



E-ISSN: 2278-4136  
P-ISSN: 2349-8234  
JPP 2018; 7(1): 560-575  
Received: 16-11-2017  
Accepted: 18-12-2017

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## Cowpathy and Vedic Krishi to Empower Food and Nutritional Security and Improve Soil Health: A Review

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#### Abstract

The study aims to evaluate the efficiency and efficacy of some *cowpathy* and *vedic krishi* inputs, viz. Vrksayurveda, Panchagavya, Kunapajala, *Beejamrit*, Jeevamirrit, Compost tea, Matka khad, Vermiwash and Amrutpani with the objectives to enhance the biological efficiency of crop plants and food production for eco-friendly nutrient and disease management and improve soil health in organic farming. *Cowpathy* and *vedic krishi* techniques are low input costs, which comply well with the ecological and socioeconomic conditions of vast segment of farming community comprising of small and marginal farmers. All the *Cowpathy* and *vedic krishi* inputs were found quite effective in enhancing the productivity of different crops and suppressing the growth of various plant pathogens by producing antibacterial and anti-fungal compounds, hormones and siderophores. Application of *vermiwash* gave 60, 10, 26 and 27% higher yield in Knol khol ( $211.67\text{qha}^{-1}$ ), onion ( $177.81\text{qha}^{-1}$ ), French-bean ( $16.3\text{qha}^{-1}$  seed yield), Pea ( $16.3\text{qha}^{-1}$ ) and Paddy ( $28.45\text{qha}^{-1}$ ), respectively over control.

*Panchagavya* 6 per cent spray recorded significantly higher Capsicum fruit yield (30.25, 37.49, 48.91, 118.91, 96.15, 86.29, 47.81 q ha<sup>-1</sup> at 60, 70, 80, 90, 100, 110 and 120 DAT, respectively), N-fixers life (23.68, 25.59 at 60 DAT and 17.77, 17.18 X 10<sup>3</sup> at harvest during *kharif* and summer, respectively). Application of *kunapajala* (T-3) treatment was effective in enhancing the morphological parameters of the leaves of tomato plant followed by conventional farming (T-1) and organic farming (T-2). The beneficial microorganisms from *Panchagavya* and their establishment in the soil improves soil fertility and provide food grains free from the health hazards of using chemical fertilizers/ pesticides. *Vermiwash*, *Beejamrit*, and *Jeevamirrit* as foliar were also proved quite effective in enhancing the productivity of different crops and effective against various plant pathogens.

**Keywords:** Cowpathy, panchagavya, kunapajala, Jeevamirrit, *Beejamrit*, Vedic Kirshi, Nutrition security

#### Introduction

Historically, Maharshi Vasishtha served the divine “Kamdhenu” Cow and Maharshi Dhanvantari offered to mankind a wonder medicine “Panchgavya” (a combination of cow urine, milk, dung, *ghee* and curd). In Sanskrit, all these five products are individually called “Gavya” and collectively termed as “Panchgavya”. Panchgavya had reverence in the scripts of Vedas (divine scripts of Indian wisdom) and Vrksayurveda (Vrksha means plants and Ayurveda means health system). Indian cow breeds are unique and distinct species, both in their appearance and characteristics. Cow is the backbone of Indian culture and rural economy, and sustains our life; represent cattle wealth and bio-diversity. It is known as “*Kamdhenu*” and “*Gaumata*” because of its nourishing nature like mother, the giver of all providing riches to humanity and is a store of medicines. The Ayurveda, the ancient Indian system of medicine, has detail mentions of importance of cow’s milk, curd, *ghee*, urine in the treatment of various human ailments. Every product has distinct qualities and uses in health, agriculture and other fields (Chauhan, 2005; Achliya *et al.*, 2004; Saxena *et al.*, 2004) [21, 79].

Cowpathy has many beneficial implications in agriculture, organic farming as good quality natural manure and bio-pesticides and as alternate energy resources. Bio-fertilizer and pest repellants obtained from cow urine and dung restores micro-nutrients and fertility of the soil and provides food free from health hazards of chemical fertilizers and pesticides. No other fertilizer in the world is as cheap and harmless as dung fertilizer. Dung and urine also provide valuable alternate source of energy in the form of biogas, fuel and electricity. Cow urine as such and/or after addition of neem leaves is a wonderful bio-pesticides which do not

accumulate in the food chain and as such do not have the harmful effects like chemical pesticides. Cow dung is excellent farmyard manure and if processed into vermicompost, very small amount is sufficient for a large field. Though, the end user claims are many but scientific validation of those claims is required. The people frustrated from the heavy medication of allopathy are using cowpathy drugs and being benefited by the Panchgavya, Jeevamruth, Beejamruth and kunapajala products. However, scientific validation of cowpathy products is required for its worldwide acceptance and popularity in terms of agricultural, energy resource and nutritious applications so as to exploit the optimal power of cowpathy for the service of mankind. Regardless of scientific validation, people are using and getting benefits of it.

The world faces multiple challenges to food security including under-nutrition and overconsumption, rising food prices, population growth, rapid diet transitions, threats to agricultural production, inefficient production practices and supply chains, and declining investment in food system research. In addition to causing widespread human suffering, food insecurity contributes to degradation and depletion of natural resources, migration to urban areas and across borders, and political and economic instability. The food system faces additional pressure as the global population grows to around 9 billion by 2050 (United Nations Population Division, 2011) [100]. This dramatic increase in global population will be accompanied by major shifts in the regional distribution of our planet's inhabitants. From 2010 to 2050, the population in Asia is estimated to grow from 4.2 billion to 5.1 billion and Africa's population to grow from 1 billion to 2.2 billion (United Nations Population Division, 2011) [100]. From 1950 to 2050, the population ratio for developing countries to developed countries is projected to shift from 2:1 to 6:1 (United Nations Population Division, 2011) [100]. As the world population has grown, the land available per capita has shrunk from 13.5 ha/person in 1950 to 3.2 ha/person in 2005, and is projected to diminish to 1.5 ha/person in 2050 (State of World Population 2007) [101].

Agriculture consumes 70% of total global 'blue water' withdrawals from available rivers and aquifers, and will increasingly compete for water with pressures from industry, domestic use and the need to maintain environmental flows (Foresight: The future of food and farming, 2011). Current farming practices, including land clearing and inefficient use of fertilizers and organic residues make agriculture a significant contributor to greenhouse gas emissions (IPCC, 2007) [37]. From the farm gate to consumers, refrigeration and other supply-chain activities are an additional major source of greenhouse gas emissions. As global demand for food, fodder and bio-energy crops grows, many agricultural systems are depleting soil fertility, biodiversity and water resources. In many regions there are large gaps between potential and actual crop yields (Foley *et al.* 2011) [28]. Every year, an estimated 12 million hectares of agricultural land, which could potentially produce 20 million tonnes of grain, are lost to land degradation, adding to the billions of hectares that are already degraded (Bai *et al.* 2008) [11]. Estimates indicate that one third of food produced for human consumption is lost or wasted across the global food system (Gustavsson *et al.* 2011) [35].

Heavy use of chemicals in agriculture has weakened the ecological base in addition to degradation of soil, water resources and quality of the food. At this juncture, a keen awareness has sprung on the adoption of "organic farming" as a remedy to cure the ills of modern chemical agriculture

Kannaiyan (2000) [41]. It is very much essential to develop a strong workable and compatible package of nutrient management through organic resources for various crops based on scientific facts, local conditions and economic viability. Panchagavya (cowpathy), Jeevamruth and Beejamruth are cheaper eco-friendly organic preparations made by cow products namely dung, urine, milk, curd and ghee. The Panchagavya is an efficient plant growth stimulant that enhances the biological efficiency of crops. It is used to activate soil and to protect the plants from diseases and also increase the nutritional quality of fruits and vegetables. It is used as a foliar spray, as soil application along with irrigation water, seed or seedling treatment *etc.* Three per cent Panchagavya is an ideal concentration for the foliar spray. Jeevamruth promotes immense biological activity in soil and makes the nutrients available to crop. Beejamruth protect the crop from soil borne and seed borne pathogens and it improves seed germination also.

(Deva Kumar *et al.*, 2008) [4] cow urine has got anti-fungal properties and also good source of plant nutrients. It is being used in crop production since ages. Liquid bio-fertilizers play a vital role in organic farming leading to green food production which is safer, healthier and tastier. The concept of bio-fertilizer is mentioned in *Vrikshyaurveda* under the generic name '*kunapajala*' by Surpala (1000 AD) in eastern India Sadhale, (1996) [77]. *Kunapajala* is a fermentation product using easily available ingredients like *Sesamum indicum* L. (Tila), bone marrow, flesh (sheep, goat, fish etc), milk, black gram (*Vigna mungo*), ghee, honey etc. The beauty of *kunapajala* is that, it can be used on any plant at any growth stage. Firminger, (1864) [26] mentioned the beneficial use of liquid manure *kunapajala* for vegetable cultivation. According to Neff *et al.*, (2003) [56], the reason behind the effectiveness of *kunapajala* is that the ingredients of *kunapajala* have been fermented, which means the proteins, fats, carbohydrates etc. are broken into simple low molecular weight products. Therefore, nutrients from *kunapajala* become available to the plants faster than from the traditionally applied organic matter. In addition, Patil, (2007) [65] mentioned that there is always a danger of passing on dormant pathogen to fields with plant based compost. But this is avoided by *kunapajala* because the *kunapajala* ingredients are cooked and fermented. So, it is concluded that the use of *kunapajala* enhances vegetative growth which leads to better yield with increased disease resistance under organic farming condition Deshmukh *et al.*, (2010) [22]. Nene, (2006) [57] mentioned that, there is no fixed proportion for the ingredients of *kunapajala* and further research is needed to standardize the procedure and test it on crops. Mishra, (2007) [49] pointed out that *kunapajala* can be a good substitute to synthetic fertilizers.

This paper reviews the critical contributions required from the scientific community in order to foster integrated, decisive policy action for addressing the interconnected challenges of food and nutritional insecurity and *cowpathy* and *vedic krishi* to increase soil health.

### Vedic Krishi

*Vedic Krishi* is natural agriculture free from all poisonous fertilizers, pesticides and herbicides, grown by farmers enjoying Vedic consciousness. It is higher consciousness spontaneously in harmony with the rhythms and cycles of nature on the local and cosmic levels and utilizing the Vedic sounds - the sounds of natural law to awaken the inner intelligence of the plants, so that their growth and health-

giving, nourishing properties are maximized to uplift the consciousness and promote a peaceful, healthy life for all who eat them.

The goal of Vedic *Krishi* is to re-enliven Natural Law in agriculture, bringing the farmer, the process of farming and the environment in complete harmony with each other. Natural Law is the unseen intelligence of nature that upholds

and nourishes all life. *Vedic Krishi* will produce Vedic food, the purest, most nutritious and most vital food available anywhere. Vedic food is vibrant in the total potential of Natural Law. It brings the intelligence of nature directly into our human physiology to create a mind and body capable of living higher states of consciousness - the full potential of life.

**Table 1:** Different “Vedic Krishi” inputs and method of preparation

S.NO.	Name of the inputs	Ingredients used and their quantities	Method of preparations
1.	<i>Panchagavya</i>	Cow dung = 1 kg (fresh) Cow dung slurry = 4 kg Cow urine = 3L Cow milk = 2L (fresh) Curd = 2 kg Cow butter oil = 1 kg (ghee)	It is a blend of 5 product obtained from cow mainly its dung, urine, milk, curd and ghee. For making <i>Panchagavya</i> thoroughly mix the required quantities of ingredients and allow fermenting for 7 days with twice stirring per day.
2.	<i>Vermiwash</i>	Earthen pitcher = three of 20L capacity Cow dung = 12-15 kg Earthworms = 100-200 Nos. Rubber pipe = 1 mt long	Put some dry grass and a 15-20 cm layer of 2-3 weeks old cow dung along with 100-200 earthworms in a pitcher. Put on the cow dung and again covered with dry grass. Allow the water to fall drop by drop into the pitcher. Collect the liquid coming from the pitcher with the help of a pipe.
3.	<i>Compost Tea</i>	Vermicompost = 5 kg Bucket = 15L capacity Gunny bag = 1 no. Rope = 2-3 m length	A small gunny bags half filled (5 kg) with <i>vermicompost</i> is handed over a water tub/bucket filled $\frac{3}{4}$ with water in a way that <i>vermicompost</i> remained submerged in water. The nutrients in the <i>vermicompost</i> get dissolved in water within 24 hours, thus making its colour like tea.
4.	<i>Matka Khad</i>	Cow dung = 5 kg Cow urine = 5L Water = 5L Jaggary = 250 gm Earthen pitcher = 1 No. of 20L capacity	Thoroughly mix 5 kg of cow dung, 5 L cow urine, 5 L water and 250 gm jaggary and put in a pitcher of 20 L capacity. The pitcher is filled up to $\frac{3}{4}$ levels only, for effective fermentation. A lid is placed over the pitcher and buried in the soil for 7 to 10 days with its neck outside the soil.
5.	<i>Beejmirit</i>	Cow dung = 50 gm Cow urine = 50 ml Cow milk (fresh) = 50 ml Lime stone = 2-3 gm Water = 1L	Thoroughly mix all the ingredients preferably in plastic/glass jar and keep overnight.
6.	<i>Jeevamirit</i>	Cow dung = 5 kg Cow urine = 5L Jaggary = 1 kg Pulse flour = 1 kg Fertile soil = $\frac{1}{2}$ kg Water = 50L	Mix all the ingredients in a drum with the help of a wooden stick. Shake the mixture 2-3 times per day regularly for 5 to 7 days for proper fermentation.
7.	<i>Amrutpani</i>	Cow butter oil = $\frac{1}{4}$ kg (ghee) Honey = $\frac{1}{2}$ kg Cow dung = 10 kg Water = 200L	Thoroughly mix quarter kilo of ghee into 10 kilos of cow dung. Blend half kilo of honey into this mixture and add 200 litres of water stirring all the time. The mixture thus obtained is Amrutpani.

Source: NCOF, Ghaziabad

### Vrkshayurvedic Farming

Vrkshayurvedic farming is scientific reorientation of eco - friendly ancient system of Indian agriculture by looking back the traditional and natural ways of food production and adopting traditional and indigenous practices and methods for cultivation of crops; by utilizing trees, plants and animal products, by products, extracts and other means with the objective of enhancing the quality of food produce (Swaminathan, 2012) [97]. Anbukkarasi and Sadasakthi, (2011) [7] indicated that basal application of *Albizia lebbek* as green leaf manure along with seed treatment and foliar spray of *Annona squamosa* leaf extract recorded the highest yield parameters viz., fruit length (21.55 cm), fruit girth (7.59 cm), number of seeds per fruits (59.20), fruit weight (18.33 g), yield (13.96 t ha<sup>-1</sup>) with a benefit cost ratio of 3.78 and also quality parameters viz., lowest crude fibre (6.17 per cent), highest crude protein (14.27 per cent) and vitamin C (14.10 mg/100 g) of Bhindi. Nandhakumar and Swaminathan, (2011) [53] indicated that there were significant differences in yield attributes of maize due to the incorporation of green leaf manures and foliar spraying of tree leaf extracts. All the yield

parameters were found to be high in the plot that received *Albizia lebbek* as green leaf manure with foliar spraying of *Annona squamosa*. Anbukkarasi and Sadasakthi, (2013) [8] reported that among the treatment combinations, *Albizia lebbek*+ *Annona squamosa* recorded the best performance for physiological parameters viz., dry matter production, crop growth rate and relative growth rate and highest uptake of N, P and K. The least incidence of pest and diseases also recorded in *Albizia lebbek* with *Annona squamosa*.

Swaminathan and Premalatha, (2014) [98] revealed that Soil incorporation of fresh leaves of tree species *Albizia lebbek* (vagai), *Senna siamea*, *Gliricidia sepium*, *Leucaena leucocephala*, *Delonix regia* (Gulmoher), at the rate of 10 t ha<sup>-1</sup>, was done 45 days prior to sowing of green gram and this served as basal nutrition to the crop followed by or foliar nutrition of leaf extracts at 5 % concentration of four tree species viz., *Alangium salvifolium*, *Annona squamosa*, *Aegle marmellos*, *Morinda tinctoria* during 30 and 45 days after sowing. It is observed that among the leaf incorporations, *Gliricidia* is found to be good and among the growth enhancers, *Aegle marmellos* is the best followed by *Morinda*

*tinctoria*. However, application of leaves of *Gliricidia sepium* @ 10.0 tha<sup>-1</sup> 45 days before sowing of green gram and, followed by that two sprayings of leaf extracts of *Aegle marmellos* @ 5 % during 30 and 45 days after sowing recorded an average yield of 2.14 tha<sup>-1</sup> and DMP of 7.63 tha<sup>-1</sup>.

### Yogic Agriculture

Yogic Agriculture or “sashwat yogic kheti” is a process that includes seed empowerment (through meditation), mind and

heart development of the farmer (through meditation) and integrated organic farming (through cow products, crop rotation and integrated pest management). As farmers gain confidence, the impact they are able to have on their crops through meditation is enhanced. Yogic Agriculture has resulted in lower costs to farmers and reduced the pressure on the environment. Other benefits have been improvements in farmers' emotional well-being and enhanced community resilience.

Nutrient	Yogic	Chemical	Cost/Profit (INR)	Yogic	Chemical
Fat	0.11%	0.20%	Net cost/ Acre	6020.00	26740.00
Protein	1.13%	0.74%	Gross cost/Acre	13378.00	28147.00
Carbohydrate	5.36%	4.15%	Total crop/Acre	13667Kg	15158Kg
Energy	27.41Kcal/100g	19.5Kcal/100g	Market value/Acre	77446.00	85895.00
Vitamin -C	14.9mg/100g	6.05mg/100g	<b>Profit/Acre</b>	<b>64068.00</b>	<b>57778.00</b>

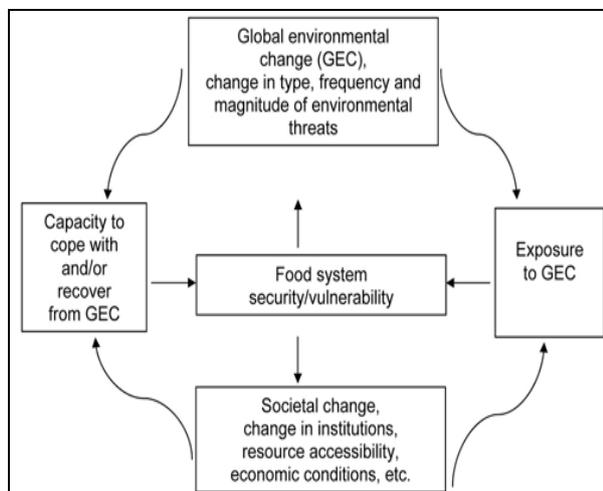
### Yogic Method

Regular meditation are conducted remotely and in the fields with specific thought practices designed to support each phase of the crop growth cycle, from empowering seeds and seed germination, through sowing, irrigation and growth, to harvest and soil replenishment.

Preliminary findings indicate that OFM-2 (organic + meditation) has the greatest soil microbial population and that seeds germinate up to a week earlier. Subsequent crops reveal higher amounts of iron, energy, protein and vitamins compared to OFM-1 (organic and CIM (chemical)), offering low-cost high-benefit methods for local communities. Some economic figures gathered by farmers and scientists.

### LEISA is about Low external input and sustainable agriculture

- a system of agriculture which is based on principles and options which are ecologically sound, economically feasible and culturally acceptable. India is home to incredible diversity in plant and animal species and is ranked among the richest areas of biodiversity in the world. Unfortunately, much of this diversity is being eroded at an alarming rate, largely due to habitat destruction and invasion by alien species. Altieri *et al.* (2012) [5] reported that agro-ecology-based production systems are bio-diverse, resilient, energetically efficient, socially just, and comprise the basis of an energy, productive and food sovereignty strategy. Gregory *et al.* (2005) [34] revealed that the crops due to specific changes in climate, accurate analysis of food security indicators could not be achieved which reflects the vulnerability of food systems which is possible by integrating bio-physical and socio-economic aspects of food systems.



**Fig 1:** Factors determining the vulnerability of food systems to global environmental change

Source: Gregory *et al.* (2005) [34].

Jaswal (2014) [39] observed that the study conducted by National Institute of Nutrition, the minimum per capita food grain required for an adult is 182.5kgyr<sup>-1</sup> whereas in India, the availability is only 173.6kgyr<sup>-1</sup> and as far as the protein

requirement is concerned, the daily intake should be 50mg but the situation seems to remain stagnant, the per capita daily intake is only 10mg.

Performance on Global Hunger Index				
Year	Rank in Hunger Index	Out of total no. of countries	Score	Status
1990			31.73	Alarming
2007	94	118	25.03	Alarming
2008	66	88	23.70	Alarming
2009	65	88	23.90	Alarming
2010	67	84	24.10	Alarming
2011	67	81	24.2	Alarming
2012	65	79	22.9	Alarming
2013	63	120	21.3	Alarming

Source:-Global Hunger Report, IFPRI

Inadequate storage capacity for foodgrain is also a big hurdle			
Year	Foodgrain stock	Storage capacity	Shortage
2008	29.88	23.89	5.99
2009	41.94	25.27	16.67
2010	46.87	28.83	18.04
2011	54.13	31.61	22.52
2012	66.78	33.6	33.18

Figures in million tonnes

Sources: Food Corporation of India, Commission for Agricultural Costs and Prices, Ministry of Agriculture, CAG

India has moved from 65<sup>th</sup> to 63<sup>rd</sup> in the Global Hunger Index of 2013, making a marginal improvement since 2012, but continues to suffering far behind other emerging countries. The score for India has improved slightly from 22.9 in 2012 to 21.3 in 2013. Further studies have indicated that consumption and expenditure on food grain have decrease up to a certain level due to increase in food prices and enlargement in the consumption of non-food item. Malnutrition and poverty are the main causes for the adoption

of food security in India. Every year nearly 5000 children die due to inadequate food consumption. HUNGAMA report published by Nandi Foundation in 2011 found that 42% of the children under the age of five are underweight and 59% are stunted. Above this, a study conducted by Food and Agricultural Organization found that 225 million people i.e. 23% of our population are undernourished and 260 million people falls under the category of above the poverty line (APL).



### Wastage of food in India

In India, 30 million people have been added to the rank of hungry since the mid 1990s and 40% children are underweight. Worldwide 852 million people are hungry due to extreme poverty and 2 billion people lack food security intermittently due to varying degree of poverty (Sources FAO, 2003). 600 million children die of hunger every year and 17000 every day. In India approximately, 320 Indians go to bed without food every night and recent data is very much alarming and situation is going even worse. Around 155 million children aged under five are stunted (too short for their age), the report says, while 52 million suffer from wasting; meaning their weight is too low for their height. Meantime, an estimated 41 million children are now overweight. Anaemia among women and adult obesity are also cause for concern. Among other key findings, it reveals that in 2016 the number of chronically undernourished people in the world is estimated to have increased to 815 million, up from 777 million in 2015 although still down from about 900 million in 2000. Globally, the prevalence of stunting fell from 29.5% to 22.9% between 2005 and 2016, although 155 million children under five years of age across the world still suffer from stunted growth. According to the report, wasting affected one in 12 of all children fewer than five years of age in 2016, more than half of whom (27.6 million) live in Southern Asia. This has set off alarm bells we cannot afford to ignore: we will not end hunger and all forms of malnutrition by 2030 unless we address all the factors that undermine food security and nutrition. Ending hunger and all

forms of malnutrition is an ambitious goal, but it is one we strongly believe can be reached if we strengthen our common efforts and work to tackle the underlying causes that leave so many people food-insecure, jeopardizing their lives, futures, and the futures of their societies.” These trends are a consequence not only of conflict and climate change but also of sweeping changes in dietary habits and economic slowdowns.

Judicious nutrient management is crucial to humification of carbon in the residues and to soil organic carbon sequestration. Soils under low-input and subsistence agricultural practices have low soil organic content which can be improved using organic amendments and strengthening nutrient recycling mechanisms (Lal and Bruce 1999) [46]. This can also lead to decreased nitrous oxide emissions by reducing leaching and volatile losses and improve nitrogen use efficiency (Lal 2003) [45]. Manure management can improve soil fertility and enhance carbon storage by increasing biomass and improving soil equilibrium. In general, the use of organic manures and compost enhances the soil organic carbon pool more than application of the same amount of nutrients as inorganic fertilizers (Gregorich *et al.* 2001) [33]. Use of residue mulching improves the soil structure, lowers bulk density and increases infiltration capacity and the soil organic carbon pool (Shaver *et al.* 2002) [83].

The diversification of agriculture for food e.g., cereals, pulses, edible oil yielding, vegetable, fuel and timber yielding plants, medicinal and fodder crops are necessary to meet the food and

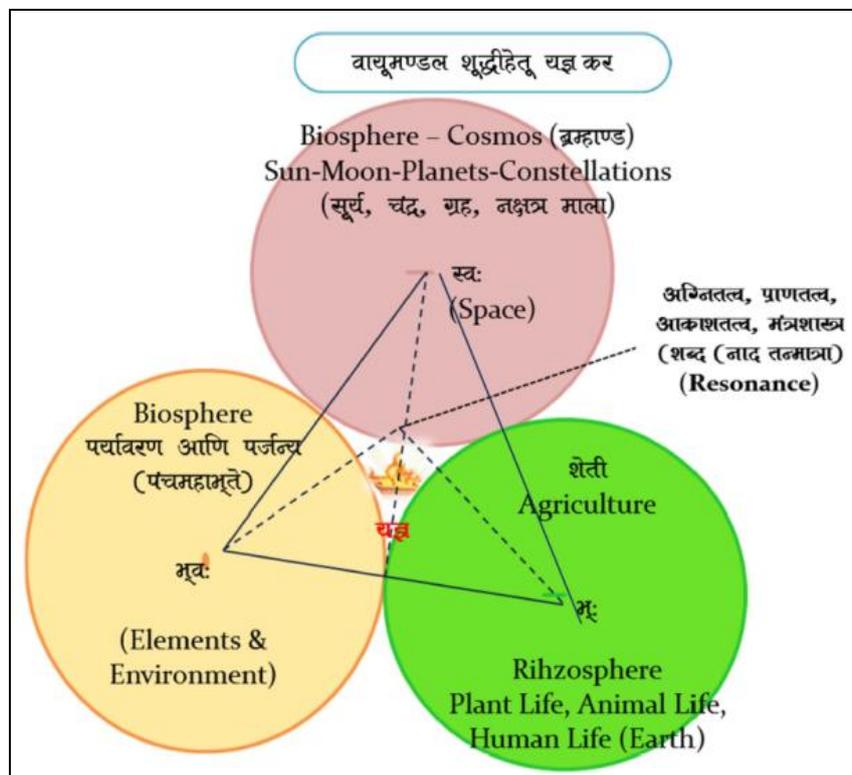
augment income to farmers to meet the food security. We will have to aim at food security in developing countries through increased and stabilized food production on an economically and environmentally sustainable technologies/ methods. Rist (2000) [75] reported that the increased potato yields by 20 % using organic fertilizers in 2000. Hine and Pretty (2008) showed that maize yields increased by 100% (from 2 to 4tha<sup>-1</sup>) in 2005; Parrot and Marsden (2002) [63] showed that millet yields increased by 75-195 % (from 0.3 to 0.6–1 tha<sup>-1</sup>) and groundnut by 100–200 % (from 0.3 to 0.6–0.9 tha<sup>-1</sup>) in 2001; and Scialabba and Hattam (2002) [81] showed that potato yields increased by 250–375 % (from 4 to 10-15 tha<sup>-1</sup>) between the early 1980s and 2000s.

### Homa Farming

The most important thing about this agricultural methodology which is based on Vedic Sciences is that it recognizes the forces of “*Aakash* (space)” the fifth element i.e. the subtle energies of both light and sound (*Nad-brahma*) to enhance the Cosmic influence of planets on plants. *Aakash* is the mother of all other elements and “*Nad*” or “*Sound*” is it’s most omnipotent and subtlest force, which has capacity to reach

Cosmos of Twenty-seven Constellations. Our Last Chance” says “when these specific mantras are uttered at the specific times of sunrise/sunset “*RESONANCE*” takes place in the pyramid. The most powerful effect is with the word “*SWAHA*”. It is the Resonance which heals.” This is how plant plagues and epidemics go away. Resonance plays vital part in natural phenomena. He further says “when Mantras are done in conjunction with Homa fires the vibrations from mantras become locked up in the ash and therefore ash becomes more powerful under this method to heal atmosphere and create conducive Biosphere for healthy growth of plants and animal life.”

*Nakshatra*-wise rain-forecast and performance of Homas according to astronomical positions of constellations for attracting influence of cosmic forces on plants / animals and for rain-induction is the area of research that leads to preparation of location based specific agro-climatic calendar. This will be another dimension of Homa farming. Additionally, it is also proposed to study the effect of ashes from *Samidhas* of Yajñīya Vrikshas used during *Havans*. The relationship of *Agnihotra*/Yajñās, environment and Agriculture are explained in the following diagram:



Agnihotra is a healing fire from the ancient science of ayurveda. It is a process of purifying the atmosphere through a specially prepared fire performed at sunrise and sunset daily. Agnihotra utilizes the combined effect of various factors involved in its science viz., burning of specific organic substances like cow's ghee, rice grains, twigs of plants like vata, audumbar, palaash, peempal and bael etc and thereby injecting the atmosphere with nutrients. The mantra vibrations chanted too have a healing and relaxing effect on the atmosphere and all the living beings. Anyone in any walk of life can do Agnihotra and heal the atmosphere in his/her own home. Hundreds of thousands of people all over the world have experienced that Agnihotra leads to greater clarity of thought, improves overall health, gives one increased energy and makes the mind more of love. Agnihotra also nourishes plant life and neutralizes harmful radiation and it harmonizes

the functioning of Prana (life energy) and can be used to purify water resource. The practice of Agnihotra is simple, easily adoptable and universal. It may be performed by all irrespective of barriers like religion, sect, creed, nationality, color, sex and age. Agnihotra is an ancient science given in Sanskrit language at the time of creation. Sanskrit was never anyone's mother tongue; it is a language of vibration. We can make changes in the atmosphere with Sanskrit mantras and fire prepared with specific organic substances, tuned to the sunrise/sunset biorhythm. The fire is prepared in a small copper pyramid of specific size and shape. Brown rice, dried cow dung (manure) and ghee (clarified unsalted butter) are the substances burned. Exactly at sunrise or sunset mantras are spoken and a small amount of rice and ghee is given to the fire. There is not just energy from the fire; subtle energies are

created by the rhythms and mantras. These energies are generated into the atmosphere by fire. This, in addition to the qualities of the materials burned, produces the full effect of this healing Homa (healing fire).

The Agnihotra- Homa is performed at the centre of the field everyday at sunset and sunrise. Vyahati Homa can be performed any time except sunset and sunrise. It can be performed before Tryambakam Havana. This Havan can be performed for having better results for few hours daily. Especially it can be

practised on new moon day and full moon day. The other way of performing Tryambakam Havana is perform it for 4 hours daily and 24 hours on full moon and new moon days. By working directly on plant metabolism and strengthening plants through cellular structural changes and changes in root system configuration, Agnihotra reduces plant disease by reducing the susceptibility of the host plant. (Rathner, 1984) [73]. Though conventional farming had some success in the beginning, after some decade's deterioration of soil, imbalance in the nature, problems like input costs rise and production falls are developing. Hence organic farming is the need of the time. Homa organic farming give higher yield per hectare than any known method of farming, organic or chemical. Hence it could not impact the target of quantity.

#### Effect of cowpathy (*Panchagavya*) on crop yield and soil health

Balasubramanian *et al.* (2001) [12] reported that dipping of rice seedlings in Panchagavya before transplanting enhanced the growth and yield. Beulah, (2002) [13] reported that the secondary and micronutrients (Ca, S and Fe), macronutrients (NPK) contents of leaves and pods of annual moringa were superior under poultry manure + neem cake + Panchagavya treatments. Higher nutrient uptake and nutrient use efficiency in both main and ratoon crops of annual moringa were also observed. Papen *et al.*, (2002) reported that panchagavya contains *Azotobacter*, *Azospirillum* and *phosphobacteria*. Panchagavya contains microorganisms in addition to nutrients that help in improving plant growth, metabolic activities and resistance to pest and diseases. In *Abelmoschus esculentus*, microbial load i.e., bacteria, fungi and actinomycetes was increased up to 21<sup>th</sup> day  $110 \times 10^6$ ,  $25 \times 10^4$  and  $21 \times 10^3$  respectively. Rajasekaran and Balakrishnan, (2002) [69] revealed that the *Abelmoschus esculentus* yield parameters were increased in 3% panchagavya spray when compared with control and other concentration. Similarly in black gram and green gram (Brito and Giriya, 2006) [18] and groundnut (Ravikumar *et al.*, 2012) [72]. The photosynthetic pigments content such as chl. A, chl. B and carotenoid were increased in 3% panchagavya spray and decreased in control in *Arachis hypogaea* (Subramanian, 2005) [93] and *Vigna radiate*, *Vigna mungo* and *Oryza sativa* (Tharmaraj, 2011) [99]. Kanimozhi, (2003) [42] revealed that application of Panchagavya at 4 per cent spray was found to be superior in respect of root yield (2.5 times kgplot<sup>-1</sup>) when compared to control in *Coleus forskohili*.

Natarajan (2007) [55] reported that the *panchagavya* contains macronutrients like N, P and K, essential micronutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA, which may provide nutrition to rhizosphere microorganisms and thus help to increase their population. Yadav and Mowade (2004) [108] opined that this increase might be due to cumulative effect of liquid organic inputs in increasing organic carbon content of soil which acted as carbon and energy source for microbes and in quick

buildup of heterotrophic micro-flora and fauna. Similar results were obtained by Shwetha (2008) [84], who reported the nutrient management through organics in soybean-wheat cropping system and found that the application of organic manures supplemented with fermented organics resulted in the significant improvement of soil microbial population and enzymatic activity. Panchagavya spray influenced significantly on P-solubilizers. Spraying of 6 % recorded higher P-solubilizers (28.43, 33.04 at 60 DAT and 27.46, 34.53 at harvest during *kharif* and summer, respectively) and lower was recorded in without panchagavya spray (25.19, 27.85 at 60 DAT and 23.73, 23.42 at harvest during *kharif* and summer, respectively). The foliar spray of panchagavya might have enhanced microbial activity on the plant parts like on leaves, shoot and fruits.

Palekar, (2006) [60] reported that Jeevamruth contains enormous amount of microbial load which multiply in the soil and acts as tonic to enhance microbial activity in soil. Swaminathan *et al.* (2007) [96] revealed that *Panchagavya* enhanced the biological efficiency of crop and the quality of fruits and vegetables production. It also increases the soil fertility. Similarly *Sanjibani* helps to improve soil fertility and enhance crop productivity and quality of product and also working as a pest-repellent. Vasanthkumar (2006) [102] and Devakumar *et al.* (2008) [4] was attributed to higher microbial load and growth hormones which might have enhanced the soil biomass thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in better growth and yield of crops. Mohanalakshmi and Vadivel, (2008) [51] revealed that application of poultry manure (5 t ha<sup>-1</sup>) + Panchagavya (3%) in aswagandha exhibited significantly superior performance by registering the highest root yield of 1354.50 kg ha<sup>-1</sup>. Vennila and Jayanthi, (2008) [103] revealed that application of 100 per cent recommended dose of fertilizer along with panchagavya spray (2%) significantly increased the number of fruits per plant, fruit weight g fruit<sup>-1</sup> and fruit yield q ha<sup>-1</sup> of okra. Sreenivasa, (2009) [89] revealed that Panchagavya, Beejamruth and Jeevamruth prepared by using cow products are known to contain beneficial microflora like *Azospirillum*, *Azotobacter*, phosphobacteria, *Pseudomonas*, lactic acid bacteria and Methylophiles in abundant numbers and also contain some useful fungi and actinomycetes. Reddy *et al.* (2010) [74] reported that the higher yield levels obtained with application of biodigester liquid manures to many field crops. Similarly, Siddaram, (2012) [86] reported that the increased yield levels of rice with biodigester liquid manures. Panchagavya spray influenced significantly on yield of capsicum per hectare.

Shivaprasad and Chittapur (2009) [85] revealed that application of *panchagavya* @ 3% in 10 days interval showed significantly higher yield per plant (86.95 g), yield per plot (1.220 kg) and yield per hectare (21.95 q) as compare to control. This is due to better source-sink relationship i.e. better vegetative growth, more number of flowering, more number of fruits till maturity. This might be due to hormonal effect of *panchagavya* along with increase in photosynthetic activity of plants which causes better source-sink relationship in chilli. Amalraj *et al.*, (2013) [6] reported that panchagavya application may enhance plant growth by nitrogen fixation, growth hormone production and control phytopathogens of many plantation crops. Vimalendran and Wahab, (2013) [10] revealed that four sprays of three percent panchagavya at 15, 25, 35 and 45 Days After Sowing (DAS) along with 100% Recommended Dose of Fertilizers (RDF) recorded the highest fresh babycorn yield (7439 and 7476 kg ha<sup>-1</sup>, in 2008 and

2009, respectively) followed by 3 sprays of 3% panchagavya along with 100% recommended dose of fertilizers (7226 kg ha<sup>-1</sup> 2008 and 7262 kg ha<sup>-1</sup> in 2009). Sakhubai *et al.*, (2014) showed that growth parameters viz., plant height (103.10 cm), number of leaves per plant (75.62), leaf length (9.52 cm), leaf breadth (9.03 cm) recorded maximum with the application of RDF and yield parameters viz., days to 50% flowering was

earlier in T<sub>10</sub> (VAM + Panchagavya + Amritpani (3% Drench and Spray) and T<sub>11</sub> (RDF (50: 40:40 kgNPK/ha, FYM-20q/ha) with 25.67DAS, herb yield recorded maximum with the application of RDF, however the organic treatment T<sub>10</sub> have shown on par results in growth and yield parameters (Table 2).

**Table 2:** Growth and Yield of Buckwheat at 45 Days after sowing

Treatments	Plant Height (cm)	No. of Leaves	Leaf Length (cm)	Leaf Breadth (cm)	Days to 50% Flowering	Herb Yield (q/ha)
T <sub>1</sub> - Vesicular Arbuscular Mycorrhiza (VAM – 25 kg/ha, soil application)	81.0	23.0	6.5	6.7	29.0	72.22
T <sub>2</sub> - VAM + Panchagavya (3% Drench)	81.3	33.0	6.8	7.2	29.0	87.34
T <sub>3</sub> - VAM + Panchagavya (3% Spray)	84.0	47.0	6.8	7.5	29.3	104.83
T <sub>4</sub> - VAM + Panchagavya (3% Drench and Spray)	91.7	61.0	7.7	7.8	30.0	98.76
T <sub>5</sub> - VAM + Amritpani (3% Drench)	86.3	34.9	6.8	7.1	29.3	108.02
T <sub>6</sub> - VAM + Amritpani (3% Spray)	81.8	42.0	6.8	7.0	29.7	112.14
T <sub>7</sub> - VAM + Amritpani (3% Drench and Spray)	84.6	54.7	6.8	6.7	29.3	126.54
T <sub>8</sub> - VAM + Panchagavya + Amritpani (3% Drench)	94.2	66.7	8.6	8.5	28.3	118.31
T <sub>9</sub> - VAM + Panchagavya + Amritpani (3% Spray)	94.4	71.4	9.3	8.9	26.7	122.42
T <sub>10</sub> - VAM + Panchagavya + Amritpani (3% Drench and Spray)	99.8	73.9	9.5	8.9	25.7	127.56
T <sub>11</sub> - RDF (50:40:40 kg NPK/ha, FYM-20q/ha)	103.1	75.6	9.0	8.9	25.7	132.71
Mean	89.3	53.0	7.7	9.0	28.4	110.08
CD 5%	2.78	2.78	0.48	0.44	0.97	13.69

Source: Sakhubai *et al.*, (2014)

Swain *et al.*, (2015) [95] revealed that foliar application of panchagavya at 3% concentration (30ml/l of solution) at 10 days interval produce highest plant height (80.17 cm), early 50% flowering (44.33 days), highest number of flowers (301.73), number of fruit (169.45) and highest yield/ha (21.95 q of dry fruit) of chilli. Boraiah *et al.*, (2017) [17] revealed that different organic liquid formulations, application of jeevamrutha, cow urine and Panchagavya 6 per cent spray recorded significantly higher fruit yield, N-fixers and P-solubilizer of Capsicum during kharif and summer respectively. Suchitra Rakesh *et al.*, (2017) [94] reported that panchagavya contains *Azotobacter*, *Azospirillum* and *phosphobacteria*. Panchagavya contains microorganisms in addition to nutrients that help in improving plant growth,

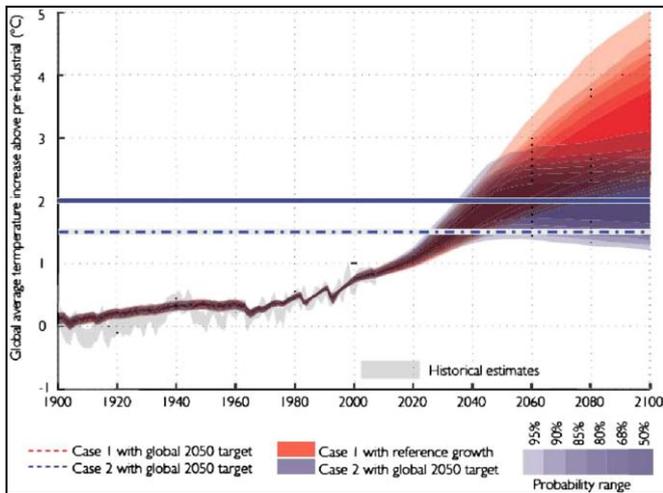
metabolic activities and resistance to pest and diseases. The, Microbial load i.e., bacteria, fungi and actinomycetes was increased up to 21<sup>th</sup> day 110x10<sup>6</sup>, 25x10<sup>4</sup> and 21x10<sup>3</sup> respectively (Table 3). Effective Micro Organisms (EMO) in panchagavya were the mixed culture of naturally occurring beneficial microbes, mostly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), actinomycetes (*Streptomyces*), photosynthetic bacteria (*Rhodospseudomonas*) and certain fungi (*Aspergillus*). The pH of panchagavya increased from 6.47 (0<sup>th</sup> day) to 6.92 (28<sup>th</sup> day). Maximum electrical conductivity was noticed on 28<sup>th</sup> day (1.78 dSm<sup>-1</sup>). The NPK content of the panchagavya 0.97, 0.92 and 0.65% was recorded maximum on 21<sup>st</sup> day after preparation respectively.

**Table 3:** Changes in Physico-chemical and biological properties of Panchagavya with time.

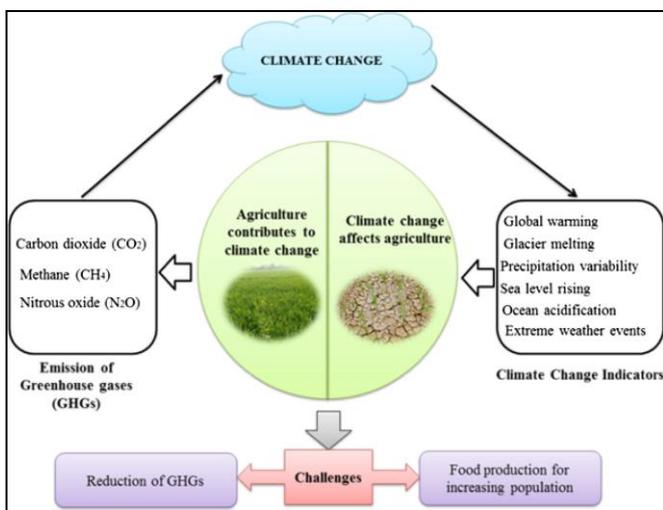
Sl. No.	Available nutrient status					Physical properties		Microbial load (Population = X cfu ml <sup>-1</sup> )		
	N	p	K	Ca	Mg	EC (dSm <sup>-1</sup> )	pH	Bacteria (10 <sup>6</sup> )	Fungi (10 <sup>4</sup> )	Actinomycetes (10 <sup>3</sup> )
0 <sup>th</sup> day	0.18	0.02	0.24	0.54	0.81	0.62	6.47	10	4	8
7 <sup>th</sup> day	0.32	0.13	0.41	1.01	1.16	0.73	6.53	21	9	16
14 <sup>th</sup> day	0.62	0.12	0.53	1.15	1.13	0.98	6.72	38	14	18
21 <sup>st</sup> day	0.97	0.28	0.65	1.31	1.63	1.20	6.83	110	25	21
28 <sup>th</sup> day	0.77	0.18	0.45	1.24	1.28	1.78	6.92	68	22	20

\*Values represent mean of three replications

Source: Suchitra Rakesh *et al.*, (2017) [94]

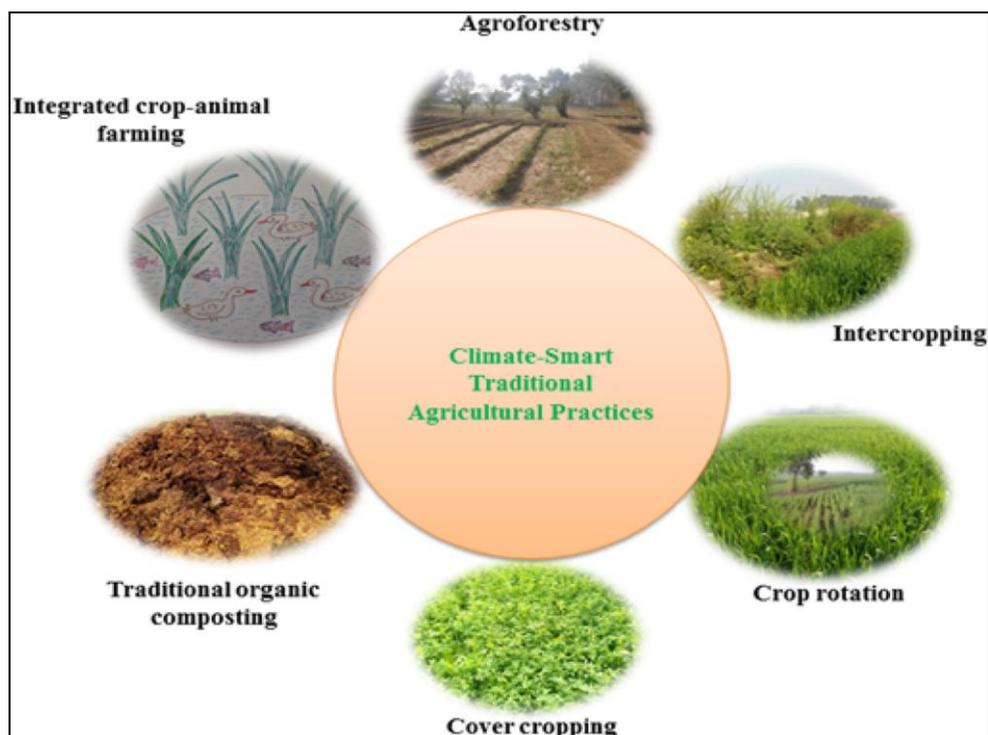


**Fig 2a:** Effects of the Copenhagen Accord on global average temperature through the 21<sup>st</sup> century



**Fig 2b:** Correlation between agriculture and climate change  
**Source:** (Rogelj *et al.* 2010).

Climate change is statistically significant difference in either the mean state of the climate or in its variability, continuing for a long period usually decades or longer (Vijaya Venkata Raman *et al.* 2012) [104]. It refers to both a shift in mean climatic conditions (e.g. temperature and precipitation) and an increase in the frequency and severity of weather extremes (Porter *et al.* 2014; Mandryk *et al.* 2017) [68, 48] (figure 2a). Agricultural activities from cropping to harvesting emit GHGs that cause climate change which in turn disturbs agriculture (Phungpracha *et al.* 2016) [67]. Therefore, climate change and agriculture are correlated (Figure 2b). Indigenous agriculture systems are diverse, adaptable, nature friendly and productive. Higher vegetational diversity in the form of crops and trees escalates the conversion of CO<sub>2</sub> to organic form and consequently reducing global warming (Misra *et al.* 2008) [50]. Mixed cropping not only decreases the risk of crop failure, pest and disease but also diversifies the food supply (Sayer and Cassman, 2013) [80]. Agro-forestry, intercropping, crop rotation, cover cropping, traditional organic composting, cowpathy and yogic agriculture and integrated crop-animal farming are prominent traditional agricultural practices. These traditional practices are advocated as the model practices for climate-smart approach in agriculture (Figure 2). The integration of trees with crops is an age-old practice that dates to the beginning of farming and animal husbandry (Onwosi *et al.* 2017) [59]. Agro-forestry enhances soil organic matter (SOM), agriculture productivity, carbon sequestration, water retention, agro-biodiversity and farmers' income (Zomer *et al.* 2016; Paul *et al.* 2017) [109, 66]. Carbon sequestration through agro-forestry influenced by several factors such as type of agro-ecosystems, tree species, and age of tree species, geographical location, environmental factors and management practices (Jose 2009) [40].



**Fig 3:** Climate-smart traditional agricultural practices

Ali *et al.* (2011) [3] reported that *Panchagavya* and *Sanjibani* organic farming practice the pH and E.C. become close to neutral (pH-from 6.8 to 7.0 and EC- from 0.2 to 0.3 mmhos). The organic carbon increased to 1.1 % from 0.71%.

Available Phosphate and Potash has increased to greater extent (P – more than 3 times and K - more than 2 times). Soil parameters exhibited improvement after one year of organic cultivation (Table 4).

**Table 4:** Effect of organic farming practice in soil health

Characteristics	Before planting <i>Kharif blackgram</i> 2008	After harvesting <i>blackgram</i> in November 2008	After harvesting <i>mustard</i> in March 2009
pH	6.8	7.8	7.0
EC	0.2	0.3	0.3
Organic Carbon%	0.71	1.1	1.5
Available P (kg ha <sup>-1</sup> )	25-40	37.4	>100
Available K (kg ha <sup>-1</sup> )	100-200	196	250
Total microbial count	2.7x10 <sup>7</sup>	6.7x10 <sup>8</sup>	3.1x10 <sup>9</sup>

Source: Ali *et al.* (2011)

### Effect of *kunapajala* on crop yield and soil health

Vedic literature provides some of the earliest written record of liquid organic manures like *Kunapajala* and *Shasyagavya* and their applications in ancient India. The name *Kunapajala* (water with smell of corpse) came from the Sanskrit words '*Kunapa*' means corpse and '*Jala*' means water. This liquid manure is prepared by mixing cow dung, cow urine, animal waste (flesh, marrow, etc.), and water in 1:1:1:2 ratios, respectively. Documents regarding *Kunapajala* were found in two possibly contemporary documents, viz. *Vrikshayurveda* by Surapala, who possibly lived around 1,000 AD in eastern India and *Lokopakara* compiled by a poet Chavundaraya around 1,025 AD in Karnataka of southern India. *Shasyagavya* (*shasya* means plant product and *gavya* means obtained from cow) is the fermented mixture of cow dung, cow urine, vegetables waste, and water in 1:1:1:2 ratios, respectively. It is generally prepared by chopping and fermenting weeds in water along with cow dung. The product is mixed thoroughly by continuous stirring, strained, and used for soil drenching in tea or as a foliar spray (Nene, 1999).

Kumar *et al.* (2001) [44] and Singh *et al.* (2004) remarked that the attainment of biomass was significantly and positively correlated with seed yield. The *kunapajala* (T-3) treatment was effective in enhancing the morphological parameters of the leaves of tomato plant followed by conventional farming (T-1) and organic farming (T-2). Relative water content (RWC) and osmotic potential (OP) of cell sap showed maximum increase under the influence of T-3 (30 % and 26 % respectively), as against T-1 (8 % and 26 % respectively) and T-2 (12 % and 6 % respectively) compared to the control (without any treatment). Ali *et al.* (2012) reported that black gram, *Shasyagavya* @ 20 and 10% spray and *Kunapajala* @ 5 and 10% spray produced better yields whereas highest yield was recorded with *Shasyagavya* 20% (0.11 kg m<sup>-1</sup>). In

mustard, the only yield indicator which significantly varied among the treatments was 1000 seed weight. The average 1,000 seed weight was maximum (2.56 g) with *Shasyagavya* 10% spray and minimum (1.5 g) in control. Notably, *Kunapajala* 3% spray exhibited better result for most of the characters as compared to other treatments in mustard.

Asha, (2006) [9, 60] showed that *Kunapajala* treated *Langali* (*Gloriosa superba* Linn) plants exhibited excellent result in terms of general growth of the plants and fruiting when compared to control group and chemical fertilizer group. Narayanan (2006) [54] revealed that improved modifications in the preparation of *Kunapajala* by mixing *Panchagavya* show tremendous results when applied to vegetables. Mishra (2007) [49] studied the growth of paddy using *Kunapajala* for every 10 days showed significant increase in growth parameters like plant height, leaf length, inflorescence length, number of grains per inflorescence etc. Bhat Ramesh and Vasanthi, (2008) [14] reported that the application of *Kunapajala* in Brinjal shows large number of branches, higher yield, fruits with lesser seeds and lower susceptibility to diseases when compared with plants grown with artificial fertilizer.

Deshmukh *et al.* (2012) [23] revealed that *kunapajala* treatment is superior to conventional farming and organic farming as it brings about physiological, biochemical and enzymatic enhancement in the leaves of tomato under organic farming conditions. Chadha *et al.* (2012) found that the application of *vermiwash* gave 60, 10, 26 and 27% higher yield in Knol khol (211.67qha<sup>-1</sup>), onion (177.81qha<sup>-1</sup>), French-bean (16.3qha<sup>-1</sup> seed yield), Pea (16.3qha<sup>-1</sup>) and paddy (28.45qha<sup>-1</sup>), respectively over control (Table 5). *Panchagavya*, *Matka Khad*, *Vermiwash* and *Jeevamruti* as foliar were also proved quite effective in enhancing the productivity of different crops and effective against various plant pathogens.

**Table 5:** Effect of application of liquid traditional inputs in Knol-khol, Onion, Pea, French bean and Paddy crops yield (q/ha) and against stalk rot (*Sclerotinia sclerotiorum*) of Cauliflower in sick soil.

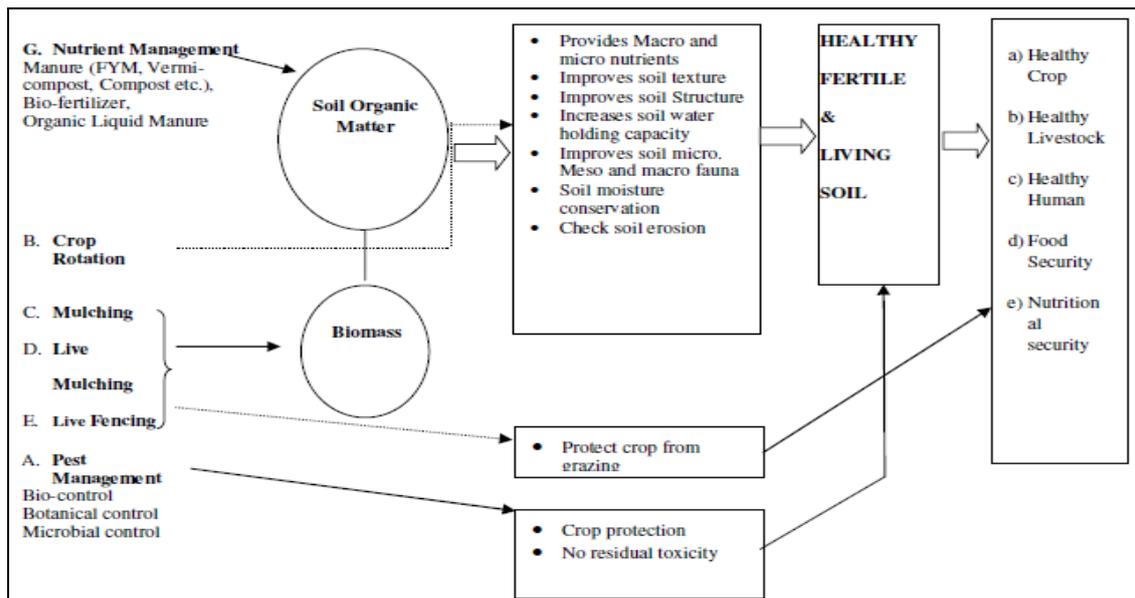
Traditional inputs	Knol-khol	Onion	Pea	French bean	Paddy	Pre-emergence infection (%)	% Disease control	Post-emergence infection (%)	% Disease control
	Marketable yield	Bulb yield	Seed yield	Seed yield	Grain yield				
Jeevamruti	159.61	182.20	15.8	12.10	25.40	56.4	43.6	14.3	85.7
Beejamruti	161.67	182.58	16.5	14.50	25.90	61.1	38.9	22.2	77.8
Panchagavya	168.89	184.10	18.9	16.50	30.86	11.1	88.9	11.1	88.9
Matka Khad	157.5	180.61	18.2	14.30	28.50	44.4	55.6	22.2	77.8
Compost tea	178.61	178.35	17.5	15.80	29.68	72.2	27.8	22.2	77.8
Vermiwash	211.67	177.81	16.3	14.50	28.45	44.5	55.5	22.2	77.8
Nadep Compost	162.65	182.60	18.3	14.90	26.87	70.2	29.8	22.2	77.8
Control	128.06	167.34	14.2	10.40	24.50	100	00	-	-
C D (5%)	19.77	9.34	2.7	1.19	3.26	2.83	13.8	1.64	1.19

Source: Chadha *et al.* (2012)

### Effect of Vedic Krishi on Soil Health

Mulching of soil surface with organic materials renders the soil soft, pulverized, and humid that ultimately creates a congenial environment for beneficial microbes to maintain bulk density and porosity in the soil (Naeini *et al.*, 2000) [52]. The improvement of soil physical properties due to organic farming has spatio-temporal dimension also. Lotter *et al.* (2003) [47] reported that organic farming is better in areas having extreme rainfall because of the higher absorption and less run-off of water in the field. Application of good quality FYM improves the total nitrogen (Bhradwaj and Guar, 1985) [15] and organic matter in the soil, which is “an important substrate of cationic exchange and the warehouse of most of the available nitrogen, phosphorus, and sulphur; the main

energy source for microorganisms; and is a key determinant of soil structure” (Ewel, 1986) [25]. It is undoubtedly an important controlling factor for C: N ratio, total and available N, N mineralization, soil moisture, microbial activity, and soil texture (Agehara and Warncke, 2005; Cabrera *et al.*, 2005) [2-20]. Significant differences and higher values of soil organic carbon, carbon stocks, and carbon sequestration rate were observed in organically managed plots compared to non-organic plots Gattinger *et al.* (2011) [32]. Application of organic fertilizer not only provides nutrient to the standing crop but also to the succeeding crop (Jannoura *et al.*, 2014) [38]. Papadopoulos *et al.* (2014) [62] notice that organic management can improve soil structure, organic matter content, and porosity in soil.



**Fig 4:** Integration of different of organic practices for sustainability of soil health

The microbial biomass and microbial activities in soil are crucial to sustain the productivity of soil. For ensuring consistent release of nutrients to the plants, there is a need to have balanced ratio of microbial biomass and activity in soil (Pandey and Singh, 2012) [61]. Organic farming is reported to have enhanced both microbial biomass and microbial activity by 20-30% and 30-100%, respectively (Stolze *et al.*, 2000) [91]. It has also been well documented that the organically managed soil enriched with several beneficial microorganisms like arbuscular mycorrhizal fungi for ensuring improved crop nutrition and decreasing soil borne diseases 8, 64. As organic farming increases the microbial activity, leads to increased competition, parasitism and predation in the rhizosphere, it collectively reduces the chances of plant disease infestation (Knudsen *et al.*, 1995; Workneh and van Bruggen, 1994) [43, 107]. Application of quality organic inputs enhances the microbial population in the soil (Fließbach and Mäder, 2000) [27]. It is reported that the bulk density of organic soil is less than the soil which was managed chemically, indicating better soil aggregations and soil physical conditions owing to increased soil organic matter (Wallingford *et al.*, 1975) [106]. There is a 29.7% increase in organic carbon under organically managed farm (1.22%) as compared to conventionally managed farm (0.94%) (Ramesh *et al.*, 2010) [71]. Dehydrogenase, alkaline phosphate, and microbial biomass carbon were higher in organic soils by 52.3%, 28.4%, and 34.4%, respectively; as compared to conventional farms (Ramesh *et al.*, 2010) [71]. Panwar *et al.* (2013) indicated that,

application of Farmyard manure 5 t ha<sup>-1</sup> + Vermicompost 2.5 t ha<sup>-1</sup> + Jeevamrut 2 times (30 and 45 DAS) to kharif sweet corn recorded significantly higher values for sweet corn cob and green fodder yield. Microbial count of bacteria, fungi and virus was significantly increased with the application of Farmyard manure 5 t ha<sup>-1</sup> + Vermicompost 2.5 t ha<sup>-1</sup> + Jeevamrut 2 times (30 and 45 DAS) which was found at par with Farmyard manure 5 t ha<sup>-1</sup> + Vermicompost 2.5 t ha<sup>-1</sup> as compared with rest of the treatments. Organic fertilizer application improved nodule dry weight, photosynthetic rates, N<sub>2</sub> fixation, and N accumulation as well as N concentration in several crops (Jannoura *et al.*, 2014) [38]. However, it was also found that organic agro-ecosystem management strongly influences the soil nutrients and enzyme activity while it has lesser influence on soil microbial communities (Bowles *et al.*, 2014) [19].

### Impact of Cowpathy on Soil Health

Microbial flora of soil plays an important role in soil health. The microorganisms present in the rhizospheres environment around the roots influence the plant growth and crop yield. The beneficial microorganisms from Panchagavya and their establishment in the soil improved the sustainability of agriculture. Soil health is the continued capacity of soil to function as a vital living system within ecosystem and land use boundaries to sustain the biological productivity. Increasing awareness of environmental impact of conventional high input intensive farming system has led to a

move towards alternatives. The organic (biological/ecological) approach is one of the alternatives to conventional production system currently being advocated (Subbarao *et al.*, 2007) [92]. Considering the potential environmental benefits of organic production and its compatibility with integrated farming approaches, quality of food and sustainability, organic agriculture is considered as a viable alternative for sustainable agricultural development (Ramesh *et al.*, 2005) [70]. Beulah *et al.* (2002) [13] opined that the beneficial microorganisms from panchagavya and their establishment in the soil improved the sustainability of agriculture as the microorganisms present in the rhizospheres environment around the roots influence the plant growth and crop yield. The possible reason for higher growth characters and increased height might be due to the growth enzymes present in Panchagavya which favoured rapid cell division and multiplication. Panchagavya is an organic formulation that enhances the biological efficiency of crop plants and quality of fruits and vegetables.

Recent findings indicate that there will need to be a 60 % increase in global food production and associated ecosystem services by 2050. However, one-third of global soils are currently facing moderate to severe degradation through soil erosion, nutrient depletion, salinity, sealing and contamination. Studies have shown increased yields where the farmer has used organic practices (Ramesh *et al.*, 2005) [70] in crops like chilli, moringa (Beulah *et al.*, 2002) [13], green gram (Somasundaram *et al.* 2003) and french bean (Selvaraj, 2003). It can be concluded that *panchagavya* as an organic growth-promoter for small and marginal vegetable growers (Boomathi, 2006) [16]. The cost-benefit to farmers was greatest when *Panchagavya* was used as a growth promoter and proved as the cheapest, while Amrit Pani, and Bokashi were the costliest alternative input (Francis and Smith, 2006) and Higher net returns and B: C ratio were evidenced when *panchagavya* was included in the nutrient management strategies in crops like rice, green gram, and black gram (Swaminathan *et al.*, 2007) [96]. Halemani *et al.*, (2004) [36] reported that the application of FYM@ 10 t ha<sup>-1</sup> decreased the bulk density, increased the infiltration rate and water holding capacity of soil. Perumal *et al.*, (2006) reported that presence of growth regulatory substances such as Indole Acetic Acid (IAA), Gibberlic Acid (GA<sub>3</sub>), Cytokinin and essential plant nutrients from panchakavya caused a tremendous influence on the growth rate in *Allium cepa*. The positive effect of panchagavya on growth and productivity of crops has been reviewed and documented by Somasundaram and Amanullah (2007) [88]. The presence of auxin in panchagavya controls the water regulation in developing fruits of okra. Regular and uniform water supply to the developing fruits resulted in increased ascorbic acid content, Barlett's index and crude protein content (Vennila and Jayanthi, 2008) [103]. Therefore, it is now considered as an efficient plant growth stimulant. Babalad *et al.*, (2009) [10] reported that organic system produced significant improvement in quality of soil mainly bulk density, maximum water holding capacity, infiltration rate, organic carbon, available nitrogen, phosphorus and potassium.

The Panchagavya, Jeevamruth and Beejamruth are ecofriendly organic preparations made from cow products. The use of organic liquid products such as Beejamruth, Jeevamruth and Panchagavya results in higher growth, yield and quality of crops. These liquid organic solutions are prepared from cow dung, urine, milk, curd, ghee, legume flour and jaggary. They contain macro nutrients, essential

micro nutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms (Palekar, 2006; Natarajan, 2007; Sreenivasa *et al.*, 2010) [60, 55, 90]. Nileemas and Sreenivasa, (2011) [58] stated that application of liquid organic manure promotes biological activity in soil and enhance nutrients availability to tomato crop. Additions of organic manure to soil enhance microbial activity and increase their ability to conserve fertigation and consequently increasing their fertility and fertilizers use efficiency as a final goal (Nanwai *et al.*, 1998). (Gad *et al.*, 2012) [31] noticed that foliar application of humic acid@ 2 g l<sup>-1</sup> increased N% and protein% of seeds and recorded higher plant height, plant dry weight, pod diameter, fresh seeds weight pod<sup>-1</sup>, number of fresh seeds pod<sup>-1</sup>, green pod yield, seeds weight dry pod<sup>-1</sup>, dry seed yield, N,P and protein percent of pea seeds.

## Conclusion

Cow is Central to our life and bio-diversity. Its progeny and its cowpathy have wide applications and have the potential for sustainable agriculture production, health and nutrition of humans, production of biofertilizers production of non-conventional energy and for maintaining the bio-diversity of the ecosystem. The use of different local formulation proved beneficial in different crops and produced better growth of plants and ultimately final product *i.e* yield of the crop. All these traditional agricultural inputs hold good promise for use in agriculture and production of safe and healthy food. *Panchagavya* and *Kunapajala* sprays to crops gave significantly higher yield than control. *Compost tea* was also found effective in suppressing various plant pathogens. Foliar application of *Beejamrit* and *Jeevamirrit* were also proved to enhance the productivity of different crops and efficacy against various plant pathogens.

Productivity is low in part because smallholder farmers produce less than their potential due to the poor adoption of best practices. The need for technology varies among farmers according to their natural resource base, land quality and connections to local and regional markets. Developing best practices in crop cultivation based on scientific methods, including applying organic inputs based on soil testing and optimizing water use with micro-irrigation systems, can help increase productivity. There is a huge potential for small farmers to increase sustainable productivity. An integrated approach is necessary to promote the highly valuable virtues and wide applications of cowpathy. Thus it can be inferred that Cowpathy, a new version of ancient science, is definitely a promising formulation in the years to come. Therefore, educating people about the benefits of cow and cowpathy can provide solution to problems of shortage of food grains, fuel, nutrition and soil health and as alternate source of energy. The hazardous effects of fertilizers and pesticides, the use of these eco-friendly traditional agricultural inputs provide alternative production technologies to organic farmers and new vistas to scientific community for further validation and refinement of age-old *Vedic Krishi* practices in present scenario to enhance food and nutritional security, save the soil health and environment. Further research identifying optimal combinations for specific agro-ecological and farming systems is needed.

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