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Living territories to transform the world

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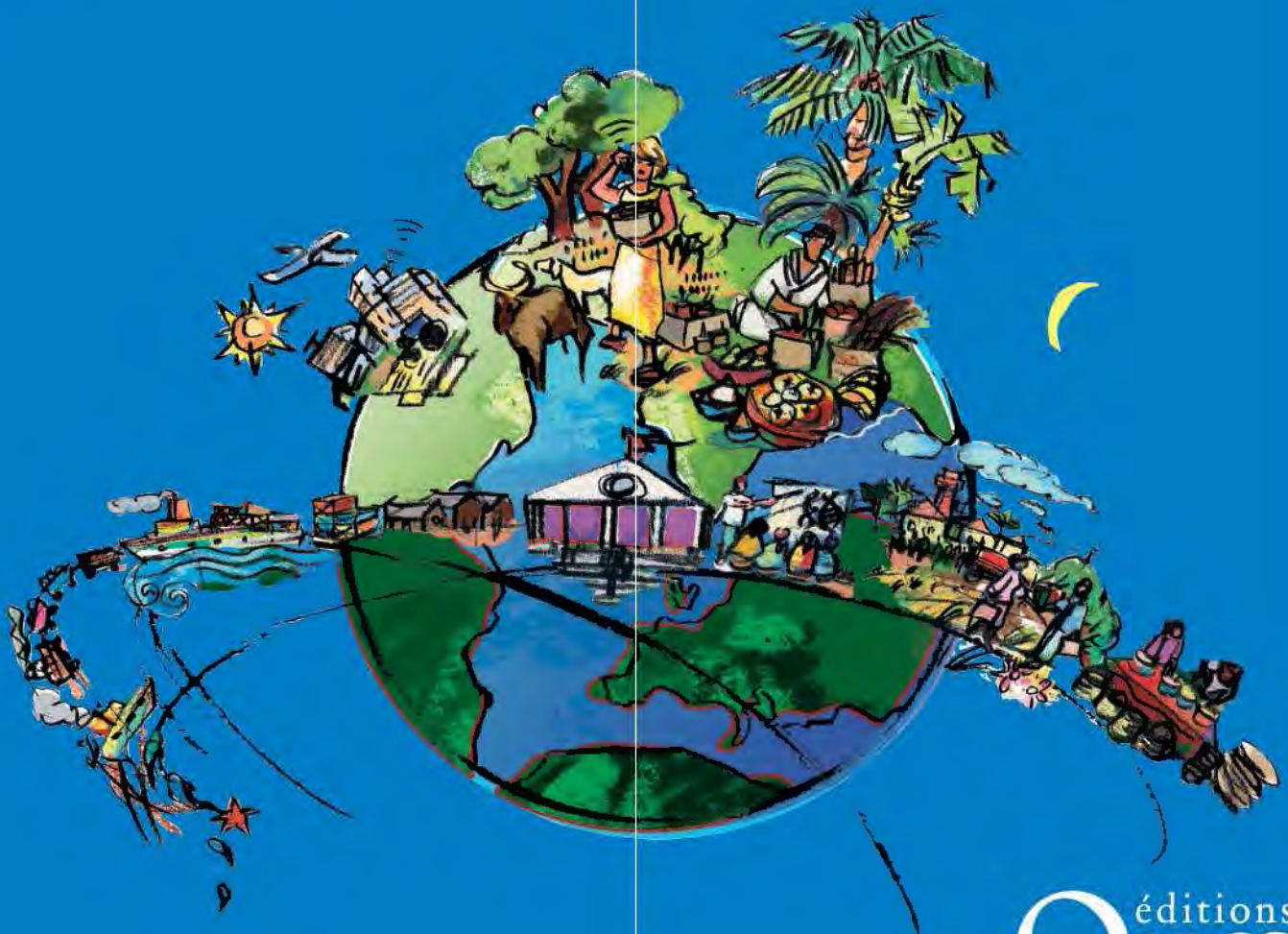
Coordinators



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Chapter 23

Diversity of crops, societies and territories

Christian Leclerc, Vanesse Labeyrie and Geo Coppens d'Eeckenbrugge

For studying the interactions between crops, societies and environments the territory can be viewed as an interface between social and biological sciences. Indeed, there is a correspondence between the diversity of crops and the linguistic, social and cultural diversity of farmers, since crops are both a product and an underlying support for the identity of human groups (Leclerc and Coppens d'Eeckenbrugge, 2012). At a continental scale, this correspondence has been confirmed for the main African cereal, as the spatial configuration of language families corresponds to that of sorghum races (Harlan and Stemler 1976; Westengen *et al.*, 2014). Similarly, at the village scale, dialectal groups are characterized by their varieties (Labeyrie *et al.*, 2014).

By considering crops as social markers of territories, researchers can identify new bridges between the social and biological sciences to design strategies for conserving the diversity of local genetic resources and promoting the sustainability and resilience of agrosystems (Altieri, 1999). Using examples from Kenyan family farming, this chapter describes the processes linking crop diversity, societies and territories, and their influence on the adaptive capacity of agricultural systems.

Territories and agrobiodiversity

Labeyrie *et al.* (2014) studied the interaction between territories and crops on the eastern slope of Mount Kenya, in an inter-ethnic contact zone (Chuka, Tharaka and Mbeere) where climatic and edaphic conditions are uniform. Even at this very small scale (15 km^2), the diversity of sorghum is linked to the respective territories of the Chuka, Tharaka and Mbeere. In particular, the double-season (ratoon) varieties, with specific genetic, morphological and agronomic characteristics, are present only in the Chuka territory. The distribution of varieties also reflects the social relationships between different groups. Thus, the *Mugeta* variety, which is only present in the Chuka and Tharaka territories, testifies to their alliance relationship (*gishiaro*). Even when a same morphological and genetic type is shared by all three groups, its denomination differs. For example, a well-defined sorghum variety with gray seeds is named

'Ngirigacha' by the Mbeere whereas the other two groups call it *'Murugue mbura imwe'* (Kamau *et al.*, 2016). Thus, a distinct nomenclature corresponds to distinct ethnic territories, with the territories including a cognitive component.

An analysis of seed sources and flows (Labeyrie *et al.*, 2016a) shows the existence of a structured network at both levels of the seed territories. Within *ntora* (residential units), 45% of the flows are observed between women and their in-laws. The centripetal orientation of the seed trade is even more pronounced outside *ntora*, with 72% of seed flows occurring amongst relatives, a proportion that must be seen in the context of the very high rate (86%) of intra-ethnic marriage.

Territories and plant adaptation

The interaction between the territory and crops has also been studied for its functional and adaptive value. Mwongera *et al.* (2014) highlighted social processes of adaptation to climate change by comparing seed losses for eight species cultivated by the Tharaka and Mwimbi. These two groups now occupy adjacent territories at altitudes of 950 m above MSL, on the eastern slope of Mount Kenya, but each has colonized this area following migrations in opposite directions. The Tharaka had to contend with an increase in rainfall and a decrease in temperature as they migrated up the slope. The Mwimbi, on the other hand, encountered new conditions that consisted of a warming of +0.8 °C to +1.09 °C and a decrease in annual rainfall of 26.7 to 32.9 mm per 100 m of descent (Camberlin *et al.*, 2014). This variation corresponds to that observed in general in Africa over the last 40 years (McCarty *et al.*, 2001). Climatic variations on this slope can thus be studied in the same way as climate variation over time (space-time substitution design).

Seed losses were analyzed as a function of the nnmber of days without rain during seedling emergence. According to the hypothesis of Leclerc and Coppens d'Eeckenbrugge (2012), if social barriers limit seed flows between commuuities, Tharaka seeds, which are already adapted to arid conditions, should be less susceptible to erratic rains than those of the Mwimbi. Indeed, by accounting for possible confounding factors (sowing practices, variety selection, number of species and varieties per farmer), the study showed that the risk of seedling loss increased by up to three times for the Mwimbi than for the Tharaka. This difference can be linked to the origins of their genetic resources, and to the fact that seed circulation is centripetal (oriented towards the centre of each ethnic group and its territory). Seeds from the Tharaka have benefited from their adaptation to droughts, which are more frequent at low altitudes. In contrast, Mwimbi seeds have traditionally been exposed to less stringent hydric conditions at high altitudes.

Thus, the history of the communities and their territory is reflected in their seeds. Since intermarriage between Tharaka and Mwimbi is rare, endogamous marriages determine the orientation of seed flows withiu their respective territories. The Tharaka constantly renew the adaptability of their seeds to drought in a medium-altitude territory by way of marriages with people living at lower altitudes. In contrast, the Mwimbi do not improve the adaptability of their genetic resources to drier conditions, since they obtain seeds from their in-laws living at higher altitudes.

Interconnections of territories

The examples above show how patterns of diversity, determined by marriages and the centripetal orientation of exchanges, help delimit territories. However, 'the paradox of the territory is that it includes components that are not all found within the boundaries of the space attributed to it [...] and that it is driven by a dynamic whose motive force is precisely in the tension between the boundaries and the necessity to surpass them' (Fontanille, 2014).

Thus, territories on the eastern slope of Mount Kenya do not correspond to the spatial configuration of the linguistic groups alone. Interactions with economic and ecological factors also play a role. In fact, one third of the seed lots originate from markets that draw seeds from production basins in a radius of about 10 km (Labeyrie *et al.*, 2016b). The uses specific to each ethnic group and the adaptation to different agroecological zones determine which varieties farmers buy or exchange, as a function of their cultural preferences and their farming systems. The local ratoon varieties are clearly dominant in highland areas with a semi-humid climate (950 m to 1500 m) where the Meru ethnic groups (Igembe, Tigania, Mwimbi) live, whereas the single-season varieties are distributed over the rest of the area, in the plains inhabited by the Tharaka (750 m), as well as in the more arid mountainous areas inhabited by the Chuka and Mbeere. Instead of territories with defined borders, cropping patterns suggest that the boundaries of territories can be modified from one year to the next based on climatic variations, as was demonstrated in northern Cameroon through analyses of seed networks (Violon *et al.*, 2016). In the longer term, migration processes establish and change these territories, as in the case of Mount Kenya where ratoon varieties were probably introduced from a distant area by the Meru, the first agricultural populations in the area (Labeyrie *et al.*, 2016b).

The interaction between territories and crops is thus observed at several space and time scales, and it is this characteristic that gives it its practical significance. If the diversity of crops reflects the identity of human groups linked to a territory, strategies to preserve and enhance local genetic resources must be considered at different spatial levels in relation to social, economic and ecological processes. Since the configuration of territories is in a flux, special attention must be accorded to the maintenance of seeds within residential and sociological units, as such conservation determines the adaptation of plants to local environmental and utilization conditions.

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