POLICIES ON POPULATION, LAND USE, AND ENVIRONMENT IN RWANDA

Paper presented at the Session "Population, Environment, and Land Use in Developing Countries", Annual Meeting of the Population Association of America, Cincinnati, Ohio, April 1-3, 1993

by

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ABSTRACT

The paper first describes the interactions between population growth, land use, and environment in Rwanda, a small, densely populated landlocked nation in the East-African Great Lakes region. These interactions are modelled using a conceptual framework applied to the neighboring Kivu region in Zaire, but adapted to the Rwandan case study. Second, the paper contends that the emphasis put on the increase of the agricultural production mostly through the use of marginal land and the lack of a timely implementation of a family planning program and the national population policy, has lead to a worsening of the interactions between population growth, land use, and environment. In an attempt to demonstrate this hypothesis, it is proposed to apply demography-driven projection scenarios to the agricultural colonization and intensification processes.

INTRODUCTION

Rwanda, a small landlocked nation in the East-African Great Lakes region, is chiefly characterized by its very low level of urbanization and very high share of the labor force engaged in traditional, subsistence agriculture (see Table 1).

TABLE 1: MAJOR DEMOGRAPHIC AND SOCIO-ECONOMIC INDICATORS FOR RWANDA

Indicator (with year)	Value
GEOGRAPHY	
Area	26,338 sq. km.
Urban population, 1989	426,000 (est.)
Population of Kigali (capital), 1988	300,000 (est.)
DEMOGRAPHY	
Population:	
Total, mid-1990	7.1 million
0-14, 1978	3.3 million
Females 15-49, 1978	3.4 million
Density, 1990	270 per sq. km.
Crude birth rate, 1987	54 per thousand
Crude death rate, 1987	17 per thousand
Rate of natural increase, 1987	3.7% per year
Rate of natural increase, 1992	3.1% per year
Total fertility rate, 1987	8.6 per woman
Total fertility rate, 1992	6.2 per woman
Infant mortality rate, 1990	120 per 1000 live births
Life expectancy at birth, 1990	48 years
Population projection, 1985	23 million in 2025
SOCIO-ECONOMIC INDICATORS	
Gross national product, 1990	310 US dollars per capita
Population working in: (1983)	
Agriculture	91%
Industry	2%
Services	7%

Sources: J. MAY, M. MUKAMANZI and M. VEKEMANS, Family Planning in Rwanda: Status and Prospects, Studies in Family Planning 21, 1, 1991: 22, WORLD BANK, World Development Report 1992. Development and the Environment, New York: Oxford University Press, 1992: 218, 268 & 272, and ONAPO, Kigali: Unpublished data.

The population of Rwanda is growing fast and is projected to double in less than 25 years, even though it appears that fertility has recently started to decline[1]. The high annual rate of population growth (estimated at 3.1 percent in 1992) has put further strain on the already hard-pressed agricultural economy. These problems have been recently compounded by the emergence of the AIDS epidemic in the early 1980s, the drought in the early 1990s which has lead to limited famine in the Southern part of the country, the armed invasion in 1990 of Rwandan refugees from Uganda and the ensuing civil war, and the pressure put on the Government to shift from the unique party rule to a multiparty system.

Ever since colonial powers ruled Rwanda, the country has been recognized as overpopulated. Consequently, various policy responses had been designed to address the population issue. By policy responses, we mean conscious responses taken by the public authorities. First, under the Belgian rule after World War I and especially after World War II, emigration policies to neighboring countries were put into place. These policies were continued by the Government of newly independent Rwanda (the country became independent in 1962). In addition, soon after independence, attempts were also made to redistribute large populations within Rwanda under cash crops projects (the "paysannats" policy), mostly in the Southern part of the country. The second major policy dealing with the population issue was to promote the increase of agricultural production. This was achieved mostly during the late 1960s and during the 1970s through the expansion of the traditional agriculture, namely the system of familial landholding and farming. The third policy response was the launching of a nation-wide family planning delivery program in the early 1980s. The National Office of Population (ONAPO) was created in 1981. The program focus was on the supply of family planning services rather than the creation of a stronger demand, although the program included a fairly large IEC (Information, Education and Communication) component. Finally, the fourth response has been the adoption in 1990 of a national population policy aimed at integrating the sectoral policies and creating a stronger demand for lower fertility (ONAPO, 1990c).

Rwanda is the most densely populated country in sub-Saharan Africa with the exception of Mauritius. Furthermore, virtually all regions of Rwanda are heavily populated (see Table 2). In Table 2, physiological densities are calculated by dividing the population by the available land. These densities are always higher than conventional densities which take into account all "land" including lakes, dams, rivers, etc. Without the city of Kigali, the Kigali

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[1] The 1992 Demographic and Health Survey in Rwanda has yielded a total fertility rate of 6.2 children per woman. This might have been caused by a higher use of modern contraception (ONAPO/DEMOGRAPHIC AND HEALTH SURVEYS, 1993: 6-7) as well as a further delay of the age at marriage.

Prefecture would have a physiological density of only 323 persons per square kilometer.

TABLE 2: ESTIMATED RWANDAN POPULATION ON JANUARY 1, 1991 AND PHYSIOLOGICAL DENSITIES, BY PREFECTURE

PREFECTURE	ESTIMATED POPULATION	AVAILABLE AREA (sq. km.)	PHYSIOLOGICAL DENSITY (per sq. km.)
BUTARE	908,273	1,757.3	517
BYUMBA	792,015	2,606.2	304
CYANGUGU	509,860	1,116.7	457
GIKONGORO	556,493	1,561.8	356
GISENYI	708,521	1,311.3	540
GITAPAMA	921,048	2,157.0	427
KIBUNGO	568,401	2,666.6	213
KIBUYE	509,860	1,296.9	393
KIGALI	908,138	2,807.9	466
KIGALI-CITY	400,430	-	-
RUHENGERI	807,196	1,442.5	560
RWANDA	**7,590,235**	**18,724.2**	**405**

Source: ONAPO/FNUAP/DTCD, Monographie démographique préfectorale. La population de Butare en chiffres, Kigali: Office National de la Population et Projet Assistance à l'ONAPO RWA/87/PO3 FNUAP/DTCD, 1991: 2-3.

This paper will first describe the interactions between population growth, land use, and environment in Rwanda, using a conceptual framework applied to the neighboring Kivu region in Zaire, but adapted to the Rwandan case study. Second, the paper will contend that the second policy response to population growth, i.e. the increase of the agricultural production, and the lack of a timely implementation of the third and fourth policy responses, has lead to a worsening of the interactions between population, land use, and environment.

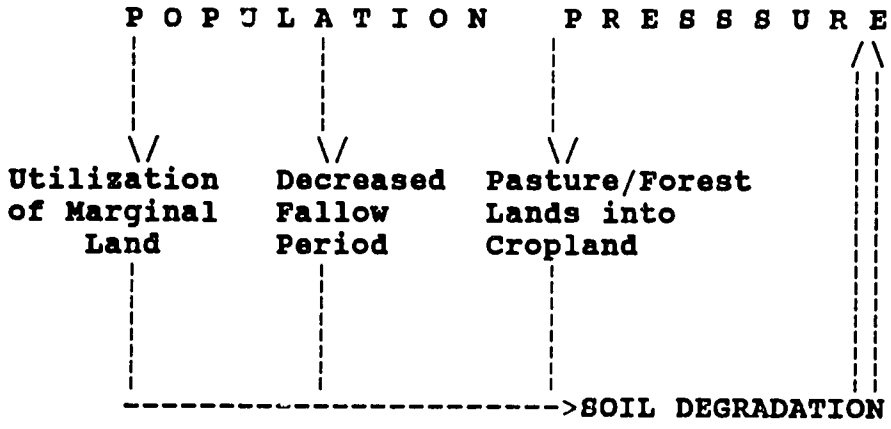
THE POPULATION, AGRICULTURE, AND ENVIRONMENT NEXUS

The model used in this study was adapted from a simulation study of population, nutritional levels, and soil erosion interactions in Eastern Kivu in Zaire (Wils et al., 1986). The model can be described as follows: the demographic pressure induces the utilization of marginal land, the shortening of fallow periods, and the conversion of pasture and (natural) forest lands into cropland. In turn, these three phenomena lead to soil degradation which reinforces the demographic pressure on natural resources,

leading to another cycle of environmental degradation (May, 1991: 7).

As in Kivu, rapid population growth and excessive population pressure in Rwanda has also lead to the utilization of marginal land, the shortening of fallow periods, and the conversion of pasture/forest lands into cropland with similar detrimental consequences on soils. Furthermore, soil degradation also reinforced population pressure on natural resources. The population, agriculture, and environment linkages in Rwanda are outlined in Figure 1.

FIGURE 1: LINKAGES BETWEEN POPULATION PRESSURE AND NATURAL RESOURCES IN RWANDA



Source: Adapted from J.F. MAY, Population et Environnement au Rwanda, Washington, D.C.: The Futures Group for The World Bank/World Resources Institute, 2nd edit., 1991: 7.

In Rwanda, the marginal lands colonized are steep areas on the hills (through terrace cultivation) and swamp areas in the valleys (through bedding cultivation). This process was accompanied by a shortening of the fallow period and an increase in the number of crops (Rwanda has currently two crop seasons[2]). Finally, the conversion of pasture land into cropland has decreased the production of manure and therefore decreased soil fertility as imported fertilizers are often too expensive. In addition, the

[2] Rwanda experiences a long dry season from June to September, followed by a short rainy season from October to January. Thereafter, a short dry season goes from January to February, followed by the large rainy season from March to May. The two rainy seasons enables Rwanda to have two annual crops. A third crop is possible, with irrigation, in some regions.

loss (often through encroachment) of about a quarter of natural forest areas since 1960, for subsistence agriculture and cash crops, has decreased the soil protection offered by forest coverage. However, the areas devoted to communal forests have increased dramatically during the period. The evolution of cultivated areas, forests, pastures, and fallow land between 1970 and 1986 is presented in Table 3.

TABLE 3: EVOLUTION OF CULTIVATED AREAS, FORESTS, PASTURES, AND FALLOW LAND (HECTARE)

UTILIZATION/YEAR	1970	1980	1986
Pastures	487,884	322,060	199,360
Communal forests	27,156	57,200	99,500
Fallow land	200,000	154,000	123,000
Cultivated land	527,660	710,400	826,500
TOTAL	**1,242,700**	**1,243,660**	**1,248,360**

Source: REPUBLIQUE RWANDAISE, Le Rwanda et le problème de ses réfugiés. Contexte historique, analyse et voies de solution, Kigali: Présidence de la République, Commission Spéciale sur les problèmes des émigrés rwandais, 1990: 117.

The dynamics of population pressure on natural resources has brought other consequences, which might in turn have further strained the fragile balance between population and the environmental resources. Unfortunately, only scattered data (often for only one point in time) are available to depict these evolutions. Among these consequences, the most important are the fragmentation of family holdings through generational transfers (every boy aged 18 is entitled to land) and the decline in agricultural production due to over-cultivation. The latter has also lead to decreasing levels of caloric intake per capita. Tables 4 and 5 illustrate the fragmentation of family holdings as expressed both by the mean areas of family holdings (or farms) and the increase in the numbers of blocks of land (plots) per holding. In Rwanda, farms are often made up of several non-contiguous plots.

In 1983, the mean average area per holding was less than 1.6 hectare in all prefectures, but less than 1 hectare in Gisenyi and Cyangugu (both adjacent to Lake Kivu in the Western part of the country). Holdings are made up from at least 3 plots and the mean areas of blocks are correlated to the mean areas of holdings: the smaller the agricultural holding, the smaller the mean area of blocks (e.g. Gisenyi and Cyangugu on Lake Kivu and Ruhengeri in the Northern part of the country).

TABLE 4: MEAN AREAS AND FRAGMENTATION OF AGRICULTURAL HOLDINGS BY PREFECTURE IN 1983 (HOLDINGS IN HECTARE AND BLOCKS IN ARE)

PREFECTURE	MEAN AREAS PER HOLDING (HECTARE)	AVERAGE NB. OF BLOCKS PER HOLDING	MEAN AREAS OF BLOCKS (ARE)
BUTARE	1.1	5.4	21.0
BYUMBA	1.4	5.3	25.5
CYANGUGU	0.9	4.0	13.2
GIKONGORO	1.3	6.0	21.6
GISENYI	0.8	6.0	13.1
GITARAMA	1.3	5.4	24.3
KIBUNGO	1.5	3.2	46.6
KIBUYE	1.2	5.9	19.7
KIGALI	1.6	3.8	42.8
RUHENGERI	1.0	6.4	15.1

Source: REPUBLIQUE RWANDAISE, Le Rwanda et le problème de ses réfugiés. Contexte historique, analyse et voies de solution, Kigali: Présidence de la République, Commission Spéciale sur les problèmes des émigrés rwandais, 1990: 122.

TABLE 5: DISTRIBUTION OF FAMILY HOLDINGS ACCORDING TO THEIR AREAS IN 1984 (IN HECTARE)

AREA (HECTARE)	NUMBER OF HOLDINGS	PERCENTAGE	PERCENTAGE OF TOTAL AREA CULTIVATED
Less than 0.25	82,811	7.4	1.1
0.25 to 0.50	211,206	19.1	6.0
0.50 to 0.75	183,749	16.6	8.4
0.75 to 1.00	153,986	13.8	10.1
1.00 to 1.50	173,858	15.6	15.8
1.50 to 2.00	123,956	11.1	15.9
More than 2.00	182,331	16.4	42.7
TOTAL	**1,111,897**	**100.0**	**100.0**

Source: J.M.V. SIBOMANA, Les menaces de la surpopulation sur l'environnement et les conditions de la vie des Rwandais, Famille, Santé, Développement 14, 1989: 7.

According to Table 5, 57 percent of holdings are smaller than 1 hectare. However, these holdings represent only one quarter of the total area cultivated in Rwanda. The decrease in the size of holdings as well as their fragmentation seem to have also brought a decrease in yields (République Rwandaise, 1990: 112 & 120) leading possibly to an agricultural involution (Ford, 1990). Furthermore, virtually all available land in Rwanda is already

being used with the exception of two sub-regions (the Nyabarongo valley and the Akagera Park).

Although it should be stressed again that the scarce data available often refer to one point in time and, moreover, do not enable to establish causal relationships, a few inescapable conclusions can be reached with the evidence at hand. First, they were 8.0 persons per cultivated hectare in 1986, namely a population of 6,574,000 for 826,500 cultivated hectares. However, in the same year, they were 5.7 per cultivable hectare, adding pasture and fallow lands to cultivated land (this assumption would definitely bring about a further decline in the agricultural output because of the lack of manure and fallow). Second, the average size of family holding was 0.74 hectare in 1986, taking into account cultivated land, but 1.0 hectare when taking into account cultivable land (assuming that pasture and fallow lands would be converted into cropland). Finally, they were 5.9 persons per holding in 1986. It should be noted that the population figures refer to December 31, 1986, the land data are taken from Table 3, and the number of holdings from Table 5.

THE POLICY RESPONSES TO DEMOGRAPHIC GROWTH

The second part of this paper will focus on the policy responses to the population problem in Rwanda and how they have affected the interactions between population, land use, and environment. We contend that both the emphasis put on the increase of agricultural production (second policy response) and the lack of a timely implementation of the third and fourth policy responses (i.e. family planning and national population policy), has lead to a worsening of the interactions between population, land use, and environment. In an attempt to demonstrate this hypothesis, we propose to apply demography-driven projection scenarios to the agricultural colonization and intensification processes. We also try to measure the consequences of delays in the implementation of the third and fourth policy responses on the interactions between population, land use, and environment.

First of all, we categorize the policy responses to the population crisis (namely, the conscious responses taken by the public authorities) into responses aimed at accommodating the effects of the population growth (first and second responses, i.e. emigration and spatial redistribution), as opposed to responses aimed at decreasing the population growth itself (third and fourth responses, i.e. family planning and population policy). Furthermore, we contend that the third and fourth responses indeed pursue the same goal, namely a reduction in fertility. The third policy response does so through a supply approach, backed by IEC activities and the fourth policy response attempts to create a stronger demand for a smaller family size. Finally, we contend that, in addition to the nature of the policy responses, it is also

important to consider their timeliness. In other words, sound policy responses might be less valuable if they are not implemented soon enough.

Historically, the first policy response has had a fairly limited impact in Rwanda, in terms of numbers of people who have accepted to emigrate to neighboring countries (e.g. Zaire, Uganda, and Tanzania). However, the impact of this policy response is difficult to measure because official emigrants were often accompanied by spontaneous emigrants. In addition, emigrants might have returned surreptitiously to Rwanda. Finally, Rwanda might have also received immigrants from the same countries (Mukamanzi, 1982: 11-21). As to the population redistribution policy which was initiated in 1963, the empty "paysannats" were quickly filled beyond capacity with internal migrants (Gotanegre et al., 1974: 93-94 and Mukamanzi, 1982: 21-28).

The second policy response, namely the process of agricultural colonization and intensification, has been by far the most important policy response ever adopted in Rwanda to cope with rapid population growth. This response has also been spelled out in every development plan (Uwizeyimana, 1991). For instance, the demo-nutritional Twiyongere Twongera Umusaruro (TTU) model prepared by ONAPO stressed the importance to increase food production to cope with the growing population but put much less emphasis on the need to reduce population growth (ONAPO, 1990b). Nevertheless, the Rwandan authorities have eventually recognized that this policy response alone would not be enough to tackle the rapid population growth and alleviate the population pressure on scarce resources.

Therefore, a third policy response was adopted (partly under donors' pressure), namely the launching of a national family planning program in 1981. The same year, the Government of Rwanda established the National Office of Population (ONAPO). The national family planning program has first experienced modest successes (May et al., 1990), but has achieved significant results toward the end of the 1980s as evidenced by the data gathered in the 1992 Demographic and Health Survey. The level of contraceptive prevalence, for modern methods only, was estimated in 1992 at 12.9 percent of married women in reproductive ages. As mentioned earlier, the total fertility rate (TFR) has declined and is now estimated at 6.2 children per woman (ONAPO/DEMOGRAPHIC AND HEALTH SURVEYS, 1993: 10 & 6), although it might be argued that the TFR was underestimated in 1992 and overestimated in 1983-87.

Finally, the fourth and last policy response, namely the preparation and adoption in 1990 of a national population policy, was aimed at integrating the sectoral policies and creating a stronger demand for smaller family size. However, the policy has not yet been fully implemented and has therefore not yet brought tangible results (ONAPO, 1990c).

Demography-driven scenarios, based on population projections, should help to differentiate the various policy responses in term of efficiency. In particular, we will analyze the results of the second policy response versus the results of the third and the fourth policy responses using simple indicators.

TABLE 6: POPULATION PROJECTIONS FOR RWANDA (1990-2030), FOR BOTH SEXES, NUMBER OF PERSONS PER CULTIVABLE HECTARE, AND NUMBER OF PERSONS PER HOLDING

YEAR	POPULATION (thousand)	PERSONS PER CULTIVABLE HECTARE	PERSONS PER HOLDING
1990	7,118	6.2	6.4
1995	8,663	7.5	7.8
2000	10,436	9.1	9.4
2005	12,343	10.7	11.1
2010	14,451	12.6	13.0
2015	16,846	14.7	15.2
2020	19,567	17.0	17.6
2025	22,558	19.6	20.3
2030	25,700	22.4	23.1

Note: The assumptions for the population projections are as follows: a decline in the total fertility rate, from 8.3 in 1990-1995 to 4.4 in 2025-2030; an increase in the expectancy of life at birth for both sexes, from 47.7 to 58.1 years for the same periods, respectively; and a negative net migration rate (-0.2) in 1990-1995 which becomes zero as soon as 2000-2005 for the remaining part of the projection span.
Sources: E. BOS, M.T. VU, A. LEVIN et R.A. BULATAO (1992), World Population Projections 1992-93 Edition, Baltimore: Johns Hopkins University Press, 416, REPUBLIQUE RWANDAISE, Le Rwanda et le problème de ses réfugiés. Contexte historique, analyse et voies de solution, Kigali: Présidence de la République, Commission Spéciale sur les problèmes des émigrés rwandais, 1990: 117, and J.M.V. SIBOMANA, Les menaces de la surpopulation sur l'environnement et les conditions de la vie des Rwandais, Famille, Santé, Développement 14, 1989: 7.

First, we examine future population trends in Rwanda. According to the latest World Bank projections, the population of Rwanda should reach 25.7 million in 2030 (see Table 6). These projections include the potential consequences of the HIV/AIDS epidemic (Bos et al., 1992). The corresponding numbers of persons per cultivable hectare (i.e. cultivated land as well as pasture and fallow lands in 1986; see Table 3) are given, along with the

average sizes of holdings (the number of holdings is taken from Table 5 and is assumed to remain constant).

Evidently, the results tend to be absurd. For instance, the physiological density in 2030 would be 1,373 persons per usable square kilometer. In fact, Rwanda already experiences a very difficult situation due to demographic pressure and the lack of available land. Only a few additional areas could be put under cultivation, e.g. the Nyabarongo valley South of Kigali and possibly the National Akagera Park (although the quality of soil is poor) in the Eastern part of the country. However, the agricultural colonization of these areas would buy little time: about 5 months in the case of the Nyabarongo valley where reclaiming 15,000 hectares would enable to relocate say, 15,000 families, whereas there are at least 40,000 new families every year in Rwanda (assuming 5 persons per family). The process of agriculture colonization will therefore have to be supplemented by dramatic agricultural intensification.

It should be added that many other problems are not taken into account here, such as the amount of land needed for fuelwood (e.g. communal forests), the lack of manure related to the decrease in pasture land, the land needed for housing and infrastructures, etc. In the near future, Rwanda is poised to face severe competition for the use of available and/or remaining land.

Second, we turn to past population trends in an attempt to assess what would have happen had Rwanda embarked much sooner on a strong policy to reduce fertility. Table 7 presents the historical population in Rwanda from 1960 to 1990 as reconstructed by ONAPO, along with the corresponding numbers of persons per cultivable hectare, i.e. cultivated land plus pasture and fallow lands (see Table 3). Then, the simulated Rwandan population, with half the annual growth rate that was actually experienced (therefore assuming a very sharp fertility decline), is presented, also with the corresponding numbers of persons per cultivable hectare. If the decline in fertility had started in Rwanda in 1960 (it actually occurred around 1985), the ratio of persons per cultivable hectare would have been lower by 70 percent in 1990. In other words, it might be argued that the ratio of persons per cultivable hectare in 1990 would have been the same as the similar ratio in 1976 (corresponding to the historical population). Therefore, Rwanda would have "bought" about 15 years.

This simple simulation is just an indication of the importance of the demographic variable on land use and environment in Rwanda. Similar simulations could possibly be applied to other indicators, such as those pertaining to land holdings and their fragmentation. It would also be useful to take into account future population trends when projecting future agricultural yields.

Finally, an additional crucial question, which is beyond the scope of this paper, would need further investigation. This is to examine whether and how could Rwanda have benefitted from the time gained by implementing earlier a strong policy to reduce fertility. This question is closely related to the concept of "time penalty" which may be associated to delays in policy aimed at reducing fertility.

TABLE 7: HISTORICAL AND SIMULATED RWANDAN POPULATIONS, IN THOUSAND, WITH CORRESPONDING NUMBERS OF PERSONS PER CULTIVABLE HECTARE FOR THE PERIOD 1960 TO 1990

YEAR	HISTORICAL POPULATION	PERSONS PER CULTIVABLE HECTARE	POPULATION WITH HALF GROWTH RATE	PERSONS PER CULTIVABLE HECTARE
1960	2,695.0	2.3	2,695.0	2.3
1965	3,191.9	2.8	2,932.9	2.6
1970	3,756.6	3.3	3,181.8	2.8
1975	4,242.6	3.7	3,381.4	2.9
1980	5,257.0	4.6	3,764.0	3.3
1985	6,352.0	5.5	4,137.5	3.6
1990	7,590.2	6.6	4,522.8	3.9

Note: Populations are given on December, 31.
Sources: ONAPO, Le Problème Démographique au Rwanda et le Cadre de sa Solution, vol. I: Interrelations Population-Développement, Kigali: Office National de la Population, 1990: 15 and REPUBLIQUE RWANDAISE, Le Rwanda et le problème de ses réfugiés. Contexte historique, analyse et voies de solution, Kigali: Présidence de la République, Commission Spéciale sur les problèmes des émigrés rwandais, 1990: 117.

CONCLUSIONS

Rwanda is the most densely populated country of continental sub-Saharan Africa and is facing severe population and resources imbalances.

After unsuccessful and/or limited policy responses to tackle the population problem (e.g. emigration and population redistribution schemes), the Rwanda authorities have endorsed a policy of large-scale agricultural colonization and intensification. However, this policy has lead to a process of environmental degradation and possible agricultural involution. Key indicators such as the ratios of persons per cultivated and cultivable hectare, the size of farm holdings, and the numbers of plots per holding have all considerably worsened since 1970.

The third and fourth policy responses to high population growth, namely the launching of a national family planning program and the adoption of a national population policy, were adopted much later, after it appeared that the process of agricultural colonization and intensification would not be sufficient to cope with the high rate of population growth. However, these responses aimed at decreasing the population growth itself (as opposed to responses aimed at accommodating the effects of the population growth) could have been implemented sooner. Simple simulations indicate that their earlier implementation might have "bought" some time. Therefore, the lack of timely policy responses aimed specifically at the reduction of the population growth has inevitably affected for the worse the interactions between population, land use, and environment. This is illustrated by the evolution of the ratio of persons per cultivable hectare.

This proposed methodological approach is holistic and replaces the agricultural colonization and intensification processes in the larger context of the various policy responses to population growth. Accordingly, it is shown that the timing of policy interventions is very important. However, it should be pointed out that additional data will be needed to fully examine the relationships between population, land use, and environment in Rwanda.

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