from frustration to information

Diversity in agroecosystems

Since experimental research on agricultural stations began, over 150 years ago, variations in yield have been observed and, although undesired, they were not viewed with concern. It was not until the beginning of this century that researchers began to bother. The solution to handle this "undesired variation" came from statisticians, who elaborated on the problem of "the error of a mean" and the analysis of variance. This analysis eliminated variation and corresponded well with the desire to control and standardise the environment of agricultural production and to homogenise farm management as much as possible. Also new approaches such as Farming Systems Research and new analytical concepts in conventional agronomy followed this standardisation. Now the debate on the treatment of variation is reopened.

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Evidence exists that within agroecosystems heterogeneity is more likely than homogeneity (de Steenhuijsen Piters & Fresco, 1994). Variation in soil properties and in crop growth may be an asset for farmers (Huxley, 1986). Yield variations therefore have to be considered largely as the result of deliberate and structural human action when confronted with a heterogeneous environment and within a specific cultural and socio-economic context.

This article presents the results of an interdisciplinary study of the Gaban village in northern Cameroon. The sources of yield variations at field and farm household level within one agroecosystem were investigated, combining biophysical, crop genotype and management characteristics of the fields with ethnic and socio-economic characteristics of the households and the farmers. The research team resided for three years in the village and collected data integrating both conventional quantitative and qualitative participatory methods.

The village of Gaban is located in the Far North Province of Cameroon, near Kaélé. The climate is semi-arid (700-800 mm/year) with one rainy season (four to five months). The various processes of soil formation have led to important pedological heterogeneity. Heavy, fertile vertisols are alternated with lighter cambisols and shallow planosols. The vertisols, being concentrated in the lower parts of the watershed, are submerged during most of the rainy season. The natural vegetation is a savanna of shrubs and trees.

The population of Gaban is composed of two ethnic groups: the autochthonous Moundang who settled 200 years ago, and the Toupouri who have arrived recently (since 1970). The village has approximately 3000 inhabitants, distributed over 350 households (an average of ten members, 5 of which are potential workers). The principal economic activities are crop production, but livestock and off-farm activities (beer brewing and trade) are also important. On the lighter cambisols and planisols, rainfed sorghum, cotton, cowpea, groundnut and Bambara groundnuts are grown, often in association. On the heavy vertisols, a transplanted dry season sorghum crop, *mouskouari*, is grown. Flanking the ephemeral streams, fruit trees and cassava plantations are found and irrigated vegetable cultivation is practised. The fallow land and the secondary savanna forest serve as pastures for livestock of local farmers (Moundang and Toupouri) and nomadic pastoralists (Fulbé and Arab nomads).

Diversity and yield variations

Within the village striking variations in yields were observed, not only in yields realised by Toupouri and Moundang farmers, but also between individual Moundang farmers. These variations could not be explained by a conventional analysis of variance. Further interpretation of results learned that yield variation had different explanations, including diverse strategies for optimising agricultural production.

The first difference observed was that Toupouri farmers obtained higher sorghum yields thanMoundang farmers (in 1992 at average 3100 kg/ha versus 2100 kg/ha). This difference in yields could finally be explained by social-cultural practices of the Toupouri farmers. High yields are realised by land and labour intensive cultivation practices (i.e. good timing of practices and intensive crop husbandry). Toupouri farmers have occasionally access to extremely large amounts of labour, due to "working parties" with other Toupouri farmers. In return to this "neighbour help", large sorghum beer parties are organised. The beer parties preserve the semi-collective and highly productive system of sorghum cropping and guarantee a high labour availability. These labour requirements cannot be met by the individual Moundang production system. Besides, it also explains why the dominant sorghum cultivar on Toupouri fields is *gling*, a cultivar which is hardly edible but highly appreciated for beer brewing!

Secondly, it was observed that the rainfed sorghum and cotton yields of individual Moundang farmers showed high variation. This could be explained by defining specific field types, which are distributed in space (see figure 1). However, more important is that field types are not equally distributed between the Moundang households. Resource-rich households, who also own cattle, dominate the nearby fields, situated up to 600 m from the homestead. These nearby fields allow for (semi) intensive, (semi) continuous cultivation of sorghum, which is possible due to large amounts of organic manure, good timing of practices and high labour inputs. However, most land of the resource-poor households is located more than 1 kilometre from the homestead and these soils are more subject to soil fer-

Photo: Bart de Steenhuisen Piters

Yield samples of mouskouari sorghum fields.

tility decline, further enforced by the fact that resource poor households hardly own cattle and thus lack manure. Only extensive sorghum and cotton cultivation in a 1:1 rotation is possible and fallow is needed after four to five years of cultivation.

Also the female farmers of the village turned out not to be a homogeneous group, showing striking variations in yields. The Toupouri female farmers obtained highest sorghum yields of all farmers in the village (at average 3700 kg/ha). This could technically be explained by their extremely high labour input in weeding, but behind this is a cultural reason. Toupouri female farmers have the obligation to feed the family for six months. To facilitate this, a husband gives one field to his wife and helps her with ploughing and sowing. Because the remaining sorghum after six months of family consumption is the only source of income to the female farmer, she will invest all available labour in producing a sorghum surplus. This seems to be economically and agronomically irrational, but makes good sense from the women's point of view.

Understanding diversity

It is clear that intensification of sorghum production in the Gaban village cannot be realised by developing one general strategy, but needs different strategies for each group of farmers, coping with different potentials and bottlenecks. This study shows that diversity and variation should be regarded as important sources of information instead of eliminating them from the research. Moreover, within the context of our quest for sustainable agriculture, they might prove to be a good basis for discussion and innovation. Understanding diversity may be the greatest challenge facing agricultural research and extension since the identification of variation at the beginning of this century.

One of the main questions is how to define the "meaningful diversity" of an agroecosystem as an input for research. Not all diversity is functional or desirable, like, for instance, the diversity caused by socio-economic inequality between Moundang farmers. Defining target groups with "fashionable" criteria may be as harmful as any generalist approach. Moreover, who is to define "meaningful diversity"? Participatory methods in which farmers have a voice in their classification are important, but the analytical criteria of the researcher and personal criteria of solidarity and affection of the farmer may result in contrasting classifications. In this discussion also higher level authorities and experts must participate, although a dialogue between these different parties will not always be an easy one.

Ethnicity, socio-economic characteristics and gender are not independent causes of diversity, but are strongly interrelated and sometimes difficult to disentangle. Moreover, farmer diversity may cause diversity of fields and variations in yields, but vice versa the latter may reinforce farmer diversity too. Therefore, diversity in agroecosystems is a complex of interrelated factors covering several scales of aggregation. Further elaboration of this "cross-scale analysis" of agroecosystems is needed.

Research on variation and diversity in agroecosystems differs from conventional agricultural research in the way data are interpreted and to a lesser extent in the use of new methods and techniques. Therefore, major flexibility is demanded of the researcher who must be able to analyse and combine both quantitative and qualitative data and information. Accordingly, it is a question of being conscious of diversity, accepting it as a relevant, realistic phenomenon, rather than a "new approach". ■

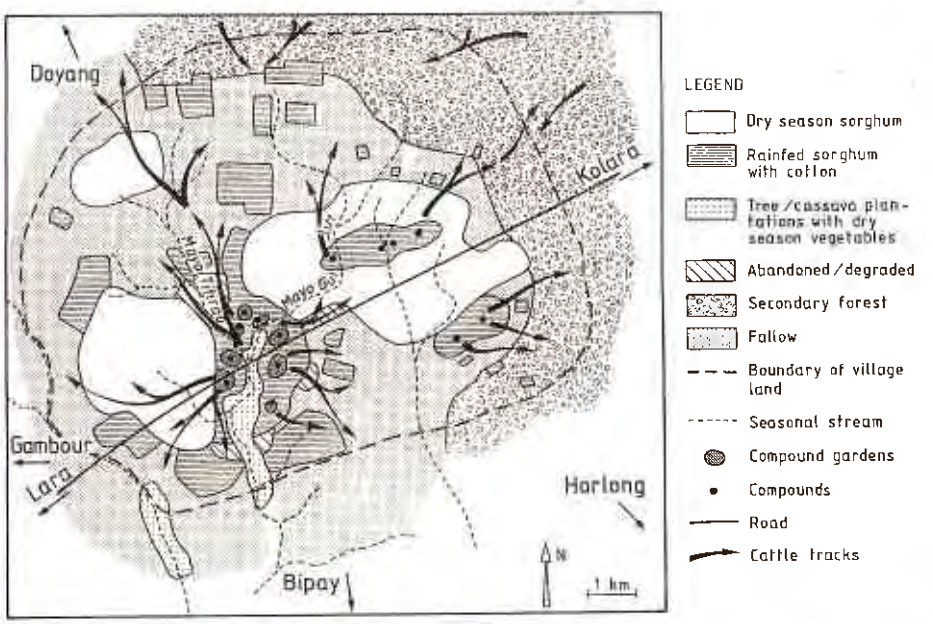

Photo: Bart de Steenhuisen Piters

Moundang female farmers ploughing a field with animal traction.

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