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## Biodynamic agriculture: A literature review

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#### Abstract

Biodynamic is a form of organic agriculture first described in the 1920s by Rudolph Steiner, and practitioners can become certified biodynamic farmers by following specified practices. Biodynamic (BD) agriculture became the subject of research efforts during the past decades, whereas a part of the scientific community looks at the BD method with skepticism and marks it as dogmatic. BD farming strives, as manifested in several publications, to positively impact cultural landscape design as well. A distinguishing feature of biodynamic farming is the use of nine biodynamic preparations described by Steiner for the purpose of enhancing soil quality and stimulating plant life. They consist of mineral, plant or animal manure extracts usually fermented and applied in small proportions to compost, manures, the soil, or directly onto plants, after dilution and stirring procedures called dynamizations. Biodynamic agriculture is indeed a very sustainable agricultural practice in terms of environmental and social sustainability, where this practice lacks in economic sustainability.

**Keywords:** Biodynamic, sustainability, biodynamic preparations, soil quality, practices

#### Introduction

Biodynamic agriculture is a form of alternative agriculture very similar to organic farming, but it includes various esoteric concepts drawn from the ideas of Rudolf Steiner (1861-1925). Initially developed since 1924, it was the first of the organic agriculture movements. Biodynamics has much in common with other organic approaches. It emphasizes the use of manures and composts and excludes the use of artificial chemicals on soil and plants. It treats soil fertility, plant growth, and livestock care as ecologically interrelated tasks, emphasizing spiritual and mystical perspectives.

#### Principles of Biodynamic Agriculture:

Rathore *et al.* (2014) and Pfeiffer (1940) states that the main principles of Biodynamic Agriculture are:

- To create a diverse and balanced farm ecosystem that can support itself from within the farm (Mason, 2003)
- To restore the soil through the incorporation of organic matter
- To treat soil as a living system
- To create a system that brings all factors which maintain life into balance
- To encourage the use and importance of green manure, crop rotation and cover crops
- Treat manure and compost in a biodynamic way, and have knowledge of enzymes and hormones.

#### Biodynamic Movement in India

Biodynamic Association of India (BDAI), situated in Bangalore has taken the charge of promoting and coordinating the biodynamic movement in India. The movement has reached India in the early 90's when Peter Proctor, a farmer from New Zealand working with biodynamic agriculture since 1965 was asked to come to India by T.G.K. Menon of Indore in 1993 to teach Indian farmers about biodynamic farming. Places among the first initiatives were Kuriniji farms near Kodaikenal, Maikaal cotton project in Madhya Pradesh and the tea projects in Darjeeling and south India. Presently, places where BD farming has been followed extensively are Mysore (ISKON farm), Gujarat (Bhaikaka Krishi Kendra), Tamilnadu (Nandanvan est., Balmadies est.) etc.

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### Biodynamic Certification

The term Biodynamic is a trademark held by the Demeter association of biodynamic farmers for the purpose of maintaining production standards used both in farming and processing foodstuffs. The trademark is intended to protect both the consumer and the producers of biodynamic produce. Demeter International an organization of member countries; each country has its own Demeter organization which is required to meet international production standards (but can also exceed them). The original Demeter organization was founded in 1928; the U.S. Demeter Association was formed in the 1980s and certified its first farm in 1982. In France, Biodivin certifies biodynamic wine.

India is working with international biodynamic farming agencies to facilitate an internationally recognised set of standards to be used during the inspection of farms desiring biodynamic certification.

### Components of Biodynamic Agriculture

Uses five sources of energy are there, i.e., Earth, Air, Water, Fire and Cosmos

### The Biodynamic Preparations

A distinguishing feature of biodynamic farming is the use of nine biodynamic preparations described by Steiner for the purpose of enhancing soil quality and stimulating plant life. They consist of mineral, plant or animal manure extracts usually fermented and applied in small proportions to compost, manures, the soil, or directly onto plants, after dilution and stirring procedures called dynamizations. The original biodynamic (BD) preparations are numbered 500–508.

### Field preparation

Field preparations, for stimulating humus formation:

- **500:** (Cow horn-manure) a humus mixture prepared by filling the horn of a cow with cow manure and burying it in the ground (40–60 cm below the surface) in the autumn. It is left to decompose during the winter and recovered for use the following spring.
- **501:** (Cow horn- silica) Crushed powdered quartz prepared by stuffing it into a horn of a cow and buried into the ground in spring and taken out in autumn. It can be mixed with 500 but usually prepared on its own (mixture of 1 tablespoon of quartz powder to 250 liters of water) The mixture is sprayed under very low pressure over the crop during the wet season, in an attempt to prevent fungal diseases. It should be sprayed on an overcast day or early in the morning to prevent burning of the leaves.

The application rate of the biodynamic field spray preparations (i.e., 500 and 501) are 300 grams per hectare of horn manure and 5 grams per hectare of horn silica. These are made by stirring the ingredients into 20-50 litres of water per hectare for an hour, using a prescribed method.

### Compost preparations

Compost preparations, used for preparing compost, employ herbs which are frequently used in medicinal remedies. Many of the same herbs are used in organic practices to make foliar fertilizers, turned into the soil as green manure, or in composting. The preparations include:

- **502:** Yarrow blossoms (*Achillea millefolium*) are stuffed into urinary bladders from Red Deer (*Cervus elaphus*), placed in the sun during summer, buried in earth during winter and retrieved in the spring.
- **503:** Chamomile blossoms (*Matricaria recutita*) are stuffed into small intestines from cattle buried in humus-rich earth in the autumn and retrieved in the spring.
- **504:** Stinging nettle (*Urtica dioica*) plants in full bloom are stuffed together underground surrounded on all sides by peat for a year.
- **505:** Oak bark (*Quercus robur*) is chopped in small pieces, placed inside the skull of a domesticated animal, surrounded by peat and buried in earth in a place where lots of rain water runs past.
- **506:** Dandelion flowers (*Taraxacum officinale*) are stuffed into the mesentery of a cow and buried in earth during winter and retrieved in the spring.
- **507:** Valerian flowers (*Valeriana officinalis*) are extracted into water.
- **508:** Horsetail (*Equisetum*).

Biodynamic preparations are intended to help moderate and regulate biological processes as well as enhance and strengthen the life (etheric) forces on the farm. The preparations are used in homeopathic quantities, meaning they produce an effect in extremely diluted amounts. As an example, just 1/16th ounce a level teaspoon of each compost preparation is added to seven- to ten-ton piles of compost. In India, the pancha gavya and amritha karaisal which are part of organic farming is also practiced in bio-dynamic farming.

### The Planting Calendar Rhythms

Many Biodynamic farmers refer to the astronomical calendar when planning activities such as pruning, cultivating, harvesting, and spraying the preparations. The Planting Calendar is about RHYTHMS - Cosmic solar & lunar/moon rhythms and Earth rhythms. It is an aid to our conscious and purposeful participation in these rhythms.

These are rhythms that sustain all life on Earth. Biodynamic farmers strive to bring life back into the soil, so that the food produced from this living soil has increased life force/vitality/nutrition, enhancing the quality of human life.

The 6 Moon Rhythms are:

1. Full-new moon	2. 29.5 days
3. Full-new moon	4. 27.3days
5. Ascending-Descending moon	6. 27.3 days
7. Moon nodes	8. 27.2 days
9. Perigee-Apogee	10. 27.5 days
11. Moon in Zodiac Constellations	12. 27.3 days

- The element most affected by the moon energies is water (for example, the sap in plants).
- In the 48 hours leading up to Full Moon there appears a distinct increase in the moisture content of the earth. The growth forces of plants seem to be enhanced.
- During the Full Moon period there is quick germination of seeds, fast plant growth, and a rapid re-growth of any cut, mown or pruned vegetation.
- Towards New Moon there is more activity underground in the soil and the flow of sap in plants is less strong.

Ascending Moon	Descending Moon
1. Cosmic forces work above the rhizosphere	1. Cosmic forces work below the rhizosphere
2. Suitable for <ul style="list-style-type: none"> <li>• Foliar application</li> <li>• Propagation activities</li> <li>• Sowing</li> <li>• Harvesting</li> </ul>	2. Suitable for <ul style="list-style-type: none"> <li>• Compost</li> <li>• Transplanting</li> <li>• Land preparation and manure application</li> <li>• Harvesting of root crops</li> </ul>

### Performance of Biodynamic Farming in Context of Climate Change and Sustainability

1. Effect on soil health and fertility
2. Sequestration of carbon
3. Yield potential
4. Nutritional quality of food
5. Management of pest and diseases

### Impact of Biodynamic Production Practices on Soil Health

A quantitative and qualitative comparison between commercial carrot and biodynamic carrot was undertaken by K. Perumal & T.M. Vatsala in 2002 with respect to physico-chemical, microbial and chromatographic properties. The parameters are analysed before manuring, after manuring and after harvesting the crops. They observed that the physico-chemical properties score higher after manuring while the microbial population count is more during post harvest condition.

R. K. Pathak & R. A. Ram in 2016<sup>[8]</sup> studied some chemical and biological properties of soil under biodynamic farming after two years of farming in CISH, Lucknow. They found out that after two years of farming there is remarkable increase in available Phosphorus, Potassium and organic carbon content and also microbial colony of yeast, mould and bacteria is very high.

Turinek *et al.* in 2009<sup>[17]</sup> studied the Soil Carbon (%) after 32 years in 'K-trial' in Sweden (1958-90) which is a long-term experiment and they found out that amount of total carbon is highest in case of biodynamic farming that is 160 t C/ha and also depth wise amount of carbon is increasing as we go from surface to deeper layer as that of other farming systems like organic, NPK medium and NPK high.

M. Turinek *et al.* (2009)<sup>[17]</sup> studied Soil carbon sequestration benefits of biodynamic farming over organic farming. They compared two long term experiment that is 33 years of 'K-trial' of Sweden and 28 years of 'DOK-trial' of Switzerland under organic and biodynamic farming in different depth of soil. They found that there is higher amount of carbon sequestered in case of biodynamic farming. Increasing the amount of carbon stored in vegetation and soil (also called carbon sequestration) is a preventative measure toward slowing carbon dioxide (CO<sub>2</sub>) build-up in the atmosphere. Soil organic carbon was maintained at the same level and even showed a small gain in the BD system at the DOK trial and K trial, whereas the organic farming systems had a net loss of soil organic carbon.

L. M. Condrón *et al.* in 2010<sup>[4]</sup> studied the chemical properties of soil after two crop rotations under control, biodynamic, organic, conventional, mineral system in New Zealand. They found out that the properties of soil like pH, total organic carbon, total nitrogen, extractable Ca and Mg highest under biodynamic farming than that of other four farming systems. *et al.* L. M. Condrón *et al.* in 2010<sup>[4]</sup> studied the Soil microbial properties of five production systems in a field experiment after two crop rotations. They found out that all that soil microbial properties like microbial

biomass, microbial respiration and activity of the soil enzymes are highest in case of biodynamic farming than that of other farming systems. Microbial population in BD preparations was found to be substantial, mainly in BD preparations 502 and 506. Several bacterial and fungal strains showed a potential for suppressing fungal plant pathogens. This could also be the reason for the significant and clear-cut difference in dehydrogenase, protease and phosphatase activities with respect to the farming systems and highest values were measured for the BD system.

### Effect on Yield Potential

R. K. Pathak & R. A. Ram in 2016<sup>[8]</sup> studied yield of various vegetables and fruits under conventional and biodynamic methods in CISH, Lucknow. They found out that there is markedly higher yield in case of cauliflower, cabbage, gooseberry and mango under biodynamic system than that of conventional system.

Sharma and co-workers (2012)<sup>[16]</sup> studied the effect of biodynamic manure (BD 500 and BD 501) in combination with vermicompost and farm yard manure on growth and yield of cumin (*Cuminum cyminum* L.). The result showed that the application of BD 500 and BD 501 along with either FYM @ 6t/ha or vermin compost @ 2t/ha recorded a significant increase of 20.56% and 12.85% in seed yield of cumin over the application of FYM @ 6t/ha and vermicompost @ 2t/ha alone, respectively.

D.J. Nath *et al.* in 2016 studied the effect of panchgavya and amritha karaisal on rice varieties viz. Bokul and Badsha Bhog under organic condition. The treatments taken into consideration are T<sub>1</sub> = FYM (5 t/ha) + Rock Phosphate (100 kg/ha), T<sub>2</sub> = FYM (5 t/ha) + Rock Phosphate (100 kg/ha) + Microbial consortium (including Zn solubilizer), T<sub>4</sub> = Application of Panchagavya with water @ 50 lit/ha at transplanting, active tillering and PI stage, T<sub>6</sub> = Application of Amrithakaraisal with water @ 1250 lit/ha at transplanting, active tillering and PI stag, T<sub>8</sub> = T<sub>1</sub> + T<sub>4</sub>, T<sub>10</sub> = T<sub>1</sub> + T<sub>6</sub>, T<sub>12</sub> = Control. T<sub>10</sub> treatment shows highest yield under Bokul variety while T<sub>2</sub> treatment shows highest yield under Badsha Bhog variety and as mean T<sub>10</sub> being the highest.

### Production of Quality Food

Rene E Valdez and Pamela G Fernandez in 2008<sup>[19]</sup> studied various quality factor of rice in Philippines They had taken three varieties i.e. Dinorado, PSBRc82, PSBRc72 H for their experiment and found out that most of the parameters are equal or more than that of synthetic and organic. To increase our understanding of the function of the alternative systems (organic - ORG and biodynamic - BD) when compared to the commonly practiced low-input (LCON) and high-input conventional (HCON) approaches, a six-year field trial was conducted in the McLaren Vale region of South Australia by Penfold and Collins. (2015)<sup>[9]</sup>. Berry and wine compositional analysis was performed on berries, juice and wines from all treatment replicates. The main quality parameters measured in the literature included soluble solids, organic acids and pH, colour, phenolics and tannins. Significant differences in descriptors used by viticulturists and winemakers to describe wines made from fruit produced under the different management systems. Consistently ORG and BD treatment wines were described more often as being rich, complex, vibrant, balanced and textural compared to LCON and HCON treatment wines. LCON and HCON wines were also described more frequently as green and unripe compared to ORG and BD. In 2013 and 2014 ORG and BD were more

often described as having black fruit and red fruit character. LCON wines in 2012 were also described more as earthy.

### **Biodynamic Way of Disease and Pest Management**

#### **Pest management**

- Cow horn silica controls fungal attack
- Biodynamic neem based liquid pesticides control soft pests (aphids, jassids, flies etc.)
- Nettle spray controls hard insects.
- Spray of biodynamic pesticides prepared from cow urine, neem, karanj (*Pongamia glabra*), *Caliotropis*, castor, *Thevtia nerrifolia*, *Vitex spp.* Leaves.
- Nettle leaves extract sprays to control hard pests.

#### **Disease management**

- Two sprays of Cow Horn silica (BD-501) at flowering and fruit development stage.
- Biodynamic tree oaste/cowdung paste for the control of gummosis and dieback.
- Spraying of horsetail (*Equisetum arvensis*) / casuarina leaves extract for the control of fungal diseases in ascending moon

### **Limitations of Biodynamic Farming**

Biodynamic agriculture is more labour intensive than conventional farming practices, which makes the produce more expensive. It's also not very conducive to mechanization, so it's difficult to practice on a large scale and its distribution is also limited. It can also be seen as a pseudoscience by non-believers, a fact that contributes to a general lack of mainstream acceptance.

### **Conclusion**

Biodynamic agriculture is indeed a very sustainable agricultural practice in terms of environmental and social sustainability, where this practice lacks in economic sustainability. Every day it is being developed and is slowly becoming incorporated into the modern agricultural world. Despite the mystery and criticism that surrounds biodynamic agriculture, the practice itself is as sustainable and self sufficient as you can get in this current era. It is one of the most environmental friendly farming practices in the world and is well on its way to being one of the sustainable options for the future. Many research showed that BD farming improves soil health and fertility (Perumal and Vatsala 2002, Condrón *et al.* 2010) <sup>[10, 4]</sup>, sequester higher amount of carbon on long term basis (Turinek *et al.*, 2009) <sup>[17]</sup> which helps to combat climate change, provides better or equal yield potential than that of other farming systems (Sharma *et al.* 2012, Pathak and Ram 2016) <sup>[16, 8]</sup>, produces quality food with better taste (Penfold and Collins 2016, Valdez and Fernandez, 2008) <sup>[19]</sup>, manage insect and pest in a eco-friendly manner. Furthermore, for biodynamic agriculture to exist as one of our future sustainable options more research would need to be conducted and more information needs to be made open to the public. The world of biodynamic agriculture is still a much closed community; and because of this the public can still be very sceptical. Nevertheless, we cannot keep relying on conventional agriculture when it causes so much damage to our fragile planet. Even still, right now it is practical to continue in this way, as it is the main supplier of our food. Until we have the ability to rely on sustainable methods for farming, we need conventional agriculture to meet our global food demand.

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