REVIEW ARTICLE

Why Natural Farming Technology be Adopted and Researches Intensified?

R.S. Dwivedi*, Rajesh Bajpai

DOI: 10.18811/ijpen.v8i03.02

Abstract

Rising environmental Pollution, decreasing soil fertility, augmenting ground water contamination with NO_3, As, Pb, Cd, etc deteriorating vegetables, fruits, edible grains and milk quality due to poisonous chemicals and thereby increasing health hazards are great threat at global level. The chemical laden agriculture is one of the pivotal causes for such consequences and "Punjab cancer train" in India carrying hundreds of cancer patients daily from Bhatinda (Punjab) to Bikaner (Rajasthan) for treatments, are well known. Natural farming technology trained farmers from eleven states *viz.,* Gujarat, Maharashtra, Uttar Pradesh, Himachal Pradesh, Madhya Pradesh, Uttarakhand, Meghalaya, Chhattisgarh, Kerala, Karnataka and Andhra Pradesh of India are getting spectacular higher yield and good quality pollutant free crop harvest and edible products. This technology is comprised of treating seeds with *Beejamrit* and *Ghanajeewamrit* to improve seed germination and improve soil health and crop growth. Spraying of *Neemastra,* or *Agniastra* or *Bramhastra* are done to control insect, pests and plant diseases without polluting environment. Natural farming is broadly synonym to *Vedic* Agriculture, cosmic farming and *Homa* therapy using *Agnihotra* ash. Promotion of microorganism, Indian earthworms, Indian breed cows and water conservation through crop residues or intercropping practices are the key epithets of natural farming. This technology has been found to be cost effective and pollution free, also called as 'Zero Budget Agriculture' since all the inputs are natural and domestically produced. The pros and cons of this technology with a view to make a sensible decision for its adoption at local, state, national and international level are discussed in this paper.

In case of some technological impetigo in attaining present level of crop productivity on large scale, the challenges before agriculture scientists are to ameliorate natural farming technology and maintain health friendly environment, harvest higher crop yield and assure food security to burgeoning population.

Keywords: Agnihotra, Biodynamic agriculture, Chemical laden agriculture, Homa organic agriculture, Organic farming, Vedic agriculture.

International Journal of Plant and Environment (2022); **ISSN:** 2454-1117 (Print), 2455-202X (Online)

Introduction

The current worldwide prime concern is environmental pollution leading to environmental warming, climate change and thereby erratic natural calamities causing irreparable loss to human life and resources. Among, various pollutants producing sources, chemical laden agriculture plays one of the pivotal roles in imparting soil sickness including salinization, nutrient imbalances, deficiency and toxicity of mineral nutrients and water and atmospheric disorders and uneconomic crop productivity (Dwivedi *et al.,* 1975; Dwivedi, 1993; Alam, 2014; Srinivasarao *et al.,* 2021). More crucial concern is the production of pollutant and chemical contaminated edible grains, vegetable, fruits, milk and non-vegetarian food product directly causing human health disorders including cancerous diseases and shortening of life Span (Singh, 2013). The use of high doses of chemical fertilisers, heavy irrigation, chemical insecticide and pesticide and heavy metal/sparingly degradable organic crop protectants are the main reasons for such consequences (Dwivedi, 1993; Palekar, 2021).

Why Chemical Laden Agriculture was Adopted?

Britishers amended many agricultural systems in India, especially the order for compulsory cultivation of indigo for "*neel*" production on fertile soil resulted less grain production in Indo-Gangetic plains including that in Bengal province. India faced Bengal famine of drought including malaria, starvation and malnutrition in1942-43 and country exhausted buffer stock of food grains (Mukerjee, 2014). Subsequently on 15th August1947, India came out of British rule which was followed by racial clash between Hindustan and Pakistan during partition. Millions of Hindus migrated from Pakistan to northern part of India. The population swelled and India faced acute shortage of food grains. Wheat imports under PL40Scheme from USA was one of the supports to India.

It is imperative to mention that except developed countries, the major populace of the world including India was facing acute shortage of food grains during the year 1960-1970 (Misra, *et al.,* 2019). Many people in India prepared bread from the undigested wheat grains picked up from the dung of bullock. These bullocks used to consume excess of wheat grain while threshing wheat. Hence, harvesting higher yield of food grain through chemical laden agriculture using improved seeds developed by Nobel Laureate Norman Borlaug (1960-1965), high

P. H. S. S. Foundation for Science and Society, 04-First Floor, Eldeco Xpress Plaza, Shaheed Path, Utrathia, Raebareli Road, Lucknow-25

***Corresponding author:** R.S. Dwivedi, P. H. S. S. Foundation for Science and Society, 04-First Floor, Eldeco Xpress Plaza, Shaheed Path, Utrathia, Raebareli Road, Lucknow-25, Email: dr.rsdw@gmail.com

How to cite this article: Dwivedi, R.S., Bajpai, R. (2022). Why Natural Farming Technology be adopted and researches intensified. International Journal of Plant and Environment. 8(3), 10-23.

Conflict of interest: None

Submitted: 14/07/2022 **Accepted:** 21/08/2022 **Published:** 30/09/2022

doses of chemical fertilizers, irrigation, chemical insecticide, pesticides and weedicides were the urgent need of the day. India came out of that crisis almost by 1968 under the leadership of Dr. M. S. Swaminathan, the then DG, ICAR, New Delhi, and has now registered fourth place among ten top most countries of the world producing and exporting agricultural products and food grains.

The present chemical laden agricultural practices have contributed significantly in causing soil sickness/soil in fertility, chemical contamination of food grain and ground water and environmental pollution which have become acute problem in all the countries including India. This can be explained through pragmatically gathered data from Punjab (India), where during 1970-80, with the use of 1kg urea 12kg wheat was produced. This value dwindled significantly to 9, 6, 3 and less than 3 kg wheat/ kg of urea application, respectively during subsequent decades 1990, 2000, 2010 and onwards accompanied with significant soil ionic imbalances, nutrients deficiencies, toxicities and decline in organic carbon within 20-25 years and become uneconomical (Fig. 1) (Anonymous, 1974; 2020). Chemical laden agricultural practices also culminated in significant decline in beneficial soil micro- and macro biota population besides, killing all earthworms which are considered as soil bioreactors (Gupta, *et al.,* 1997; Pathak, 2018). The gain and loss due to chemical laden agriculture are illustrated in Fig. 1.

Natural Farming Technology

Natural agricultural technology, free from chemical use is considered as panacea of all type of disorders caused due to present chemical laden agriculture and had been prevailing in India since long i.e. about 10,000 BC (Kumar and Singh, 2021). Only in 1957, a legislation on the use of fertilizers under essential commodities act, was passed by Government of India. Prior to that the use of chemical fertilizer was negligible and the resultant agricultural produce was sufficient to feed Indian population. However, due to reasons explained above, the chemical laden farming (CLF) was opted and its merits and de merits are realized now. To combat with disastrous vagaries of CLF Subhash Palekar for the first time in 1985, un-earthen and promulgated a simple organic farming technology which was initially named as "Zero Budget Farming", since natural and domestically produced materials are used in this technology with a little dependence on the market.

Parallel to this, in 1988 Gerlecka, and in 1989, Paranjpe published effect of old Indian technology *'Agnihotra'* on agricultural crops and human health based on experiments conducted in USA, India and Germany. Subsequently the details on Vedic agriculture, cosmic agriculture and *Agnihotra* leading to pollutant free higher crop yield based on climate and seasonal conditions, natures gesture and biodynamic almanac was unearthed by Pathak and Ram (2004).

Because of ancient awareness in organic agriculture in India, people from Sikkim knew it in large and therefore adopted 100% organic agriculture in the state. It became first "organic state in the world" and honoured with "Oscar Award" in 2018 by FAO (UN) (Sadalge, 2018).

Subsequently, Mr. Subhash Palekar from Amarawati district (Maharashtra) formulated *Beejamrit* (for seed treatment), *Jeevamrit*, *Ghanjeevamrit* (for soil application) and *Neemastra*, *Agniastra* and *Brahmastra* (warding off insects), with the help of ancient literature (Palekar, 2021). He found that the rearing of one Indian cow breed was sufficient to cater the need of 12-acre land. In different states, especially in Maharashtra, farmers followed Palekar technology and harvested good yield with higher return. Similarly, Acharaya Devvrat (presently the Governor of Gujarat state) working at Kurukshetra, Haryana recorded beneficial effect of Subhas Palerker's technology on paddy and wheat crop and grain quality right from first year of 2011 to 2016 unlike organic farming. Costly inputs like vermicompost (VC) (4.5 tone/acre) + 200 Kg biofertilizer + biopesticide + 4-5 irrigation to annual crop make organic farming costlier than present chemical laden farming. Secondly, yield decline unlike zero budget farming was also recorded by Acharya Devvrat as an inevitable process in organic farming (Lok Samman, 2022).

Subhash Palekar, was given "Padmashree award" in the year 2016 for his new concept and renamed zero budget farming as "natural farming" in the year 2017 which was recognised by "Nitiaayog" and thereafter Government of India recommended for its promotion in different states specially Himachal Pradesh, Gujarat, Karnataka, Kerala, Meghalaya, Chhattisgarh and Uttarakhand. Now "LokBharati" Indian organization established in 1992 started creating awareness about natural farming among farmers since 2011 through a magazine entitled "Lok Samman" (2022).The regular publication of this magazine spread awareness about natural agriculture and the coordinator Mr. B. P. Singh contacted farmers and trained 1000s of agrarians in the country including that of Uttar Pradesh. Currently Government of India through Indian Council of Agriculture Research (ICAR), New Delhi has directed all state agricultural universities and ICAR institutes to grow crops following natural farming technologies and evaluate its suitability so as to fix the target for its adoption in the country (ICAR, 2013; Lok Samman, 2022).

Natural Farming differs from organic farming since later requires addition of 4-5 tons/ acres Vermicompost (VC) + 200 kg bio fertilizer besides bio pesticide to control pest and diseases. Thus, it is market dependent and costly farming practice. Secondly, VC is made through the involvement of European earthworms e.g. *Eiseniafetida, Lampito mauritu* and *Perionyx excavates,*and have heavy metals such as Pb, Cr, Cu, Cd, As, Si, that are added in it through their excreta. Heavy metals content in VC was within limit of USEPA (United State Environment Protection Agency) for biosolid which could be used safely for agricultural purposes (Panday *et al* 2014). However, based on soil sickness experienced by chemical laden farming, Palekar (2021) views appears to be logical and convincing that regular use of heavy metals contaminated vermicompost under organic farming would be dangerous to soil one day. On the other hand, in natural farming, the domestic products are used as input which is not market dependent and does not use even a pinch of chemical. This is most cost-effective technology and called as 'Zero Budget Farming'. Natural farming' promotes the use of *Deshi (Indigenous breed)* Cows, its dung and urine for agriculture purposes and minimise the dependence of farmers on the purchase of inputs such as fertilizers, weedicide, insecticide and fungicide and thereby reducing the cost of cultivation and making farming profitable. *Pheretima cummunissima,*

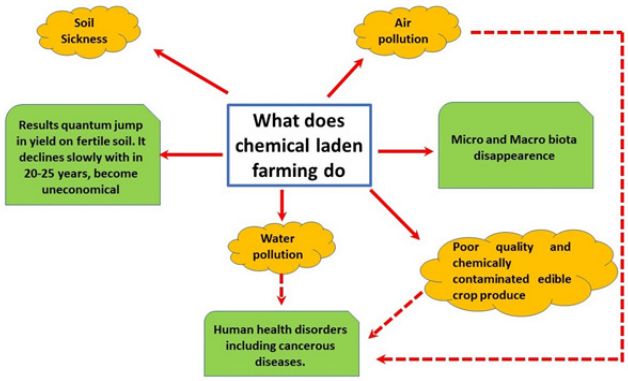

Fig. 1: Demerits surpass the merits of chemical laden farming.

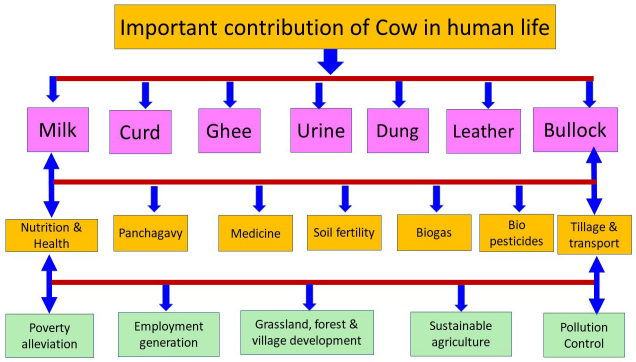

Fig. 2: Importance of cow in human life.

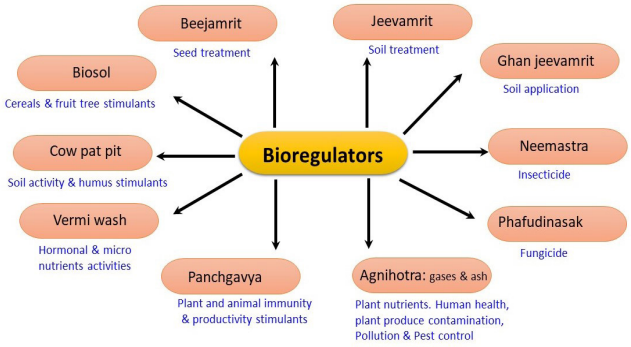

Fig. 3: Bioregulators formation by Indian Cow products.

Pheretima pasthuma, Eutyphacus and Lumbricus. Beside this, Indian earthworms are involved and promote natural farming practices and pose no risk of heavy metals at any stage (Palekar, 2021). Further distinguishing details between two farming are mentioned in Table 1.

At present, thousands of farmers from different states including Gujarat, Maharashtra, U.P, Himachal Pradesh, M.P, Uttarakhand, Meghalaya, Chhattisgarh, Kerala, Karnataka and Andhra Pradesh of India are taking the benefit of this technology based on training imparted by Palekar. A comprehensive detail about natural farming technology, its origin, our compulsion for its adoption, advantages, technological concerns and perspective views are diagrammatically depicted in this article.

Basics of Natural Farming

Natural agriculture has been livelihood of people in India since long which is considered as old as 10,000BC (Kumar and Singh, 2021). This technology is now termed as "Rishi Agriculture", since the natural products are used for crop cultivation. Basic concept of natural farming is the use of natural organic resources and domestic products in a manner to supply sufficient nutrients to plants, guard their growth and development, and sustain soil fertility, maintain pollution free environment (Soil+water+atmosphere) and finally to achieve higher yield of good quality health friendly edible products. Visualising the theme, the following components are essential for natural farming:

- Rearing of Indian breed cows
- Monitoring of Indian cow's milk, curd, ghee, dung and urine production
- Promotion of microorganism in soil and air
- Promotion of Indian earthworm in soil
- Enhancing soil humus
- Use of technologies to promote rain fed agriculture and reduce irrigation water requirement.
- Use of mulching with dry plant products
- Use of bioenhancer
- Promotion of biocontrol of insect pest and weeds
- Promotion of inter cropping concepts
- Promotion of cosmic agriculture (Not very essential)
- Promotion of animal forces with a view to use bullocks for small farmers, reduce pressure on fossil fuel, environmental pollution and raise cow dung and urine for FYM production and other agricultural uses.

Rearing of Indian Cows

Indian cows have been regarded as "Kamdhenu" (means provider of all which you need), even before Vedic era (1500BC-500BC). Vedic literature says "Gawwah Sarve Sukh Prada" means "Cow can give all pleasures to human being, wealth as well as health". Cows have specific rumen potential in which all left over materials like Bhusa (coarse powder of dry wheat straw), Paddy straw, grasses, sugarcane leaf, cakes, chuni etc., produced under chemical laden agriculture consumed are digested and in turn cow provides dung, urine and milk free from all contaminants. Production of such contamination free products useful for plant, animal and human being is not possible by any industry or laboratories (Pathak and Ram, 2004).

Hump of Indian cows is pyramid in shape, belly a replica of many cosmoses and horns have capacity to mediate cosmic energy. All these in turn result the production of dung, urine, and milk enriched with energy, advantageous microbes, bacteria, antioxidant properties and nutritional values. Italian scientist Prof. G.C. Bea Gad, has proved that cow dung kills bacteria that causes malaria and T.B. (Pathak and Ram, 2004).

Cow's rumen, udder and teats are full of beneficial bacteria (*Bacillus* sp.) and they produce 6 beneficial materials e.g. dung, urine, gorochana/gorocan (cattle light or cow light), milk, curd and ghee for human beings as discussed in Bhavishya Purana in between 1st to 8thcentury. Except ghee all are enriched with microbial consortium. NBRI (CSIR), Lucknow reported that milk from cow Sahiwal breed is equal to mother milk and impart good health to children for years together (Pathak, 2009). Because of hump on the back of Indian cows a pyramid is formed which

Table 1: Difference between natural farming and organic farming

Attributes	*Natural farming*	*Organic farming*
Rearing of Indian breed cow/ha	One cow will cater the need of 4 ha land	25-30 cows
Kind of input/manure/fertilizer required	*Beejamrit, Jeevamrit, Neemastra*, Mulching, Indian cow breed, Indian earthworms.	Vermicompost, Biofertilizer, Garbej Enzymer, Waste decomposer, Bio Insecticide, E M Solution (Microbial culture of Japan and Europe), Cows, European Earthworms.
Earthworms	Indian breed- *Pheretima cummunissima, Pheretima posthuma, Eutyphacus, Cubricus*and *Lumricus terrestis*are required for humus preparation and porosity of soil. Survive well under Indian environment and burrow soil up to 15feet deep. No/little replenishment of earthworm is required.	European breed- *Eisenia fatida, Lampito mauritii, Perionyx excavatus*. They remain mostly on soil surface and do not survive for longer period in Indian soil at 25-40^0 C. Hence require regular replenishment and thereby investment.
Rain fed agriculture and cropping pattern	In India about 70% agriculture is rain fed. Natural farming technologies through *Beejamrit* and *Jeevamrit/Ghanjeevamrit* are suited to protect rain fed crops. Inter cropping and mix cropping is preferred besides sole cropping.	Regular irrigation is required for crop growth. Not much suited to rainfed crops or inter cropping and mix cropping concept.
Mulching	Mulching is essential feature. It helps in reducing water requirement of crop, promotion of soil microorganism, earthworm population, soil porosity and water holding capacity	Mulching in not essential feature.
Seeds	Deshi seeds and Hybrid seeds are used	Deshi seeds are not preferred
Soil health	Natural Farming balances soil and eliminate pollutant and heavy metal from soil by activating micro-organism through harnessing cosmic energy.	It balances soil health. However, regular use of vermi compost increases the chance of accumulation of heavy metal e.g. Cd, Hg, Pb, Si, As and Cu in soil above dangerous limit.
Farming response	On practicing natural farming, the crop yield within 3 years is stabilised and reaches at peak (Table 2).	Even at the end of IIIrd year paddy yield remain much below normal yield (Table 2). Farmers run in deficit at least for two years while following organic farming practices
Organic matter accumulation	Initial organic carbon of SUFS (Sick and infertile soil) of 0.3% rises above and by the end of third year it is reached to a level of 0.8-1.0% in many fields (Table 2).	Organic carbon of SUFS rises slowly above 0.3% and by the end of third year it touches 0.4-0.6% (Table 2).
Cost of cultivation and net profit	Natural and domestic product are the inputs hence cost of cultivation is low. Net profit is higher than organic faming	Cost of cultivation is higher than present chemical laden agriculture. Net profit is very low (Table 2).
Cosmic Farming	Farming practices in consonance of energy through nature's gesture using B D (Biodynamic) Calendar for different crops have been practiced since ancient Vedic era. Higher yield is assured.	It does not consider cosmic energy harvest, natures gesture and B D calendar for crop production
Homa therapy	This is very cost effective ancient Indian technology and its impacts are operative on large area. Agnihotra vis-a-vis Homa practices (release of gases) and use of its ash in Agriculture combat all types of environmental pollution and provide relief to crop from insect-pest attack and to human being from various lethal diseases.	This is not practiced in organic agriculture.

Note: Cosmic Farming and Homa therapy are highly technical and not yet much explored. Hence, Palekar has not included it in natural farming.

harness energy from Sun and Ketu as a result of which nutritious us and anti- oxidant carotenoids light yellow in colour, are formed in the milk of cows. This milk gives all type of strength to children drinking regularly in place of mother milk. The importance of cows in human life and environmental pollution control is summarised in Fig. 2.

Bio Regulators

Bio regulators are available for all crop activities and prepared by fermentation of cow products over specific duration. These have impact to improve soil fertility, crop productivity and quality, pest and disease management. It is interesting to record that these are potent source of macro, micro nutrients, PGR activities,

Table 2: Comparative effect of natural, organic and present chemical laden agriculture on the organic carbon and paddy yield on sick and unfertile soil (SUFS). (Initial SUFS, OC: 0.3% and paddy yield:15q/acre) **

Components	*Natural Farming*	*Organic Farming*	*Chemical laden agriculture*
1. No of Cows required/acre	One Indian cow breed is sufficient to cater the need of 12 acre	10-12 cows/acre	Nil
2. Major constituents	*Beejamrit, Jeevaamrit, Neemastra*, *Mulching,* /Indian cow breed, Indian earthworms (also Agnihotra-Homa Ash and cosmic energy harvest)	Vermi compost, Biofertilizer, Garbej enzyme, waste decomposer, Bio insecticide, EM solution (microbial culture of Japan and Europe).Cows European, Earthworms.	120 kg N, 60 K_2O /acre + insecticide, fungicide
3. Cost of paddy cultivation/ acre (Rs.)	2500/-	12000-14000/-	10000-12000/-
4. Average yield during first three years (q/acre)	(21+28+34=83) 27	(12+15+24=51) 17	(11+10+9=30)10
5. Total income (Rs./acre)	27x1600=43200/-	17x1600=27200	10x1600=16000/-
6. Net profit/Loss (Rs./acre)	40700/-	14200/-	5000/-
7. Organic Carbon build up after three years	0.80-1.0%	0.40-0.60% (Rise in accumulation of heavy ions-Hg, Cd, Pb, Cr, As, Cu, and Si in soil is expected)	0.23-0.25% Carbon. Results rise in soil sickness, pollutants, soil infertility.

** Table Compiled on basis of data published by Palekar (2021, 2022); Devvrat (2022) and MSP of paddy fixed by Govt of India.

Table 3: Microbial consortium in *Jeevamrit* analysed on 5th day of sampling (Pathak, 2009)

Organisms	*Viable cells*
Azospirillum sp.	$2x10^6$
Phosphate solubilizing microbes	$2x10^6$
Pseudomonas sp.	$2x10^2$
Trichoderma sp.	$2x10^6$
Yeast and Moulds	$2x10^7$

immunity enhancement, drought resistance and yield boosting processes in many ways. These can be prepared by every farmer with simple infrastructure as per crop need. The common bio enhancer, which are used as present are *Beejamirit, Jeevamrit, Panchgavya* and many others. There is no compatibility with chemicals at any stage of farming but can be integrated with each other to get synergistic response. Cow based bio enhancer activities are summarized in Fig. 3.

Mulching

It is considered essential for crop growth under rainfed and irrigated conditions. Major role played by mulches as enumerated by Pathak (2018) are:

- Helpful in saving water requirement through minimization of run off and evaporation by cutting solar radiation.
- Reduces overheating and promote cooling of soil and thus help in maintaining continue root and soil biological activities
- It encourages development of white fibrous root, real organs for absorption of plant nutrition from soil and cytokine's production.
- The fibrous roots grow in upper layer of soil and hence it is essential to keep top upper layer few inches deep in friable conditions. This is done very well through mulching.
- With many vegetables and some fruits direct contact of soil is avoided and thereby their spoilage too.
- Continuous mulching and its drenching with bioenhancer, enhances and sustains organic carbon and microbial population in soil.
- Mulching helps in weed management, enhancing dark condition to soil, earthworm and termite activities, quick decomposition of mulching layer and there by enriching soilhumus friability and aeration.
- Drenching of mulching layer with Brahmastra etc. (Palekar 2021) may be done to avoid termites' growth, if occur.

Earthworms

Earthworms are known as pulse of soil. They play major role in maintenance of soil fertility and quality production. Earthworms are chief operators of nature's microbial factory. Local earthworms and uncountable micro-organism in the soil are chief source of plant nutrition. They eat gravels, lime stone, organic biomass, move upwards and downwards making capillaries in soil. This encourages better infiltration of water and helpful in upward movement of nutrition in available forms (Yang and Ralig, 2018). Earthworm's excrement contains five times more nitrogen, 7 time more phosphorous, 11 time more K and 2-time Mg and Ca than normal soil (Pathak, 2018). Work casts can promote lusts growth of plants probably due to plant growth promoter like cytokinin and auxin present in the casts. Earthworms inoculated areas are found to be warmer at night and cooler during day than surrounding earthworm free area. Improved porosity of soil with earthworms shows an increase in soil-air volume from 8-30%, thereby water in filtrations and water holding capacity (Pathak, 2019). The most striking effects of earthworms may be stimulation of microbial activity including *Actinomyceties*, *A. steptomyces, Azotobactor* and *Azospirillium,* thereby help in managing soil born fungal disease, reducing root disease and mediating nitrogen from biosphere. Earthworms release certain vitamins and similar substances in soil, which may be of the B groups vitamins or free amino acids as soil-microbes-plant bioregulator (Pathak, 2018).

Table 4: Biodynamic farming and Gardening calendar (Pathak and Ram 2004)

Details Months	*Moon Opposite to Saturn*	*New Moon*	*Full Moon*	*Ascending Period*	*Descending Period*	*Node*	*Moon*		*Sun Position*	*Sowing and planting dates*			
							Pg	*Ag*		*Root*	*Leaf*	*Flower*	*Seed/Fruit*
January	20	22	7	1-7,23-31	8-22	2,16,29	3,31	19	1-4 January in Sagittarius 15 January-12 February in Capricorn	4,5,13,14,31	9,18,26	6,7,24	1,11,12,15,20,28
February	16	20	6	1-6,21-29	7-20	132,26	-	16	13 Feb.-13 March in Aquarius	10,18,19,27,28	5,6,14,23	1,3,21,21	7,8,16,17,24,25
March	14	21	7	1-7,22-31	8-21	24	27	12	14 March-12 April in Pisces	8,18,26	4,13,21,31	9,10,18,19, 27,28,29	5,6,14,15,22,23
April	8	19	5	1-5,20-30	6-19	7,20	24	8	13 April-13 May in Aries	4,5,13,22,23	9,17,18,27,28	6,14,16,25	2,3,11,30
May	8	19	5	1-5,20-31	6-19	4,17	21	6	14 May-13 June in Taurus	2,10,19,20,29,30	6,14,15,24,25	12,13,22,23,31	8,18,27
June	5	18	3	1-3,19-30	4-18	1,14,28	17	3	14 June-15July in Gemini	6,7,16,25,26,30	2,3,11,21	8,9,18,19,27	4,5,13,23,24
July	3,30	17	2,31	1-2,18-31	3-17	11,25	15	2,30	16 July-15 August in Cancer	4,13,14,23,31	8,9,18,19,27	6,15,16,24	2,10,20,21,29
August	27	16	30	17-30	1-16,31	7,21	11	27	16 August-15 September in Leo	9,10,19,28	4,5,14,15,23,24,31	2,3,12,22,30	4,13,17,26
September	23	14	28	15-28	1-14,29-30	3,17	8	23	16 September-17 October in Virgo	5,6,15,16,23,24	10,11,20,29	1,9,18,26	12,13,22,30
October	21	14	29	15-28	1-14,29-30	15	6	18	17 October-15 November in Libra	3,4,12,13,21,22,30,31	8,17,25,26	5,6,23,24	1,10,11,19
November	17	12	27	13-27	1-12,28-30	11,24	2	14,30	15 November-14 December Scorpion	9,17,18,26,27	4,5,13,14,22	1,2,20,29,30	7,15,16,25
December	14	12	26	13-26	1-12,27-31	8,21	27	13	15 December-14 January in Sagittarius	7,14,22,25	1,2,11,19,29	8,9,17,26	4,5,12,13,15,22,31

Perigee (Pg, Full Moon)
The point where the moon is closest to the earth. Apogee (Ag, New Moon)-The point where Moon is farthest from the earth. Moon again returns to perigee and apogee in 29.5 days. Node-The point where Moon crosses Path of the Sun is called as node. Node days are not suitable for doing any agricultural activity. Ascending-Increasing arc of the Moon. Descending-Decreasing arc of the Moon. Moon opposite to Saturn-Suitable for doing all agricultural activities. Zodiac signs corresponding to elements-Virgo, Capricorn and Taurus-Root or earth days. Cancer, Scorpion and Pisces-Leaf or water days. Gemini, Libra and Aquarius-Flower or Air days. Sagittarius, Aries and Leo- Fruit/Seed/Fire days. Sowing-48 hours before the full Moon are most suitable.

The essential components of natural farming formulated in 2004 by Palekar are as follow (Palekar, 2021):

Seed treatment

The seeds are treated with *Beejamrit* and dried in shade before sowing so as to get better germination and high seedling vigour. *Beejamrit* is prepared as follow:

5 kg cow dung + 5 L cow urine + 50 g lime + about hundred-gram dry soil from the cropped/cultivated field (c/cf)+ 20 L water are mixed together in container and kept for 24 hrs. This mixture is stirred at least two times by wooden stick in 24 hrs. In this mixture 100 kg seeds are added and mix properly. Such seeds are dried in shade and sown in the field. *Beejamrit* has anti-oxidant properties and have millions of microbes which enhance germination, sustain very good seedling vigour and reduce seedling mortality.

Soil Treatment

Soil is treated before sowing by *Jeevamrit*. It contains millions of microbes which help in releasing soil nutrients to roots for better plant growth. *Jeevamrit* is prepared as follow:

Cow urine 5-10 L+ cow dung 10 kg + solid jaggery 1-2 kg +1-2 kg legume seed powder + 100 g dry soil form c/cf + 200 L water are mix properly in a container and covered with jute bag. Stirring of this mixture is done clockwise in morning and evening. After 48 hours of incubation, the mixture is filtered and used for treating soil. This *Jeevamrit* should be used within 7 days after preparation. To take a crop soil is treated 5 times as follow:

- 200 L *Jeevamrit* is sufficient to treat 0.4 ha (i.e.1acre) land area.
- After one month of sowing 5 L *Jeevamrit* mixed with 1000 mL water is sprayed on 0.4 ha land area.
- After 21 days 10 L *Jeevamrit* mixed with 150 L water is sprayed on crop.
- At interval of 21 days 20 L *Jeevamrit* mix with 200 L water is sprayed over one acre crop land area.
- Final spray is done at milking stage of crop by mixing 5-10 L sour butter milk (chaach) with 200 L water.

Note: Soil treatment is labour intensive practices. However, treatment of soil with *Jeevamrit* does not require more than one irrigation to wheat crop.

Jeevamrit is very effective source of nutrients because it is a rich bioformulation which contains a consortium of microbes consisted of nitrogen assimilation, nutrient release and quick decomposing microbes as mentioned in Table 3.

Soil Application

In the absence of Jeevamrit, the nutrients are added in soil through Ghan Jeevamrit by applying its powdered form in the field. Ghan Jeevamrit is prepared as follows:

100 kg cow dung + 1 kg powdered legume seeds +100 gm dry soil from c/cf+5 L cow urine are mixed thoroughly to form a paste. This paste is covered with jute bags for 48 hr in shade. After this, it is allowed to dry which is powdered and filled in the bag. This can be used for 6 months after preparation. 100 kg *Ghan Jeevamrit* is required for 1 acre land area.

Note: This technique is handy but requires about 5 irrigations to wheat crop. Water requirement could be reduced through mulching and furrow irrigation.

Irrigation and Mulching

When *Jeevamrit* is used as fertilizer, only one irrigation is required during entire crop growth and that too for soil preparation and seeds showing. Five sprays of *Jeevamrit* take care of water requirement of any annual crop. However, the use of *Ghan Jeevamrit* as fertilizer, the crop is irrigated 3–5 times as per need. Mulching of land with any dry straw is done with view to reduce evaporation and maintain high soil moister, provide shade on soil surface and maintain 25–30^{o}C soil temperature. These conditions, help in enhancing the activity of soil microbes and Indian earthworms and there by releasing more soil nutrients for plant growth. Besides this, the higher microbial activity enhances the decomposition of wooden mulch material and there by fast nutrients recycling.

Plant Protection

Visualising the lethal effect of chemical insecticide, fungicide and pesticide on human health, environmental pollution, ground water pollution and contamination of edible grains, Palekar developed organic insecticide and fungicide in1988 (Palekar, 2021). The plant leaves, cow dung and urine, butter milk, tobacco leaves, chillies, asafoetida, turmeric, ginger and garlic which are health and eco-friendly and many of that form the constituents of our daily diet are used to prepare pesticides. The details about that are discussed below (Palekar, 2021):

- Phafudinashak (Fungicide):

5 L sour butter milk (3-4 days old) mix with 200 L water when sprayed on crops the fungus are killed.

- Keetnashak (Insecticide):

a. ***Neemastra:*** It is sprayed on the crop to kill sucking insects, larvae, pupa, beetles, and grasshoppers. Following components are mixed to prepare Nemastra

Neem leaves/ fruit 5 kg + Indian cow urine 5 L + Indian cow dung 1 kg + water 100 L.

Leaves of neem/ fruit are crushed and added in water. There after cow dung and urine are added and mixed thoroughly with help of wooden stick. This container is placed under shade for 48 hours and covered by jute bags. The mixer is stirred with

Table 5: Effect of Agnihotra + organic farming on powdery mildew (*Spaerotheca pannasa*) disease incidence (%) in rose and disease incidence (%) and yield (ton/hectare) of cabbage and potato).

Treatments	*Rose disease*	*Cabbage disease*	*Yield of Cabbage*	*Potato late blight*	*Yield of Potato*
Organic	4.4	5.0	64.3	65.0	8.4
Organic+ Agnihotra	2.9	3.0	69.2	11.0	9.6
Conventional	12.3	25.3	52.3	65.0	4.2
Control	25.9	45.2	46.3	80.0	2.5

(Adopted from Selvaraj, et al., 2009)

wooden stick clockwise daily in morning and evening. This is filtered using cloth and sprayed on crop Table 5.

b: ***Agniastra***: Similar to *Neemastra* it is sprayed on crop to kill sucking insects, larvae, pupa, beetles and grasshopper. This has following constituents:

Indian cow urine – 20 L + Neem leaves 5 Kg + Tobacco leaves powder 500 g + pungent green Chillies paste- 500 g + Indian garlic paste – 500 g.

Finely cut Neem leaves and other materials are mixed with cow urine and heated on low flame till boiling. This mixer is placed under shade and stirred morning and evening with a wooden stick. It is filtered with cloth. Six L of filtered mixture is mix with 200 L water and sprayed on crop to control the insects. Active, life of this mixer is expired within three months.

c: *Brahmastra*: Spraying of this control big sucking insects, beetles and grasshoppers. *Brahmastra* is constituted with following:

Desi cow urine – 10 L + Neem leaves 5 kg + paste of leaves, 2 kg each of guava, papaya, mango, and castor. Mix the paste of these leaves in cow urine. Heat on low flame till boiling. Keep it in shade for cooling for 48 hrs. Filter with cloth. 2.5 – 3.0 L filtrate is mixed with 100 L water and sprayed on 1 acre land to kill the insects. This extract is effective for 6 months.

d: *Dasparni* Ark*:*** This is sprayed on crop to kill all type of insects. This ark is prepared as follows:

Water 100 L + Indian cow dung 2 kg + leaves of Neem/ Castur/Bel/Sitaphal/Genda/Tulsi/Dhatura/Mango/Guava/Anar/ Pungent/karela/Goldmohar/Arjun/Kaner/Papaya: Leaves of any 10 plants each of 2 kg is used + turmeric pastes 500 g +ginger paste – 500 g + asafoetida – 10 g + Tobacco leaves – 1 kg + pungent green chillies – 1 kg + Desi Garlic pest – 1 kg.

Mix well all with wooden stick. Cover with jute bag and keep in shade for 30-40 days. Stir well two times in a day. Filters with cloth and keep extract in separate container. Six litre of extract can be added in 200 L water and sprayed on 1 acre crop. The affectivity of extract expires after six months.

Reasons for Soil Sickness and Health Hazardousness under Chemical Laden Farming

Like allopathic medicines, the merits and demerits of chemical laden farming is most convincing (Fig. 1). Visualising some cultural practices like preparation of land, irrigation, harvesting of crop, storage of crop produces etc. common to natural/ organic/biodynamic/homa/chemical laden agriculture, it has become essential to know the detailed reasons for not getting recommendations from scientific and farmers community to follow chemical laden agriculture. Understanding of this will help in conserving, prolonging and sustaining the utilities and advantages of natural, organic, biodynamic, or Homa agriculture over chemical laden agriculture. Reasons for soil sickness and health hazardousness due to chemical laden farming is illustrated in Fig. 4.

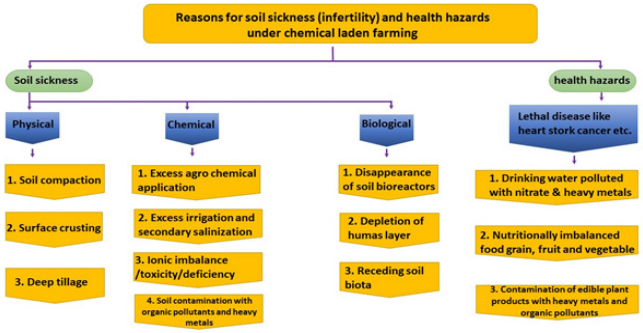

Fig. 4: Soil sickness and health hazardousness as the outcome of present chemical faming system.

(A) Physical

- **Soil compaction:** Soil has potential to withstand 32kg pressure per square foot at which soil air and moisture film are not disturb. However, due to regular use of heavy machinery soil have become compact and its air and water film have been reduced. Consequently, root movement and water penetration in soil is restricted and there by crop growth and yield are reduced (Ahmed *et al.,* 2007 Srinivasrao *et al.,* 2021).
- **Soil crusting:** Due to mono culture: rice-wheat rotation, top six inches soils are in action and dry out quickly in absence of mulching. Clay particles in soil are easily dispersible when water recedes and the clay is filtered on the surface and form a hard crust. Since, the soil biota including earth worms disappeared due to chemical laden agriculture, the top soil is not connected well with down one. The supply of both water and nutrients are impeded to surface soil and require frequent irrigation and nutrient supply to meet crop requirement. This further harden the soil and increased cost of cultivation and there by reduces net profit.

Secondly, inorganic nutrients/chemical fertilizers are present in cations – anions or acid–base forms. After application in the soil, these ions occupy places on clay exchange complex and pore space. For example, exchangeable/absorbable nitrogen in urea is 46%, K in potassium sulphate is 48%, and P in super phosphate is 16%. The rest of the portion is base present in pore space which work as a cementing agent for soil particles and thereby cause hardening of soil (Palekar, 2021).

- **Deep Tillage:** Deep tillage or ploughing result soil compaction and reduce overall porosity, water holding capacity and overall hospitable environment to plants (Daan, 2013; 2019). As a result, farmer has to water more which increases the risk of soil erosion during heavy rain (Singh *et al.,* 2019; Sreekanth *et al.,* 2017). Secondly, the natural micro and macro biome of soil such as bacteria, fungi earthworm and insects are disrupted due to sub soiling caused by deep tillage. In fact, these organisms contribute to stability and porosity of soil structure as well as the richness of soil in form of organic matter due to breaking down of plant residues and soil mulching materials. Mineral elements are made more available by these organisms for plant growth (Dhrunarayan and Babu, 1983; Mythili and Goedecke, 2016). Thus, deep tillage provides un suitable environment to plants by bringing sub soil on surface layer (Ahmad,*et al.,* 2007; Srinivasrao *et al.,* 2021).

(B) Chemical

- **Ionic imbalance, deficiency and toxicity:** In present system of chemical laden agriculture besides fertilizers, essential

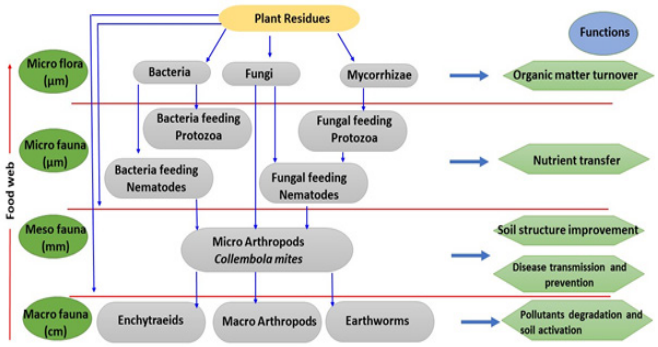

Fig. 5: Role of soil biota in soil activation, nutrient release and pollutants & disease elimination (Soil tropic level: © 2012 Nature education adopted from Gupta *et al.,* 1997).

heavy metals, plant nutrients, weedicides, insecticides, and fungicides are used as per demand of crops. The ionic imbalances in soil are created because of receding soil organic carbon and secondary because only part of nutrients is absorbed, some part is fixed and become available and rest is leached to ground water. For example, only 42–60% plant nitrogen is absorbed and rest is leached out. In absence of humus there is no buffering media to maintain ionic balance (Srinivasarao *et al.,* 2017). Consequently, deficiency and toxicity of secondary and micro nutrients appears (Dwivedi *et al.,* 1975). The yield of crop is reduced and cost of cultivation and demand of additional nutrient is increased (Dwivedi, 1986; Anonymous, 2012).

- **Excessive irrigation and secondary soil salinization:** Maharashtra state in India is a burning example where to get higher yield of sugarcane to an extend of 150 tonnes per hectare, 30-45 irrigations were given as compare to that of 5-12 in other states. This has resulted soil salinization in an area of about 100 km^2 land due which Sanghali Sugar and Khandasari Mill (Sanghali) an Shri Datta Sugar mill (Kolhapur) are almost closed and now even weed are not growing (Dwivedi, 1993). It has been estimated that heavy irrigation under chemical laden farming is causing secondary salinization in the range about 0.2m ha -1.7million-hectare annually in India (Dwivedi, 1993).
- **Flooding, surface water runoff and soil erosion:** Because of soil compactness and poor soil aeration, even light rainfall result flooding, surface water runoff and there by soil erosion too (Ahmad *et al.,* 2007; Lal *et al.,* 2018). This causes contamination of both surface and under groundwater with heavy metals used in different Agro-Chemicals. Nitrate, Arsenic, Lead and Cadmium are most common pollutants of water which are added significantly due to present chemical laden agriculture. This process also makes the soil poor in fertility. Soil degradation, heavy metal accumulation, soil erosion, due to soil compaction was recently reviewed well by Shrinivasarao (2021).

(C) Biological

The soil is alive. In one tea spoon of agricultural soil there can be several millions of bacterial and fungal strands, thousands of flagellates and amoeba, hundreds of ciliates, nematodes and tiny insects and 5 or more earthworms. These are essential for healthy growth of plant (Du Pont and Beegle, 2012). All biotas are inter dependant. For example, tiny insects rip and shed leaves of plants, fungi and bacteria consume them and excrete sticky substances that holds the soil together into aggregates and provide food to entire web of organism. Nematodes consume fungi and bacteria and excrete ammonia an important source of N for plants. Plant residues add organic carbon in soil and promote the growth of fungi that excrete enzymes such as chitinase, which can break tough to digest materials. Mineral elements are released. Cations eg. Ca, Mg, K etc. are held on negative charged clay and Zn etc., on negative charged organic matter (humus or organic chelates) and thus become available to plants (Magdoff and Van ES, 2009). All these natural processes are jeopardised under chemical laden agriculture and soil becomes un productive. Further details are mentioned below:

- **Disappearance of soil bioreactors (Indian earthworms):** The Indian earthworms swallow/consume soil and act as bioreactor as a result of which soil is enriched with enzymes, available nutrients and fine and porous soil particles. All the earthworms are virtually died due to present chemical laden agriculture. Earthworms burrow soil upto 6-15 feet deep and come out on earth surface through another new pores. They repeat these actions many times during summer, winter and especially in rainy seasons and thereby make soil porous. Consequently, irrigation/ rain water is absorb in soil and become available to plants significantly for longer period as compare to soil devoid of earthworms. Secondly, the humus layer in soil is formed due to its interaction with stubble, dry leaves, roots and soil mulching plant materials. The soil become more fertile, organic carbon percentage increases and inorganic material become more available to plants under organic/ natural farming as compare to chemical laden farming (Kale and Karmegham, 2010). The functions of Indian earthworm in the soil have seen recorded as follows:

* Maintain dynamic equilibrium and regulate soil fertility

* Earthworms are decomposer of dead and decomposing organic matter and derive their nutrition from bacteria and fungi that grow there.

* They fragment organic matter and make contribution in recycling of nutrients.

Earthworms serve as indicator of contamination of pollutants, agrochemicals, heavy metals, toxic metals and industrial effluent, deforestation as they die or disappear. Whereas, humus induced activities and good land management keep them active.

- **Soil biota:** Soil biota forms trophic levels in soil food web and play significant role in organic matter turnover, nutrient transfer, soil structure improvement, disease transfer and prevention and pollutant degradation and soil activation. They disappear in chemical laden farming and soil become sick. Soil biota is consisted of microorganisms (bacteria, fungi, Archaea, and algae) soil animals (protozoa, nematodes, springtails, spider, insects and earthworms) and plants (Soil quality institutes, 2001). Soil biota is classified into three groups:

* *Macrofauna*: Enchytraeids, Earthworms, Macro-orthopods. These macrofauna can be measured in centimetre. They form

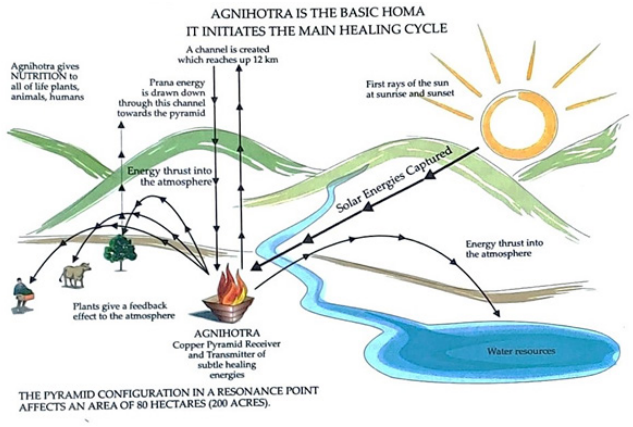

Fig. 6: Current findings on mode of action of *Agnihotra-Homa* therapy in controlling environmental pollution and plant and human diseases and regulating plant -animal nutrition though capturing solar energy (Berk and Johanson, 2009; 2020).

the base of trophic level in soil food web (Fig. 5)

* *Mesofauna*: micro-orthopods, mites, collembolan. These can be measured in millimetres.
* *Microfauna*: Protozoa, nematodes. These can be measured in micro meters. Some details about earthworms have been discussed above.

Plant growth promoting rhizobacteria (PGPR) present in soil (Bhattacharya, 2012) play significant role in alleviation of drought stress in plants by producing osmolytes like exopolysaccharide (EPS),1-aminocyclopropane-1-1carboxylate (ACC) and volatile compounds. The phytohormones, deaminases and antioxidant accumulation, up regulation /down regulation of stress responsible genes and alteration in the morphology of roots are also caused which results PGPR induced systemic tolerance (IST) in plants to withstand drought. (Vurukonda *et al.,* 2016). However, PGPR in general, has been found to result better growth of plants under field conditions (Bhattacharya, 2012). Soil biota has potential to regulate greenhouse gases (Fortuna, 2012), mitigate climate change adverse effect, deactivate pollutants and drive ecosystem stability (Yang and Ralig, 2018).

Natural farming encourages growth and development of soil biota and there by sustain good soil health, disease tolerance in plant and higher crop productivity unlike that of chemical laden farming. Importance of trophic level in soil food web and its role in soil health is illustrated in Fig. 5 (Gupta *et al.,* 1997).

Human Health Hazardousness

Soil, water, air and edible product quality deterioration and pollution due to chemical laden farming is a great threat for human survival. Because, a human cannot survive without air for more than three minutes, without water for more than three days and without food more than 30 days. Food and water can be transported from other places but air cannot. Hence presence of pure local air is most essential.

Secondly 40-60% of nitrogen is absorbed by plants and rest is leached to ground water. Thus, drinking water is polluted not only by NO_3 but by heavy metals and other chemicals complex least to ground due to use of insecticides, fungicides and herbicides. Intake of all such pollutants components results stroke, heart diseases, lung cancer, acute and chronic respiratory diseases, accruing to about 1.7 million death per annum in India (Lancet report, 2020) and 4.2 million per annum in the world due to outdoor pollution as per WHO (Max Roser, 2021).

An agriculturally developed state like Punjab in India, has become Capita of Cancer with 90 patents per 1 lakhs people against that of 80 as national average. Bhatinda and adjoining villages of Punjab have recorded 136 cancer patients per 1 lakhs people in 2013 (Singh, 2013). Consequently, a train called as "Cancer train" or "Punjab cancer train" run from Bhatinda to nearest cancer hospital named as *"Acharya Tulshi* Cancer Hospital and Research Centre" Bikaner (Rajasthan, India) for the treatment. The train carries at least 100 patients daily. Similarly, a cancer train running daily from Kapurthala (Punjab) carries 100 of patient daily to Chandigarh cancer hospital for treatment. These are disastrous apathies of chemical laden farming and need to be rectified.

Biodynamic Agriculture

The English word Biodynamics was derived from Greek word "Bios" means life and "dynamic" means energy (Greek civilization 1200 BC- 600 AD). This Greek word appears to be translation of Sanskrit word *"Jeevityorjavanum Krishi"* which was popular in India since about 10000 BC and Vedic era/Krishi 1500BC-500BC. In Sanskrit *Jeevitva* mean living and *urjavanam* means energy and Krishi means Agriculture.

In Indian literature organic agriculture (Biodynamic and Agnihotra farming etc.) is describe in Artherveda (1500BC-500BC) however, visualizing in western literature the biodynamic faming was spawned by Late Anthroposophist, Rudolf Steinar which become popular since 1922 (Pathak and Ram, 2004).

Biodynamic farming refers to working with energy which creates and maintains life. In biodynamic agriculture, the use of all five energies e.g. Earth, Water, Air, Fire and Cosmic are utilized judiciously. In fact, when soil is balanced then only healthy plant will grow and transmit both life giving and life maintaining substances and the energy food on which human and animal survival is based. It has been observed that in this system energy from Cosmas, mother earth, cow and plants are systematic, complimentary and harnessed synergistically. Biodynamic agriculture is based on following eight principles as narrated by Pathak and Ram (2004).

- Restoration of the soil, through incorporation of organic matter in the form of humus, which holds its fertility,
- Augmentation and maintenance of soil activity since soil is a living system,
- Maintaining higher level of organic matter as the basic factor for soil life,
- Biodynamic method is not only fertilizing the soil but skilful application of factors contributing to soil life and health,
- Establishing a system that brings into balance all factors which maintain life,
- The biodynamic way on the knowledge of enzymes, hormones and related factors besides treating manure and compost are also considered.
- It puts special emphasis on the importance of crop rotation, green manuring and cover crops,
- Soil is not only a chemical, mineral or organic system, but it also has a physical structure. Maintenance of a crumbly, friable, deep, well aerated structure is essential features of biodynamic agriculture.

In biodynamic farming all agriculture operations starting from preparation of soil, planting to harvesting and storage of crop produce are done as per cosmos oscillation and interaction period and especially of moon ascending and descending period. Almanac prepared in India based on mathematical calculation and star movement take care of agriculture operation. A biodynamical calendar for farming and gardening is cited in Table 4. All dates corresponding to agricultural operations are mentioned for year 2004. For every year agriculture Almanac (time table) varies. Performing of agricultural operations as per Almanac result better germination, least pest attack, higher yield and superior storage environment to crop produce. Farmers have to visualize agricultural activity as per time table.

Critical Scientific Comments

Under current age of fast communication, the biodynamic agricultural practices appear to be cumbersome. Secondarily still about 65% Indian agriculture is rain fed and depend on monsoon rain and nature rain distribution. Hence as per biodynamic calendar, the agricultural operations may not coincide with the rainfall. This may lead to agriculture failure and very poor crop productivity and production. Palekar also agrees that cosmos energy affect plant and animal lives but in absence of detailed practical information under changing environmental conditions, it is not advisable to follow. Studies are therefore, required to understand biodynamic in detail so as to suit to all agro climatic conditions and assure higher crop productivity and there by food security.

Perigee (Pg, Full Moon)

The point where the moon is closest to the earth. Apogee (Ag, New Moon)-The point where Moon is farthest from the earth. Moon again returns to perigee and apogee in 29.5 days. Node-The point where Moon crosses Path of the Sun is called as node. Node days are not suitable for doing any agricultural activity. Ascending-Increasing arc of the Moon. Descending-Decreasing arc of the Moon. Moon opposite to Saturn-Suitable for doing all agricultural activities. Zodiac signs corresponding to elements-Virgo, Capricorn and Taurus-Root or earth days. Cancer, Scorpion and Pisces-Leaf or water days. Gemini, Libra and Aquarius-Flower or Air days. Sagittarius, Aries and Leo-Fruit/Seed/Fire days. Sowing-48 hours before the full Moon is most suitable.

Homa Organic Farming

Due to hybrid pollution of living components like soil, water, sub soil water and air which are essential for survival of living beings in an ecosystem have now become sick. Consequently, the organic forming (Lord Northbourne; Walter James; Albert Howard: considered as originator/ founder/father) which was giving wonderful positive results 10 to15 years ago has now become uneconomical and fail to give higher yield (Johanson and Heschi, 2009; Berk and Johanson, 2009). Metallic, non-metallic and gaseous toxicants and pollutants of various types have resulted disorders in nutrients, gases, micro and macro biota, essential and complimentary for the survival and growth of plant, animal and human. All these have gone out of order and attained irreversible state.

Homa therapy an ancient "Indian vedic science" promulgated by an Indian Sant Paranjpe 1989 and called as "Yagna" or "Yajna" or "Yagya" have given the hope of rescue and relief from such deteriorated state.

Few experiments conducted on homa therapy under deteriorated environmental conditions in different parts of world viz: USA (Paranjpe, 1989; Rathner, 2009), Poland (Bizberg, 2009; Weir, 2009), Germany (Berk, 2009; Berk and Johanson, 2009; 2020), South America (Hernandez and Macan, 2009; Garcia, 2009), Turkey and middle east (Szcypior, 2009) and India (Pathak and Ram, 2004; Pathak, 2009; Selvaraj *et al.,* 2009; Bhujbal, 1981; Paranjpe, 1989) have confirmed its effects on environmental rejuvenation, receding of pollution and insect attack on plants, control of plants and human disease and significant improvement in crop yield and quality.

Homa therapy means healing of environment, the atmosphere and the life. The basic tools in Homa therapy are "Agnihotra" – a small fire prepared in a "Copper pyramid" exactly to synchronize with arrival of first ray of sun rise and last ray of sun set. The details about agnihotra have been describe by Pathak and Ram (2004); Johnson and Heschl (2009); Berk and Jonhonson (2020) and presented here diagrammatically in Fig. 6 to illustrate the process and mode of action of Agnihotra in reclaiming edaphic and atmospheric conditions and improving animal and human health.

How does Homa Work?

Homa heals the environment and thereby improves polluted soil, water, air and ground water. Microorganisms, microbiota and predator population protecting plant surface and towards of disease and pests and raise crop yield and quality are enhanced. There are two views through which Homa works:

- *Ancient views*: At sun rise many fires, electricity, ethers and more subtle energies emanating from Sun and reaching to earth produce a flood effect giving a music that can be heard even today for some time at silent places.

The morning Agnihotra mantra is the essence of that music. At Sun set the flood receded. Agnigotra along with mantra activates the quintessential sound of that flood which is maintained till sun rise. Mantra in Sanskrit is quintessential sound of that music and should be chanted in Sanskrit only (Berk and Jonhonson, 2020). This sound enlivens and purify everything in its path destroy impure components in its wake making all life to rejoice (Paranjpe, 1989).

- *Modern Views*:

* Using Oscilloscope, the special sound in Homa fire have been recorded. It interacts with sound of Mantra and that creates resonance effect. This invigorates the cells of plants leading to better reproductive cycle (Heschl, 2009).
* FIR (Far Infrared) rays which are considered as positive energy is more specifically produced when transitional elements are heated and furthered by their oxides. Copper oxides are produced during Agnihotra. FIR of 4-27µm wavelength is absorb deep upto 3-5 cm in any living bodies. This interacts with human body, produces useful chemicals and improves physiology (Shendye, 2009).

Specific FIR is known to kill microbial cells and inhibit cancer cells growth. The aforesaid activities might be reason for killing

insect diseases, harmful microbes and induction of resistance against diseases in plants and finally improvement in their productivity and quality (Shendye, 2009).

* The effect of Homa therapy on purifying water quality and alkaline, sodic and acid soils, soil microbe, soil biota population, reducing radioactivity (recorded in Australia), air pollution and raising crop yield and crop productivity was reviewed by Berk (2009). Its effect is illustrated in table 4.
* Same human efforts are required to heal 1-200 acre land area. One resonance point can heal upto 200 acres (80 hectare of land).

Critical Scientific Comments

Homa therapy (Agnihotra) has been tested widely and very good results have been recorded. However, performing of Agnihotra daily at morning and evening appears to be cumbersome. Secondly, environmental activities eg. winds and storms movement, sun shine hours, cloudy conditions and rainfall will affect spread of Homa smokes and harnessing of solar energy. Hence, Agnihotra might become effective if entire region follows Homa practice. Thirdly, it requires cows' ghee (a costly input) and cow dung cake daily. Amendments in Homa therapy may be searched out for its quick and wider adoption.

Why Natural Farming be Evaluated?

There are as many as 15-127 agro climatic regions (ACR) in India, classified by National Agriculture commission, 1971 and National Agricultural Research Project and National Bureau of soil survey and land use planning (NBSS and LUP, 1971). However, the cultivation of annual and perennial food grain, vegetable, horticultural, fruit trees and plantation crops differ under different agro climatic conditions. Soil type, temperature, rainfall, and crop productivity also differ in these regions. Natural farming or zero budget farming results were very good but it was initially tested in Amarawati district and adjoining, area in Maharashtra State representing western plateau and hills. Hence, suitability of natural farming be evaluated at least in eight agro climatic zones/regions (ACR) recognized by ICAR-AICRP on Vegetable crops) (ICAR-AICRP-VG2013) as mentioned below:

- Humid Western Himalayan Region: (J.K., HP, Uttarakhand)
- Humid Bengal-Assam Basin: (West Bengal and Assam)
- Humid Eastern Himalayan and Bay Island: (Sikkim, Meghalaya, Manipur, Nagaland, Mizorum, Tripura, Arunanchal Pradesh, Andaman & Nicobar Island)
- Subhumid to Humid Eastern and South east plain: (Chattisgarh, Orissa, Andhra Pradesh)
- Subhumid Sutlaj Ganga Alluvial Plains: (UP, Punjab, Bihar, Jharkhand)
- Arid Western Plains: (Rajasthan, Gujarat, Haryana, Delhi)
- Semi-arid Lava Plateau and Central High Land: (MP, Maharashtra, Goa)
- Humid to Semi-Arid Western Ghat and Karnataka Plateau: (TN, Karnataka, Kerala, Pondicherry)

It is interesting to note that a crop (Annual or perennial) does grow in more than one ACR. But its same variety does not perform well in all the zones and require replacement by new genotype adaptable to that zone for getting better growth and yield. Hence natural farming technology should also be tested based on the same principle in different zones so as to find out its suitability and effectiveness on crop yield. Besides this, following are the known reasons why natural farming technology be evaluated.

- Variation in soil types and their organic matter contents in inter and intra ACR.
- Intensity of rainfall and its distribution also vary in inter and intra ACR.
- Variation in crop types and their nutrients and water requirements under varying soil type and hydro, humid and thermal conditions.
- Types and intensity of insect pest attack and plant protection practices differ in different ACR.
- Variation in self-life of crop produce and deterioration in their quality under varying hydro, humid and thermal surrounding.

The aforesaid variations are natural and beyond human control. Secondly to attain satisfactory results, the amendments in technologies and doses should be attempted keeping environmental conservation and control of edaphic and atmospheric pollution, chemical contamination and concept / practices of zero budget natural farming and sustaining of higher crop yield in mind.

Conclusions

Natural farming technology appears to be self-sustaining organic agriculture since, it uses locally available natural inputs consisting of native soil microbes, green and dry parts of different plants, Indian cow products especially urine and dung, soil mulching, homemade natural pesticides, etc. This promotes soil biotas including different microbes, earthworms, soil bioreactors, etc controlling nutrients fixation, release and availability, and soil-plant health. However, this technology may be tested under different agro-climatic conditions and if, necessary it's treatments be modified to combat impetigo limiting higher crop productivity keeping soil and human-health-friendly environment and national food security in mind. Regarding agnihotra and biodynamic organic agriculture, there is need for more research and tests to understand their utilities and methodologies for adoption under different agro-climatic conditions in the present era of environmental warming, rising pollution, and soil-plant-human health disorders.

Acknowledgement

Authors are thankful to Prof. R. P. Singh, Secretary, PHSS Foundation for Science and Society, Lucknow-226025, for encouraging us to write this article. Thanks, are also due to Mr. Anchal Jain and Mr. Krishna Singh for their help in preparation of manuscript.

References

Ahmad, N., Hassan, F. and Qadir, G. (2007). Effect of subsurface soil compaction and improvement measures on soil properties. Int. J. Agric. Biol. 9:509–513.

Alam, A (2014). Soil degradation: a challenge to sustainable agri culture. Int.J.Sci.Res.Agri.Sci. 1(4):50-55

Anonymous (1974). Annual report on "All India coordinated project on micro nutrient and nutrition, soil test and plant response. PAU Ludhiana, Punjab.

Anonymous (2012). CSWCR&TI Annual Report. Central Soil Water onservation Research and Training Institute, Dehradun.

Anonymous (2020). Annual report on "All India coordinated project on micro nutrient and nutrition, soil test and plant response. PAU Ludhiana, Punjab.

Berk, U. (2009). Agnihotra and homa therapy – scientific perspective Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefold Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 46-52

Berk, U. and Jonhonson, B. (2020). Agnihotra and its impact on environment and human health. Kahaar 7(1-2): 24-30

Berk, U. and Johanson, B. (2009). Brain storming conference in cooperation with Planning Commission Govt. of India: Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 98.

Bhattacharya, P. N (2012). Plant growth promoting rhizobacteria: Emergence in agriculture. World J. Microbiology Biotechnology 28(4):1327-50

Bhujbal, B.G. (1981). Agnihotra and grapes. Biochemistry 120:105-125 (https://www.agnihotra.org/2015/03/15/agnihotra-and-grapes/)

Bizberg, J. (2009). Homa organic farming in Poland miraculous success in acid soil. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 36-37

Bunemann, E. K., Bongioron, Z.G., Bai Rachel Creamer, G.B., de Deyn, R.G.M., de Goede, L., Fleskns, V., Geissen, T.W.M., Kuijper, Paul Mader, M.M., Pulleman, W., Sukkel J.W., van Groenigen, L., Brussard. (2018). Soil quality -A critical review. Soil Biology and Biochemistry 120: 105-125 Daan, (2013). Healthy soil microbes: healthy people- The Atlantic (online available). https://www.theatlantic.com/health/archive/2013/06/healthy-soil-microbes-healthy-people/276710/

Daan (2019). Soil compaction/UMN extension (online available https://extension.umn.edu/soil-management-and-health/soil-compaction) Devvrat, A. (2022). Thoughts of Acharaya Devvrat: Natural farming. Self- tested first and then spread to millions of farmers. Loksamman 16(1): 16-17.

Dhruvanarayana, V.V. and Babu, R. (1983). Estimation of soil erosion in India. J Irri. Drain. Eng.109 (4): 419-434

Du Pont, S.T. and Beegle, D (2012). Soil quality concepts. Penn state extension. National institute of Agriculture, USDA grant, 2009-49400-05869.

Dwivedi, R.S.(1993). Sugarcane Management on Salt affected Soils. IISR, Lucknow (TIFAC-ICAR project) report pp 62.

Dwivedi, R.S.(1986). Mineral Nutrition of Ground nut. Metropolitan Book Co., New Delhi.

Dwivedi, R.S., Randhawa, N.S, Takkar, P.N, Bansal, R.L. (1975). Phosphorus and zinc Interaction 1: Sites of zinc accumulation at high level of phosphorus. Plant and Soil, 43,639-48.

Fortuna, A.M. (2012). Soil Biota. Nature education Knowledge 3 (10): 1-8 Garcia, I. (2009). Homa organic farming and Banana. Proceeding of Bringing

homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 28-32

Gerlecka, E. (1988). Observation with agnihotra ash and water. Satsang 16 (1-3):1-25, . Fire fold path INC, medison VA, USA

Gupta V.V.R.et al. (1997). Life in Soil. Adelaide, Australia Cooperative Res. Cent. for Soil and Land management, CSIRO, University of Adelaide (1997). Hernandez, A. and Macan, A. (2009). Experience with homa organic farming in Peru. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefold Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 26-27

Heschl, K. (2009). Experience with agnihotra and radio activity. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 44

ICAR (AICRP-VG) (2013). (1971-2013), Agro Climatic regions (ACR). Released by Indian Agricultural Statical Research Institute, New Delhi 110025, India. Interaction 1: Sites of zinc accumulation at high level of phosphorus.

Johanson, B. and Heschil, K. (2009). Homa Organic farming. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 26-27

Kale, RD. and Karmegham, N. (2010). Topics with emphasis on Indian ecosystem. Environmental Soil Science. Review article/ open access. Article ID 414356/http://doi.org/10.1155/2010/414356.

Kumar, C.A. and Singh, K.K. (2021). Traditional agriculture-metrological knowledge in ancient India. Rastra Dharma 75 (3): 35-58.

Lal, M., Patidar, J., Kumar, S. and Patidar, P. (2018). Different integrated farming system model for irrigated co ndition of India on basis of economic assessment: a case study: a review.Int. J. Mol. Sci .6(4): 166–175

Lancet Report, (2020). Air pollution killed 1.7 Indians. J. Lancet Planetary Health. Down to Earth. (http://wwwdowntoearth.org.in)

Lok Samman (2022). Many problems-One Solution: Natural Agriculture. b. Food Series Environmental diversion /warming. Natural Agriculture as a solution. (ed.Rai. SS). 16(1):3-4 (English translation from Hindi)

Magdoff, F. and Van E.S. (2009). Building soil for better crops. Beltsville, Md: Sustainable Agriculture research and Education Programme .15. Management, CSIRO, Univ. Adelaide (Australia).

Max Roser. (2021). Global death toll from air pollution. WHO:7 millions (outdoor-4.2million and Indoor-3.8 millions) WHO (http://www.who.int.>health-topics.)

Misra, V., Tiwari, A., Aadhar, S. Ah, R., Xia, M.U. and Pal, D.S. 2019. Drought and Famines in India1870-2016.https://doi.org/10-1029/2018GLO81477. (agupubs.onlinelibrary.Wiley.com.)

Mukerjee, M. (2014). Bengal famine of 1943.An appraisal of famine inquiry commission. Economic and Political Weekly 49(11):71-75

Mythili, G. and Goedecke, J. (2016). Economic of land degradation in India. In Economics of land degradation and improvement-A Global Assessment for sustainable development (eds Nkonya, E. et al.) Springer Open Chapter 15, pp 431-4469.

National Bureau of Soil Survey & Land Use Planning (NBSS-LUP). (1971) https:// vikaspedia.in/agriculture/crop-production/weather-information/ agro-climatic-zones-in-india (cited on 10-09-2022)

Palekar, S. (2022). Many problems- one solution: Natural agricultural campaign. Loksamman 16 (1): 12-15.

Palekar, S. (2021). Subhas Palekar Prakrit Krishi (SPNF) Darshan aur Tantra. Published at, 19, Jayakalani sai nagar post, Amarawati, 444607, Maharashtra.

Panday, R., Basnet, B.B., Bhatt, P.S. and Tamrakar, A.S. (2014). Bioconcentration of heavy metals in vermi composting earthworm. (E. fetida, P. excanvatus and L. mauritii) in Nepal. J. Microbiology, Biotechnology and food science 3(5): 416-418

Paranjpe, V.V. (1989). Homa therapy–our last chance. The slandered reference book "Agnihotra and homa therapy." Agnihotra Press, INC, Madison VA, USA.

Pathak, R.K. (2009). Integration of organic forming system for sustainable mango and potato production. Eds. Berk, U. and Johnason, B. Bringing Homa organic farming into main stream of Indian agricultural system. Govt of India, Jalgaon Maharashtra. Pp 18-24

Pathak, R.K. (2018). Cosmic nutrient management. Fivefold path mission. Personal communication email pathkaramkripal@gmail.com, 9454974422

Pathak, R.K. (2019). Success story of cosmic production of vegetable crops. E mail: pathakramkripal@gmail.com, 945494422.

Pathak, R.K. and Ram, R.A. (2004). Manual on Vedic Krishi. Central Institute for Subtropical Horticulture, Lucknow, Army printing press, Lucknow pp 44-45.

Rathner, B. (2009). Homa Psychotherapy. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefold Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 97 Sadalge, N.B. (2018). Sikkim wins UN's OSCAR for the best policies to become world first organic state. India Today 17th October 2018

Selvaraj, N., Anita, B., Ranchana, P. and Xavier, K. (2009). Studies on the effect on agnihotra on the yield and quality of horticulture crops. Proceed- ing of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefold path Publications, Shree Nivas, 40 Ashok Nagar Maharashtra, pp 56-60

Shendye, A. (2009). Scientific basis of Agnihotra. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 61-62

Singh, R., Singh, H. and Raghubanshi, A.S. (2019). Challenges and opportunities for agricultural sustainability in changing climate scenarios: a perspective on Indian Agriculture. J. Tropical Ecology 60(2): 167-185.

Singh, J. (2013). Punjab cancer train. Down to Earth 2nd February 2013. Soil 43: 639-648, (htttps://www.downtoearth.org.in)

Sreekanth, M., Hakeem, A.H., Ahmed, Q.J.P. and Rashid, I. (2017). Low productivity of Indian agriculture with special reference on cereals. J. Pharma. Pharmacol 6(5): 239-243.

Srinivasarao, Ch., Indoria, A.K. and Sharma, K.L. (2017). Effective management practices for improving soil organic matter for increasing crop productivity in rainfed agroecology of India. Curr. Sci. 112: 1497–1504.

Srinivasrao Ch., Rakesh, S., Kumar, G.R., Manasa, R., Somashkar, G., Lakshmi, C.S., Kundu, S. (2021). Soil degradation challenges for sustainable agriculture in tropical India. Curr. Sci.120 (3): 492-500.

Szcypior, R. (2009). Experience with homa therapy in Turkey and Middle East. Proceeding of Bringing homa organic farming into the mainstream of Indian agriculture system. Fivefolds Publications Shree Nivas 40 Ashok Nagar Maharashtra, pp 33

Vurukonda, S. S. K.P., Vardharajula, S., Shrivastava, M., SkZ A. (2016). Enhancement of drought stress tolerance in crops by plant growth promoting rhizobacteria. Microbiol Res. 184: 13-24.

Weir,L. (2009). Preparation and application of Gloria Biosol. - ibid-Wicke, B. et al., (2011). The global technical and economic potential of bioenergy from salt affected soils. Energy, Envior. Sci 4: 2669-2681

Yang, G. and Ralig, M.C. (2018). How soil biota drive ecosystem stability. Trends in plant science 23 (12): 1057-1067