring social features of plantation economy societies, especially in Africa (Quesnel and Vimard, 1999; Chauveau and Dozon, 1985). Thus the growing autonomy of nuclear families (in contrast with generations and relations living together) in the Madagascan Highlands is an example that can be considered to be an adaptation. The land area available and the frequency of climatic events partially determine the numbers in residential groups. When production conditions are no longer such as to provide work and food for all the persons in a household, the unit divides—the temporary or permanent departure of one or several members can be decided. Households use various strategies in 'bad years' (too much rain or not enough, a hurricane and a lean season that is too long, etc.): withdrawal of children from school and the use of child labour are two 'adjustment variables' used by households in case of an unexpected shock (Robilliard *et al.*, 2010). Conversely, if the number of persons forming the residential unit is too small in the light of resources, farming households may choose to actually adopt or host children among their relations, to call on foreigners to work on the farm or delay the marriage of young adults so that they stay and work on the farm. This requires fairly flexible forms of social and family organisation. There are many adaptation levels both in Madagascar and elsewhere in Africa (Brucker *et al.*, 2012), including mobility, change of the marrying age and/or the rules of inheritance and residence, the sending out or hosting of children, the schooling or not of children and even fertility (Adjamagbo and Delaunay, 1998; Delaunay, 1994).

2. However, conditions changed from the 1980s onwards: faced with the scale of deforestation in the country, the government set up forest protection policies: in the west, the pioneer front hit its natural limits and, above all, coffee and cacao prices fell drastically on the international markets and gradually resulted in these crops showing poor profits.

Adaptation: what to and how?

The studies performed show the complexity of human societies and the considerable variability of responses to environmental changes. Adaptation is found to be an incessant process of reconstruction of agricultural production conditions and forms of family and social organisation as a result of climate events and changes of course, but also of various other socio-economic, political and institutional factors. Caution is required. This is not a question of establishing a determinist link between 'environmental changes', 'perception of these changes', 'modification of farming techniques and production' and 'social change'. Indeed, it is difficult to separate the impact of environmental conditions from those of other possible factors for change. So the question of migration is a complex one. Environmental migratory dynamics exist but numerous other factors influence the migratory choices made by households (Brucker *et al.*, 2012). A recent study conducted in the Yemen concerning regions in which climate change already has an impact on the living conditions of populations shows that a very large proportion of migration is stimulated first of all by socioeconomic and not environmental factors (Joseph and Wodon, 2013). Likewise, Henry *et al.* (2004) show all the complexity and diversity of the causes and procedures of migration in Burkina Faso. No direct link has been shown between rainfall conditions (and climatic conditions more generally) and the intensity of migration in rural Burkina Faso, including the drought zones where climatic stress could have been expected to form strong encouragement for the departure of populations. In contrast, features such as ethnic group, type of work and level of education are clearly identified as individual variables that account for migration (Henry *et al.*, 2004).

Farming populations in Africa face up to a great number of constraints on which their social and family life and farming practices depend: constraints as varied as volatile agricultural prices, limited access to inputs or seed, problems of local or national political governance, limited access to basic health or education services, poor road systems and problems of security. Changes in farming practices or in the demographic behaviour of rural populations are therefore 'multifactorial'. Environmental problems are thus only one of the many constraints that the population have to face up to.

This synthesis of research results comes out in favour of taking into account the complexity of the relations between social change, climatic events and environmental changes. We now describe the results of research carried out in rural Benin in order to illustrate this complexity.

The research was conducted within the framework of the programme '*Changements environnementaux et sociaux en Afrique: passé, présent et futur*' (ESCAPE)[3].

3. ESCAPE is a programme funded by ANR CEP&S 2010. It groups 8 research laboratories at several French institutions (IRD, CIRAD, CNRS, etc.) and partners in the South (Université Cheikh Anta Diop in Senegal, AGRHYMET and LASDEL in Niger, CEFORP in Benin, the Direction Nationale de la Météorologie in Mali, etc.).

Strategies for forcing up to environmental events (Djougou local authority area)

The district of Djougou is the Donga department in northern Benin and about 461 km from Cotonou, the economic capital of the country. The population was 266,522 in 2012 (INSAE, 2013). In 2011, 40% of the population were below the poverty threshold[4], 10% more than in 2009 (INSAE, 2012). Access to health care is still difficult[5]. Households are an average of 8.8 km from a health centre[6] and the cost of medical care is an obstacle. Likewise, access to public education is not always easy in Djougou (shortage of classes and teachers). However, the raw school primary attendance figures[7] (115% in 2011-2012) are fairly similar to those of Benin as a whole (120%) (Ministère des Enseignements Maternel et Primaire, 2012). In Djougou, rates of completion of primary schooling[8] are smaller than the national average (63% against 71%), especially for girls (52% against 66%) (Ministère des Enseignements Maternel et Primaire, 2012). Less than 30% of adults (over 18) are literate (45% in Benin as a whole) (INSAE, 2012).

The economy of Djougou is based mainly on farming. About 75% of households are farmers (INSAE, 2013). With a Sudan-Guinean climate, a rainy season (April to October) and a dry season (mid-October to mid-April), the main crops are maize, yam, millet, cassava and sorghum; soya and cowpea are also grown[9]. Cash crops such as cashew, shea and nere are also grown. Some households are market gardeners around reservoirs and in low-lying areas. The rearing of cattle and small ruminants (goats and sheep) is a marginal activity at the scale of Djougou. Most farmers own their land (75% of households in 2013). Farms are small and the average cultivated area was estimated to be less than 3 ha in the 2012 season (INSAE and MAEP, 2013).

The strategic position of Djougou as a crossroads and transit centre is a fundamental advantage for trade and in particular for shipment of farm produce and processed goods. Indeed, trade in manufactured goods and crop and animal products form the second economic activity of Djougou after crops and livestock. In addition, there are

4. The threshold defined by the Institut national de la statistique et de l'analyse économique (INSAE) was CFAF 138,754 per person per year in 2009 and CFAF 120,839 in 2011.

5. As regards health, the Djougou district is part of an area covered by three districts: Djougou, Copargo and Ouaké. The 22 sub-divisions of the health zone each have at least one public health centre.

6. Ministry of Health (2013), health statistics yearbook.

7. This is the ratio of the number of pupils, whatever their age, at primary schools to the number of children with the official age for primary school education (6-11 years old). As children over the official age (11) are enrolled in primary education (either because they have started school late or have repeated years), the second figure may exceed 100%.

8. The percentage of children with the official age for completing primary education who have in fact completed this.

9. In 2012, 91% of Djougou farmers grew maize, 79% grew yam, 62% grew cassava, 53% grew sorghum and 44% grew millet (INSAE and MAEP, 2013).

several regional markets in the district (at Djougou, Kolokondé, Partago, Bougou and Kpaouya) and purchases are made there by traders from nearby districts and certain neighbouring countries. The sale of agricultural goods should not therefore involve any difficulties for producers if the agricultural sectors are sufficiently well organised.

The climatic and environmental conditions in Djougou can be considered to be favourable for agriculture. There have been no strong variations in rainfall in recent years. Annual cumulated rainfall has not changed since 1993. It is greater than that observed during the previous decade that was marked by major droughts (the 1980s) but less than the cumulated figures in the 1960s and 1970s. Annual rainfall depth has been stable since the 1990s but there have been strong annual variations and changes in the dates of the beginning and end of the dry season. Temperatures have continued to rise, mainly at night (+ 1.2 °C in Djougou since 1950) and at the end of the dry season, that is to say at the start of the farming season. These changes have already led farmers to change some of the farming practices. In Djougou, as elsewhere in Benin, farmers display an ability to adapt (Kpadonou *et al.*, 2012). For example, the recent use of short cycle maize varieties by Djougou farmers can be seen as an adaptation to the changes in environmental contexts (see Chapter 17).

The data produced within the framework of the ESCAPE project mean that we can show that farmers are overcoming environmental risks by adaptations in farming but also by means of socioeconomic and demographic strategies. However, although adaptation capacity is real and has many features, it can be supposed that it will weaken if environmental problems worsen, given the context described above (limited access to health services and education, frequent poverty, low literacy level).

As part of the work of ESCAPE, we surveyed 1,120 households distributed in a zone whose boundary lies 2 km to the east and west of a transect running north and south of the town of Djougou (with the centre of the town excepted). A household is defined as a group of persons, related or not, residing in the same space. It is also the site of a great number of decisions including those by the head of the farm and concerning the farm. We conducted sociodemographic and agricultural surveys of households, questioning heads of household (1,120) and then persons identified as being responsible for a farm (1,232). A person responsible for a farm is someone who has farmed at least one field during the last three rainy seasons, with responsibility for the organisation of the work and the choice of crop.

We have data concerning the composition of each household (number of members, family ties with the head of the household) and certain characteristics of individual persons (age, sex, activity, education, etc.). We also collected a few farming data at household level (area of land owned, area cultivated, fallows). Next, each head of farm was interviewed about his farming practices (type of crops, changes in varieties during the last 10 years, introduction of new crops, changes in cultivated areas, etc.) and his perception of climatic events and environmental changes (rainfall, wind, temperature, etc.).

Results

Large households but a fairly small reserve of labour

Djougou households have an average size of 8.3 persons. They generally consist of a man (referred to as the head of the household) his wife (or wives), their child/children; a brother and his family may be added to this group. The large size of households[10] results in particular from the fact that polygamy is frequent in Djougou: a third of the heads of households have second wives. It is also explained by high fertility: heads of households declare an average of 8.7 live births[11].

Farming uses mainly family labour with the proportion of farms using paid farm labour being less than 50% for all crops except for cash crops such as soya, groundnuts and cotton. Household size and composition are thus important information. The average number of residents is 4.7 adults (over 15 years old); however, only 1.4 of these say that they are agricultural workers. The others are either at school if they are young, do not work or have other jobs. In particular, a great majority of women have non-agricultural work, with 63% working at the date of the survey and with 72% of these persons working outside farming. They work mainly in trade (especially in processed agricultural products) and crafts. Of the men who work (82% of those over 18), 88% are crop and/or livestock farmers. The non-agricultural work of women and certain young adults can be seen as a pluriactivity strategy and a diversification of household income. Women's income means that the household has cash (for expenditure on health, schooling, the purchase of consumers durables such as clothes, etc.). However, women's work off the family farms is dependent on the environmental conditions and their jobs can be affected by unforeseen environmental events. For example, this is the case of women aided by development projects and sometimes organised as associations that make shea butter.

Food security of the household is a priority

Heads of farms must therefore organise farm work with comparatively limited labour. Because of this constraint, they organise their work and choose crops that allow them to first and foremost produce enough to feed their family. Food security is the main priority. This is why more than 80% of farmers grew maize (85%), yam (83%) or cassava (60%) during the 2012 rainy season. Cash crops such as soya and cotton are not a priority and are grown by 25% and 20% of households respectively. Livestock is fairly little developed: 31% of farms owned at least one sheep and 16% possessed at east one ox at the time of the survey.

Households can sell their production—and even their food crops— when the harvest is large enough. Thus during the season preceding the survey slightly less than half of the farms had sold part of their yam and maize crops. Some farms have surpluses

10. In 2011, average household size in rural Benin was 5.3 persons and the average for the Donga department was 7.1 (INSAE, 2012)

11. The synthetic fertility index was 4.9 for Benin and 4.7 for the Donga in 2012 (population and health survey).

every year and others only in good years. The good and bad years depend of course on climatic conditions but also on the dynamics of the household. Illness or the death of a member of the household can also call farm production into question: for example, money earmarked for the purchase of inputs may be used to pay for health care or a funeral. The sudden death of an adult also reduces the household labour force.

Nevertheless, fewer than 15% of the households stated in the survey that they had been short of food for the household in 2010, 2011 (10%) and 2012 (9%). Food security is thus assured overall in this survey zone[12], either because the farmers grow enough to cover their consumption or because they have sufficient cash income to purchase foodstuffs when their own production is too small.

The diversification of income: a necessary strategy that must not compete with agricultural work

Among this population in which cash savings are rare, non-agricultural income is essential for facing a climatic event or a demographic shock (death or illness). The diversification of income is neither specific to Benin nor a new strategy. The strategies of rural households in poor countries today feature the maintaining and continuous adaptation of a range of activities (Ellis, 2008). Diversification is a possible response to the inter-annual variability of crop yields and hence of farm incomes; it limits the risks inherent in agriculture. Pluriactivity can be either by the specialisation of individual persons (some work on the land while others have non-agricultural jobs) or by cumulating several activities by one person. In Djougou, migration is one of the ways of diversifying sources of income. Some young girls are sent to Cotonou as domestic staff and young boys may also leave the household to work in town. Children from the Djougou district are thus strongly represented in domestic labour in the economic capital (Kouton *et al.*, 2009). Migration limits household size, and hence expenditure, and the income (in cash or in kind) generated by the children's work may be received by the parents. It is probable that more young children leave in bad years but parents may put their children on the urban labour market in both good and bad farming years to anticipate the irregularity income from one year to the next (Affo, 2014).

The activities of the various persons must be organised to prevent pluriactivity from compromising the farming activity of the household. The head of the farm—who is often also the head of the household—is responsible for this. He must ensure that all the workers can be mobilised for agricultural tasks and that those leaving for long-term migration are not essential on the farm. The availability of workers depends on a large number of factors (health, schooling, migration). An increasing number of young adults migrate temporarily to Nigeria. They leave to take paid jobs in the rural frontier zones where commercial farming is developing (Bonnassieux and Gangneron, 2015).

12. This was confirmed at the scale of the Djougou administrative area where only 13% of households were classified by INSAE as suffering from food insecurity (Insae and Maep, 2013).

According to the latter authors, the migrants are 'groups in a position of inferiority'—younger children and adults form who access to land is difficult, etc. They do not migrate as part of a diversification strategy but rather in a quest for emancipation in the face of the authority of their parents, for example. Today, the heads of farms do not always have the legitimacy needed to hold back young adults who wish to migrate to gain personal experience and their own incomes (Droy *et al.*, 2014). This is obviously a strong constraint in the management of family labour and means that young workers are not available during the farming period. Thus the use of paid labour from elsewhere is not rare, especially for cash crops: 70% of cotton growers and 52% of soya growers had used paid farmworkers. Family labour is still dominant for food crops but is not always sufficient: 50% of growers of maize, 41% of growers of yams and 28% of growers of cassava had hired at least one paid worker from elsewhere to help them.

Effective adaptation strategies?

The society we observed in Djougou is therefore dynamic, with social and family structures and persons who modify the way they function and their practices (agricultural, economic and demographic) in order to ensure their food security and their economic survival. Nevertheless, these survival strategies might show their limits in the face of new environmental changes and events.

First of all, the effectiveness of pluriactivity and the diversification of income as observed today in resisting increasingly frequent shocks or events can be questioned. Work for women outside family farms is often strongly dependent on the farming sector and then sensitive to climate shocks. This is the case of the processing of shea[13]. Several Benin associations and international organisations and cooperation operations are trying to support shea butter production in the region by stimulating the modernisation of production facilities, helping women to store the nuts and making it easier to obtain funding[14]. Many other initiatives are aimed at supporting women's work in rural areas: the organisation of women's groups for the purchase, storage and sale of maize and cotton (e.g. the Kpebouko supported by the Netherland Development Organisation), the organisation of the milk sector for the manufacture, conservation and sale of Peul cheeses (Belgian Development Agency), etc. Many of these projects for rural women are aimed at creating paid activities to enhance their autonomy and diversify the income of their households. Very few guide women to sectors that are less sensitive to climatic disturbance and less dependent on natural resources.

The capacity for adaptation of households would obviously be greater if they had better 'human capital'. However, education and literacy levels are poor in Djougou and this limits the possibility of lasting placing on the non-urban labour market and even the development of agricultural activities. School attendance and vocational

13. Without technical changes, the yields of shea areas may decrease in a context of climate change (rise in temperature and change of the rainfall regime) (Gnangle *et al.*, 2012).

14. An example is the very active cooperation between the Djougou town council and the town of Évreux (France) http://www.evreux-djougou.org/

training (agricultural and non-agricultural) are not sufficiently accessible. Nearly 7 persons in 10 surveyed were uneducated and only 1 in 10 had attended secondary education[15]. National data show that the literacy rate of 15-24-year-olds in Djougou in 2011 (51%) was 15% lower than that of Benin (65%) (INSAE, 2012).

This lack of training also contributes to the under-employment of young adults[16]. More than half of 15-24-year old working population in the Djougou district are under-employed (INSAE, 2012). Furthermore, these young people often have no access to land (BONNASSIEUX and GANGNERON, 2015) and are economically dependent on their families. Job opportunities in the non-agricultural sectors are comparatively limited locally and even on an internal migration basis. The strong urbanisation of Benin occurred without industrialisation and urban jobs are rare in both the formal and informal sectors. Young adults and even some married men may choose to emigrate to Nigeria in the hope of earning wages (DROY *et al.*, 2014).

Rural households are still massively dependent on their agricultural income in an economically difficult context. Poorly organised sectors, farmers' organisations that are not always efficient (MOUMOUNI, 2013), limited storage capacity and limited on-site processing capacity make farms very fragile and incomes very variable from one year to the next.

For all these reasons (little scope for pluriactivity, rare non-agricultural jobs, poor human capital, variable economic context) and doubtless many others, rural families are vulnerable and their survival often depends on their endogenous capacity for adaptation and innovation. This vulnerability will increase with an intensification of unforeseen events. Nobody knows if family adaptation capacity will be sufficient to face this new situation (rising temperatures, more frequent violent rainfall). It is therefore urgent to reduce the vulnerability of rural people by raising the educational level of young people, improving their health, making farm incomes secure, organising marketing channels and enhancing the processing of local agricultural produce.

Conclusion

A very great number of research programmes in the fields of agronomy and geography have undertaken the study of the implications of climate change for agricultural production modes (ABIDJI *et al.*, 2012; ETWIRE *et al.*, 2013). Research in social science has been focused on adaptation and innovation strategies and even on the forms of resilience of African families in a context of environmental change. The review of the

15. According to the 2011-2012 demography and health survey (EDS), fewer than 1% of adults had completed secondary education. These results corroborate those of our ESCAPE survey.

16. Under-employment covers all works as understood by the International Labour Office (ILO) who fill one of the following conditions: they work part time, wish to work more and have availability for this; they work part time (and are in a situation other than that described above) or full time but have worked less than usual during a reference period because of partial unemployment (temporary lay-off) or bad weather.

literature and our results for Djougou confirm that this a complex question and that there are many forms of adaptation to face an unforeseen event or an environmental change. Mentions can be made of changes in family structures (polygamy, cohabitation of generations, etc.), the calendar and intensity of fertility, strategies for the schooling of children, the involvement of women and men in agricultural activities, procedures for the handing on of land, pluriactivity and migration.

Although these changes have been observed clearly and described in the literature, their relation of cause and effect as regards the environment is often difficult to establish, especially when climate change is concerned. This results to a considerable extent from the fact that climate changes are at a macro level whereas sociodemographic analysis is only pertinent at the level of households, that is to say at a micro level. Furthermore, it is very difficult overall to identify what in the context—whatever it is—triggers a change in sociodemographic or economic strategies. Individual persons, households and families are set in contexts that may change, like the climate or the natural environment.

An intensification of migration, rendering households nuclear, changing the rules of marriage, decreasing fertility, etc. are responses to multiple changes of different kinds and with different temporal features and among which global climate changes that weight on agricultural production conditions form part. If an unforeseen environmental event can trigger a crisis (agricultural, economic, political or social), there is often prior vulnerability to this event. It can reasonably be considered that the more the population has access to public services (education and health), to banking services (loans) and to agricultural extension, the more protection they will receive from the authorities regulating agricultural prices, and the more organised they will be. Their vulnerability will decrease and they will be more capable of standing up to a shock or an unforeseen event.

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