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► **To cite this version:**

Hubert Cochet. Agrarian dynamics and population growth in Burundi: agroecology before its time. Dossiers de l'Environnement de l'INRA, 2012. hal-02529951

HAL Id: hal-02529951

<https://hal.science/hal-02529951>

Submitted on 6 Apr 2020

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Agrarian dynamics and population growth in Burundi: agroecology before its time¹

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Burundi is a small country of 27,000 km² with eight million inhabitants, whose landscape is generally mountainous and lies between 1,000 and 2,000 metres above sea level. The picture one can paint of Burundi, like neighbouring Rwanda, is one of densely populated countryside (200 inhabitants per km² in 1990, close to 300 today), that density representing rural density, since the towns are of a modest size in both countries. Settlements are scattered, with very small agricultural production units, measuring on average less than one hectare. Exclusively manual and mainly centred on food crops, farming in Burundi might appear, to the uninformed observer, to be a picture of "traditional" farming directly inherited from the past.

However, the agrarian history of this little country in the African Great Lakes region has an exceptional amount to teach anyone with questions about the future of farming and food production in this part of the world, and food production for mankind as a whole.

A diachronic approach to the agrarian history of Burundi reveals that it has seen two major agricultural revolutions which have deeply transformed its farming, not through recourse to fossil fuels and industrial inputs, like the countries of the North, but almost exclusively based on organic mechanisms and human ingenuity. Long before the term even existed, Burundian peasant farmers invented agroecology and made biomass management the central issue both for the production systems in place and for the social relations forged between actors.

In this way, Burundi achieved food independence in the late 1940s, allowing it to cope with population growth in the second half of the XXth century which might have been maintained had it not been plunged into civil war in 1993.



1. This text was first published as a chapter in the book by B.A. Wolfer (dir.): *Agricultures et paysanneries du monde. Mondes en mouvement, politiques en transition*. Permission granted © Quae Editions, 2010.

Epistemological obstacles

When I arrived in Burundi, I was immediately struck by a feeling of unease linked to the following question: at the time, anyone setting foot in the country had to take one of two entry points, a kind of required passage. First was the ethnic variable, the distinction between Hutu (a group thought to be of agricultural origin) and Tutsi (a group thought to be specialised in pastoral activities) being supposed to shed plenty of light on farming matters; second was population “pressure”, which for some, neo-Malthusians, was the source of all ills, and for others, more inspired by the theories of Boserup², the motor of change. There are not many parts of the world where advocates of these “opposing” theories have come in more direct opposition, in particular in the agricultural sphere.

From the outset of this research, was it necessary to conform to this line of thinking and approach the issue of Burundian agriculture based on these perspectives that were considered indispensable? I decided, there and then, that the answer was no. I did not have many arguments to justify my choice, but some sort of intuition led me to distance myself from them. So I disposed of these two entry points. Along the way, these two “interpretative keys” proved instead to be epistemological obstacles, in the full sense of the term. The choice I had made not to take this path proved justified, and enabled me to formulate new hypotheses and thus to take a new approach to agriculture in this region of the world.

By disposing of these questions, I made a number of enemies within the community of researchers and experts working in these regions. I had to work rather solitarily, mostly with students of the Burundi Faculty of Economics and with farmers themselves, to try to come back to looking at the facts, to talk to people and to attach the utmost importance to agrarian history, since it was in the name of that history that the most devastating of ideologies were created, then renewed and expanded upon in recent years.

The aim, then, was to try to understand this country’s agricultural development, viewed as a long-term process (it is a country whose agrarian history spans two thousand years), and to attempt to reconstruct what had happened, to gather up the facts, to interpret them and perhaps to give a different interpretation to the successive crises suffered by the country, each crisis making way for a complete transformation of the agrarian system.

The results of that research are what I will try to present here. Without dwelling on methodological aspects or what concepts were used, I will stress above all what might be retained from this agrarian dynamic, coming back, in the conclusion, to these two epistemological obstacles which I circumvented at the start.

The antiquity of agrarian history in this region of the world

It is now almost certain that agriculture and pastoralism have been associated for 2000 years in this region of the world³. This may seem insignificant, but if one looks at the ethno-political conflicts of recent decades, at times still “explained” in terms of the historical subjugation of the Hutus, considered a group of indigenous farmers, by a group of non-indigenous herdsmen, the Tutsis, discovering that the association between agriculture and livestock dates back 2,000 years in this region seems important to me.

Some 1,500 or 2,000 years ago, then, an agro-pastoral system emerged. Agricultural activities were based on the cultivation of cereals – sorghum and finger millet⁴ – continuous cultivation which involved, not slash-and-burn systems with a long rotation period, but tillage systems involving

2. Boserup E. (1965). *The Conditions of Agricultural Growth: The Economics of Agriculture under Population Pressure*, 124 p., London and New York.

3. Schoenbrun D.L. (1990). *Early History in Eastern Africa's Great Lakes Region: Linguistic, Ecological, and Archaeological Approaches, ca. 500 B.C. to ca. A.D. 1000*, Los Angeles, USA; Van Grunderbeek M. C. and Roche E. (2007), Multidisciplinary Evidence of Mixed Farming during the Early Iron Age in Rwanda and Burundi in Denham T., Iriarte J. and Vrydaghs L. (ed.) *Rethinking Agriculture: Archaeological and Ethnoarchaeological Perspectives, One World Archaeology*, n° 51, California: Left Coast Press, Inc., 299-319.

4. *Eleusine corocana*, a cereal very likely to have been domesticated in East Africa.

digging and successional sowing over short periods. At the same time, sedentary livestock emerged, producing both milk (part of which was turned into butter) and meat, and providing animal excrement which was meticulously collected to fertilise the arable land, in a real association of agriculture and livestock. These sedentary agricultural and livestock activities were pursued by people who spoke the same language and lived in the same hills, in settlements located on the tops of those hills.

Towards the XVIIIth century, both Burundi and Rwanda witnessed what I have termed an “agricultural revolution”, in other words, a series of highly significant transformations to farming, social relations and society as a whole.

A little-known agricultural revolution radically changed the agrarian system in the XVIIIth century

Widespread cultivation of plants from the Americas and the introduction of a new agricultural calendar

Maize and beans⁵ appeared in Burundian farms and very quickly spread throughout the region. At the same time, double-cropping developed, in other words, farmers were able to harvest two crops a year on the same plot of land. This, too, was a major innovation.

In this region, where a double harvest is made possible by precipitation levels (it rains from September/October to May/June), this was not the case prior to the introduction of plants from the Americas: a single cycle of sorghum or finger millet was cultivated each year (these cereals having a relatively long cycle here). The introduction of new plant material from the Americas enabled farmers, by means of an innovation process which it is hard to reconstruct precisely, to put in place a far more intensive agricultural calendar, with a cycle of maize combined with beans in the first part of the rainy season, followed immediately by a cycle of sorghum. Whereas up until then sorghum had been planted at the beginning of the rainy season, sorghum sowing was consequently put back to mid-season in order to be able to fit in a crop cycle of the new plant material before it. All of this took place in the XVIIIth century.

The result of this transformation was a twofold increase in overall labour productivity. At the time, it was a significant advance. A working person was thus able to produce the equivalent of 20 quintals of cereals and pulses per year as a result of these changes, where he had previously produced scarcely more than ten (Cochet, 2001).

Improvements to associative practices between agriculture and livestock

Another significant change in this period involved improvements to associative practices between agriculture and livestock, with the increasingly meticulous recovery of animal excrement and longer stabling periods. Cattle would sleep in the farmyard and their dung would be collected by hand each morning, to be spread on the cultivated land. During the long rainy season, the settlements being located on the hilltops, little channels were built to carry the nutrient-rich rainwater to the cultivated plots.

In this emerging new society, cattle played an absolutely central role, from two points of view. First, they were the only accumulable asset, and thus represented capital in both the literal and the figurative sense, so that what distinguished one farmer from another at that time was the size of his herds. Second, cattle were the medium for fertility transfers from the saltus (pastures) to the ager (crops). For that reason, a farmer who had a large herd was rich not only because he possessed a large herd, but because he had access to large quantities of recoverable cow dung, which would enable him – or others, through clientelist relations – to cultivate bigger plots offering higher yields. Thus, from that time forth, cattle were right at the heart of mechanisms of accumulation and differentiation between farmers.

5. Of the genus *Phaseolus*; beans of the genus *Vigna* date back much further in Africa.

Clientelistic relations and tributary relations

The XVIIIth century saw the curious spread of *relations of clientelism* based essentially on the management of fertility, in this case organic manure. What were known as “cow contracts” became increasingly widespread. These were contracts binding the owner of a large herd to someone who had very few or no cows, and gave those with no cattle, in exchange for a fee and/or services, access to a heifer⁶, and thus to the fertility transfers which cattle enabled. These social relations thus allowed the association between agriculture and pastoralism to spread well beyond what would have otherwise been possible given the very unequal distribution of cattle ownership.

In this period, social relations of a tributary nature also emerged. A tributary society was put in place in Burundi, whereby a kingdom (as in neighbouring Rwanda) and the new ruling class (princes of royal blood, priests, seers, ritualists, *etc.*) lived off the levying of a tribute. Its legitimacy was, to some extent, tied to the fact that the King was guarantor of the fertility of the land, cows and women of the kingdom: an entire politico-religious aristocracy emerged and, curiously, all the agrarian rites – that is, all the religious aspects of that society – revolved around the new agricultural calendar and the possibility of having two harvests a year on the same plot of land. The sorghum plantings having been postponed to the middle of the rainy season, the date of those plantings (late December) became a national festival, accompanied by a strict ban on planting sorghum before that date⁷. The whole politico-religious structure which was put in place in this period crystallised the agrarian transformations which had emerged throughout the XVIIIth century.

These multiple technical, social and political transformations made possible continuous population growth throughout the XVIIIth and XIXth centuries. It was a period of expansion and growth. Population growth was obviously very slow (no more than 0.5 to 0.75 % per year), but it was almost continuous⁸ (see Figure 2).

At that time, it is difficult to know precisely what was meant by the categories Hutu and Tutsi. They appear to have been social categories: people with large herds, who were therefore at the top of the social pyramid, considered themselves, and were considered, Tutsis, while those who had few cattle considered themselves, and were considered, Hutus. These categories were therefore not “ethnic”, since an important farmer who through misfortune (*e.g.* lightning) lost his herd was “downgraded” to the category of Hutu. Thus it had little to do with ethnic distinctions, although property (cows) was obviously, like identity, passed on in a hereditary manner, which here meant from father to son.

1891-1944: Fifty years of agrarian crisis

At the end of the XIXth century, this system suffered an extremely sudden crisis which would last more than 50 years, from 1891 to 1944, over five decades of very severe crisis. Population growth came to a standstill during these years, meaning that the country was regularly ravaged by famine and epidemics. This crisis therefore signalled a break with the previous two centuries of agricultural growth (Figure 2).

6. Chrétien J.P. (1984), *Agronomie, consommation et travail dans l'agriculture du Burundi du XVIII^e au XX^e siècle*, in Cartier M. (ed.) *Le travail et ses représentations*, Paris, 123-178. Botte R. (1969), *Burundi: la relation ubugabire dans la tête de ceux qui la décrivent*, in “Les relations personnelles de subordination dans les sociétés interlacustres de l'Afrique centrale”, *Cahiers d'Etudes Africaines*, Vol IX.3, n° 35, 363-371.

7. Bahenduzi M. (1991), *Le rituel du Muganuro dans l'histoire du Burundi des origines au XX^e siècle*, doctoral thesis. University of Paris 1 Panthéon-Sorbonne, CRA, Paris.

8. Thibon C. (1989), *L'expansion du peuplement dans la région des Grands Lacs au XIX^e siècle*, in *Canadian Journal of African Studies*, vol. 23, n° 1, Association canadienne des études africaines, 54-72.

9. Thibon C. (1999), *Recherche en histoire rurale. Sociétés rurales en modernisation. Pyrénées XIX^e siècle, Burundi XX^e siècle. Une histoire sociale du politique. Tome 1: Synthèse Burundi: Croissance, transition démographique et crises socio-politiques au Burundi 1880-1993, Une population prise au piège d'une fatalité ou de dérives socio-démographiques modernes*, HDR qualifying thesis for research directorship, Université de Pau et des pays de l'Adour, Pau.

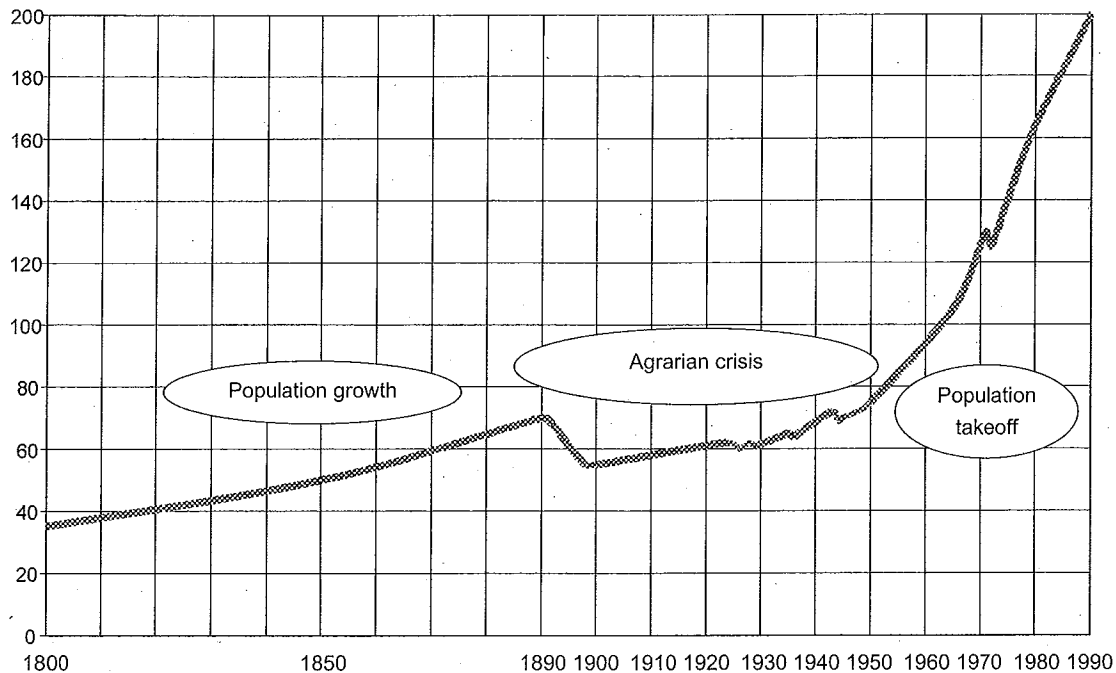


Figure 2. Changes in population density in Burundi from 1800 to 1990, showing slow population growth in the XIXth century, major crisis until the early 1940s, then sustained growth. Source: H. Cochet, based on the work of Christian Thibon (1999)⁹. The diagram shows a hypothetical reconstruction of XIXth century population growth based on a slow progression of 0.5 to 0.75 % per year.

In order to explain and interpret this crisis, the period in question needs to be split into two.

To begin with (in the first 25 years), it was a Malthusian crisis. It was triggered by epizootic diseases: cattle in Burundi and Rwanda were decimated by rinderpest, foot-and-mouth disease and trypanosomiasis (sleeping sickness). Evidently, with the disappearance of the cattle (up to 90 % in some areas), the entire structure collapsed, since cattle were both farmers' capital and the medium for fertility transfer which made that farming sustainable. If we seek to understand the reasons for this crisis, we can show that it results from a certain "ceiling" being exceeded, that is, the maximum capacity of this agrarian system to feed a given population. It can be estimated that, at that time, approximately 12 hectares per family were required for the system to be sustainable, taking into account the area of pasture needed to maintain a small herd, itself necessary to renew the fertility of the land, which was intensively cultivated using the double-cropping system. Bearing in mind that each family could contain five or six people (lineage-based social relations, and with them the extended family, having long since become looser), 12 hectares per family gives a possible population density of 50 inhabitants per km², which was quite considerable at the time. By 1890, that population density would appear to have been greatly exceeded, reaching 65 or 70 inhabitants per km². The earliest census available, showing a population density of 55 inhabitants per km², is that conducted by the settlers in the first years of the XXth century, after the first great famine. It is therefore certain that the ceiling had been greatly exceeded and that population density was established well above what the agrarian system could sustainably feed. The consequences of that overpopulation are easy to understand: in order to feed a population that was continually growing, it was necessary to expand the areas under cultivation at the expense of pasture land, while at the same time there was an increased need for animal dung to restore the fertility of the fields. With everyone striving to have as many cattle as possible (multiplication of "cow contracts" for the worst off, raiding of neighbouring lands for the princes), the result would have been widespread overgrazing, a kind

of “tragedy of the commons”¹⁰, where it was in the individual interests of each farmer to accumulate cattle in an attempt to curb the unavoidable reduction in the ratio of animal dung to area under cultivation. This crisis of widespread overgrazing would explain, to a large extent, the suddenness of the epizootics: the fact that the cattle were killed off so violently by microbes, despite some of them having long been present in the region, shows that they were very weak and unable to resist the microbial attacks.

Although European colonisation took place in this period, the crisis in the agrarian system was first and foremost an endogenous crisis, or at least it can be interpreted as such in its initial stage.

In a subsequent stage, colonisation played a decisive role in prolonging the crisis. The reason it went on for so long was the colonial pressure exerted on peasant farmers from the first decades of the XXth century. Burundi and Rwanda were colonised by Germany, but the Germans did not have time to put in place a proper colonial administration because they were expelled from the region by the League of Nations following their defeat in the First World War. In 1918, the League of Nations handed Rwanda and Burundi over to Belgium, and it was the Belgian Government that would put in place this colonial system, in the 1920s and 30s.

Colonial policy would worsen and prolong the crisis. The mechanism was quite simple: capitation (poll tax), compulsory coffee-growing, all manner of colonial *corvées*, and compulsory food crops meant an increase in levies and a considerable diversion of labour, at a time when peasant farmers were suffering a serious crisis. There is no doubt that these new pressures worsened the crisis. It is worth remembering that, at that time, anyone unable to pay their tax was subjected to corporal punishment. In order to be able to pay this tax, whose relative weight went on rising in relation to what taxpayers could expect to sell, people had two options: they could either sell their last cows or goats, further worsening the process of decapitalisation brought about by the crisis, or flee the country to take refuge in the British colonies, where it was easier to hide or gain access to paid employment. The result was a labour drain, which increased the tax burden on the workforce that remained in the country.

Another aspect of colonial policy, which was to leave lasting marks, was the purely ethnic interpretation which missionaries and colonial administrators made of the society they encountered. According to the dominant ideology of the 1930s, any difference between social groups could be explained solely by means of race, and, what is more, races were hierarchical by nature. A whole body of literature appeared during this period to explain how the Hutus were an ethnic group of farmers which had been subjugated by an ethnic group of pastoralists, considered superior, the Tutsis. This ethnic interpretation was facilitated by the ravages of the agrarian crisis mentioned previously, because the society discovered by the settlers was, in actual fact, a society where only a small elite still had cattle, since 90% had been decimated. The only families who had managed to keep or renew part of their livestock were those who previously had the most, those who had several herds looked after by herdsmen in different places and had therefore been able to spread the risk, while the vast majority of the population had lost all their cattle. But the settlers interpreted it as follows: those who still had cattle were presumed to be a “pastoral people”, while those who had none were assumed never to have had any, and were therefore a “farming people”. This view, ignorant of the past, was not only wrong, but the colonial administration decreed that this minority of “pastoralists” was endowed with superior qualities and was therefore predestined to rule over the others. It was from among their ranks, then, that the young men trained to become the “indigenous” fraction of the colonial administration were chosen: policemen, tax collectors, nurses, agricultural advisers, veterinary officers, *etc.*

That half-century (1891-1944) saw five successive famines. Each time population growth resumed its rhythm, once more the population was ravaged by deadly famines, and this went on until 1943-44, the last famine in Burundi’s history. In 1945, population density was still 55 inhabitants per km².

10. In the sense of G. Hardin, *The Tragedy of the Commons*, in *Science* (13 December 1968).

Agrarian transformations in the second half of the XXth century

The end of the colonial period signalled a recovery from the crisis. Here again, the timeline that can be established for the agrarian system does not coincide with the political timeline. The recovery from the crisis and what I shall call the triggering of a new agricultural revolution did not coincide with independence, but occurred a good ten years earlier, as things began to change once again from 1945 onwards.

From 1944, the population curve took off (figure 2). In 1960, the threshold of 100 inhabitants per km² was reached, and all the experts sounded the alarm that the system had reached capacity and we were heading straight for a new imbalance between population and resources; Malthusian models were the order of the day for setting all the warning lights flashing. In the 1990s, the 200 inhabitants per km² mark was reached. Even so, the country achieved food self-sufficiency, suffering no more serious food crises since 1943-44. The population trebled, food production did too, and, in addition, both Burundi and Rwanda became exporters of high-quality arabica coffee and tea. This spectacular growth took place with no industrial inputs: no fertilisers, no plant-protection products, no new tools except the factory-produced hoe making it unique enough to be highlighted. Burundi's production saw exponential growth, at the same pace as its population, with no new inputs, and it enjoyed food self-sufficiency which would still be the case today if it had not been plunged into civil war in 1993.

A major upheaval then took place and a series of highly significant transformations which I will attempt to outline below.

Banana plantations

Anyone who travels through the hills of Rwanda and Burundi is struck by the ubiquitous banana trees. These hills present a very verdant landscape, where the upper half of almost every hill is covered in banana trees. Today they hold an important place in the Burundian and Rwandan landscapes, but, interestingly, this is a recent phenomenon. The Burundians were familiar with the banana tree but, up until the 1940s, they cultivated them very little. One of the first dynamics of the second half of the XXth century was that the hills became partly covered with banana trees.

From a genetic perspective, these are highly original cultivars. They are "dessert bananas" (genotype AAA), rather than "plantains". Yet these cultivars are not consumed as fruit, but solely in the form of "banana beer" (the fermented juice). The bunches of bananas are picked; then, after a few days in which the bunches are buried, bananas are peeled; they are placed in a kind of macerating trough, to which water is added; then they are worked to try to remove as much sugar as possible. There is demand for this product alone: the banana juice, which will go on to be fermented to produce "beer". All of the crop waste – the trunk of the banana tree, its leaves, the stalks of the bunches, the banana skins and the banana paste after the juice has been extracted – is returned to the soil, *i.e.* scattered around the banana plantation.

An agronomic analysis of this cropping system reveals how remarkably efficient it is. An analysis of the minerals in a plot cultivated using this system gives a balanced result because there is practically no loss of minerals: in the banana juice, there is little more than sugar (carbon), water and vitamins, so practically no nitrogen, phosphorus or potassium (NPK). All of these minerals are returned to the soil. Because banana plantations are also very efficient at preventing run-off and leaching, here is a cropping system which, for the first time in Burundi's history, does not require animal dung. As far as carbon footprint is concerned, banana plantations act as carbon sinks, and nearly all of that carbon, with the exception of the fraction contained in the juice, is returned to the soil. They therefore have an overwhelmingly positive carbon footprint, which is another unique characteristic of an agrarian system in which animal dung has become extremely rare: banana plantations do not require it and are themselves biomass-producing systems, accumulating carbon each time the waste is returned to the soil. The result is a spectacular improvement to the soil of banana plantations.

Another characteristic of this cropping system is that it is also highly efficient from a microeconomic point of view. All the calculations carried out, for all the regions of Burundi, show that whether it is evaluated on the basis of the wealth created per unit of area (value added/ha) or the wealth created per day of labour devoted to this cultivation system (value added/day of labour), this cultivation system is the most efficient from a microeconomic perspective (Cochet, 2001).

All of which goes to explain why, throughout the second half of the XXth century, farmers did all they could to expand their banana plantations as much as possible.

Intensification and complexification of crop combinations

On the other plots of their farms, farmers planted increasingly complex and sophisticated crop combinations, with sometimes as many as seven or eight different species on the same plot, resulting in a sort of “muddle” that would make any agronomist’s head spin. But it was an organised, managed muddle, where not a single square centimetre was wasted, not a single ray of sunlight touched a leaf before touching the ground and not a single cubic centimetre of ground was not taken up by the roots of such and such a cultivated plant.

This sophistication of crop combinations was quite spectacular and was the result of a process of labour intensification of cropping systems. It occurred both on the hillsides and in the lowlands separating each topographical unit – each hill – from its neighbour.

Coffee

In the colonial period, coffee was a compulsory crop. The coffee was purchased from households so that they could use the money to pay their poll tax. From the 1950s onwards, the relative price of coffee became advantageous to farmers. For the first time in their lives, they found that coffee was a source of purchasing power (it would remain so until the late 1970s) and they deliberately set about increasing the areas under coffee cultivation.

Coffee was not the only woody species to be planted in the hills of Burundi. Besides tea, which replaces coffee above an altitude of 2,000 metres, many useful trees were planted by farmers within their banana plantations (fruit trees) or on the edge of their plots (*eucalyptus*, *grevillea*), so that in places the Burundian landscape takes on a wooded appearance that is all the more remarkable given that this tree cover became more dense as population “pressure” increased, contrary to an idea firmly rooted in people’s minds.

This series of transformations at individual farm level, in a context where farm areas were decreasing as population density increased and farms were divided up between heirs, enabled an overall increase in production per unit of area, and explain how a 50% increase in cultivated areas (between 1950 and 1990) could have led to a 150% increase in food production (in addition to large-scale production of coffee and tea). An increase in the number of crop cycles (both on the hills and in the lowlands) and in the complexity of crop combinations; the development of banana plantations and the transformation of fertility-renewal methods; labour intensification; and, lastly, the doubling or trebling of food production: all of this amounted to a new agricultural revolution, yet with no industrial inputs – no tools, no fertilisers, no plant-protection products – a glimpse of the “doubly green” revolution which some experts have their hopes set on today¹¹.

This spectacular development led many researchers, academics and experts to interpret the evolution of Burundian agriculture by stressing the theories developed by Ester Boserup from 1965 onwards. In reaction to Malthusian and neo-Malthusian theories, Boserup had produced a model in which “population pressure”, rather than being the source of all ills, was considered the driving force behind development: it was “population pressure” that forced people to intensify and “population pressure” that explained this high growth of production.

11. Griffon M. (Ed.), 1996. *Vers une révolution doublement verte*, Fondation Prospective & Innovation, CIRAD.

Admittedly, population growth went hand in hand with these transformations, since smaller and smaller production units meant that farmers intensified out of necessity. But this model of interpretation proves completely ineffectual when it comes to explaining why this process did not get started sooner and what its limits are or what crises it can withstand.

Why did this spectacular development process not get under way until the second half of the 1940s? The answer is, quite simply, because it was held back by colonial pressure. The fact is that all the elements of this transformation of the agrarian systems were slowly put in place in the 1920s and 30s, but in a rudimentary fashion on each farm. At that time, farmers were required to plant coffee in order to pay their tax and to devote 100 to 150 days of labour per year to "colonial corvée", so that although all the elements of this new agrarian system were present in the Burundian countryside well before the 1940s, that development was impossible while colonial constraints remained.

The end of the 1940s was marked by the abolition of forced labour and compulsory food crops, and by a context of relative prices where coffee became a source of purchasing power. Thus the easing of colonial pressure was a first *sine qua non* condition for these transformations to flourish.

Meanwhile, the labour force which had emigrated to the British territories returned en masse, beginning as early as the 1950s and, more decisively, after independence (1962). Hundreds of thousands of Burundians who had fled their country returned to their hills and set about devoting most of their time to managing their little patch of land.

Another necessary condition for this process was to maintain, or increase, the scattered nature of settlements. This new management of available biomass and the creation of banana plantations around farmers' homes could not have taken place in the context of nucleated settlements. Fortunately, attempts at villagisation, very much in vogue in the 1970s, both in this region and elsewhere, failed in Rwanda and Burundi. That failure was partly due to the fact that people were sufficiently attached to their banana plantations to steadfastly refuse to be resettled. Villagisation would have made the anthropisation of these lands impossible, or far more laborious.

Finally, emphasis should be put on the relatively egalitarian nature of this development process. Since in most cases the accumulation of capital meant the accumulation of biomass – people's capital being their banana plantation and the carbon sink it represented – that accumulation was necessarily slow and continuous, and did not lend itself to processes of despoilment or sudden accumulation, in particular through market trading.

Limits on this process

Concerning the banana plantations

The progressive anthropisation of the land by means of this cultivation system based on banana plantations was subject to two kinds of limitation. Although the consumption of fermented banana juice plays a not insignificant role in adult calorie intake, that consumption was not limitless and urban markets were a poor outlet. A second, agronomic limit was the fact that the centrifugal expansion of the banana plantations and the accompanying anthropisation of the land slowed down on the slopes, partly because the soil became more and more desaturated and acidic as one descended the slopes, and partly because, to set this process in motion, the animal dung was extremely valuable when the first banana trees were planted. Once there were scarcely any cattle left in the more densely populated areas of Rwanda and Burundi, it was no longer possible for the animal dung to play this *starter* role in the setting-up of the banana plantations, amounting to a second limit on the expansion of the banana plantations.

Total absence of inputs

It is a virtue of this development that such a feat was achieved with almost no industrial inputs and with an emphasis on the organic processes which are today the subject of agroecology theories.



But one should not be too quick to rejoice about the intrinsically “organic” nature of this development. For it is clear today that Burundian farmers will be unable to take this intensification process any further without having access to a minimum of carefully used inputs (fertilisers, plant-protection products) and a wider variety of tools (even if they remain manual). The extreme lack of inputs available to Burundian farmers today puts a fundamental limit on this process.

Concerning coffee

Coffee was one of the mainsprings of this development, but also one of the main stumbling blocks. Coffee itself was not the issue, but the fact that it was compulsory for Burundian farmers to grow it, which is something quite different.

The cultivation of coffee plants was made compulsory in the 1930s, and the cultivation method has changed little since then. Coffee had to be grown as a pure crop, on land often determined by the authorities (for a long time, along the roadsides); pruning had to be carried out a certain number of times, at regular intervals; and, above all, the coffee had to be *mulched*, which meant spreading a 20 cm layer of fresh organic matter over the coffee plot each year, at the end of the rainy season (the recommended amount being 20 to 25 tonnes of dry matter per hectare!). This covering of organic matter has various agronomic benefits: it restricts evaporation during the dry season; it provides effective protection against erosion and run-off; it smothers weeds; and it is an outstanding source of fertility, because this organic matter decomposes to the benefit of the coffee.

In the colonial period, roads were built across all the hillsides of Burundi and Rwanda, and farmers were required to plant coffee on either side of the roads. An inspector would pass by in his jeep or on his motorbike to check that the mulching had been properly carried out and, if he was in any doubt, he might get out of his car and insert a brand-new pencil into the *mulch* down to the soil, without encountering the least resistance. If that was not the case, the farmer was subjected to corporal punishment. Since then, little has changed: in the 1990s, mulching was still compulsory and the corporal punishment had merely been replaced with fines.

Today, this method of coffee cultivation poses many extremely serious problems. Where is this biomass to be found in farms that today cover less than one hectare? First, in the banana plantations: it seems natural for part of the crop waste from a banana plantation to be transferred to a coffee plot; but when that is not enough, there must be recourse to all the plots under food crops. So the second flow of biomass to emerge at the heart of each farm involves all the waste from its food crops, which is transported to the coffee plantation: the canes and stems of maize and sorghum, the haulms of sweet potatoes and beans (including the roots that are pulled up), and all the weeds. If that is not enough, farmers may resort to the last few acres of residual grazing land. In the most densely populated areas of Rwanda and Burundi, there is little pasture land left, so here, a ban on grazing these pastures must be imposed (which means getting rid of the last goat or cow), in order to scythe them and transfer the biomass obtained to the coffee plot.

This standard cultivation method leads to the emergence of multiple flows of biomass within the farm, all of which converge on the coffee plot. The intensity of these flows depends, first, on the farm area and, second, on the ratio of mulch-producing area to area under coffee, *i.e.* the relative position held by coffee in the farm's useful agricultural area. It depends also on the resources which farmers have to purchase biomass, there having emerged a veritable carbon market as this resource becomes increasingly scarce.

These new centripetal flows to the benefit of coffee and at the expense of all other plots weaken farms considerably. All that I have said higher up about banana plantations ceases to apply if the carbon, rather than accumulating on site, is transferred to the coffee plantations. The agronomic and economic effectiveness of this "banana plantation" cropping system is therefore directly threatened by the intensity of transfers to coffee plantations. As regards the complex food-crop combinations which farmers have introduced, it is clear that transferring all the crop waste, sometimes including part of the root system, multiplies by a factor of two or three the amount of minerals lost by these plots. As regards residual grazing land, it accelerates the disappearance of livestock and hence the fertility transfers which it was, and at times still is, able to offer, to the benefit of the cultivated land.

It is clearly apparent, then, that this unilateral policy (the imposed method for coffee cultivation) has become a threat to the farm as a whole and, by extension, to the entire agrarian system. This entirely obsolete cultivation method has become not only an agronomic dead end, but also an economic and social one.

In Burundi, biomass – carbon – has had a market price since the 1980s. When the poorest farmers have nothing left to sell, they sell their biomass (their crop waste, weeds, *etc.*) to their neighbours who have the means to buy it. Not only has biomass acquired a market price, it also has a colossal opportunity cost. This opportunity cost means the end of livestock; it means lower yields for food crops, since the loss of minerals undermines the renewal of fertility on those plots; and it means the reduced effectiveness of the "banana plantation" cropping system. This opportunity cost is thus entirely disproportionate, and calls into question both coffee cultivation in Burundi and the agrarian system as a whole.

Coffee cultivation is called into question all the more by producers as movements in the relative price of coffee make its production financially less and less viable. As a result, farmers are increasingly hesitant about sacrificing their biomass for a crop which gives them less and less of a return.

What is the explanation for such an inappropriate cultivation method being maintained for so long, and for this single, standardised method to have remained compulsory? Asking this question in the early 1990s in Burundi was no easy matter. Although it was clearly one of the most serious issues for Burundian agriculture, practically no research had been carried out on the subject. Merely by questioning this cultivation method, on strictly agronomic grounds, one aroused fears and opposition of a highly unscientific nature.

Coffee did, after all, account for 80% of export revenue. It was through export duties that the State coffers were filled. Levies on exports and international aid were what enabled the Burundian Government to function. The power in Burundi having been seized by a small minority – a political

minority – questioning this cultivation method was perceived by all the leaders and scientists of both countries as tantamount to questioning the country's entire economy and, more specifically, the State budget. In other words, it was impossible at the time, despite the agronomic and economic evidence.

Conclusion: carbon at the heart of development

To conclude, I would like to come back to the two “traps” which I sought to circumvent in my approach to Burundian agriculture: population “pressure” as a way in to agrarian systems, and the ethnic variable.

As far as population pressure is concerned, the debate between Malthus and Boserup is still omnipresent in Burundi, in the scientific, academic and political spheres. Malthusian theories were behind the crisis scenario that was awaited since the 1960s. But when the crisis didn't happen, the alarm went on being sounded over the following decades, without understanding the reasons behind the intensification processes that were taking place.

To the neo-Malthusians, population pressure was the cause of all ills, because it led to erosion, deforestation and the cultivation of the steepest slopes; so it was this population pressure that would be the cause of the crisis. To try to anticipate the crisis, since it was not possible to combat population growth - the Catholic Church being strongly opposed to birth control - it was necessary to “combat” erosion, to “combat” deforestation, and so on, the implication being that the cause of the crisis was agriculture itself, and hence peasant farmers and the intensification they had carried out. Yet everything about the Burundian landscape indicates the opposite: it is the least densely populated areas that show signs of erosion, deforestation and environmental degradation. Meanwhile, in the most densely populated areas - 600 inhabitants per km² - one finds wooded landscapes, a real human achievement, the people having planted trees everywhere: a phenomenon of intensification and artificialisation of ecosystems leading to the opposite of massive deforestation and a worsening of erosion phenomena. By considering farmers, and farming in general, to be the cause of this looming crisis, it was possible to justify a good many aspects of agricultural policy, including the excessive supervision of producers and the condemning of their practices. So all agronomic research and advisory services were concentrated on improving technical “packages” to be distributed around the countryside, even if they went against the views of producers themselves, which was enough to justify a move to authoritarianism from the regime.

At the same time, since the production curve more or less coincided with the population curve, others advocated Boserup's model, to the extent that, when there was a shortage of reliable statistics, annual production growth was measured simply by adding to the figure for the previous year the same percentage as for population growth! This practice was widespread among advocates of this theory: “overpopulation”, both a considerable, and inexhaustible, pool of labour in the countryside, provided justification for “putting peasant farmers to work”. This “labour investment” (in Boserup's sense) was made into an equally authoritarian means of mobilising rural people to build roads, drain marshland, *etc.*, carrying on the colonial tradition of forced mobilisation of the population.

More recently, this theory of Boserup's has also been accorded neoliberal virtues. Since farmers were able to intensify, it was sufficient for them to be more and more numerous for that intensification to take place: this justified the State and public authorities' withdrawal from any productive role; it was sufficient to make sure market signals reached farmers.

These two theories, despite being systematically opposed, have more in common than it seems, since both take the ratio between population and resources as the starting point for their analysis. So, whether production is considered an independent variable (Malthus) or whether population growth is that independent variable (Boserup), these two theories ultimately coincide in their inability to really explain the crises, to put social relations back at the centre of the phenomena observed, and to attempt to see in what conditions those crises might or might not be overcome.

Although there is still much room for progress, the accumulation of fertility capital, at the centre of the process of development of Burundian agriculture, has today slowed down, hindered in many ways. A massive diversion of biomass to the exclusive benefit of coffee cultivation through the compulsory mulching technique, a shortage of inputs, uncontrolled attacks from parasites, in particular on banana trees and beans, a system of relative prices which makes fertilisers and plant-protection products inaccessible, repeated and massive infringements of free access to resources: all these obstacles make it increasingly difficult to pursue and expand the intensification dynamics under way since the 1950s. The obstacle to the continuation of these processes today should therefore not be sought in the practices of peasant farmers themselves, and the crisis is in no way the result of exceeding a population ceiling imposed by the productive capacity of cropping and livestock systems. It has far more to do with the conditions in which producers are today integrated with market trading and the social relations in which they are involved, which limit the productive capacity of the agrarian system. Just like in ancient Burundian society, the storage and concentration, appropriation and management of carbon are once more at the centre of social relations.

Finally, Burundi's agricultural development has been inward-looking and, despite the development of coffee-growing, has remained above all based on the domestic market, even though that market has remained limited to agricultural produce and highly restricted by the narrowness of urban markets. Protected by 1,500 km of poor roads separating it from the Indian Ocean, Burundi has managed to take control of its participation in international trade and to limit its destructive impact on the food-production sector. Despite very low labour productivity, farming remains alive and the country has for a long time been self-sufficient. The agrarian transformations of the past decades are certainly a remarkable example of endogenous development, based only on local resources. As for coffee, there is no need to revive an old, outdated debate on the competition between food crops and export crops. Coffee was without a doubt the best vehicle for participation in international trade. But it was necessary for Burundi's clear comparative advantage not to have been drastically reduced by the opportunity cost of the biomass required by the compulsory mulching technique for coffee-growing, and the extremely serious indirect effects this had on the national economy.