Biodynamic Farming and Ecology

by Frank van Steensel

Frank van Steensel wrote this article in response to a request for ideas for Association policy on genetic engineering. In a note to the editor he said:

"It is my belief that before we can determine if something is of value to us or a cause of concern we need to know what we stand for, who are we as biodynamic farmers and gardeners. When we have determined who we are, then we can move on to find out what is useful to us to reach our mutual goal. Herein I see a challenge for the policy advisory group because personally I do not know the Association's points of view. Anthroposophical? Yes. The use of preparations? Yes. Good husbandry? Yes. But what do these mean in practice?

We need to be able to say:
We stand for such and such and therefore we have (no) use for this and that, because it is (not) in line with our approach/thinking. Personally I am of the opinion that we are a positive bunch. We are not against conventional farming but for biodynamic farming. This means we do not have to fight others, we only have to show them that we lead a rich and quality life and why we do so.

Question: Did the Association determine who we are as biodynamic farmers and gardeners? If so I would like to use that material for this project, as from it it must be easy to say if genetic engineering is a useful tool for us or not.

If not, we could also determine if there are other alternatives that are more in line with our views. We also have a comprehensive task ahead of us of which I think needs grassroots involvement since I believe the farmer/gardener or member has a central place in biodynamics. Furthermore contracting a facilitator for this project seems to be appropriate, as it is a comprehensive task and an urgent one since we are on the threshold of change. Once we have worked through these basic matters it is an easy task to determine our point of view in any other matter, not just genetic engineering. It will save us lots of work compared to dealing with issues in a case-by-case approach.

As a starting point for a grassroots development we could have an issue of *Harvests* devoted to points of view on biodynamic farming and gardening. Out of this we could find common ground for further discussions. Since biodynamics is a comprehensive approach it will be very hard to be brief and to the point."

The editor invites further articles on this issue. If there are sufficient then there could well be a whole issue of Harvests *on this topic of who we are, what we stand for, and what are our mutual goals.*

To start things going, the following is what Frank calls his "brief view, one that is largely influenced by European researchers and farmers." In this article he uses the terms "farm", "farmer" and ""farming" inclusively – many of the ideas apply to gardening as well. He also uses the pronoun "he" to mean "he and she" as the context requires. We thank the Louis Bolk Institute, Driebergen Netherlands, for the use of the illustration and some of the tabular material in this article.

To me the most important view in biodynamic farming is the hierarchical approach to living systems, from cosmos down to microorganism. The central organism in this hierarchy is the human being. Biodynamic farming is about farmers and their developmental road, a road to understanding the relationship between earth and cosmos, between the physical and higher worlds. We all deal with this in our own manner and all our views and experiences are lessons.

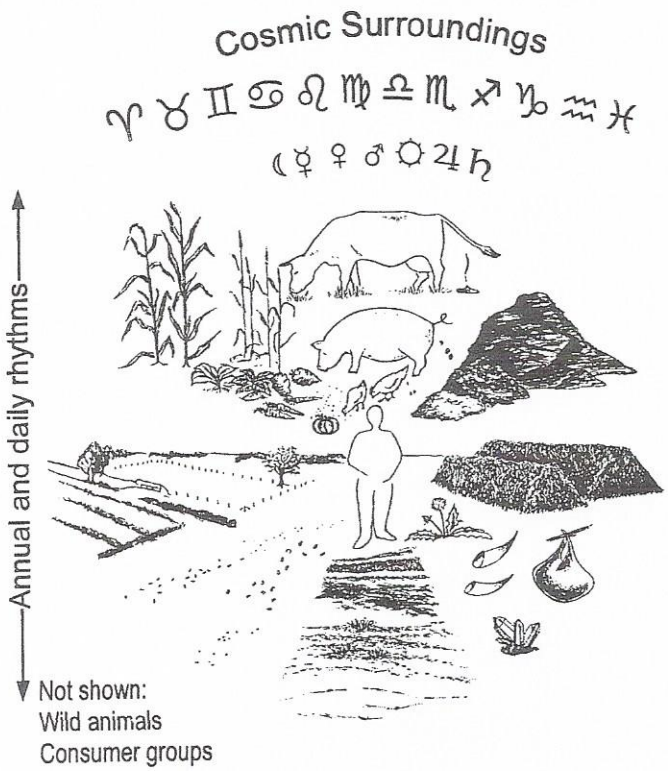
The farmer materialises (brings the farm into existence), and has a choice in how that is done. He may set out to dominate, in which case he will be in a continual struggle with the surrounding environment (the will of Nature, the formative forces, ecological succession, the higher or spiritual worlds, etc.). Alternatively he can learn to work with Nature, in which case they both determine the materialised farm in an ever evolving manner. The farm becomes a unity, an organism born out of the human and Nature. So in the centre we have the farmer who is in relation with the surrounding nature or environment.

The farm is a part of nature but can be divided into different "organs". Putting all the healthy organs together in a balanced relationship is, in my view, the essence of creating a farm individuality – biodynamic farming. We have to acknowledge the different hierarchies and learn to understand them, as they are the driving forces or steering mechanisms. We have a good understand of the material world due to the development of science, but generally we lack knowledge about the higher worlds; about biological life, about cycles, about rhythms, about processes and about subtle forces. As biodynamic farmers steering our farms towards a mutual goal we must learn to work with all of these in a conscious fashion.

Farm as an individuality

The most striking characteristic of biodynamic farming is the description of the farm as an individuality. Rudolf Steiner (1924) even draws a parallel between human individuality and farm individuality. Each farm is in her appearance, relations and proportions in principle unique. G.W. Schmidt gives the following picture of a farm organism.
(see over)

Farm organism with her organs, embedded in the natural, cosmic and cultural environments.
Adapted from GW Schmidt and T Baars by Kyla Mitchell



Key: 1. Soil; 2. Seeds; 3. Hayland and pasture; 4. Food, fodder crops and fruits; 5. Farm animals; 6. Manure; 7. Compost; 8. Biodynamic preparations; 9. Human beings.

A farm can only act as an organism if it has the necessary organs that can supplement one another. This creates a stable situation (mature stage), which can level off disturbances from outside. Another important characteristic is the closed cycle theory, in that a farm has to have as much as possible a closed energy and matter cycle. The starting point for the farm is the geological existence, as the soil type determines both the possibilities and limits the farming practices. So the following list of tasks for the different organs begins with the soil.

Soil

The soil is an important factor in biodynamic farming. Farming problems in general go together with soil problems. Soil development gives a good insight in problems that might occur, because they often arise when you are not managing the soil according to its current state of development. For example on young clay and loamy soils it is difficult to create a sufficient amount of humus because mineralisation is high. Decomposition is very fast as there is likely to be plenty of lime present. Stable humus formation is certainly not predominant, and the subsoil is originally very loose and has a spongy structure. Because of the low humus content the soil structure is very vulnerable. This means that the farmer has to be careful with his decisions on when to till and work the soil. Compaction is definitely a challenge. Earthworms normally restore the structure after compaction but have a hard time living in soils with low humus content. Young soils also have a rapid nitrogen transformation. They are rich in potasium, but phosphorus can be a challenge because phosphorus reacts with lime under high pH conditions, just as do iron and aluminium.

Older soils have different challenges. The subsoil can be compacted. The lack of lime gives structural problems in the surface layer, which means that heavy soils can be used only as pastures. These soils are generally acid which means that the humus formation is good. The humification processes are in strong comparison to the mineralisation processes. Nitrogen is retained better in the humus compounds. Potassium and phosphate are often consumed or leached out, so phosphatic fertilising with rock phosphate is useful and effective because fixation is likely to be low.

As a rule, soil improvement management practises have to fit the soil's development. What is effective and useful for a young soil can be harmful for an old soil. Young and old soils can by guided to the "mature stage" by the right cultivation practise. Young soils can do with stimulation towards "ripening"; old soils can do with help in breaking through their rigidity. High impact practices are in general not very effective. Using a subsoiler is a good practice on older soils to make them more dynamic, as it will break the compacted layer of leached-down humus and clay. Mineralisation is also stimulated. In young soils compaction occurs as an effect of overburdening it with machinery and animals. In those cases a resting periods in pasture and

Some Terms Used in This Article

Mineralisation: Complex chemical forms of nutrient elements (N, P, K etc.) found, for example, in humus are transformed to simple chemical forms for plant uptake.

Humification: Nutrients such as mineral nitrogen become stored in the soil humus in what the chemist refers to as "organic"* form. Humification is an opposite type of process to mineralisation as it builds up complex chemical forms.

Fixation: A nutrient is changed into a form in which it can be stored.

Buffer: Something that prevents or smoothes out wide swings in nutrient levels.

* This use of the word "organic" is a place where industrial chemist and ecologist meet. From this perspective, organic farming is so called because it focuses on what the chemist calls organic forms of nutrients, rather than on mineral forms.

growing of deep rooting crops stimulate a good soil development. Older soils can also be limed which will stimulate mineralisation.

Polarity thinking, as demonstrated above is useful in the decision making. If you ignore it, what is an advantage in the short term might turn against you in the longer term.

Another important goal is to keep the soil alive with organic fertilizers. Living soil can be recognised by the organic matter or humus content. Organic matter in the soil maintains soil life and is a significant factor in the soil water regulating capability. Humus forms a buffer against leaching of nutrients and at the same time it is a buffer for plant nutrients. The type of manure and the way of composting are factors which differentiate the soil in its development. Pig manure is by its content (it has sticky characteristics) very useful on sandy soils. Chicken, horse, sheep and goat manures find better use on clay soils. Cow manure enriched with straw (stable manure) is very useful as a fertilising medium on every soil type.

Seeds

Biodynamic practises include developing the farm's own animals and cultivating its own plants. Genetic improvement and breeding is farm based. Taking into consideration that this method is time consuming it is possible to develop regional breeds, comparable with the former "land races". Schmidt (in Baars, 1990) shows in his own grain improvement work that the improvement of modern grains which are "stiffened" leads to differentiation in form. For example, the genetically improved Schmidt rye bred by his father develops seven different types of seed head. According to Schmidt this differentiation in forms is a major goal in genetic improvement

Another interesting object in grain improvement is the straw/ root ratio. Under biodynamic conditions with limited fertilising possibilities rye varieties with long straws produce better than short straw varieties. The root system of long straw varieties is better developed, more open. Short straw varieties are more useful on plots fertilised with soluble minerals. A good developed root system is not really necessary in that case. The rye variety developed by Schmidt for the former situation has thus a root length of about two metres, and this also contributes towards soil organic matter.

Hayfields and pasture

The diversity of species in old (permanent) pastures is an important factor in the diversity of the the farm, and through that the wider environment.

The vegetation is also an expression of the soil, water and nutritional conditions. Each biodynamic farm shows its soil type through in the plant species it supports. In mainstream farming pasture is mainly rye grasses.

Food, fodder crops and fruits

The following are important points to look at:

- Diversity
- Increasing and/or maintaining soil fertility
- Adapted species

Diversity is maintained in the rotation scheme; and is diversity in time as well as in space Adapted species are explained above under "seeds". In the rotation soil fertility is taken into consideration. Strong preferences are given to one or two yearly pastures (with legumes), manure enriched with straw and cereal cropping. The measurement of success should be humus formation.

Farm animals

Diversity and well adapted species are the goals, the same as we saw before. "Genetic improvements" as characterised by Prof. F. Bakels are preferred. Selection on lifetime production instead of annual production is the main goal in this scheme. For example cows are selected on their life production which in turn means that they are selected on longevity in combination with good production. Bakels looks for physical characteristics, such as how the difference between male and female are related to the male-female differences in wild species. For example, some modern breeding involves selecting bulls on dairy – that is female – characteristics. Even as in the rye we see a differentiation, we see the same in animal forms. In one herd there will be different animal sizes and types.

Manure and compost

Manures enriched with straw are preferable. Cow manure is seen as the best for all soil types. Depending on the soil type other manure can be incorporated to improve one sidedness of the soil. These are not quantitative but qualitative measures. Aerobic decomposition of manure contributes to humus formation. In compost lots of waste products can be reused (garden wastes, kitchen wastes, pruning material, ditch slush). The goal of fertilising is not to feed the plant directly but to feed soil life.

The ideal carbon - nitrogen ratio for composting is 33/1. With materials in this ratio it is in theory possible to fix all nitrogen into the biomass. At the same time, carbon is available in sufficient amounts to maintain the soil organisms and biomass.

Preparations

Rudolf Steiner (1924) had developed several preparations. The biodynamic preparations are mainly herb-based materials which are fermented in an animal organ for part of the year. They contribute to the soil fertility and liveliness. Research is on-going into them, but the current indications are:

Preparation 500 has a positive influence on the soil, such as increasing the pH, stimulating mineralisation and humification, increasing germination and root development. Preparation 501 stimulates processes in the plant (light and warmth processes), like assimilation in the digestive process, ripening, shelf life, and taste. The compost preparations and cow pat pit also have an important role to play.

All preparations work as regulators on crop and/or soil development and decrease the susceptibility to pest and diseases.

Humans

Human beings in the form of a community take a central position in farming. The farmer has to develop a personal relation/feeling with the organs of the farm individuality . Within the farm one or several persons have to feel responsible for certain areas on the farm. People specialise through personal preferences, but specialisation on a farm level is not the intention and is not encouraged. The farmer has to take part in the processes of perceiving, interpreting and judging, and his role as a judger can't be taken over by a computer.

Natural environment

Care should be taken for the natural environment. Creating hedges, woods or solitary trees make the environment richer, and regulating flora and fauna will appear. Research in England showed that hedges were an important hiding place for fauna.

Table 1: From Baars, 1990

Number of species	In hedges	Total	Percent in hedges
Mammals	20	50	40
Reptiles	6	6	100
Birds	40	200	20
Butterflies	25	60	42
Bumblebees	8	17	47

In the Netherlands it is known that in hedges and woods there are 460 plant species, which is one third of the Dutch flora. Steiner says the following in his agricultural course:

"The correct balance of woods, orchards, bushes and meadows – with their natural growth of fungi – is so essential to good farming that your farm will really be more successful even if this means a slight reduction in your tillable acreage. There is no true economy in using so much of your land that all the things I've mentioned disappear. The resulting loss in quality will far outweigh the advantage of being able to cultivate a larger area at the expense of other things"

Some Further Terms Used in This Article

Homeostasis: A self-governing stable level of activity.

Respiration: The life activity in organisms that releases energy. Usually uses oxygen.

Community production: The total productive yield of all the organisms in the community i.e. the ecosystem.

Detritus: Waste that can be broken down.

Entropy: The physicists' measure of disorder – reducing entropy lowers disorder, increasing entropy leads to higher disorder. Entropy generally reduces in living organisms, while almost everywhere else in the physical universe entropy is increasing.

R- selection: Selection according to a group of characteristics that tend to be juvenile or immature characteristics. R - selected plants are often opportunistic, favouring growth over form.

K-selection: Selection according to a group of characteristics that tend to be adult or mature characteristics. K- selected plants are often more given to growing in a well-recognised form than to filling up an available space with opportunistic growth.

I think Steiner is referring here to what in modern ecology is called increased control of, or homeostasis with, the physical environment. In short this stands for maximum protection versus maximum production.

Cosmic surroundings

Even the cosmos has its influence on farming practices. Sun and moon are plainly visible, the influence and the effects are clear for most people. Moon rhythms are clearly visible in some life forms. Steiner describes the relation between the amount of rainfall and the moon period. There is a particular nuance in this relationship. According to an American research the relationship exists but it has to be differentiated from the west to the east – it is too simple to depend on a single factor. The relationships are being researched. According to bio-meteorologists the biodynamic view that there are relationships between crop growth and the planetary movements – movement in relation to each other or the zodiac – are not as unlikely as conventional farmers accept. Bio-meteorology is a new scientific discipline for the

study of direct and indirect influences between physical and chemical factors in the atmosphere and the living organisms – even including those between cosmic phenomena and organic and inorganic nature on earth.

Some of the relation: cosmos – farming in biodynamics is worked out in the sowing calendar of Maria Thun. In this calendar the relation between plant growth and the zodiac take a central place.

I strongly support the above view of biodynamic farming due to my background (soil sciences) and interest (ecology). It is interesting to compare the above view with ecological succession, which has gained a wide acceptance in the science world.

The succession of Odum

The biodynamic approach towards ecology is very similar to the ecological succession developed by Odum. Odum is more fixed on the succession of the flora and fauna of the ecosystem. The soil, which is in fact the basis of the ecosystem is not taken into account within his succession theory. He himself states that ecological succession results from modification of the physical environment by the community; that is, succession is community controlled even though the physical environment determines the pattern, the rate of change, and often sets limits to how far development can go. So in this case the credit goes to biodynamics which also "sees" the succession/development in the "physical environment" of soil.

This approach gives at the same time the answer to one of Odum's questions. He wonders if, after the mature stage the parallel with organisms goes further and if "old age" occurs. The phenomenological approach of the biodynamic scientist confirms the old-age stage, as it follows development from a newly formed soil to a ripened soil to a totally leached soil. Certain nuances should be recognised, as the matter is not always straight forward but the scheme is there. Like Odum, biodynamics recognises the importance of the mature ecosystem. The overall homeostasis of a mature ecosystem with a developed internal symbioses, good nutrient conservation, good stability (resistance to external perturbations), good entropy and high information content are recognised by both. Although the tabular model of ecological succession from Odum is more sophisticated it is certainly comparable with the simplified tabular model used in my article *Soil Development and Testing*, in *Harvests*, Vol 51, No2, 1998. I placed soil at the bottom of the table on page 13 because in modern ecology the soil development is not considered as a part of the succession theory. For farming practices though it is very useful and this is recognised in biodynamics.

The conclusion drawn from this is that the train of thoughts from Odum and biodynamics follow the same track.

A tabular model of ecological succession: Trends expected in development of ecosystems

	Ecosystem attributes	Developmental stages	Mature stages
	Community energetics		
1	Gross production /community respiration (P/R ratio)	Greater or less than 1	Approaches 1
2	Gross production /standing crop biomass (P/B ratio)	High	Low
3	Biomass supported/unit energy flow (B/E ratio)	Low	High
4	Net community production	High	Low
5	Food chains	Linear, predominantly grazing	Weblike, predominantl y detritus
	Community structure		
6	Total organic matter	Small	Large
7	Inorganic nutrients	Extrabiotic	Intrabiotic
8	Species diversity – variety component	Low	High
9	Species diversity –	Low	High
10	Biochemical diversity	Low	High
11	Stratification and spatial	Poorly organised	Well
	Life history		
12	Niche specialisation	Broad	Narrow
13	Size of organism	Small	Broad
14	Life cycles	Short, simple	Long,
	Nutrient cycling		
15	Mineral cycles	Open	Closed
16	Nutrient exchange rate, between organisms and	Rapid	Slow
17	Role of detritus in nutrient regeneration	Unimportant	Important
	Selection pressure		
18	Growth form	For rapid growth ("r-selection")	For feedback control ("K-
19	Production	Quantity	Quality
	Overall homeostasis		
20	Internal symbiosis	Undeveloped	Developed
21	Nutrient conservation	Poor	Good
22	Stability (resistance to external perturbations)	Poor	Good
23	Entropy	High	Low
24	Information	Low	High

Source: Odum, E.P., in *Science*, vol 164, pp.265

Conclusion

In my view biodynamic farming strives for a ecosystem based on a mature or climax stage. This is clear because it has the following advantages:

Developed internal symbioses, good nutrient conservation, good stability (resistance to external perturbations), low entropy and high information content. Like Odum, biodynamic farmers believe that this (maximum protection instead of maximum production) is a step in establishing rational land-use policies (it is even considered spiritually the correct way).

It all comes back to the climax elements. In biodynamics we can recognise those in:

- An ample rotation, providing variation in time as well as in space.
- Organic fertilising in which the amount of fertiliser used is adjusted to the number of animals could be kept if they were entirely fed by the farm's own production. The maintenance of good organic fertilising underlines the importance of detritus and organic matter to a climax ecosystem.
- Dissolves the problem of pests and diseases by the farming system instead of controlling; regulating by the presence of a good food web.
- Creating woody elements (hedges etc.) and other "wild" spots; thus increasing diversity, stimulating a more complex food web etc. Regulating of the farm ecosystem by predatory insects, birds and mammals becomes possible.
- Mixed farms, in which the crop production and the animal production are in balance not only create a larger diversity but also an almost closed nutrient cycle. By minimising imports of matter and by creating an organic matter cycle between farm disciplines the impact upon the environment is minimal. Research shows that good biodynamic farms have a nett import of nitrogen from the air by using legumes. The leaching of nitrate by drainage water is minimal, the drainage water is accepted as drinking water even under the tight regulations in the Netherlands. (Vereyken, 1990 and Baars and Van Ijzendoorn, 1990).
- Adapted species: selection of adapted species occurs in two ways:
  1: selected for the farm, chosen species are suitable for farm conditions;
  2: selection on the farm, genetic improvement takes place on the farm with the purpose of increase diversity within the species. E.g. By improving cows they are pushed in the direction of K selection. (Mainstream farmers push the selection in the direction of r-selection; shorter lived, higher production)

Back to the Issue

With this scientific insight we can conclude that technologies that steer the farm system or organism towards a climax stage are acceptable to biodynamic farmers. The question then becomes does gene technology help us work towards a climax system?

Currently gene technology is not without risks (fact), and discussing that I feel is a waste of time for the Bio Dynamic Farming and Gardening Association. An already overburdened organisation has to concentrate on real issues. The really important question is: Is gene technology so important/useful that we want to take the current risks? Does it support our way of farming?

My view is that gene technology contributes towards a pioneering phase instead of a climax phase. This can be supported by a lot of arguments but I am running ahead of the discussion. I feel the need for more input from farmers and members.

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