

The well-proportioned farm organism. Just a pleasing image of a mixed farming system or rather a basic requirement for functioning organic husbandry?

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Introduction

The basic references and textbooks on organic farming describe the method as aiming at and using the benefits of a certain, diversified farm structure. As outlined below, similar concepts and notions of “the farm” have been described both by the pioneers of organic farming and the pioneers of agricultural sciences, albeit using various terms. Driven mainly by economic rationalization and market forces, an increasing number of organic farming and gardening enterprises have moved more and more away from diversified towards rather simple farm structures. This is exemplified by farms specialized on fruit and vegetable growing or stockless arable farms.

The question arises whether this development is neutral or perhaps even beneficial for the long-term productivity and stability of organic farms, or whether organic farming only works successfully in the long run in a diversified system with balanced, well-proportioned, interdependent components. Without attempting to give a final answer to this question, this paper aims to describe some basic elements of organic farming, some inevitable consequences of simplification vs. diversification and, generally, to attract more attention to this matter. More discussion and more research on this subject seems to be necessary, as long-term experiments or case studies of organic production systems are not available.

The basic ideas of organic farming as regards farm structure (literature review)

In a number of publications written by pioneers of organic farming and other persons between the 1920s and today, the ideal farm has been described, using various terms, as a diversified, balanced system. The organizational principle of a farm and of farm management is described by these authors as *organic*. Quite clear statements on this issue are presented by Scofield (1986) referring to, among others, Lord Northbourne, who is taken to be the first who used the term *organic* with this meaning in his book “Look to the Land”, published in 1940. Scofield quotes Lord Northbourne:

“The best can only spring from that kind of biological completeness which has been called wholeness. If it is to be attained, the farm itself must have a biological completeness; it must be a living entity, it must be a unit which has within itself a balanced organic life. Every branch of the work is interlocked with all the others. The cycle of conversion of vegetable products through the animal into manure and back to vegetable is of great complexity, and highly sensitive, especially over long periods, to any disturbance of its proper balance. The penalty for failure to maintain this balance is, in the long run, a progressive impoverishment of the soil. Real fertility can only be built up gradually under a system appropriate to the conditions of each particular farm, and by adherence to the essentials of that system, whatever they may be in each case, over long periods. Such building up of a coherent living unity is utterly incompatible with frequent changes of system and with specialization. ... Mixed farming is real farming. Unduly specialized ‘farming’ is something else; it must depend on imported fertility, it cannot be self-sufficient nor an organic whole.” ...

Using terms of today Lord Northbourne’s description can be summarized by the keywords farm organism, ecological stability, sustainability, long-term viability of a farm. In a similar way, and sometimes with the same words as Lord Northbourne, other practitioners and scientists have described a farm as an interdependent system and the fertility and long-term productivity of the system as being based on its diversity and on interdependent cooperation among its components. “The branches of a farm are in reality branches of the same tree-trunk. Heart, lung, liver and other organs in the body of an animal, each organ, considered separately, has its specific tasks, although a common bloodstream flows towards all, and each organ is dependent if considered separately; the same is true for the several branches of a farm” (Aereboe, 1920). - “A triple band encloses the land use branches in a farm, deprives them of independence and turns them into parts of an organic whole... The consideration of this triple band allots a certain size to each single branch, and the size must not be exceeded, otherwise the whole will be damaged” (Brinkmann, 1922; p. 73). A similar view is described by the terms *farm organism* or *agricultural individuality* (Koepf et al., 1976; Sattler & Wistinghausen, 1992; Steiner, 1924), although the latter term includes

additional aspects and elements based on anthroposophy, e.g. the “cosmic life” (Steiner). He described his specific view of agriculture several times in his agricultural lectures, stating for instance that “agriculture can be regarded as a really well-rounded individuality”; “this cannot be achieved completely, but each agriculture should approximate to this ideal” (beginning of the second lecture).

In the sense of these references the term *well-proportioned farm organism* can be used for a balanced farm. Although having different, personal backgrounds the common message of the quoted authors is to make a connection between how a farm is constructed and how well it works. In other words, according to these authors the well-proportioned farm organism is not merely an allegory, a pleasing image, but a basic requirement for establishing an agroecosystem that can develop long-term productivity and stability and can, therefore, be independent from ‘imported fertility’ (Lord Northbourne) or ‘external remedies’ (Steiner, 1924; p. 42).

These references already give an answer to the initial question of how important a balanced, diversified farm is. But additional and more detailed information on that subject has been provided by research on natural and agricultural ecosystems carried out some decades after the principles of organic farming were set out. It is interesting to note that in general biology and ecology even the term *ecosystem* did not yet exist when organic farming started (this term is taken to have been introduced to the scientific community by Tansley, 1935).

The basic characteristics and capabilities of natural ecosystems and agroecosystems (literature review)

A natural ecosystem is characterized by four basic parameters (Haber, 1979):

- productivity (production of biomass),
- functional stability (operatively sound function),
- diversity (of plant and animal species) and
- self-regulative capability.

The same parameters basically also characterize an agroecosystem, i.e. an ecosystem which is influenced or dominated by anthropogenic impacts. The differences between a natural ecosystem and an agroecosystem have been described in detail by Haber (1980). He also explained the consequences for the regulation dynamics in both types of systems, pointing out that mainly two objectives are pursued with cultivation techniques: the natural diversity of a biocoenosis will be limited to one or only a few species of plants on a field, and harvested biomass will be taken out regularly as yield. Anthropogenic impacts interfere with the natural (endogenous) regulation processes in the system that remain latently active. Thus, responses of the system will occur as outcomes of anthropogenic impacts, e.g. weed growth compensates for restricted species diversity, pests and diseases can appear in huge numbers because the crop is a wide-spread host plant. These side-effects make it necessary to introduce further interventions and anthropogenic impacts, e.g. by weed and pest control, soil tillage etc. This connection represents *positive* feedback, as one side causes and intensifies the other. In contrast to this, natural ecosystems (without restricted biocoenosis and harvested biomass) show regulation dynamics representing *negative* feedback, as clearly demonstrated by a predator-prey relationship, i.e. one side limits the development of the other.

The terms *positive* and *negative* feedback may be slightly confusing in this context, as from the agricultural point of view, at least from aspects of high sustainability and low environmental impact, positive feedback is a negative reaction (as it forces the farmer to repeatedly apply new and potentially harmful techniques), whereas negative feedback is mostly positive and welcome, as it enables the farmer to utilize natural processes for yield production and to avoid or lessen some undesirable side-effects. Put very simply, knowing and using the negative feedback of agroecosystems enables the farmer to work together with nature instead of against it.

The description of regulation dynamics given so far is in principle applicable to both organically and conventionally managed agroecosystems. However, it is highly interesting to compare basic elements of organic and conventional farming from this aspect, e.g. the different strategies of and approaches to fertilization and plant protection. Schaumann et al. (1975) gave some examples to explain that organic and biodynamic management aims at intensifying natural processes, whereas conventional management intends to replace them. The two approaches may be responsible for the different types of feedback stimulated in an agroecosystem.

Structure, diversity and functional stability of a farm organism (discussion)

Considering the various quoted sources, there is no doubt that the well-proportioned farm organism represents a basic concept of both the structure and functioning of an organically managed farm. The term has sometimes been misunderstood to mean an enclosed, self-contained system. However, this view is certainly wrong, as each organism and each living system of organisms has to be open to its environment, although the nutrient cycles of an organic farm should indeed be as closed as possible, i.e. unavoidable nutrient losses as low as possible. As regards fertiliz-

ers and feedstuffs, the more crucial point is that “the kinds of substances and the intensity of their circulation is controlled by the activity of the organisms” belonging to a farm (Schaumann et al., 1975).

The well-proportioned farm organism is not a stereotype, fixed for all conditions and constant for all times; site conditions will always influence it strongly. This is also true for the economic site conditions and market forces that may modify the farm structure as much as the natural site conditions do. But no set of conditions should do so predominantly or even exclusively. To come back to Lord Northbourne (as quoted by Scofield, 1986): “The variety of systems of farming which are in the full sense mixed farming are infinite. There is ample room for adaption to local conditions without abandoning the principle, which is that of working towards the greatest possible diversification so as to produce as complete an organic whole as possible”. Today, as organic farming has spread worldwide, the problems and unsolved questions concerning adaption to local conditions may be larger or more numerous than in Lord Northbourne’s days, but his statement is still valid. We should address more effort to identifying, discussing and solving such problems.

From the organism perspective, specialization of a farm means to take an organ or a group of organs out of the system. If the system is to continue working in the same way, the functions of the missing organs have to be substituted. For example, if legumes are taken out of the crop rotation (in favour of cash crops), the farm will have to import all the nitrogen needed for the crops in the shape of mineral or organic fertilizers. Additionally, the weed suppressing effect of legumes (particularly in the case of perennial legume crops) has to be replaced by other techniques of weed control. The organic matter that legumes supply to the soil, the missing fodder for the animals, the beneficial effect of flowering legumes to bees etc., all these functions have to be substituted, if deficits within the farm and its surrounding landscape are to be avoided. The higher the degree of specialization is, the more functions have to be substituted. Within a limited range some functions can be substituted by means of cultivation techniques which are also used in organic farming, e.g. biological sprays for pest control. But beyond a certain degree of specialization the biological techniques are an insufficient substitute; the farm system is fully dependent on external systems and remedies and no longer “a self-sufficient organic whole”. The reason for this situation may be that some parts of the self-regulation processes in the agroecosystem remain always active and respond to the replacement of original organs and to the other cultivation techniques applied. A specialized farm driven by differentiating forces can be seen as a dis-proportioned organism consisting of, for example, heart and stomach only, or of arms and legs but without body and head. Such farm systems need an incessant supply of remedies and must be permanently hooked up to external systems to stay alive and to maintain their basic functions. Needless to say, this is neither what organic farming intends nor how it can be practised successfully.

Diversification, in contrast to specialization, leads to a system of interdependent and interacting components. The components can supply materials and functions needed by any other part of the system, or a component can profit from something provided by another part. This is the basis on which a single organism works and is in exchange with its environment. A farm working like that can be regarded as an organism on a higher level, i.e. it works based on similar processes and has capabilities of control and regulation similar to a single organism. These capabilities are crucial characteristics as regards the long-term development and performance of a farm that works on the basis of self-regulation.

As outlined above we basically know that the functions of an agroecosystem are linked with its structure. Not only a certain diversity but also a certain set of operations (“impacts”) is necessary for the long-term fertility and sustainability of a farm if it is managed organically. However, the question is: Which degree? We do not know exactly how much diversity (and as regards which parameters) is necessary to develop and maintain sustainable self-regulation. As far as I know from the literature on ecology, there is no simple relationship in the sense that the more diverse the agroecosystem is the more sustainable it is. On the contrary, under certain conditions, e.g. in deserts, ecosystems can be quite simple and very stable. But such conditions are quite untypical of and different from those regions where we usually engage in agriculture. Thus, there is an extensive need for research on which elements of diversity contribute how much and under which site conditions to sustainability.

Conclusions

- The question of how significant farm structure is for its performance and sustainability is relevant both to organic farming practice and to ecological research. More knowledge about this matter is essential. In practice this information is useful to develop and modify organic farming for extreme site conditions and for specialized farming systems (fruit or vegetable growing, stockless arable farming, pastoral nomadism, aquaculture etc.). Research findings on the connections between farm structure and sustainability will considerably enlarge our insight into agroecosystems and will stimulate all agricultural methods.

- Obviously there is a limit to the degree of specialisation or simplification of a farming or horticultural enterprise if managed organically. Co-operation between neighbouring enterprises - of course, all of them being managed organically - is a perspective that can and should be developed to enable the sustainability of each participating farm. This co-operation has to be organized in such a way that the pair or group of farms involved correspond in total to the farm organism. This requires more than economic relations or the exchange of manure and feedstuffs between farms. Standards and methods for inspection and certification of such farm co-operations need to be elaborated "without abandoning the principle" (see above, Lord Northbourne). However, the suggestions of Baars (1998) are no real solution in that regard.
- Better criteria systems for assessing the overall long-term performance of organic production systems need to be developed. Some work has been done (Dabbert, 1990; Lampkin, 1988; Merrill, 1983), however mainly concerning sustainability and sustainability criteria (Geng et al., 1990; Keeney, 1989; Neher, 1992; Schaller, 1993; Senanayake, 1991). Organic farming demands a great deal of itself including social and ethical values (e.g. Dahlberg, 1988; Woodward, 1995). Moreover, the latter needs to be discussed as well, as other views and opinions also exist (Haest, 1995).

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