The geographic dimension of the Doubly Green Revolution

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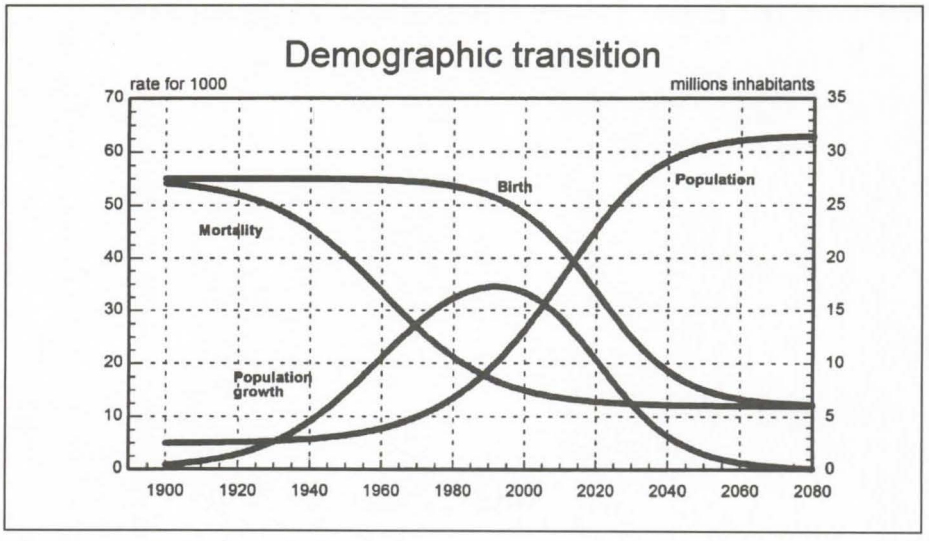
To be operational, reasoning on the prospects of the Doubly Green Revolution has to be done mainly at the country scale. It is at this level that, agricultural, economic and political decisions are made in order to impel sustainable intensification of agriculture. General demographic and economic equilibria, have to be identified and preserved at the national level but for historical, climatical, pedological and cultural reasons, the agricultural and rural reality is heterogeneous. This heterogeneity is written in space and can be geographically approached.

The demographic challenge

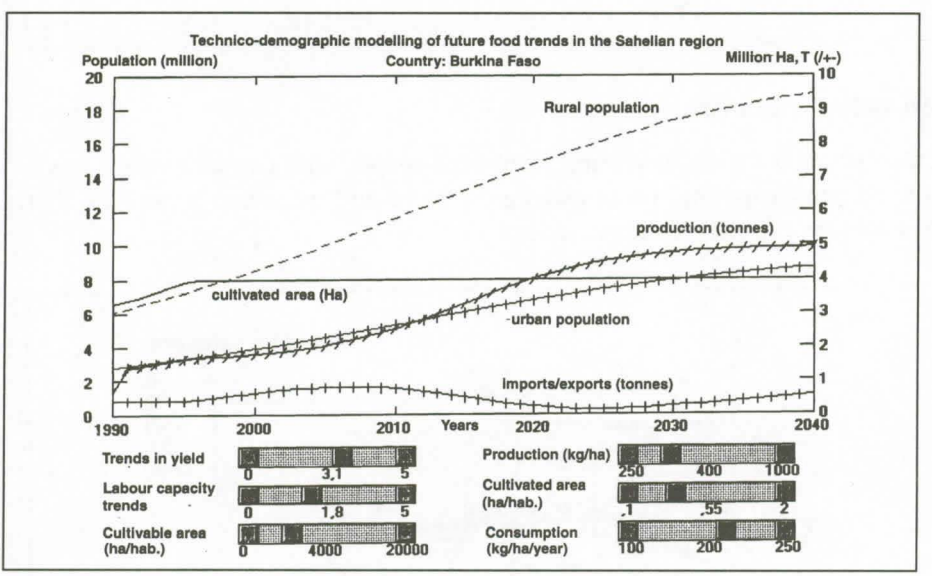
Population forecasts imply that agriculture has to be intensified. Demographers make their projections based on the theory of demographic transition. Since his



theory can be represented, it can be used to elaborate scenarios on the demographic futures of a country. What is known of death and birth rates in Burkina Faso, and the hypothesis of the beginning of the decline of the demographic growth rate since 1990 enable us to build this graph. On this graph, we see that between today and the year 2020 the population will be doubled with a trend towards 32 million (to be compared to the actual 10 million). Whatever the hypothesis, we have to remember that for the next 30 years, the population increase will be almost linear before starting to decline.

The agricultural challenge

Still reasoning at the level of one country, each additional inhabitant is an additional consumer but he can also be an additional agricultural worker if he can have access to arable land. To maintain the existing level of food per capita and the existing trade balance, as long as arable land is available, will require increasing the cultivated area at the same rate as the rural population working in agriculture. Labour productivity, like land productivity, has to grow at the same rate as the number of people to be fed by each agricultural worker. When all the arable land is under cultivation, the land productivity has to follow the demographic growth rate. These relations can be written like equations, and computers allow interactions. (Benoit–Cattin M., De Grandi, 1994).

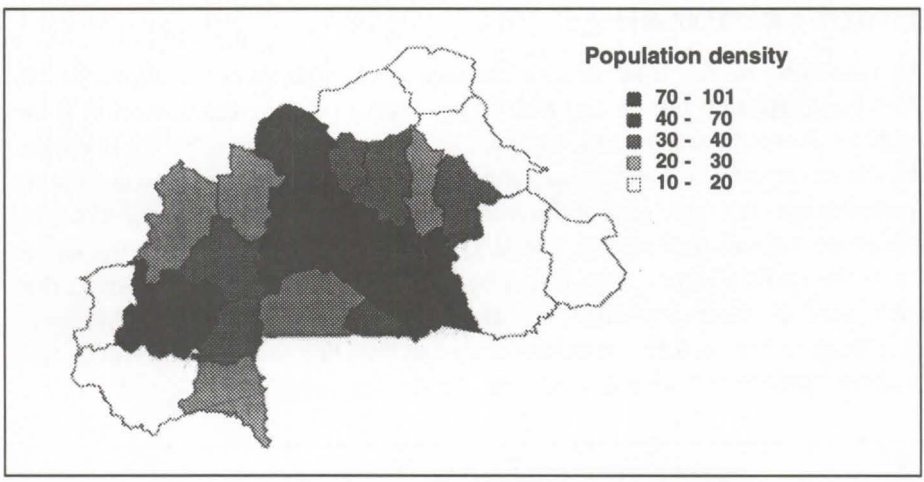


The evaluation of what is really arable is very important. If we accept the level of 8.9 million hectares of arable land (FAO and IBRD) for Burkina Faso and our demographical forecasts, the current system of extensive growth could continue as all the arable land will never be under cultivation. But if we accept our evalu-

ation of 4 million hectares, labour productivity will have to improve fivefold and yields threefold. Due to the heterogeneity of the actual world, these forecasts have to be linked with a more precise geographical approach to be operational.

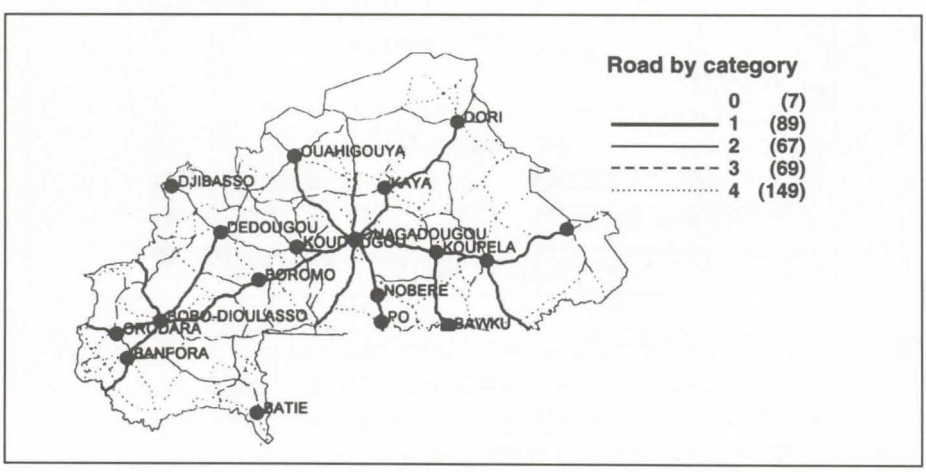
An unevenly scattered rural population

Even on the basis of rough administrative division (30 provinces), the heterogeneity of the rural population is evident and can be explained by the history of the population more than by the quality of natural resources.



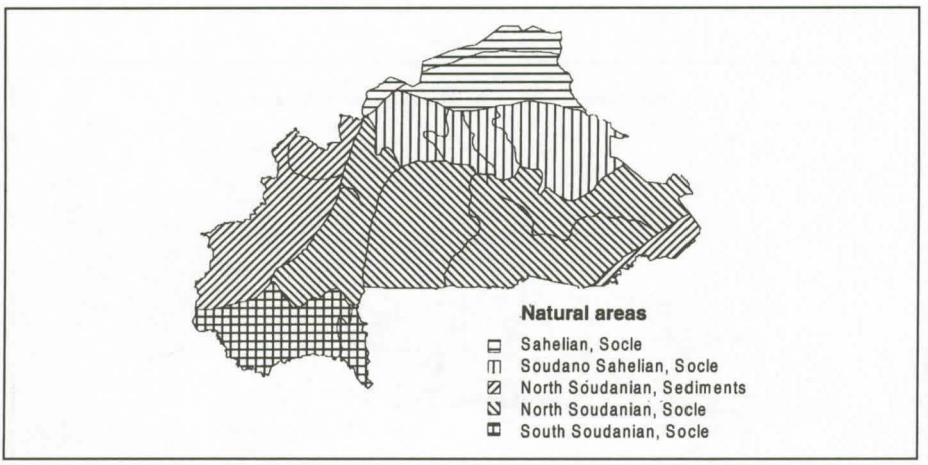
An urban network

Cities attract a rapidly increasing number of people, who consume staple foods without producing any. These cities grow more and more into a network that structurs the national economic space.



A heterogeneous natural environment

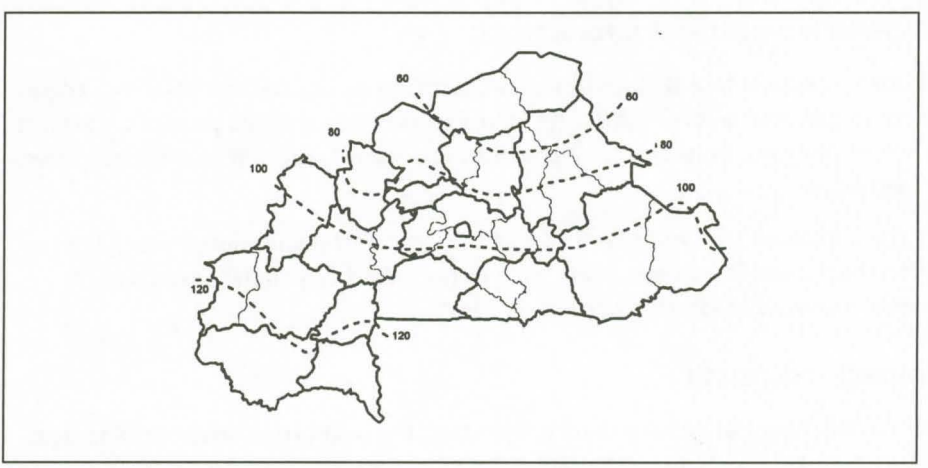
The natural environment is influenced by a rough north to south rainfall increase, like in all the countries of the sub-region. Interactions between climate and geology have produced different types of soils that support different types of vegetation. The resulting natural environments can be mapped. Zoning can be done by mixing administrative limits with maps of environments and populations.



Agronomic characterization of zones

Data from surveys, experimentation and remote sensing can be made coherent by using feeding them into bioclimatical, agronomical or zootechnical models.

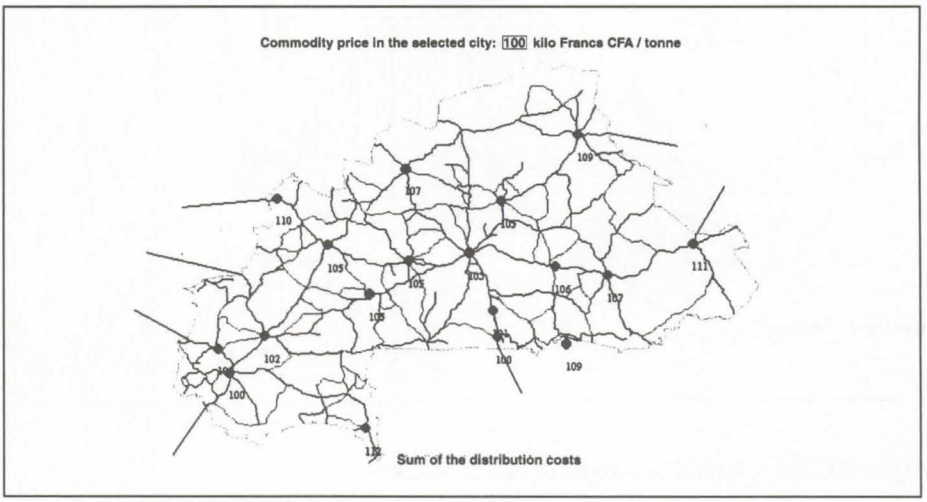
The results can be mapped individually or according to agricultural zones.



Above: growing cycle for sorghum, as proposed by agroclimatologists, and an example of zoning that aggregates the provinces in 17 zones.

Economic structuring of space

Relative prices change over space and time as affected by State intervention in price formation for agricultural products and inputs. Indeed, there are taxes and subsidies, for stabilisation (over time) and/or compensation (over space). Knowing the locations of the market places for the different zones makes it possible to calculate the market prices according to the hypotheses on policies, and to calculate the average for each zone.



Above: impact of the transportation cost for a product imported through Pô or Banfora at initial price of 100 CFA/kg.

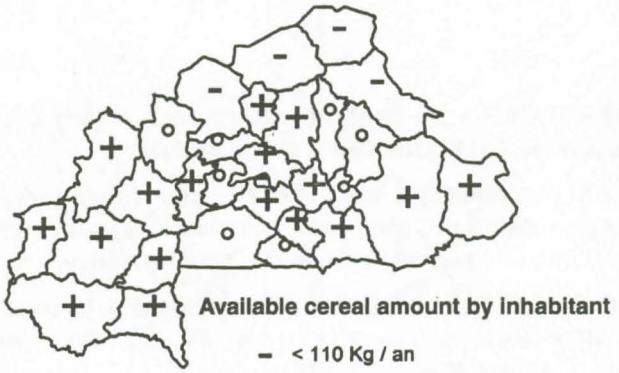
Agro-sylvo-pastoral interactions

A zone's pedoclimatical characteristics determine its agricultural potential, according to different levels of intensity linked to the demographic pressure. Farmers choices of crops, animals and techniques are market-dependent (relative prices, credit etc.).

These interactions can be handled with a technico-economic model, which is adapted to each zone to accommodate previously established parameters (soil types, potential productivity, labour availability, prices).

Impact indicators

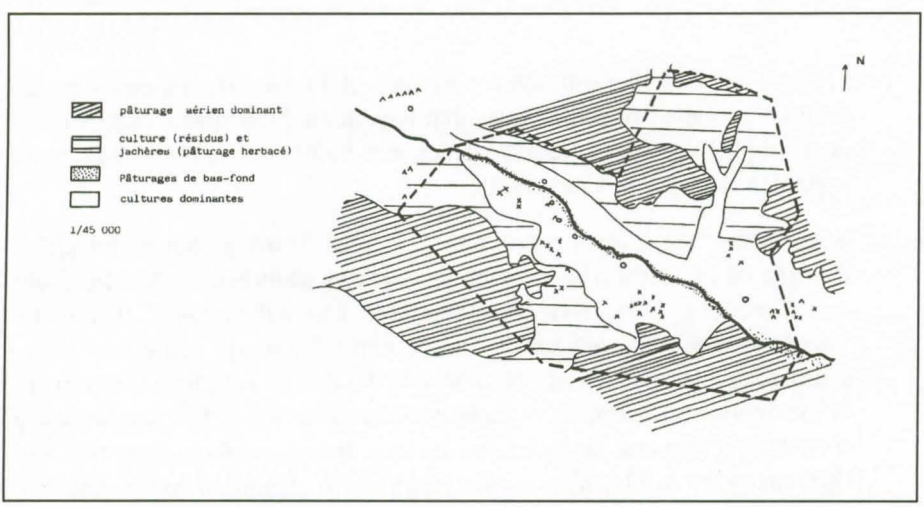
Within the range of validity of its parameters, the technico-economical and agro-sylvo-pastoral model can generate a lot of results that can be mapped for the impact evaluation of any policy. Policies are simulated according to different hypotheses on technologies and demography.



Above: level of satisfaction of cereal needs by zone.

Other geographical scales

The calibration of the technico-economic model is based on real, well documented situations, usually village monographs for which mapping land development can be very useful.



Above: different uses of Boukere villagelands in Burkina Faso.

Since on the other hand, boundaries are quite imprecise, it is important to think in terms of wider regional and subregional spaces.

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Comments and debates

Session chaired by Antoine Cornet, ORSTOM

F. HEIDHUES: I agree largely with the conclusions of the two papers, nevertheless I think that there are some issues that have to be highlighted. But before, I want to pick up one of Hubert Manichon's comments: is the eco-regional approach old wine in a new bottle?

When I first heard for the first time the term "eco-regional approach", I thought of my university courses in regional economics and, then, the "new" model of Thünen's "isolated state". One asks oneself: it is really Thünen's model that we are discussing here? There are some very interesting parallels to be drawn. Thünen was the first to introduce the concept of the economic factors in regional resource allocation. His revolutionary contribution was that he promoted the idea that regional development and regional resource allocation are not just a matter of natural factors like soil, climate or water and so on, but also of transport cost. But, in his model, he used very idealized regions eliminating the differences in natural resource endowment. His basic idea is that a region can be seen as a complex interaction between natural resources and economic factors, we might also add social and political factors.