SIGNIFICANCE OF BIODYNAMIC METHODS TO REBUILD SELF-RELIANT SMALL HOLDER FARMING SYSTEMS

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In response to the global calls for land conservation, sustainable land management, soil quality restoration through eco-friendly farming practices a number of alternative farming models have been added up to the world agriculture system, over the years. Biodynamic farming is one of the first known works in this series. The biological-dynamic methods were introduced a century ago by Austrian philosopher Rudolf Steiner, in Germany to a group of nature-loving farmers from six European countries. His student Ehrenfried Pfeiffer, German soil scientist, popularized these methods as biodynamic (BD) method of farming.

BD farming has been labelled as pseudoscience by many people throughout its dissemination process to different parts of the world. However, this farming model that is known as an advanced version of organic agriculture, stress on sole use of natural preparations avoiding agricultural chemicals completely, has managed to add its footprints in 65 countries till now with more than 7000 practicing farmers and certified area of 251,842 BD hectares.

Germany tops in the area under biodynamic farming with 84,426 BD hectares followed by Australia with 49,797 BD hectares and India ranked fifth in the list with an area of 9,303 BD hectares (Paul and Hennig 2020). The Biodynamic Federation Demeter International (BFDI) database shows European countries as the hub of BD farms (Figure 1) and farmers of nearly 36 countries are gathered under country level biodynamic organizations.

Biodynamic farming has the strictest certification standards known as 'International Demeter Biodynamic Standard', among the eco-friendly farming approaches. The standard is decided by the member organizations and it is based on BD principles. To assure the compliance of Demeter farms with the BD standard the farms are inspected annually in addition to the organic inspection. Nearly twenty countries have their own Demeter certification bodies. In India, Biodynamic Association of India (BDAI) was formed in 1999 with its registered office at Bangalore, Karnataka. The BD certification agency in the country is 'Demeter India'.

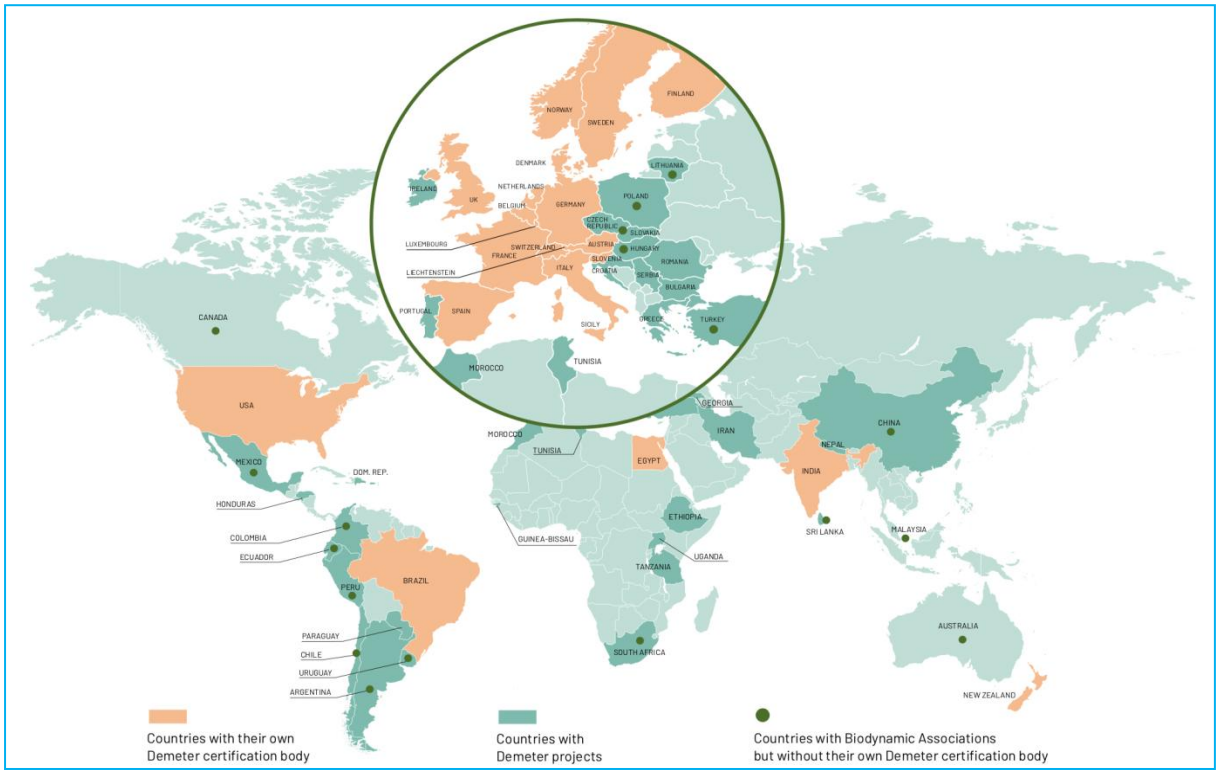

Figure 1 Map showing worldwide scenario of biodynamic agriculture (source: https://demeter.net/about/organisation/)

BIODYNAMIC FARMING: PRINCIPLES AND PRACTICES

Soil is treated as most valuable component in a BD farm since it is the foundation of our food production system. Hence, all the biological as well as dynamic practices are integrated in such a way that their combined effect contributes to soil health restoration in a BD farm.

Biological practices in BD farming include a set of popular eco-friendly practices such as mixed farming, recycling farm waste through composting, growing cover crops, green manuring, crop rotation and companion planting.

Dynamic practices that are meant for keeping the BD farm in alignment with earth's natural rhythms includes practices like biodynamic calendar for sowing different types of crops (e.g., root crop, leafy crop, flower crop, fruit crop etc.) based on the lunar and celestial events (Figure 2), use of special BD preparations, and peppering as a pest control method.

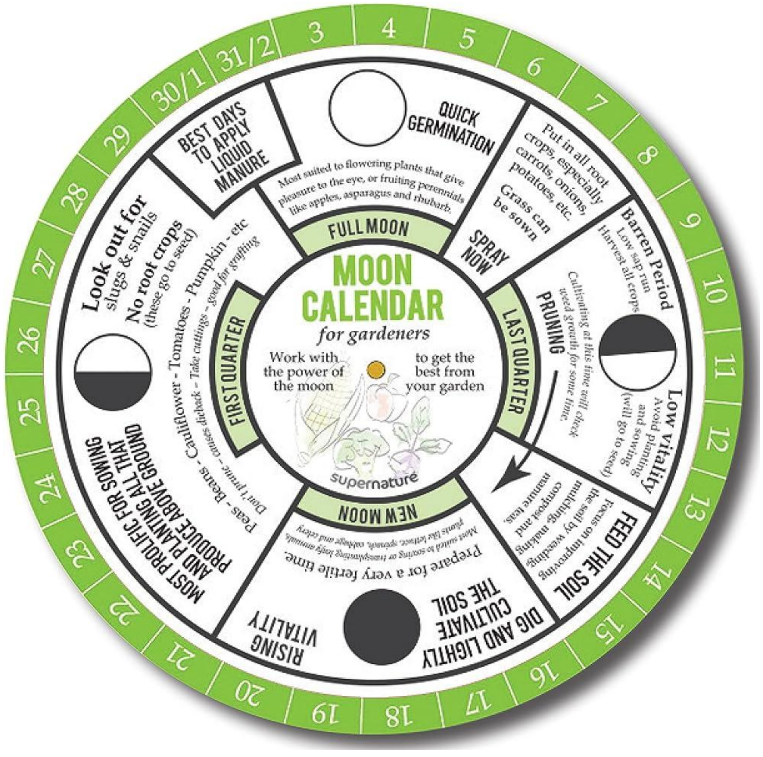

Figure 2. A model sowing calendar used in biodynamic farming

BIODYNAMIC PREPARATIONS:

BD preparations numbered as BD 500-508 used in this farming approach. They are either plant or animal based products, mostly fermented for a period of 6 months by burying in the ground after filling inside animal organs. These preparations are buried by September-October in northern hemisphere and by March-April, sometimes in May in southern hemisphere. BD preparations are generally applied in very small quantities either as a soil or foliar spray and in compost preparation. For example cow horn manure @ 100g/ha and cow horn silica @ 4g/ha after diluting them in 25 to 50 L water. An overview of the nine BD preparations and their benefits is given in Table 1.

Table 1 Relationship of BD preparations with soil and plant health

BD Preparations	Significance
BD 500 - Cow horn manure	Soil health restoration through promoting root activity, regulating nutrient elements and stimulating soil microbes
BD 501 - Cow horn silica	Enhances light metabolism, photosynthesis and chlorophyll in plants
BD 502 - Yarrow blossoms (*Achillea millefolium*)	Associated with the processes of potassium, sulphur and trace elements.
BD 503 - Chamomile blossoms (*Matricaria chamomilla)*	Associated with processes of calcium and sulphur.
BD 504 - Stinging nettle plant (*Urtica dioica*)	Associated with processes of potassium, sulphur, calcium and Iron.
BD 505 - Oak bark (*Quercus robur*)	Rich source of calcium. Helps plants to resist biotic stress.
BD 506 - Dandelion flowers (*Taraxacum officinale*)	Associated with living silica processes. Activates light influences in the soil.
BD 507 - Valerian flowers (*Valeriana officinalis*)	Related with phosphorous activity. Acts as protecting sheet over compost heap.
BD 508 - Horsetail plant (*Equisetum arvense*)	Very high in silica. Helps to prevent fungal diseases in the early season.

(Source: https://www.biodynamic.org.uk/ & https://agritech.tnau.ac.in/org_farm/orgfarm_biodynmic.html)

According to the promoters of BD farming, the synergistic effect of BD preparations help plants to develop a dynamic relationship with soil, water, air, warmth, and cosmos so that they can grow in a healthy and balanced way by availing the necessary nutrients and becoming resilient to pests, diseases and extreme climate conditions.

BD preparations generally make use of animal organs like cow horn, stag bladder, bovine intestine, mesentery and skull to pack ingredients before its burial. This is primarily due to particular properties they possess as a result of their former function within the animal. For example, during the preparation of BD 503, bovine intestine is used to fill dried chamomile flowers before burying in soil because, the former acts as a catalyst to expedite the fermentation process.

SCIENTIFIC INQUIRY OF BIODYNAMIC FARMING

Meta-analyses carried out by Turinek et al (2009) and Chritopher et al (2019) on research in biodynamic agriculture showed substantial evidence for the benefits of this farming approach to ecosystem particularly to rebuilding of soils, plant health and food quality. However, a few studies conveyed that application of biodynamic preparations and composted farmyard manure produced more or less similar results in stimulating activity of beneficial soil microbes (Zeller and Kopke, 2004 and Faust et al, 2017).

Study carried out at ICAR- Indian Institute of Soil Science by Radha and Rao (2014) identified plant growth promoting attributes viz., IAA production, P solubilization and biocontrol ability of cowdung based BD preparations like BD 500 and cow pat pit (CPP). They reported presence of microbial biostimulants *Bacillus licheniformis* in CPP

and *Lysinibacillus xylanilyticus* in BD 500. Another study carried out by Thakur et al (2018) reported fungi as the dominant microbial group present in BD 500 and actinobacteria in BD compost. Their research identified biodynamic preparations have higher nitrogen content than cowdung manure like 2.1% more in BD 500, 1.82% more in Cow Pat Pit and 1.12% more in BD Compost: (Figure 3)

Figure 3. Samples of some biodynamic preparations (from Kuriji farm, Tamil Nadu) used in the ICAR-IISS research

A recent research report showed cow horn as a critical prerequisite for the BD 500 preparation because, the sulphur-rich layer of keratin present in the horn has strong linkage with the horn manure maturation process. Keratin boosts beneficial bacterial and fungal communities in the manure so as to transform it to a probiotic food to restore soil fertility (Zanardo et al, 2023). Jukneviciene et.al. (2019) reported a higher soil enzymatic activity (urease and saccharine) with horn manure application.

BIODYNAMIC FARMING IN INDIA

The concept of biodynamic farming started to spread in India in the early 1990s with the initiative of Padma Sri Thacheril Govindan Kutty Menon (T.G.K. Menon) who was the Director of a Madhya Pradesh based organization *Kasturbagram Krishi Kshethra*. He brought Mr. Peter Proctor of New Zealand Biodynamic Association to India in the year 1993, to educate farmers about biodynamic method. Proctor and is wife Rachel Pomeroy trained many farmers of Tamil Nadu, Karnataka and Gujarat and helped them convert their farms to biodynamic.

Major biodynamic practitioners of India today such as Kurinji organic food farm located in the Dindigul district of Tamil Nadu and Bhaikaka Krishi Kendra located in the Anand district of Gujarat were transformed into biodynamic 16-20 years ago with the help of this couple.

According to the Biodynamic Association of India (BDAI), there are currently, more than 500 small as well as large BD farms are there in India, but, most of these farms are not formally certified. A wide variety of crops including food grain crops, fruits, vegetables, spices and beverage crops are being grown here for family food requirement as well as targeting the domestic and export markets (https://biodynamics.in). The best example for export oriented farming in the country using biodynamic methods is the internationally recognized 'Araku Coffee', grown in the tribal farm lands of Araku Valley villages located along the Eastern Ghats in Andhra Pradesh. The Araku coffee plantation, managed by more than 20,000 farmers of the Small and Marginal Tribal Coffee Farmers Mutually Aided Cooperative Society (SAMTFMACS) spread in an area of 12,000 acres across 803 villages (Ganguly, 2023). Reportedly, it is the largest certified biodynamic coffee plantation in the world (https://arakucoffee.com).

Since its formation in 1999 BDAI support the spread of biodynamic farming within the country through organizing year-round training activities all over India, with the help of practicing biodynamic farmers. Most of the training programmes are held on functioning biodynamic farms keeping the resident farmer as one of the instructors so that participants get necessary 'hands-on' experience on different BD practices. Irrespective of these efforts this low cost eco-friendly farming method is unknown to a large share of farmers

in India. One of the possible reasons behind low adoption of this farming method might be the complexity in preparing the BD preparations. For instance, making of BD preparations demand a long time period and considerable efforts. Additionally, plants used in the BD compost preparations are not commonly found in many parts of India, and their cultivation and processing for BD farming may not be feasible for individual farmers. Finally, the social taboos associated with use of animal organs for making BD preparations can be the demotivating factors for the small and marginal farmers living in the remote villages. There may be other reasons for the slow spread of BD farming in India but, unfortunately, not many studies have been conducted to investigate the issue.

CONCLUSION

Biodynamic farming is reportedly a nature friendly low-cost farming approach that has the potential even to transform the small and marginal farms of a region self-reliant if they work in a cooperative mode. However, more studies are required to understand why this farming method is in the low adoption category though it is being recognized as cost-effective. In addition, to quantify the socio-ecological sustainability dimensions of BD farming as well to ascertain capability of BD methods to support the farm based livelihoods of India it is necessary to carry out multi location trials. This will further help government and policy making agencies to come up with strategies to popularise the technology in potential regions of the country.

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