Diversity as a key concept for organic agriculture

Langer, V.[1] & Frederiksen, P.[2]

Key words: crop diversity, farm diversity, indicator, biodiversity, mixed farming

Abstract

Diversity is a key concept of organic agriculture and is intuitively perceived as having positive, but not always explicit, consequences for the internal functioning of the farm as well as for the impact on environment and farmland nature. In two groups of specialised organic farms (arable and dairy) and a group of mixed farms, links between production diversity and diversity at the scales above and below, as well as relations to potential farmland biodiversity, are examined. Results show that diversity in different scales are not consistently correlated, i.e. neither high diversity in farm household on-farm activities, nor diversity in agricultural production are linked to high crop and land use diversity. Furthermore, there are no simple relations between diversity measures and potential benefits for farmland biodiversity

Introduction

Diversity is a key concept of organic agriculture in a range of scales: within-field diversity (intercropping or mixed cropping is perceived as better than monoculture), diversity in crops and livestock (many crop and livestock types are perceived as better than few), production diversity (mixed farming is perceived as more harmonious than specialized farming) (Köbke, 2000) and organic farms with a diversity of activities (both agricultural and non-agricultural) are seen as desirable in connection with short market chains and rural development (Ploeg et al, 2002b). Diversity per se is in this way intuitively perceived as having positive, however not always explicit, consequences, not only for the internal functioning of the farm, but also for the impact on environment and farmland nature. The notion of improved internal function of the farm with higher diversity has been documented by e.g. more efficient nutrient cycling on farms with both crop and livestock production, improved resource efficiency by grazing with more types of animals (Sehested et al., 2004) and in the well known fact that rotations with many crop types decrease the risk of pests and diseases. The notion that a diversity of income generating activities beyond the agricultural production increases the stability of the farm by risk dispersion and contributes to rural development, is also well documented (Ploeg et al., 2002a). These activities include processing and marketing agricultural products (e.g. farm shops, box schemes), farm tourism, alternative energy production, hunting and fishing activities, and there are indications that organic farms more frequently than conventional engage in these activities. As the ongoing structural development within the organic farming sector in many regions takes the route of farm specialization and enlargement similar to the conventional sector (Langer et al., 2005; Levin, 2007), developing the concept of diversity and possibly adding facets to the picture of specialized organic farms and

[1] Dept. of Agricultural Science, University of Copenhagen, Hojbakkegaards Alle 9, DK-2630 Taastrup, Denmark, E-Mail vl[a]life.ku.dk, Internet www.life.ku.dk

[2] Dept. of Policy Analysis, National Environmental Research Institute, University of Aarhus, P.O. Box 358, DK-4000 Roskilde, Denmark, E-mail pfr[a]dmu.dk, Internet www.dmu.dk

their counterparts, mixed farms, seems appropriate. Therefore, we ask the two questions illustrated in figure 1:

How is diversity in production linked to diversity at the scales above and below? In other words, do farms with specialized agricultural production exhibit less diversity on the scale above – the farm household – and below: crop and livestock diversity?

How is diversity on these different scales linked to potential farmland biodiversity, measured by land use and structure?

Tab. 1: Diversity measures on different scales relevant for organic farming

Scale	Diversity measure	Measures for potential biodiversity
Landscape	Crop diversity (number of crop types)	Degree of disturbance: • %permanent grassland • % annual crops • % of annual crops mechanically weeded
Agricultural production	Specialized versus mixed farms Diversity of production sectors Diversity in livestock types	→ Field size
Farm household	Diversity of economic activities on the farm in addition to agricultural production	Area of unfarmed habitats/ha Diversity of unfarmed habitats

Materials and methods

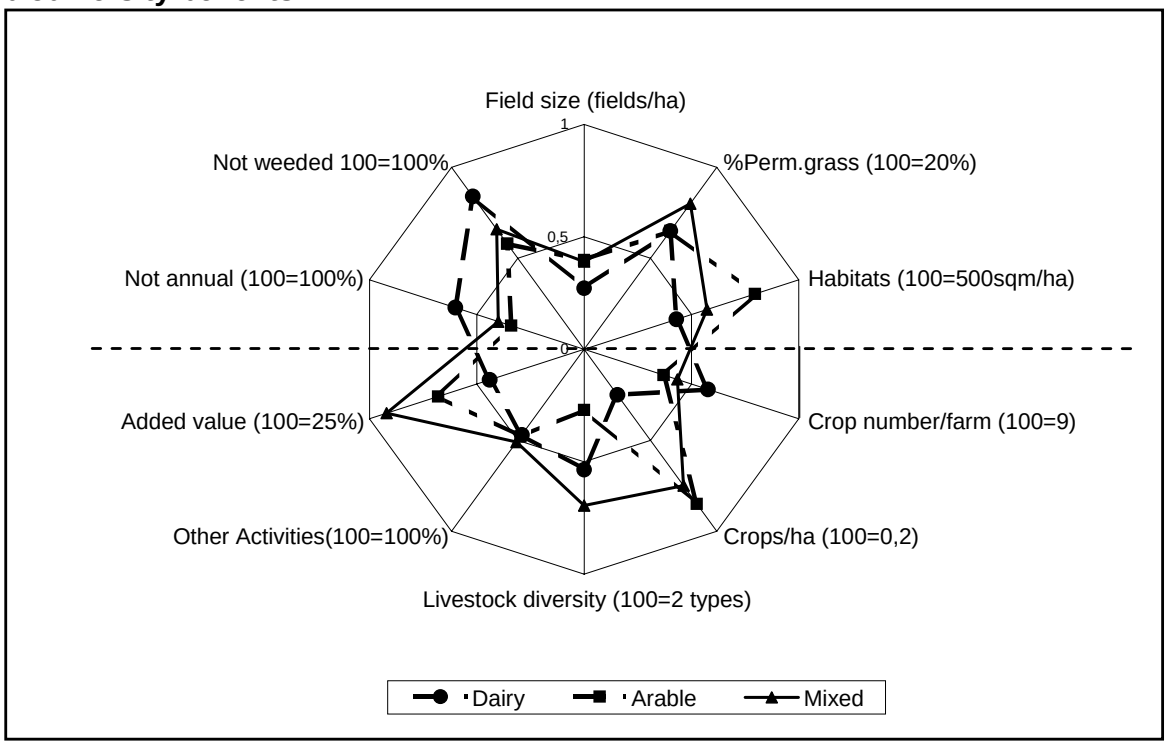
The links between diversity in three different scales as well as links between production diversity and characteristics relevant for farmland biodiversity were examined on three groups of organic farms, distinguished by being either specialized or mixed: Specialized dairy farms (N=80, mean 1,28 LU/ha, 109 ha), specialized arable farms (N=137, mean 0,14 LU/ha, 31 ha) and mixed farms (N=75, 1,03 LU/ha, 41 ha) were surveyed for land use and management, livestock production and household activities in 2001 (Frederiksen and Langer 2004) and classified into farm types based on their production structure. For crop diversity, the number of crop types out of nine possible (cereals, oilseed, legumes, crop for silage, row crops, seed crops, clover-grass ley, fallow, and permanent grassland) were calculated per farm and per ha farmed area. As a measure of on-farm economic activities beyond production two measures were used: whether the farm household was engaged in any other activities, and whether these included activities with the aim of adding value to agricultural products through processing or direct marketing. Measures of potential biodiversity were degree of disturbance (distribution on permanent, annual, weeded annual), which is known to affect weeds and below/above ground fauna in fields, and quantity/quality of unfarmed habitats, known to affect biodiversity on landscape level.

Results

Diversity on different scales (lower half of diagram) and characteristics potentially favourable for farmland biodiversity (upper half of diagram) are shown for the three farm types in figure 1. Mixed farms are seen to have a larger number of commercially

produced livestock (Livestock diversity) as well as a higher frequency of engagement in activities with the aim of adding value to agricultural products (Added value) than the two specialized farm types. Crop diversity measured by number of crops per ha is similar on mixed farms and specialized arable farms, whereas it is considerable lower on specialized dairy farms (Crops/ha). Mixed farms have a larger proportion of permanent grassland than the two specialized farm types, whereas mean field size is similar to specialized arable farms but smaller than specialized dairy farms and a density of unfarmed habitats intermediate between the two specialized farm types. Specialized dairy farms exhibit considerably more undisturbed land area, measured by less annual crops and a smaller proportion of this under mechanical weeding.

Figure 1: Measures of diversity in different scales in relation to potential biodiversity benefits



Discussion

The concept of mixed farming is often used when discussing diversity in production, but is an ill defined concept, often merely defined by its contrast, specialized farming. Quantitative definitions in the literature are few and not necessarily suited for organic farms. In EU statistics mixed farms are simply farms where no single production sector, e.g. dairy cows, contributes with more than 2/3 of the economic size. Crop diversity has been used as indicator of both management intensity (Herzog et al., 2006) and as a landscape heterogeneity measure (Benton et al., 2003). The results here show, that due to the correlations between farm size, field size and crop number, which are highly contextual, using number of crops per ha supplements the measure of crops per farm unit. The results confirm that mixed farms contribute to potential farmland biodiversity benefits by providing not only larger areas with permanent grassland than both arable and dairy farms, but also a high number of crops per ha, altogether securing a high heterogeneity for the benefit of biodiversity (Benton et al., 2003). On the other hand the large specialized dairy farms, in spite of having larger fields and less crops per ha, contribute positively to biodiversity benefits by providing a

higher proportion of perennial grassland as well as more annual crops, not mechanically weeded, and thus altogether a less disturbed environment than on the two other farm types.

Conclusions

Diversity in different scales are not consistently correlated, i.e. neither high diversity in farm household on-farm activities, nor diversity in agricultural production are linked to high crop and land use diversity. Furthermore, there are no simple relations between diversity measures and potential benefits for farmland biodiversity. Crop diversity may be assessed on farm scale when discussing it as a measure of improving internal functions on the farm and spreading risk. However when used as a measure of potential benefit for farmland the close links between farm size and number of crops means that crop diversity should be discussed on an area scale. Whether crop diversity is beneficial for biodiversity, depends on the specific crop types. In the discussion of structural development within organic farming, concepts of specialisation and mixed farming should be expanded, and the links with other farm characteristics considered crucial for satisfying the organic principles should be explored.

Acknowledgments

Funding for this project “Nature Quality in Organic farming” was provided by DARCOF, the Danish Research Centre for Organic Food and Farming.

References

Benton T., Vickery J. & Wilson J.D. (2003): Farmland biodiversity: is habitat heterogeneity the key? Trends in Ecology and Evolution 18: 182-188.

Frederiksen P. & Langer V. (2004): Nature management and livelihood strategies on Danish organic farms. In: Cristovão, A. (ed.): 6th European IFSA Symposium on Farming and Rural Systems Research and Extension, Vol 1: 361-374

Herzog F., Steiner B., Bailey D., Baudry J., Billeter R., Bukacek R., De Blust G., De Cock R., Dirksen J., Dormann C.F., De Filiipi R., Frossard E., Liira J., Schmidt T., Stöckli R., Thenail C., Wingerden W. van, Bugter R. (2006): Assessing the intensity of temperate European agriculture at the landscape scale. European Journal of Agronomy 24: 165-181

Köpke U. (2000): The evolution of environmentally sound sustainable farming systems. In Alföldi T., Lockeretz W. & Niggli U. (eds.): Proceedings of the 13th International IFOAM Scientific Conference, Basel, p. 714-717

Langer V., Frederiksen P. & Dejgaard Jensen J. (2005): The Development of Farm Size on Danish Organic Farms - A Comment on the Conventionalisation Debate. In Köpke, U., Niggli, U., Neuhoff, D., Cornish, P., Lockeretz, W. & Willer, H. (eds.): Researching Sustainable Systems. Proceedings of the First Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR), pp. 321-324.

Levin G. (2007): Relationships between Danish organic farming and landscape composition. Agriculture, Ecosystems and Environment 120: 330-344

Ploeg J.D. van der, Roep D., Renting H., Banks J., Mielgo A.A., Gorman M., Knickel K., Schaer B., Ventura F. (2002a): The socio-economic impact of rural development processes in Europe. In Ploeg J.D. van der, Banks J. & Long A. (eds): Living countrysides. Elsevier, p. 180-191

Ploeg J.D. van der, Long A. & Banks J. (2002b) Rural development: The State of the art. In Ploeg J.D. van der, Banks J. & Long A. (eds): Living countrysides. Elsevier, p. 8-17

Sehested J., Søegaard K., Danielsen V., Roepstorff A. & Monrad J. (2004): Grazing with heifers and sows alone or mixed: herbage quality, sward structure and animal weight gain. Livestock Production Science 88: 223–238