Dr. Trilochan Mohapatra
Secretary DARE and Director General - ICAR
Indian Council of Agricultural Research
Krishi Bhavan, New Delhi 110 001

Foreword

The three major challenges confronted by the agriculture sector in India are, increase in productivity per unit of land, reducing rural poverty through a socially inclusive strategy and meeting food security needs. Modern agricultural practices which are heavily dependent on the use of chemical pesticides, inorganic fertilizers and growth regulators have raised the agricultural production manifold but at the cost of resource depletion, environmental deterioration and loss of crop diversity. Therefore, it was realized that modern agriculture is not sustainable in the long run and hence there is an immense need for appropriate interventions to address the prevailing constraints with emphasis on the conservation of natural resources and maintain the quality of the environment.

Natural Farming is a traditional method which is chemical-free and agroecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. It basically aims to increase farmer's yield by maximizing natural inputs and by avoiding the use of non-natural inputs *viz.*, fertilizer, herbicides and pesticides to optimize production potential and thus provide abundant, high quality, healthy food at the best price.

Natural Farming or Zero Budget Natural Farming (ZBNF) or "Do-Nothing" farming has become a pivotal point of discussion among the agricultural scientists, government, farmers and several other informal groups engaged in agriculture. This is mainly due to the reason that there are two diametrically opposite schools of thought on this topic co-existing in the country. Some scientists straightaway discard the philosophy of Natural Farming. On the other hand, its proponents are claiming the method to be a panacea for all problems causing distress in Indian agriculture, especially for smallholders.

This book entitled **"Natural farming in millets- A Revolution in Indian Agriculture"** summarizes the importance of natural farming in millets, explaining in detail the key themes of nutrient management, weed management, insect and pest management complimented with a few success stories witnessed in the district. Further, it gives a clear picture to the reader, describing all the features of natural farming techniques and elucidate how it can remain as an answer to the environmental, social and economic crises the world is encountering today.

In this endeavour, the authors of this book are highly appreciated for their sincere efforts to make this book a unique and indispensable resource that offers valuable information and which would be a snapshot for the progress of natural farming in millets.

(Trilochan Mohapatra)

Dated : 30-3-2022
New Delhi

Dr. Vilas A.Tonapi
Director
ICAR - Indian Institute of Millet Research
Hyderabad-500 030

Foreword

"Indian agriculture is in a way, a victim of its own Green revolution's past success". The green revolution has resulted in a heavy dependence on expensive chemical inputs obtained from markets, causing farmers to be distressed. The crops being subjected to vagaries of monsoons are becoming more vulnerable to pests and diseases and farmers are compelled to apply higher doses of pesticides year after year. This leads to perpetual and increasing fluctuations in the crop yields and quality of output as well as unpredictable farm incomes. The excess application of agri-chemicals is leading to the deterioration of soil quality, along with loss of biodiversity and health hazards to human beings.As a result, farmers became dependent on informal credit institutions that provide credit at relatively higher interest rates which have often pushed farmers into a debt trap.

Hence, most of the farmers in the country are looking for alternative models of agriculture. Natural farming is one such alternative farming that mimics nature and demands no industrially manufactured inputs. It is a system that works along with natural biodiversity, encouraging the complexity of living organisms which in turn contributes to the quality and productivity of the food crops.

Natural farming is one of the approaches towards attaining the Rainbow Revolution.The main objective of this farming approachis to make agriculture economically viable, climate-resilient, livelihood profitable and aiming to reduce cost of cultivation, enhance yields and reduce risks by promoting the adoption of an agroecology framework.

This book entitled **"Natural farming in millets- A Revolution in Indian Agriculture"** speaks about the ecological and resource perspective of natural farming, regarding all crops in general and millets in particular. It seeks to pursue a holistic approach encompassing farming along with food, health, nutrition, livelihood and ecological securities. The authors and contributors of this book are highly appreciated for their efforts to make this book a unique and indispensable resource that offers a diverse range of information on sustainable agricultural systems for the long-term health of humankind and biosphere as a whole.

(Vilas A. Tonapi)

CONTENTS

Natural Farming in Millets

Introduction :

Natural farming can be defined as the art, practice and the science of working with a chemical-free farming and livestock based. Soundly grounded in agro-ecology, it is a science of working with nature to achieve much more with less and a diversified farming system that integrates crops, trees and livestock, allowing the optimum use of functional biodiversity. It holds the promise of enhancing farmers' income while delivering many other benefits, such as restoration of soil fertility and environmental health and mitigating or reducing greenhouse gas emissions. It builds on natural or ecological processes that exist in or around farms. Natural farming aims to increase farmer's yield by maximizing production factors (soil) and by avoiding the use of non-natural inputs (fertilizers, herbicides and pesticides) to maximize production potential and thus provide ample, high quality healthy food at the lowest possible cost.

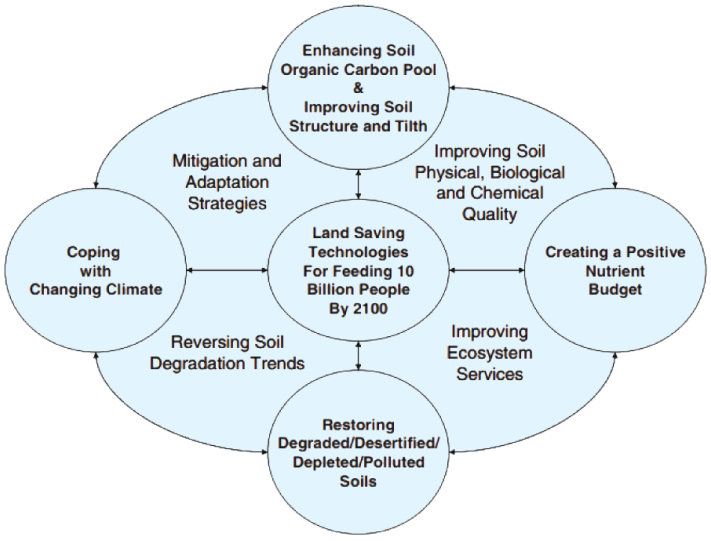
In India, natural farming is often referred to as "Rishi kheti", which includes ancient vedic principles of farming including use of animal waste and herbs for controlling pests, diseases and promoting growth. The rishi's or Indian sages use cow products like buttermilk, milk, curd and its waste urine and dung for preparing growth promoters. This farming is regarded as non - violent without any usage of chemical fertilizers and pesticides. Internationally, natural farming is considered as a form of regenerative agriculture, a prominent strategy to save the planet. It has the potential to manage land practices and sequester carbon from the atmosphere in soils and plants, where it is actually useful instead of being detrimental.

The golden rule is to enrich the level of organic matter in the soil, since this promotes the microbial life and thus soil fertility. Conventional farming, on the other hand, does not strive to maximize yields through the use of inputs, necessitating extensive cultivation over larger areas to produce the desired quantites. Thus, natural farming has the blessings of all those who dream of a world where "Mother Nature" triumphs over technical advancement, which is nonetheless responsible for one of the greatest tragedies for biodiversity: the disappearance of millions of acres of forest. Natural farming aims to improve and preserve the soil quality, whereas conventional farming destroys it in every situation. Conservation of crop diversity, no tillage, watershed management and efficient water use are the crucial steps in natural farming.

Sustainability as a goal in Indian agriculture development

Agriculture is at the heart of all the great debates related to the environment, water, biodiversity, war on hunger and all issues that will determine the future of our planet. However, the perception of agriculture by the media, politicians and the public at large conceal numerous misconceptions that are the result of continuing misinformation and a lack of communication on the part of farmers on how their profession and practices have evolved.

Serious global issues such as poverty, illness, food prices, climate change, global market, pollution, pest adaptation and resistance, soil degradation, decreasing biodiversity and desertification can be explained by the increasing artificialization of human society. The pressure on finite soil resources is likely to be exacerbated by global warming, soil degradation, pollution and decrease of available fresh water, urbanization and industrialization. Here are the five tenets of sustainable agriculture to improve crop yields and soil resources.



Five Tenets of Sustainable Agriculture

1. Enhancement of Soil Organic Carbon and Soil Structure:

It is essential to enhance organic carbon levels above the threshold minimum of 1.2% in the root zone for the major soils of the tropics. Increasing organic carbon concentration implies maintaining a positive ecosystem carbon budget. There also exists a close relationship between organic carbon concentration and soil structure as moderated by the activity and species

diversity of soil fauna. Increase in organic carbon and improvement in structure and tilth, enhance water, soil aeration, nutrient storage and availability. Improving the overall soil physical quality is essential for increasing root growth, development and enhancing uptake of water and nutrients.

2. Creating a Positive Nutrient Budget:

Most cropland soils of sub-Saharan Africa and South Asia have experienced a negative nutrient budget of 30–40 kg of NPK/ha/yr on a continental scale since 1960s. The negative nutrient budget is caused by the prevalence of extractive farming practices, including removal of crop residues for fodder, fuel, use of animal dung for household cooking and unbalanced application of nutrients. Soils depleted of inherent nutrient reserves do not respond to other inputs such as the adoption of improved varieties.

3. Soil Restoration:

Restoring the quality of degraded, desertified, depleted and contaminated soils is essential for meeting the demands of an increasing population with growing aspirations for high standards of living. In addition to enhancing the net primary productivity and agronomic output, restoring degraded and desertified soils also improves the environment.

4. Adapting Agriculture to Changing Climate:

Reducing the adverse impact of climate change necessitates adapting agronomic practices to reduce the spreading risks. Ex-ante risk management options include:

a) Soil management by mulching, no-till farming, delayed fertilizer application, integrated nutrient management options, runoff management and adequate weed control.

b) Plant management involving variety selection, staggered time of planting, low-planting density, bunch planting and intercropping.

c) Farming system management involving diversification, agroforestry and mixed farming.

5. Land Saving Technologies:

With the decreasing availability of per capita land area and supply of fresh water resources for agriculture, it is essential to increase productivity per unit area of existing land through agricultural intensification. The goal is to intensively cultivate the best soils using best management practices to obtain maximum yield so that land can be saved for nature conservancy. With the adoption of specialized technologies that builds upon traditional knowledge but also use modern scientific innovations, per capita land area requirements can be decreased to less than 0.03 ha.

Intensive agriculture is wrongly perceived as synonymous with productivism and pollution and extensive agriculture is meant to protect the soil when in fact it leads to soil depletion through overgrazing, deforestation and expanding desserts. This is why extensive agriculture is often considered as sustainable as opposed to intensive agriculture that is thought responsible for pollution and diminishing of our future resources. Sustainability creates and maintains the ideal conditions between man and the environment; it is a profession that places man closest with nature and it needs to be well tuned with the surrounding environment. Sustainable agriculture through soil, water and seed management can increase crop yields, an efficient warehousing and distribution system is also necessary to ensure that the output reaches the consumers and it can be achieved through the practice of natural farming.

Social Welfare

The substitution of chemical inputs in natural farming generally results in higher demand for labour in comparison with conventional agriculture and therefore, should contribute to rural employment and help keep in business small farms which would otherwise not be able to cope with intensification and global competition.

Economic Wellbeing

Nature based farming represents real opportunities on several levels, contributing to rural economies through sustainable development such as ecological tourism to Natural farms is a tool to help small farmers to earn additional income and in this way support the transition from conventional farming to natural farming.

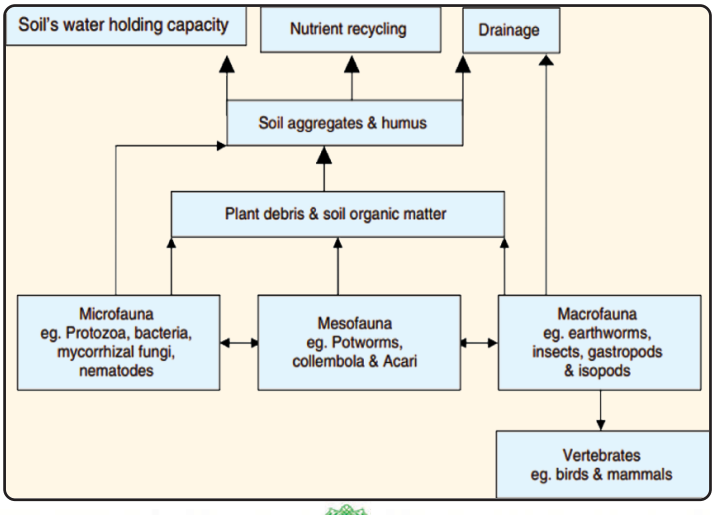
Ecological Aspects

Natural inputs provides a better root system and ability to interact with beneficial soil micro-organisms, ability to suppress weeds, contributing to soil, crop and seed health, good product quality, high yield level and high yield stability.

Social, Economic and Ecological aspects of Natural Farming

Soil Biodiversity:

The importance of soil biodiversity in agriculture has not been appropriately considered because crop productivity has been increased through the use of inorganic fertilizers, pesticides, plant breeding, soil tillage, liming, and irrigation. Soil biodiversity is normally indicated as the variability of the living forms, soil fauna, flora, vertebrates, birds, and mammals within a habitat or a management system of a territory involved in agricultural activity. With regard to soil fauna, microbial mass diversity and biological activity are higher in undisturbed soil or soil system that is managed using conservation agriculture techniques compared to those receiving deep cultivation. With respect to microfauna management practices that favor bacteria would also be expected to favor protozoa since bacteria are their main food source. Also, the abundance of mesofauna was greater where conservation agriculture was practiced in comparison to compacted soil. The negative effects on micro-arthropod populations are caused by the physical disturbance of the soil from plough-based tillage. Some individuals may be killed initially by abrasion during tillage operation, or by being trapped in soil clods after tillage inversion. Soil microbes play vital role in variety of soil processes *viz*., particapte in nutrient processing by promoting the decomposition of organic materials, degradation of xenobiotics, soil carbon sequestration and even protect against crop diseases.



Role of Earthworms in natural farming: Earthworms are a significant part of the macrofauna in many soils, affecting soil properties through their feeding, casting, and burrowing activities. Earthworms stimulate microbial activity, soil aggregation, soil water content and water holding capacity by modifying the soil's physical structure, thus decreasing the risk of erosion. Minimum soil disturbance, especially if combined with the return of crop residues and additional organic manure supply, increases earthworm population especially deep-burrowing species. Moreover, reduction of tillage intensity encourages earthworm population in the soil. Mouldboard ploughing and no-till represents the two extremes of agricultural soil management systems and systems with intermediate levels of soil disturbance and surface residue usually show populations to be similarly in between the two extremes. Earthworms are also important for mixing plant residues and other materials into the soil, which may be particularly important in no-till systems due to the lack of mechanical mixing by tillage implements.

Origin/History of Natural Farming:

Natural farming is not a technique but a view, or a way of seeing ourselves as a part of nature, rather than separate from or above it. The natural farming approach was first introduced by **Masanobu Fukuoka**, a Japanese farmer and philosopher, in his book **"The One-Straw Revolution"** written in 1975. It is also referred as "the Fukuoka Method", "the natural way of farming" or "do-nothing farming". The title refers not to lack of effort, but to the avoidance of manufactured inputs and equipment. He described Natural Farming as a diversified farming system that integrates crops, trees and livestock, allowing the optimum use of functional biodiversity with the following aspects.

- Physical work and labor can be highly reduced as compared to other agricultural systems.
- Yields similar to chemical agriculture is possible.
- There is an increase in soil fertility year after year.
- Water requirement is minimized.

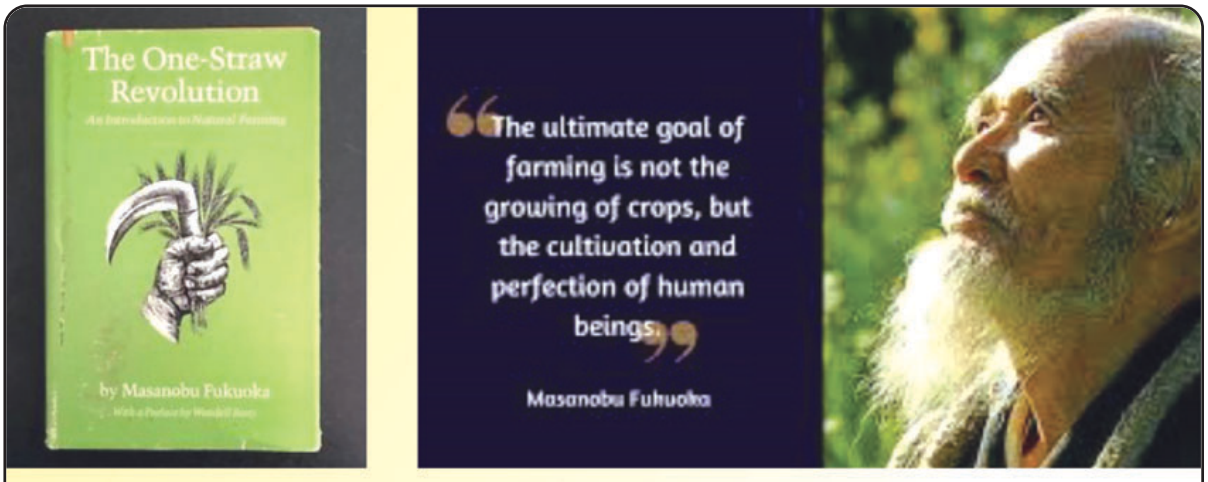
Bhaskar Save, known as the "Gandhi of Natural Farming" in India has inspired and mentored 3 generations of organic and natural farmers. Save's way of farming and teachings are rooted in his deep understanding of the symbiotic relationships in nature. He described natural farming as a holistic and bio-diverse organic farming in harmony with nature. It is low-intervention, environmentally friendly, sustainable and economically profitable. It is a "do-nothing" type of farming in its most evolved form, where nature takes care of everything and little needs to be done by the farmer.

"Who planted the great, ancient forests? Who tilled the land? Who provided seed, manure, irrigation, or protection from pests?" "From where do the trees – including those on Rocky Mountains – get their water, their nitrogen, phosphorous, potash? are the major questions posed in nature. "In our forests, untended by man, the food trees – like ber, jambul, mango, wild fig, mahua, tamarind, jungle sapota – yield so abundantly in their season, that the branches sag with weight of the fruits. On earth, a constant inter-play of the six key factors (paribals) of nature, interacting with sunlight. Three are: air, water and soil. Working in tandem with these, are the three orders of life: the world of plants; the realm of insects, micro-organisms and animal kingdom. These six key factors maintain a dynamic balance and together, they harmonize the nature's grand symphony. "Man has no right to disrupt any of the paribals of nature, but modern technology, wedded to commerce, rather than compassion, has proved disastrous at all levels. They have despoiled and polluted the soil, water and air, wiped out most of the forests and killed its creatures.

In India, after the Green Revolution, farmers have raised their production by planting improved varieties, benefited by more water and increased inputs of agrochemicals, fossil-fuel energy and capital investment. Relentlessly, farmers under modern agricultural practices spray deadly poisons on their fields, massacring nature's micro-organisms and insects - the unpretentious, but tireless little fertility workers that maintain the vital, ventilated quality of the soil, recycling all life-ebbed biomass into nourishment for plants. These noxious chemicals also inevitably poison the water and nature's animal kingdom, including humans. The modern agriculture practices heavily dependent on the use of chemical pesticides, inorganic fertilizers and growth regulators have raised the agricultural production manifold but at the cost of resource depletion, environmental deterioration and loss of crop diversity. Thus, there is a high need to shift the agriculture system from 'Green Revolution' to 'Evergreen Revolution'.

Therefore, it was realized that modern agriculture is not sustainable in the long run; hence, the concept of sustainable agriculture emerged which not only emphasizes on the conservation of the natural resources but also maintains the quality of the environment. Sustainable agriculture is in fact the successful management of resources for agriculture to satisfy the changing human needs, while maintaining or enhancing the quality of environment and conserving the natural resources. It is a balanced management system of renewable resources including soil, wildlife, forest, crops, fish, livestock, plant genetic resources and ecosystems without degradation. It also endeavors to provide food, livelihood, for current and future generations maintaining and improving productivity and ecosystem services of these resources.

Moreover, it has been understood that, the on-going population explosion, unsustainable agriculture practices and fast scientific and technological advancement cannot be reversed unless there is collective thinking, will and effort. These call for public awareness and participation to bring about an attitude change and finally restricting further damage to the environment. However, in recent years, environmental awareness has gained increased attention and it has become a bit of a trend: from environmentally friendly green building to organic food. The term “go green,” is often used to sensitize people regarding protection of the natural environment and to help them to make better economic choices. In both developed and developing countries, there is a need to adopt new approaches to increase food supplies while protecting the resource on which they depend.



(Source- www.finalstraw.org)

Aim of Natural Farming:

➢ To make farming viable and aspirational by increasing the net income of farmers on account of cost reduction, reduced risks, similar yields, income from intercropping.

➢ To drastically cut down production costs by encouraging farmers to prepare essential biological inputs using on-farm, natural and home-grown resources.

Vision : To develop environmentally sustainable and economically stable farming practices to enhance the living standards of the farmers, conserving the natural resources without compromising on the crop yields.

Mission: It holds the promise of enhancing farmer's income while delivering many other benefits, such as restoration of soil fertility and environmental health, integrating all the available natural resources.

Objectives of Natural farming:

- ***Minimized Cost of Production:*** by developing cost- effective farming practice with scope for raising employment and rural development.
- ***Ensures Better Health:*** by not using any synthetic chemicals and eliminate health risks and hazards
- ***Employment Generation:*** on account of natural farming input enterprises, value addition, marketing in local areas, etc. Its potential to generate employment, thereby stemming the migration of rural youth.
- ***Environment Conservation:*** by ensuring better soil biology, improved agrobiodiversity and a more judicious usage of water with much smaller carbon and nitrogen footprints.
- ***Reduced Water Consumption:*** Working with diverse crops that help each other and cover the soil to prevent unnecessary water loss through evaporation as natural farming optimizes the amount of crop per drop.
- ***Rejuvenates Soil Health:*** The most immediate impact of Natural farming is on biology of soil - on microbes and other living organisms such as earthworms.
- ***Livestock Sustainability:*** Integration of livestock (Eco Friendly bio-inputs, such as Jivamrit and Beejamrit, are prepared from cow dung and urine) in the farming system plays an important role in Natural farming and helps in restoring the ecosystem.

- ***Resilience:*** The changes in soil structure with the help of organic carbon, no/low tillage and plant diversity are supporting plant growth by imparting resilience to the crops against weather extremities.

How is Natural farming different from organic farming?

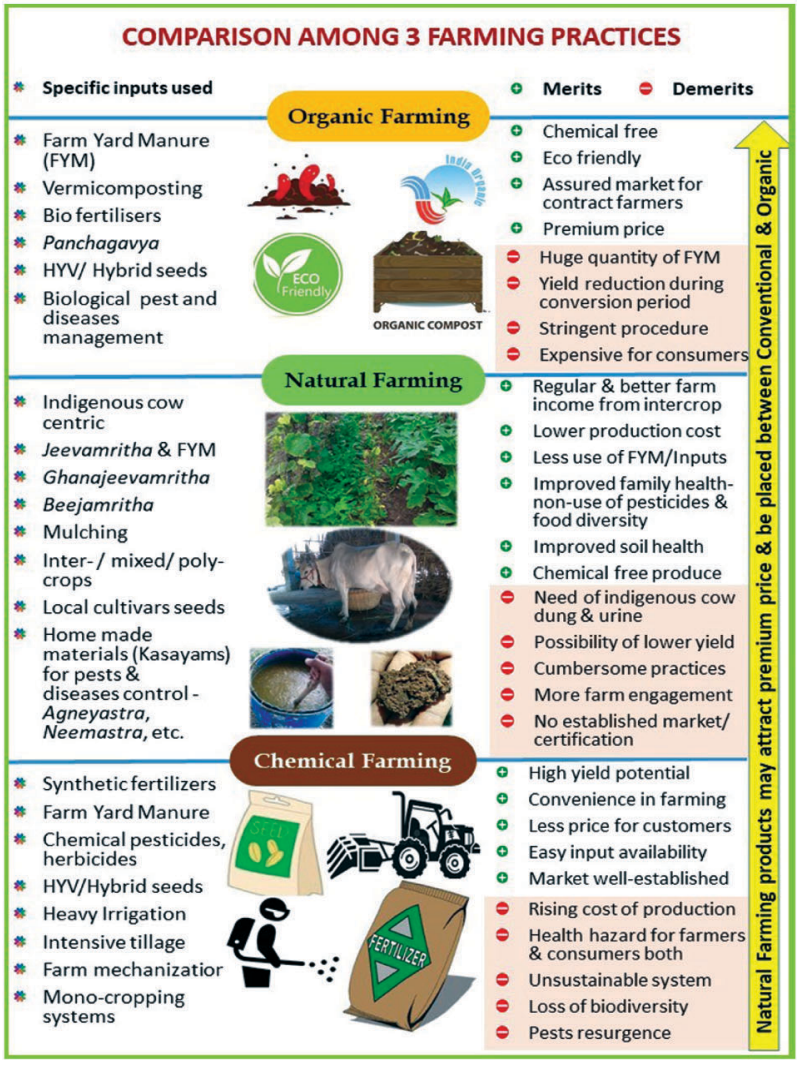
Natural farming is a system where the laws of nature are applied to agricultural practices. This method works along with the natural biodiversity of each farmed area, encouraging the complexity of living organisms, both plants and animals that shape each particular ecosystem to thrive along with food plants.

Organic farming	Natural farming
✦ In organic farming, organic fertilizers and manures like compost, vermicompost, cow dung manure, etc. are used and added to farmlands from external sources.	✦ In natural farming, neither chemical nor organic fertilizers are added to the soil. In fact, no external fertilizers are added to soil or give to plants whatsoever.
✦ In natural farming, decomposition of organic matter by microbes and earthworms is encouraged right on the soil surface itself, which gradually adds nutrition in the soil, over the period.	✦ In organic farming, decomposition of organic matter by microbes and earthworms is encouraged right on the soil surface and sub-surface which gradually adds nutrition in the soil, over the period.
✦ Organic farming still requires basic agro practices like plowing, tilting, incorporation of manures, weeding, etc. to be performed.	✦ In natural farming there no plowing, no tilting of soil and no fertilizers and no weeding is done just the way it would be in natural ecosystems.
✦ Organic farming is still expensive due to the requirement of bulk manuresand it has an ecological impact on surrounding environments.	✦ Natural agriculture is an extremely low-cost farming method, completely molding with local biodiversity.

- There are many working models of nat ural farming all over the world, the zero-budget natural farming (ZBNF) is the most popular model in India. This comprehensive, naturaland spiritual farming system is developed by Padma Shri Subhash Palekar.

Similarities between natural farming and organic farming:

- Both natural and organic farming are chemical free and more or less poison free farming methods.
- Both systems discourage farmers from using any chemical fertilizers, pesticides on plants and in all agricultural practices.
- Both farming methods encourage farmers to use local breeds of seeds and native varieties of vegetables, grains, pulses and other crops.
- Organic and natural farming methods promote nonchemical and homemade pest control methods.



Strategies for Natural Farming

The natural farming (eco-agriculture) is considered even superior to organic farming in the sense that the former does not lay emphasis on ecosystem function and wild biodiversity conservation. The eco-agriculture increases agricultural production and simultaneously restores biodiversity and other ecosystem functions, in a landscape or ecosystem management context with the following strategies.

(i) **Creation of biodiversity reserves that also benefit local farming communities:** The farming principle includes the Low External Input Sustainable Agriculture (LEISA). Rainwater harvesting, management and soil health care are integral parts of the system. The crop pests are largely controlled (but not completely eliminated) by a traditional practice. The farm manure and 'vermicompost' (that is the compost of digested farm waste by earthworms which also pulverize the soil) are extensively used to enhance the soil organic matter, particularly the humus. The economic viability is ensured through regular income from composite culture of medicinal, agricultural, plantation crops and farm animals. From the biodiversity point of view, the shift from the usual monoculture to polyculture ensures that a wider spectrum of species of insects, birds, small mammals and reptiles make use of the habitat. The inclusion of honeybees (apiculture) provides additional income from honey and also helps in pollination of vanilla; where adequate water is available, edible and ornamental fish culture is also included.

(ii) **Development of habitat networks with agriculture in non-farmed areas:** This involves the integration of agricultural landscapes in many non-farmed areas with high-quality habitat for wild species that are compatible with farming. For example, the traditional farmers provide facilities for barn owls to contain destructive rodents.

(iii) **Reduction or even reversal of the conversion of wild lands into agriculture :** by increasing farm productivity.

(iv) **Minimize agricultural pollution:** through more resource-efficient methods of managing nutrients, pests and waste. This is a basic principle governing all the approaches towards sustainable agriculture, conservation of biodiversity, health and welfare of all the rural women, children and men constituting especially the farming families.

(v) **Modification of management of soil, water and vegetation resources :** in order to enhance the habitat quality in and around farms. An excellent example is the concept of

promoting a community-led integrated gene management system to achieve sustainable development and food. Accordingly, it allows farmers the right to register farmers' variety, right to receive reward and recognition for conservation of agro-biodiversity, right to receive benefit sharing from a new commercial variety developed by using farmers' variety and right to re-sow, exchange, share or sell farm saved seeds.

(vi) **Modification of the farming systems to mimic natural ecosystems:** Economically useful trees, shrubs and perennial grasses are integrated into farm in ways that mimic the natural vegetative structure and ecological functions to create suitable habitat niches for wildlife. In a nutshell, eco-agriculture involves developing mutually reinforcing relationships between agricultural productivity and conservation of nature. Thus, the eco-agriculture involves concurrent action plans towards agricultural growth, poverty alleviation and biodiversity conservation. In the conventional approach, these three goals seldom complemented one another. In fact, agricultural growth and biodiversity conservation were erroneously regarded as mutually exclusive.

Zero Budget Natural Farming: A Green Approach for India

Zero budget natural farming is a unique chemical-free method of agriculture that involves agro-ecology and is drawn from traditional Indian practices. It aims to bring down the cost of production to nearly zero and return to a pre-green revolution style of farming. It claims that there is no need for expensive inputs such as fertilizers, pesticides and intensive irrigation. The inputs used for seed treatments and other inoculations are locally available in the form of cow dung and cow urine. ZBNF farmers have lower cost of inputs and thus have better capacity to increase the incomes. At the same time ZBNF crops helps in retaining soil fertility and is climate change resilient. It is both a social and environmental programme which ensures that farming (particularly for small landholders) is economically viable by enhancing farm biodiversity and ecosystem services. It aims to reduce farmers' costs by eliminating external inputs and using in-situ resources to rejuvenate soils, whilst simultaneously increasing incomes and restoring ecosystem health by means of diverse multilayered cropping systems.

How Did Zero Budget Natural Farming Start in India?

The Green Revolution started to ruin livelihoods and lands, few farmers started their research to return to alternative systems. One of them was a Maharashtrian agriculturist Shri Subhash Palekar, developed it in the mid-1990s as an alternative to Green Revolution methods which was driven by chemical, intensive irrigation and pesticides.

Mr. Subhash Palekar argued that the rising cost of external inputs is the main cause of suicide and indebtedness among farmers. The impact of chemicals on long-term fertility and the environment is devastating. He,in coordination with the Japanese philosopher Fukuoka came forward with techniques of natural farming and were widely promoted as zero budget natural farming.

Features of Zero budget natural farming (ZBNF):

- Commercial level farming can be done in almost zero budget only by using locally available and farm-based resources.
- According to ZBNF principles, plants get 98% of their supply of nutrients from the air, water and sunlight. And the remaining 2% can be fulfilled by good quality soil with plenty of friendly microorganisms. (Just like in forests and natural systems)
- **Soil microclimate:** The soil is always supposed to be covered with an organic mulch, which creates humus and encourages the growth of friendly microorganisms.
- **Desi cow:** The system requires cow dung and cow urine (Gomutra) obtained from Indian breed cow only. Desi cow is apparently the purest as far as the microbial content of cow dung and urine goes.
- **Cultures:** A farm made bio-culture named 'Jeevamrutha' is added to the soil instead of fertilizers to improve microflora in the soil. Jeevamrutha is derived from very little cow dung and cow urine of desi cow breed.
- Natural, farm-made pesticides like Dashparni ark and Neem Astra are used to control pests and diseases.
- Weeds are considered essential and used as living or dead mulch layer.
- In ZBNF, multi-cropping is encouraged over single crop method.

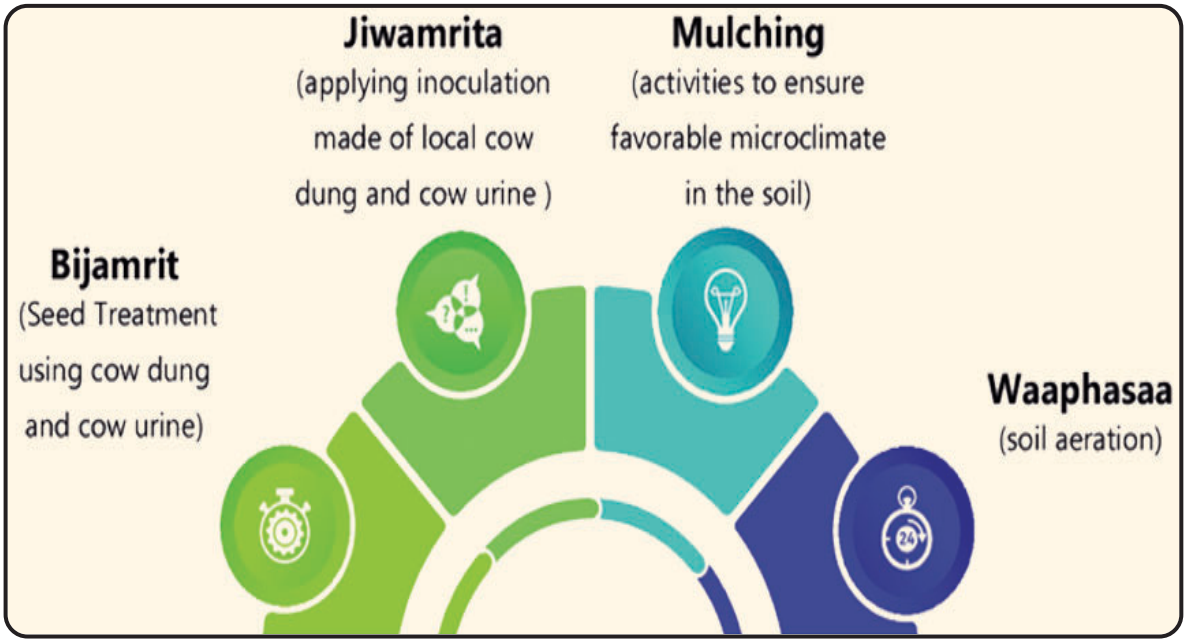
Why is ZBNF necessary?

From the (NSSO) National Sample Survey Office data, 70% plus of farmers spend more they earn and most farmers have debt. The indebtedness level is around 90% in states like Andhra Pradesh and Telangana, where each household has an average debt of Rs 1 lakh. To achieve the promise of the central government to double the income of farmers by 2022, one factor being considered is natural farming method zero budget natural farming.

Hence ZBNF method is essential as.....

- Farmers depend on loans.
- The economic survey has highlighted the ecological benefits.
- Cost of farming inputs is rapidly increasing.
- The number of farmer's suicide cases are growing continuously.
- The demand for safe food increased among customers.
- Unstable market price.

Four Pillars of Zero Budget Natural Farming:



The four principles of ZBNF :

1. Zero budget farming:

The production cost for the farmer is zero as no input needs to be purchased. As 1.5 to 2.0 % of the nutrients are taken from the soil by the plant (the rest is taken from the air, water and solar energy), there is no need to add fertilizers. These nutrients provided by nature (as in the forest) are totally free of cost. As a zero cost technique, natural farming is an appropriate answer to the current agriculture crisis and particularly to farmers great indebtedness and dependence on money lenders, that increasingly leads many of them to commit suicide.

2. Natural inputs :

Natural farming does not require chemical inputs or organic compost like vermiculture but promotes a natural catalyst of biological activity in the soil and natural protection from diseases. The nutrients (Nitrogen, Phosphate, Potash, Iron, Sulphur, Calcium) which are present in the soil are not in an available form for the plants. They first need to be transformed through the action of micro-organisms (bacteria, microbes and local earthworms) that are normally present in the soil as well. But the excessive use of chemicals have destroyed these micro-organisms. It is thus necessary to reintroduce them through natural methods like application of local cow dung which, according to Subash Palekar, contains 3 to 5 millions of such beneficial microbes. His researches showed that local cow dung from *Bos indicus* (humped cow)is the most effective compared to foreign cows (Jersey, Holstein). The entire ZBNF method is centered on the Indian cow, which historically has been part of Indian rural life. Only one cow is needed to cultivate 30 acres of lands (most Indian farmers own less than 1 acre) as one cow gives about 11 kilograms of dung per day and as only to kilograms of local cow dung are required per month to cultivate one acre of land.

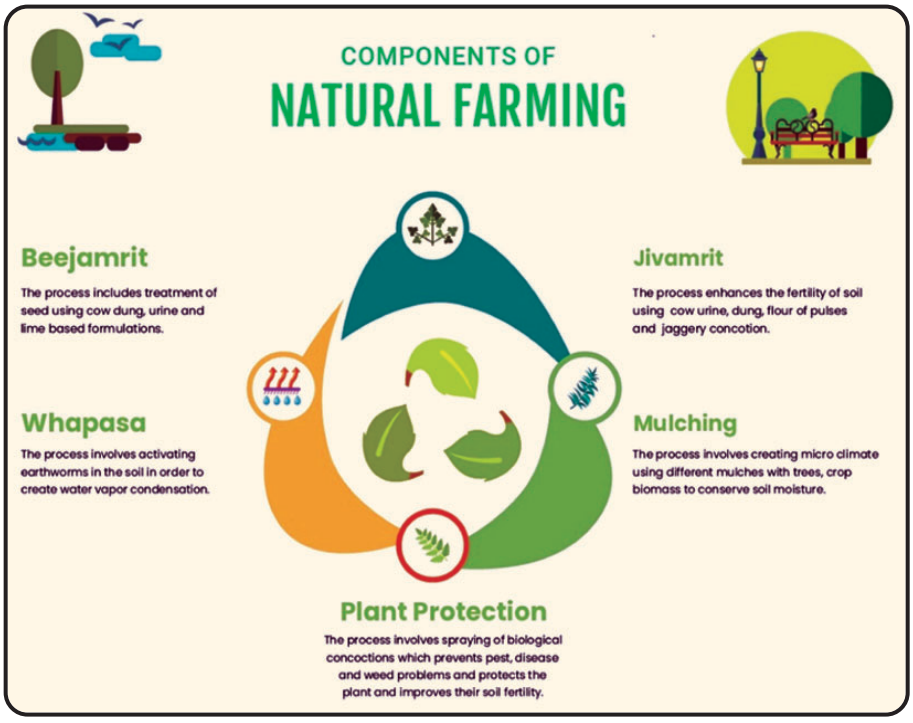
3. Multicropping :

Intercropping, multicropping or mixed cropping, as opposed to mono-cropping which has been imposed by industrial and mechanized agriculture, is the cultivation of two or more crops in proximity in the same field, during a growing season, to promote interaction between them. It is based on the assertion that there is a complementarity between plants. This is primarily how ZBNF gets its “Zero Budget” name. It doesn’t mean that the farmer is going to have no costs at all, but rather that any costs will be compensated for by income from intercrops, making farming a close to zero budget activity. Natural farming enhances the use of the soil and its nutrients through this complementarity between the crops.

4. Mulching :

Mulching is also one the four wheels of Zero Budget Natural Farming. It is necessary to create the micro-climate under which micro-organisms can best develop, that is 25 to 32 °C temperature, 65 to 72 % moisture and darkness and warmth in the soil. Mulching indeed conserves humidity of the soil (therefore diminishing the need for irrigation), cools it and protects its micro-organisms.

Components of Natural farming:



1. **Beejamrutha/Bijamrita** : It is used in the treatment of seeds, seedlings or any other planting material. Beejamrutha protects young roots from fungus as well as from soil-borne and seedborne diseases that commonly damage the plants after the monsoon period. It is basically a mixture of local cow dung, a powerful natural fungicide and cow urine, a strong anti-bacterial liquid, lime and soil.

   Usage: Mix Beejamrutha to the seeds by hand and dry them thoroughly before sowing. For leguminous seeds, just dip them quickly and let them dry. Simply dip leguminous seeds in water and set them aside to dry.

Preparation of Bheejamrutham

For 100 kg Seed treatment

- 20 ltr Water
- 5 ltr Cow Urine from Desi cow
- 5 kg Fresh Cow dung from Desi cow
- 50 gm edible Lime stone
- 1 fist of soil from farm land. This is to reactivate the microbes that exist for years in the soil.

Preparation:

- Combine all the ingredients and stir well using wooden stick in a clockwise direction.
- Store it overnight for fermentation.
- Use it for seed treatment the next day
- *For Monocot Gramineae family crops, like grains, pulses, millets, oilseeds, except soya and groundnut:* Sprinkle Bheejamruth on the seeds and mix slowly with fingers. Do not rub the seeds since it will lose its skin and be damaged.

- *For Potato, Banana sapling, ginger, turmeric:* Place the seeds in a pour Bamboo basket and dip it into Beejamruth for few seconds and then hang it out.
- *Sweet potato, beetel leaves, vanilla, cuttings:* Plant them after dipping in Beejamruth.
- *Seeds of Fruits:* Sow the seeds after dipping them in Beejamruth and drying them.
- *Seeds of Vegetables:* Remove the seeds from the packet and wash them, soak in Beejamruth, dry it and sow it.

Why Beejamrutham?

When the fungus-coated seeds are planted, the fungus in the seeds leads to death of the plant. Under adequate moisture, they enter the root and work their way up the plant until they reach the leaves. When the seed is coated with Beejamruth, its coating kills the fungus on the seed, protecting the seed and its further growth. This avoids the diseases transmitted by seeds. This Process is called Purification / Shuddhikaranam / Bheejasanskara of the Seed.

2. **Jivamrita/jeevamrutha:** It is a fermented microbial culture which provides nutrients and most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity. During the fermentation process, aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic ingredients (like pulse flour). A handful of undisturbed soil is also added to the preparation, as inoculate of native species of microbes and organisms. Jeevamrutha also helps to prevent fungal and bacterial plant diseases.

Ingredints

- 200 lit water
- 10 lit Cow Urine.
- 10 kg Cow dung (the Fresher the better.)
- 1 kg Jaggery or 4 lit of Sugarcane juice or 10kg small pieces Sugarcane or 1 kg Sweet Fruit Pulp
- 1 kg - Besan (best) or Toor Dal or Horse Gram
- 100 gm - farm soil

Preparation of Jeevamrutha :

- Mix all the ingredients and rotate clockwise for 15 mins and cover it with a rug and keep in shade, not to be exposed to sunlight and rain water.
- Leave it for fermentation for 48 hrs. If the climate is colder than 12^0C then keep it for minimum of 4 days.
- Mix it twice a day during dawn and dusk for a minute.
- After 48hrs / 4 days, Jeevamrutham will be ready for use.

Usage:

After preparation, this Jeevamrutham can be used for next 7 - 14 days stored in 200 lit barrel or cement tank or plastic tank.

Dosage:

Per acre 200 – 400 lit Jeevamrutham should be applied to the crop once or twice a month along with Irrigation water.

When to use Jeevamrutha:

When the wind temperature is between 25 and 36 degrees, the humidity is 65 to 90 percent and the solar light intensity is 5000 - 7000 candles, Jeevamrutham performs best in the soil with the best microclimate. This condition occurs only during the rainy season, Dakshinayanam (June-December), when the South West and North East monsoons are active. During the wet season, Jeevamrutham produces the best results.

How to utilize Jeevamrutham

Filter the Jeevamrutham and place it over the vakyal/swayle in a barrel. Jeevamrutham should only be applied in damp soil. If the weather is dry, apply it in the evening or at night. It can be applied through irrigation water or direct application on the surface of the soil.

Application:

- Apply 2-5 lit Jeevamrutham around the canopy of the tree (inside border of the shadow during 12 noon under the tree)
- After Rainy season, feed jeevamrutham along with Irrigation water @ 200 lit – 400 lit per acre
- 1 tea cup Jeevamrutham should be applied between 2 plants directly in the soil once or twice a month.

Jeevamrutha is of three types:

1. Drava jeevamrutha
2. Ghana jeevamrutha (Solid state jeevamrutha)
3. Semi-solid state jeevamrutha

Courtesy : Smt. K. Saraswathi, CEO, Sabala NGO, Vizianagaram

Preparation of Dravajeevamruta:

Fill a barrel with 200 litres of water and add 10 kg of fresh local cow dung, 5 to 10 litres of aged cow urine, 2 kg of jaggery (a local brown sugar), 2 kg of pulse flour and a handful of soil from the farm's bund. Stir the solution thoroughly and leave it to ferment in the shade for 48 hours. Dravajeevamrutha is now ready for use and 200 litres of jeevamrutha is enough to cover one acre of land.

Usage:

Apply the Dravajeevamrutha to the crops twice a month along with the irrigation water or as a 10% foliar spray.

Preparation of solid state jeevamruta (Ghana jeevamruta):

Spread 200 kg of cow dung manure evenly on the floor to make a layer. Add 20 litres of liquid Jeevamrutham to the manure and mix well. Completely combine the ingredients. After that, the cow dung heap is sealed with a jute bag for 48 hours and left for fermentation to take place. Then spread out on the ground to dry in the sun. Collect the dry manure when it has dried and store it in jute bags in the room. Ghana jeevamrutham can be kept in the refrigerator for six months.

Usage: 200kg Ghana jeevamrutha is required per acre in the sowing period. Use 50kg of Ghana jeevamrutha in between two crops to get good yields. Ghana jeevamrutham can be prepared in 3 ways based on the availability of the raw materials.

Ghana jeevamrutham per acre - method 1.

100 kg of Desi Cow Dung (Cow dung is good for 21 days if its kept moist by sprinkling water and storing in shade)

1kg Jaggery

1kg Besan

- Mix all ingredients, knead well and store as a heap for 48 hrs. in shade (No water / rain or Sunlight must fall on this heap)
- If the temperature drops below 12^0 C, these heaps need to be covered with rug sack to keep a constant temperature to create conducive climate for the micro-organisms.
- After 48hrs, spread it on land and dry it. Flip it upside down during the day so that all particles get exposed to sunlight and dries up.
- Using a wooden back, break the lumps into powder once they have dried fully, fill it in sacks and store them.

Ghana jeevamrutham per acre - Method 2

- Take 200 kg dried and sieved powered cow dung farm manure.
- Spread it slightly sprinkle 20 lit Jeevamrutham over it and mix it well using a spade thoroughly.
- Heap the mixture under shade to keep away from water and sunlight for 48 hrs.

- If the temperature drops below 12^{0}C, this heap needs to be covered with rug sack to keep a constant temperature to create a conducive climate for micro-organisms.
- After 48hrs, spread and dry the mixture under the sun and mix it during the day to dry it properly.
- Once it's completely dried up, break the existing lumps os any powder form using wooden bat
- Fill them into sacks and store it. This will be sufficient for 1 acre and can be used for 1 year.

Ghana jeevamrutham from Gobar Gas Slurry per acre - Method 3

- Collect Gobar Gas Slurry and dry it in sunlight. Once it's completely dried up break any existing lumps into powder form using wooden bat and then store it.

Ingredients:

50 kg dried Gobar gas powder

50kg Desi Cow Dung

1kg Jaggery

1kg Besan

Preparation:

Mix the ingredients well and store it as a heap in shade for 48hrs and keep it away from sunlight and rain. After 48hr, dry it under the sun and mix well during the day. Once it is completely dried up, break any existing lumps into powder form using wooden bat. Fill them into sacks and store it. This will be good enough for 1 acre and can be used for 1 year.

Preparation of Semi-solid state jeevamruta:

5 litres cow urine, 100 kg cow dung, 1 kg pulse flour, 1 kg jaggery and a handful of fertile soil are the components. Mix all ingrediants together with a small quantity water and make tiny balls out of the mixture and place it in direct sunshine to dry. Keep the dry balls close to the sprinkler or dripper's mouth. When water falls on the semi-solid Jeevamrutham, the bacteria are reactivated.

3. **Acchadana – Mulching:** According to Palekar, there are three types of mulching:

a. Soil Mulch: This protects topsoil during cultivation and does not destroy it during tillage. It promotes aeration and water retention in the soil.

b. Straw Mulch: Straw material usually refers to the dried biomass waste of previous crops.

c. Live Mulch (Symbiotic intercrops and mixed crops): It is essential to develop multiple cropping patterns of monocotyledons and dicotyledons grown in the same field, to supply all essential elements to the soil and crops. For instance, legumes are of the dicot group and are nitrogen-fixing plants. Monocots such as rice and wheat supply other elements like potash, phosphate and sulphur.

4. **Whapasa:** It is the condition where there are both air molecules and water molecules present in the soil and thereby helping in reducing irrigation requirement.

5. Plant protection concoctions in Natural Farming:

1. Neemasthram

Ingredients:

Green neem leaves-5kg

Dry neem leaves-5kg

Neem fruits-5kg

Desi cow urine- 5 lit

Desi cow dung-1kg

Preparation : In a cement drum take 100 litres of water and to it add 5kg of green leaves or dry leaves or fruits of neem. Mix 5 lits of desi cow urine and 1 kg of desi cow dung in the cement drum. Mix all the contents thoroughly with the help of a stick in clockwise direction. Cover it with a cloth and store it in shade for 48hrs. Stir atleast twice a day at dawn and dusk for 1 minute so that. All the alkaloids in the neem will get dissolved. After 48hrs, strain it and spray it on plants. This can be stored in cool dry place for 6 months.

Benefits:

Neemastra controls the sucking pests, caterpillars.

2. 5% Neem solution:

Ingredients: Neem seed-5kg; Soap nuts-500g; Soap powder- 100g

Preparation : Initially pulverize 5kg of neem seed and tie in a linen bag. Soak the neem seed powder and the bag in 10 lit of water for 10-12 hours. To extract as much azadiractin as possible into the water, squeeze the wet neem powder for 15-20 min. Filter the neem solution through fine mesh strainer and add 100 gm soap powder or 500 gm soapnut juice to it. Spray this solution in one acre of field after diluting it in 100 of water in the evenings. Neem solution cannot be stored, hence spraying should be done immediatly after preparation.

Uses:

1. It can be used in all crops and nurseries.
2. It can be used in fruit crops
3. This is effective against sucking pests and early instar larvae during initial 30-45 days crop duration.

Neem solution contains Azadiractin, an insect repellent that is effective against all stages of the insect life cycle. The limonoids in the neem solution helps to improve the plant's health.

1. Agni asthram:

Ingredients: 10 lit Desi Cow Urine, 5 kg Neem leaves paste, 1 kg tobacco leaves, 1-2 kg green chilli paste, 500 gm desi garlic paste

Preparation:

Take 10 lits cow urine, 1 kg tobaaco leaves paste, 5 kg neem leaves paste, 1-2 kg green chilli paste and 0.5 kg garlic paste in a container and boil the contents for some time after the lid is covered. Cool the contents for 48 hrs and filter with thin cloth before storing the solution in a container. Use 2-3 lits of Agniasthra per acre by mixing with 100 litres of water which is effective for 3months.

Uses : It works against borers such as stem borer, fruit borer and other types of borers. Spray 200 litres of water with 6 litres of Agniastram to kill both root borer pests.

Preparation of Agniasthra

4. Brahmasthram:

Brahmastram - Another natural pesticide for both smaller and bigger pests (especially bigger caterpillars).

Ingredients:

20 lit Desi Cow Urine

2 kg Neem vantages and leaves cut and ground into paste

2 kg Karanj / Ponga leaves ground into paste.

2 kg Custard apple leaves paste

2 kg Castor leaves paste

2 kg Datura leave paste (if Datura not available)

2 kg Mango leaves paste

Preparation:

Mix all the contents thoroughly clockwise with the help of a stick well clockwise, close it with a lid and boil the contents for half an hour until 4 full boils and cool the contents for 48 hrs. Mix the solution morning and evening for a min. After 48hrs, filter the solution with a thin cloth after 48 hours to obtain bharmarasthra.

Application:

This bharmarasthra can be stored upto 6 months. 2-3 lits of bharmarasthra is should be blended with 100 lits of water to cover one acre area.

Uses : It is effective against stem borer, fruit borer and other kinds of borers

5. Vavilakukashayam:

Vavilaku (*Vitex negundo*) is rich in alkaloids and Nirnudin and hence this solution is helpful for controlling pests and diseases in plants.

Ingredients:

Vitex negundo leaves -5kg

Soap powder-100g

Soap nuts-500g

Preparation: Boil the leaves of *Vitex negundo* for 1 hour in 10 litres of water. During the boiling process, use a stick to mix the ingredients in between. Cool the contents before filtering the solution with a fine cloth. Before spraying this vavilakukasayam, add 100 gm soap powder or 500 gm soap nut juice to the solution and mix this solution with 100 litres of water.

Uses:

1. This is effective against sucking pests, tobacco caterpillars, borers, maruka, leaf eating caterpillars, *etc.*
2. This can be used in all crops and it has to be sprayed two times at 10 days interval.
3. During initial 30-45 days duration, 100 litres solution is sufficient. Between 60-90 days, 150 litres solution is required and at later stages, 200 litres solution is needed.
4. This kasayam can control thrips in groundnut, leaf folder in chilly, sucking pests in vegetable crops, etc.

6. Meenamrutam:

Ingredients:

Fresh fish – 1kg;

Desi cow urine- 5lit;

Jaggery- 1 kg;

Toddy sap- 1lit;

Desi cow ghee-50g,

Honey-50g

Preparation:

Meenamrutam is generally prepared in two phases. It takes 20 days time for completion of two phases and it can be stored upto 6 months time. In the first phase, fish is to be cleaned properly and cut into small pieces. To this add 1kg jaggery powder and keep a side for 30 min. In a mud pot, take 5 lits of desi cow urine and add fish and jaggery to the urine. Mix the contents 2-3 times a day in a pot with a dry clean stick. After 10 days, the solution will be filtered and stored in a plastic jar.

In the second phase, add 1 lit toddy sap, 50 g Desi cow ghee and 50g Honey to the solution in plastic jar and close the lid and keep it for 10 days without intermittent stirrings. Within 10 days meenamrutam will be ready for use. 2.5-5 lit per acre of meenamrutam should be used after mixing with 100 lit of water.

Uses:

1. It preventes the micro and macro nutrient deficiencies in plants.
2. It improves the female to male flower ratios in vegetables, guards and pomegranate.
3. It improves the immunity of plants against the pests and diseases.
4. It is effective against leaf spot diseases, fruit rot diseases in horticultural crops.
5. It effectively controls sucking pests and early instar larvae
6. It improves the quality and nutritive values of fruits and vegetables.

7. Panchagavya:

Fresh Cow Dung – 5 kg

Cow Urine (need not be fresh) – 3 lit

Cow Milk boiled and cooled (not refrigerated) – 2 lit

Fresh Cow Curd – 2 lit

Cow Ghee – 500 gms

Well ripened Bananas – 12

Black organic jaggery dissolved in 3 lit of water (Alternatively use sugarcane juice of the same volume) – 500 gms

Fresh tender coconut water – 3 lit

Fresh Grape Juice – 2 lit

Methodology:

1. Take a wide mouth plastic, clay or wooden container. Do not use a metal container. Make sure its clean and sundry it for a day or two to sterilize it.
2. Mix the cow dung and ghee in the container using a wooden stick. Stir in clockwise direction in a rhythmic motion. Then stir in anti-clockwise direction. Mixing should not be done vigorously as it will kill the beneficial microbes in cow dung.
3. Cover the container with a thick cloth to protect it from insects.
4. Leave this mixture for three days. It should be kept out of direct sunlight and rain. Give it a stir once in the morning and once in the evening. It works perfect if the process repeated twelve times in each direction.
5. Stir in the remaining ingrediants gradualy on the forth day. Make sure that swirling the mixture in a single direction at a slow pace.
6. Leave this to ferment for 15 days and then stir it once in the morning and once in the evening.
7. Now Panchagavya is ready to use. Store it in a place away from direct sun and rain. Keep it covered and stir two times a day. If the guidelines are followed properly this concoction can be stored up to 2 months.
8. To use Panchagavya, dilute it with 30 parts water and can be used as a liquid fertilizer.

Uses:

1. As a fertilizer it can be used once every two weeks during vegetative period and once a week during flowering and fruiting. As a foliar spray it should be used weekly.
2. It can be used for control of pests.
3. It promotes the growth of large and healthier leaves and stems.
4. It helps in development of dense plant canopy and root system.
5. Yield is higher in terms of both quantity and quality.

8. Sapthadhanyankura Kashayam

A nutritional supplement / Growth formula for plants during flowering.

Ingredients:

Soak 100 gm sesame seeds in a cup of water for 24 hrs. Then take a big bowl and add 100 gms Green Moong dal, 100 gms Black Urud, 100 mg Lobiya, 100 gm Horse gram or Kollu, 100 gm Chana , 100gm Wheat, 200 ltr Water and 10 ltr desi cow urine.

Preparation:

- Mix all the ingredients with hand and soak it in water overnight.
- Next day drain the dals in a cloth and tie the not and hang it for sprouting.
- The water drained from dal is highly nutritious, hence it should be stored for later use.
- When the sesame and the other lentils sprout upto 1 cm, take them out of the cloth and grind them using manual grinder.
- Add the drained water in which the dals were soaked as is very nutritious.

- Add the ground paste into this mixture of 200 lit water and 10lit cow urine and mix well with stick is clockwise direction.
- Keep it aside for Ionization for 2 hrs and then filter it with cloth.
- Use it within 48hrs of preparation.

Application:

This can be sprayed on the plants at their flowering or milking stage. This will improve the density of the pods and make them immune and yield good growth.

9. Green chilli and garlic paste solution:

This solution is highly effective to control tobacco caterpillar and red hairy caterpillar (third instar larvae) in crops like cotton, red gram, castor, chickpea, groundnut, brinjal, tomato and chilli. It is mainly used to control fruit borers.

Ingredients

Green chilli: 3 kg

Garlic: 1/2 kg

Kerosene: 250 ml

Detergent powder: 100 g

Preparation

Grind 3 kg green chilli into a fine paste and mix it with 10 lit of water. Stir it clockwise and soak overnight. Filter this solution with a cotton cloth. Grind half kg garlic cloves and mix it in 240 ml kerosene and soak overnight. Add 100 g detergent powder and prepare 10 lit solution. Mix these solutions and dilute to 100 lit and spray during evening times.

10. Tobacco leaf extract

It is effective against mealy bugs, green hoppers and white flies

Ingredients

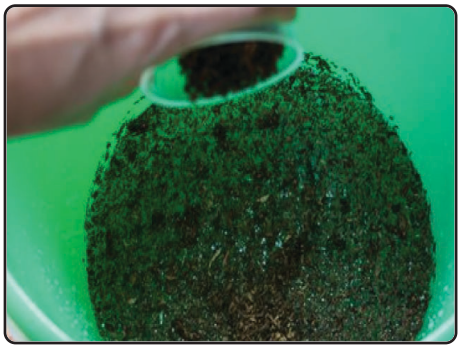
Tobacco leaf paste: 1 kg (small leaves and stems)

Detergent powder: 100 g or soapnuts 500 g

Preparation

Boil tobacco leaf paste in 10 lit water for 30-60 min and filter with a cotton cloth. Add 100 g detergent powder or 500 g soapnut extract. Dilute this solution to 100 lit and spray during evening times.

Precautions: Cover nose and mouth with cloth and wear full sleeves. Spray only one or two times during the crop period. Use the solution within a day. Do not store the solution.



11. Beal leaf concoction

It is very effective to control plant diseases such as neck blast in paddy due to presence of several phytochemicals and alkaloids.

Ingredients

Beal (Maredu) leaves: 5 kg

Detergent powder : 100 g or soapnuts 500 g

Preparation

Boil bael leaves for 30-60 minutes in 10 litres of water, then strain with a cotton cloth. While the solution is boiling, stir it clockwise. Add 500 g soapnut extract or 100 g detergent powder to it. This solution should be diluted to 100 lit and sprayed in the evening times.

This environmentally safe method, developed at NRRI to prevent rice blast disease, was sprayed on the blast infested field, consisting of aqueous extract of Bael leaf @ 25 g/litre of water and steamed aqueous extract of Tulsi leaf @ 25 g/litre of water.

12. Dried ginger and milk solution

Ingredients

Fine powder of dried ginger 200 g

Water 2 lit

Cow/Buffalo milk 5 lit

Preparation

Add finely grinded dried ginger to 2 lit of water and boil it until it becomes into one-liter concentrated aqueous solution. Add this solution to 5 lit boiled milk after cooling. Mix this solution to 200 lit of water and spray for one acre of field.

Preparation of dry ginger and milk solution

13. Datura aqueous leaf extract

Most of the parts of Datura plant including its roots, leaves and fruits have medicinal properties that controls many of the fungi, bacteria and weed plants. It is good for digestion in cattle. It is very effective pesticide as it works either by contact or systemic mode of action.

Ingredients

Datura leaves-2.5 kg

Water for boiling- 15 lit

Preparation

Boil datura leaves in 15 lit of water for 30-50 min and filter the solution with fine cloth. Add 100 lit of water to dilute the solution and spray in the field during evening times. This can control small insects within 6-7 hours and the solution can be used for any crop.

Preparation of datura leaf extract

14. Dashaparni Kashayam : One stop concoction for various pesticides

This can be used instead of all the above astrams

Ingredients:

Ingredients of Dasaparni Kashayam

- 200lit Water
- 20lit Desi Cow Urine
- 2kg Desi Cow Dung
- 200 gm Turmeric Powder
- 500gm Ginger Paste
- 10gm Hing powder
- 1 kg Tobacco powder
- 1kg Hot Green chilli Paste
- 500gm Desi Garlic Paste
- 2kg Neem leaves and twigs cut into smaller pieces.
- 2kg Karanj / Ponga leaves (Not paste)
- 2kg Custard Apple Leaves (Not Paste)
- 2kg Castor Leaves (Not Paste)
- 2kg Dhatura leaves (Not Paste)
- 2kg Vilvam Leaves (Not Paste)
- 2kg Krishna Thulasi stem, leaves, seeds. cut into small pieces.
- 2kg Marigold root, branch, stem, flower, leaves. cut into small pieces.
- 2kg Erukam leaves
- 2kg Ganneru leaves.
- 2kg Mango leaves
- 2kg Papaya leaves.
- 2kg Hibiscus leaves
- 2kg Murungai leaves.
- 2kg Elandhapazham leaves
- 2kg Babul tree with stem. and leaves.
- 2kg Turmeric leaves cut into pieces.
- 2kg Ginger leaves cut into pieces.

- 2kg Coffee leaves cut into pieces.
- 2kg Bouganville leaves with flowers cut into pieces.
- 2kg Casiatora leaves and flowers.
- 2kg Pomogranate leaves.

Preparation:

Mix all of the components together until the tobacco powder is completely dissolved in the water. It should be covered with a rug and left overnight. On the next morning add 1 kg of tobacco powder, 1 pound of hot green chilli paste, 500gm desi garlic paste and carefully cover it and keep it aside for 24 hours. On the next day, take any **10 leaves** from the above **23 leaves**. out of which **first 5 leaves are *important*.** Mix these leaves in the earlier liquid, immerse them, mix them well and cover it with lid and store it for 40 days in dark, dry place. Stir it for 1 min every day during dawn and dusk. After 40 days, filter it with cloth and use it to spray.

Expiry date: 6 months.

Application:

Mix 200lit water + 6lit Dasaparni Kashayam.

This one concoction is enough to control all the pests, weeds and fungal diseases.

Non-negotiable principles of natural farming:

1. Deep summer ploughings
2. Campfires
3. Light traps
4. Seed treatment with Bijamrutam
5. Soil fertility enrichment through green manuring, NADEP composting and Debolkar method
6. Growing of border crops
7. Growing of trap crops
8. Intercropping, mixed cropping and multistoried cropping
9. Pheromone traps for borers
10. Establishment of bird perches in the crop
11. Formation of alleyways
12. Sticky traps
13. Creating awareness on preparation of ghanajeevamrutam and pachagavya
14. Preparation of kashayas by using local resources and their usage

NADEP composting:

- *The NADEP method of organic composting was developed by a Gandhian worker called Narayan Deorao Pandharipande of Maharastra (Pusad).*
- Compost can be prepared from a wide range of organic materials including dead plant material such as crop residues, weeds, forest litter and kitchen waste.
- Compost making is an efficient way of converting all kinds of biomass into high value manures that serves as a good alternative to farmyard manure, especially for crop-growing households without livestock.

Description

- This method of making compost involves the construction of a simple, rectangular brick tank with enough spaces maintained between the bricks for necessary aeration.
- The recommended size of the tank is 10 ft (length) x 5 ft (breadth) x 3 ft (height).
- All the four walls of NADEP tank are provided with 6// vents by removing every alternate brick after the height of 1 ft. from bottom for aeration.
- Tank can be constructed in mud mortar or cement mortar.

Raw materials required for filling NADEP tank

- Agricultural waste (Dry & green) – 1350-1400 kgs.
- Cattle dung or biogas slurry – 98 – 100 kgs.
- Fine sieved soil – 1675 kgs.
- Water – 1350-1400 litres.
- The important technique in the manufacture of NADEP compost is that, the entire tank should be filled in one go, within 24 hours and should not go beyond 48 hours, as this would affect the quality of the compost.
- Thatched roof, brick wall flooring, air vents, green-farm technologies for small and marginal farms resources center for sustainable development
- *Before filling:* the tank is plastered with dilute cattle dung slurry to facilitate bacterial activity from all four sides. It is also filled in definite layers, each layer consisting of the following sub layers.

Sub-layer-1

- 4 to 6// thick layer of fine sticks, stems, (To facilitate aeration) followed by 4 to 6// layer of dry and green biomass.

Sub-layer-2

- 4 kgs, cow dung is mixed with 100 litres of water and sprinkled thoroughly on the agricultural waste to facilitate microbial activity.'

Sub-layer-3

- 60 kgs. of fine dry soil is spread uniformly over the soaked biomass for moisture retention and acts as a buffer during biodegradation. Thus the proportion of organic materials for each layer is 100 kgs. Organic biomass: 4kgs cow dung + 100 litres water+60 kgs soil. In this way, approximately 10 -12 layers are filled in each tank. After filling the tank, biomass is covered with 3// thick layer of soil and sealed with cow dung +mud plaster.

Maintainance

- After 15-30 days of filling the organic biomass in the tank gets automatically pressed down to 2 ft.
- The tank is refilled by giving 2-3 layers over it and is resealed.
- After filling, the tank is left undisturbed for 3 months, but should be moistened at intervals of every 6-15 days.
- The entire tank is covered with a thatched roof to prevent excessive evaporation of moisture.
- Under any circumstances, no cracks should be allowed to develop. If they do, they should be promptly filled up with slurry.

Benefits

- Reduced cash expenses on chemical fertilizer, improved soil fertility, increased crop yield.
- Supports organic crop production, reduced dependence on outside inputs.
- From each NADEP tank approximately 2.5 tons of compost is prepared with in 90-120 days.
- The use of compost reduced the need for mineral fertilizer thus reducing production costs and outside dependence.

NADEP COMPOST

Natural farming practices in millets

For short duration millets crops:

Duration	Natural farming practices
At the time of sowing	Seed treatment with Bijamrut
At the time of intercultivations	Application of 100kg of Ghanajeevamrutam
At 30 DAS	Spraying of 5 litres of Dravajeevamrutam in 100 litres of water
At 51 DAS	Spraying of 10 litres of Dravajeevamrutam in 150 litres of water
At 72 DAS	Spraying of 20 litres of Dravajeevamrutam in 200 litres of water
At 93 DAS	Spraying of 5 litres of well fermented butter milk or dry ginger milk solution in 200 litres of water

For long duration millet crops:

Duration	Natural farming practices
At the time of sowing	Seed treatment with Bijamrutam
At the time of intercultivations	Application of 100kg of Ghanajeevamrutam
At 30 DAS	Spraying of 5 litres of Dravajeevamrutam in 100 litres of water
At 51 DAS	Spraying of 10 litres of Dravajeevamrutam in 150 litres of water
At 72 DAS	Spraying of 5-6 litres of Neemasthram in 200 litres of water
At 93 DAS	Spraying of 20 litres of Dravajeevamrutam in 200 litres of water
At 114 DAS	Spraying of 5 litres of well fermented butter milk or dry ginger milk (fermented for three days) kashaya in 200 litres of water

Finger Millet

Soils : Finger millet can be cultivated in light red soils to heavy soils with good drainage facility. Soils with water logging conditions are not suitable.

Time of Sowing : Finger millet is in *kharif* sown during the months of July - August and for *Rabi*, during November-December and January-February for the summer crops.

Varieties suitable for cultivation:

Variety	Season	Crop duration (days)	Yield (Q/acre)
Champavathi	All Seasons	80-85	10-12
Bharathi	All Seasons	105-110	14-16
Sri Chaitanya	Kharif	110-115	12-16
Vakula	Kharif, Rabi	105-110	13-15
Hima	Rabi	105-110	10-12
Suvarnamukhi	Kharif, Rabi	105	14-15
Veghavathi	Kharif, Rabi	115-120	15-16
Indravathi	Kharif, Rabi	115-120	15-16

Intercropping :

Intercropping of Ragi + Pigeon pea in 8:2 proportions is highly profitable with a spacing of 30cm × 10cm in finger millet and 60 cm x 20 cm in Pigeon pea. Ragi + field bean in 8:1 proportion can also be followed with spacing of 30cm between the rows and plant to plant distance of 10cm in case of ragi and 20cm in case of field bean is recommended. Ragi + soybean in the proportion of 1:1 can also be cultivated.

SRI method of Ragi cultivation:

*Sub treatment with Bheejamrutha:

Bheejamrutha protects from pests and diseases in eco-friendly manner. Take 5kg of local cow dung in a cloth and bound it by the tape and hang this in the 20 lit water upto 12 hours. Take one litre water and add 50gm lime in it and leave it stable for a night. Then next morning, squeeze this bundle of cow dung in a bucket of water and collect this cow dung solutions. Add a handful of soil in this cow dung water solution and stir it well. Finally add 5 litre desi cow urine in that solution and add the lime water and stir it well. This prepared Bheejamrutha is used for seed treatment of finger millet before sowing in nursery. Add 5gm of *Tricoderma harzianum* and 5gm of *pseudomonas fluorescens* to 1kg of seed for seed treated.

Preparation of Nursery:

Sowing : Seed treatment with Bheejamrutha, sand/soil and compost in the ratio of 1:1:1 proportion is to be done before sowing.

Nursery : Nursery of 40sq.m is required for 1 acre of main field.

- First lines have to be drawn with the help of wooden marker at a spacing of 10 inches X 10 inches for transplanting the seedlings from nursery.
- Rows or ridges are to be made by using the bicycle wheeler.

System of Finger Millet Intensification (SMI) – An agro ecological innovation:

- Spray 3% panchagavya solution or Jeevamrutha before 4-5days of transplanting the seedlings.
- 15-25 days old seedlings should be planted in the main field.

Before Sowing:

- Water/irrigate the seedlings 2 hours before transplanting, which makes the soil loose so that seedlings can be pulled easily.
- Seedlings should be carefully pulled to prevent the soil around the roots from being disturbed. If possible, lift the soil with a shovel so the roots come along with the soil.
- The seedlings should be transported to the main field within half an hour after they seedlings are pulled before drying of soil around the roots. Seedlings are transplanted at a spacing of 10 inches × 10 inches by using cord or marker.
- Seedlings should be planted at a shallow depth, when the seedlings are planted at the junction of lines, care should be taken to prevent the roots from damaging.

Management of Nursery :

- **Time of Sowing in Nursery:** Sown during the 1st to 3rd week of july month.
- **Sowing of Seeds:** Sow seeds at a depth of 1/2cm in the soil. Spacing of 3-4 cm between the seeds is recommended.
- **Protection of seeds:** Seeds are to be covered with vermicompost and Jeevamrutha has to be applied at regular intervals.

Preparation of Jeevamrutha:

To 10 lit of water in a barrel, add 5 kg cow dung, 5 lit of cow urine and stir it well. Later add 250gm of jaggery, 250 gm of pulse flour and a handful of soil from the bund of the farm and stir the solution well. Allow this solution to be stable for 1 hour in shade. Finally, this prepared

jeevamrutha should be diluted with water in the ratio of 1: 20 lit dilution and around 200 lit of jeevamrutha is sufficient for 1 acre of land.

Field Preparation:

- Plough the field thrice at an interval of 8–10 days and Jeevamrutha has to be sprayed in the field before last plough in order to maintain sufficient moisture in soil and also to conserve organic compounds.
- Level the field with leveller after ploughing.

Planting seedlings in main field

Weeding, pulling of vertical round logs over the plants:

- Manual weeding should be done thrice at an interval of 10-15 days with a hand weeder between the rows. This helps to not only remove the weeds but also improves the aeration in the vicinity of the root zone and enhance the plant growth.
- Spray 1 lit Jeevamrutha mixed in 10 lit of water immediately after the removal of weeds.
- After removing the weeds, hollowed out wooden log has to be pulled over the plants in order to bend the plants. This helps in increase the unable of more tillers and roots.

Differences between Chemical method & SRI method of Cultivation

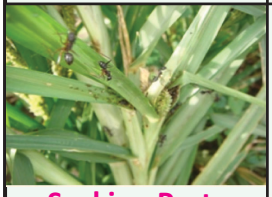
	Chemical Method	SRI Method
Seed rate	5kg	500 gm
Seed treatment Vermicompost	Not followed	Jaggery, Cow urine, Hot water,
Method of sowing	Broadcasting	Transplanting 20-25 days old nursery is transplanted in square method
Spacing method	No spacing	10 cmX10 cm in square
Weeding, Pulling of log	Not followed or	practiced Followed / Practiced after 15,25 and 40 days
Irrigation (Rabi)	2 times	4 times
Stems per plant	1	8-10
No.of tillers per hill	3-4	7-8
Stem	thin	thick
Roots	Shallow	Penetrates deep upto 1 cm
Yield per acre	0.4 tonnes	1-1.5 ton nes
Yield per ha	1 tonne	2.5 to 3.75 tonnes

Manures:

FYM (or) Vermicompost : 2 tonnes of FYM or 800 kg of vermicompost or 2.5 tonnes of NADEP compost per acre has to be incorporated prior to 1 5-20 days of sowing. Apply 125kg Ghanajeevamrutha per acre just before sowing, another 125 kg at 30 DAS and liquid Jeevamarutha at 45 DAS and 60 DAS. Foliar spray of 3% panchagavya should be done at flowering stage.

Crop Protection :

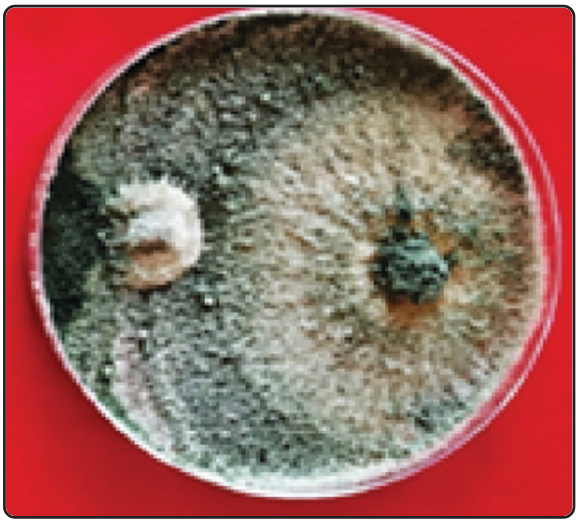
Pests

Name of the pest	Symptom	Control
 Pinkbollworm	Matured and developed larvae are pinkish in colour which tunnels into the stem and thereby kills the stem. If crop is infested at earhead or panicle stage white ear heads are formed. These larvae move from one plant to other and damages the crop.	✦ Install 5 pheromone traps per acre. ✦ Spray 5 % neem seed kernel extract or neemasthra ✦ After 10 days spray Bhramastra ✦ If infestation is severe, apply Agniasthra.
 Aphids	Aphids infect during the ear head stage and feed on the inflorescence, grains and damages the crop	✦ When aphids infest, remove them either by using hands or by shaking the ear heads. ✦ Install 5 pheromone traps per acre. ✦ Use marigold or castor as trap crops. ✦ If infestation is severe spray green chilli- Garlic extract. ✦ Install 15 bird perches per acre.
 Sucking Pests	Mealy bugs, Green leaf hopper, white leaf hopper suck the sap from plants and damages the crops.	✦ Install 15-20 bird perches per acre. ✦ Plant 3 rows of maize crop around the field.
 Termites	Termites infests the ragi plants generally and cause more damage. when grown under light soils and under rainfed conditions termites infestation will be heavy.	✦ Destroy the hills of termites. ✦ Spray cow dung +cow urine+ Asafoetida.

Diseases:

Name of the Disease	Disease Symptom	Control
Blast	It occurs both in the nursery and main field. Showers of rains with high humidity in air and night temperatures of 20°C intensifies the blast disease. Spindle shaped spots are seen on leave, nodes and fingers.	✦ Maintain field without any weeds. ✦ Selections of blast resistant varieties such as Ratnagiri, Sri Chaitanya, Bharathi. ✦ Cow dung+ cow urine+ Asafoetida is sprayed twice within a interval of 10 days.

Pseudomonas fluorescens* and *Trichoderma asperellum* against *Rhizoctonia solani
(Dual culture techniques)



Diseases of Finger millet (Blast)



Neck blast



Finger blast

Leaf blast



Healthy

Banded blight

Extracts used for the control of pests in finger millet :

Neem extract: (for control of sucking pests, Mealy bugs):

Pour 100 lit of water in a large earthen pot or barrel and add 5 lit of cow urine, 5 kg cow dung. Extracts from 5 kg neem leaf is mixed in this barrel. Stir/ mix the solution well and keep it for 24 hours. It is to be stirred twice a day with stick and later filtered through a cloth and 100 ml of this filtered solution is mixed with 5 litres of water and sprayed.

Multiple use extract (for the control of sucking pests, stem borers):

Pour 10 lit cow urine in an earthen pot or barrel and 3 kg neem leaves are crushed and the extract is mixed with the cow urine in the pot. Later crush 2 kg custard apple leaves, 2kg papaya leaves, 2 kg pomegranate leaves, 2kg Guava leaves and extract is added to the pot. This mixture is boiled until reduced to 1/5th of its concentration. After cooling, leave it undisturbed for 24 hours and after that bound/ tie it inside a cloth and filter. This filtered 100 ml solution is mixed with 5 lit of water and sprayed.

Firey Solution (for control of leaf folders, stem borers):

Pour 10 lit of cow urine in an earthen pot and mix it with the extract obtained by crushing 1 kg tobacco leaf and later add extracts 500 g of green chilli, 500 g of garlic to it. Finally add the extract obtained by crushing 5 kg of neem leaves to it and boil this mixture until it reduces to 1/ 5th of its concentration. After cooling allow it be stable for 24 hours and then tie in a cloth and filter. This filtered 100 ml of solution is mixed with 5 lit of water and this sprayed.

Kunda solution (for control of stem borer, fungi, leaf hoppers):

Required ingredients:

- Cow dung 1kg
- Cow urine 2 lit
- Neem Leaves 1kg
- Calotropis leaves 1kg
- Pongamia leaves 1kg
- Jaggery/ Molasses 50 gm
- Hand full of soil from termite hill.

Process of preparation:

- Above mentioned contents are mixed in an earthen pot and cover the pot with gunny bag and keep it in dark for 7 days.
- After 7 days, filter this solution and dilute it by adding water.
- Apply 15 ml of this solution mixed with 1 lit of water over matured plants and 25ml of solution mixed with 1 lit of water over tender plants.
- Later on every 7th day 2 lit of cow urine is mixed with the remaining contents in the pot and can be used for a period of 6 months.
- This solution can be effectively and against stem borers, leaf hoppers and fungi.

Control of Diseases:

Seed treatment with *Tricoderma harzianum* @ 5 gm/kg of seed and spraying of 0.5% *Pseudomonas fluorescens* solution twice in the field at an interval of 10 days.

Barnyard Millet

This crop is grown in Asia majorly in the countries of India, Nepal, Malaysia, Pakistan, Japan and China. In India, it is being cultivated in the states of Madhya Pradesh, Andhra Pradesh, U.P, Tamil Nadu, Karnataka, Maharashtra and Bihar. In Tamil Nâdu, it is grown in the areas of Selam, Dharmapuri, Krishnagiri, Coimbatore, Thiruchanapalli,Madurai, Dhindigal, Thirunalveri, Ramachandrapuram, Kerur, Perambadur and Namakhal districts. In Andhra Pradesh, it is cultivated sparsely in less area.

Under irrigated conditions Co-1, Co-(KV)-2 can be cultivated and sown during June-July.

Soils:

Light red soils and well drained black soils are suitable for barnyard cultivation. Low fertile, medium drained soils are also quite suitable for cultivation.

Climate:

This crop can be grown under any climatic conditions.

Crop Duration:

Kharif crops sown during the months of June-July when monsoon occurs. It is a short duration crop which comes to maturity within 6 weeks.

Seeds & Sowing:

Generally sown when rain conditions prevail during the first week of july by broadcasting or by placing the seed at the depth of 3-4cm in soil.

Seed Rate:

Seed rate of 3.2 to 4 kg/acre is required. In some of the areas of Maharashtra, they are sown by transplanting seedlings but a spacing of 25x10 cm would be preferable.

Fertilizers & Manures:

Apply 2-4 tonnes of FYM per ha before sowing. 15 lit of 3 % Panchagavya, Bheejamurutha, mixed in 200 liters spray fluid is to be sprayed after sowing.

Water Management:

Generally, banyard millet is cultivated under rainfed conditions, but if dry conditions prevail for longer durations, one irrigation has to be given during panicle formation stage. It is susceptible to waterlogged condition and hence during heavy rains, excess water has to be drained.

Weed management:

The field has to be maintained without any weeds during the first 25-30 days of sowing.

Crop Protection – Diseases

Name of the Pest	Control
Stem borer	Agni-astra can be sprayed for its efficient management
Downy Mildew	Seeds are to be procured from disease free plants. Infected plants in the field are to be removed and destroyed. Seed treatment with 5gm *Tricoderma harzianum* per kg seed is recommended. 0.5 % (0.5 gm in 1 lit water) spray solution is to be sprayed under field conditions.
Rust	5 gm of *Tricoderma harzianum* mixed with 1 kg of seed for seed treatment. To spraying 0.5 % spray solution is required

Diseases of Barnyard millet

Barnyard millet

Banded blight

Harvesting & Threshing:

When the grains turn yellow and the leaves turn greenish yellow, the crop can be harvested by cutting it just above the soil, then drying and threshing it after a week.

It is possible to obtain 160-240 kg grain and 480 kg fodder yield per acre. Around 4-4.8 quintals of yield can be gained if improved management procedures are implemented.

Proso Millet

Proso millet is widely cultivated in the countries like India, Japan, China, Egypt, Arabia & West - Europe. In our country it is being cultivated in Madhya pradesh, Uttar Pradesh, Bihar, Tamilnadu, Maharastra and Andhra Pradesh. In Tamilnadu it is grown in the districts of Vellore, Thiruvananallai, Selam, Namakkol, Dharmapuri, Krishmagiri, Madurai, Dhindigal, Thirunalveli and Jhuthukudi. In Andhra Pradesh it is cultivated in the North coastal areas and high-altitude tribal areas as a rainfed crop.

Crop duration: 60-90 days(kharif)

Land Preparation: The main field should be ploughed thrice with a country plough and nursery must be established.

Seed Treatment: Seed has to be treated with Bheejamrutham @ ml/kg.

Seed Rate & Sowing: A seed rate of 3.2 to 4 kg per acre is necessary. Seeds are spread either by broadcasting or by line sowing 25x10 cm spacing.

Sowing Time: It should be sown as a *kharif* crop from the first week of June to the last week of July. Around 842 germplasm samples were collected from around 30 Nations in the ICRISAT gene banks and research is underway to produce new types.

Water Management:

Generally, irrigation is not required during the kharif season. When the weather remains dry for prolonged periods of time during the tillering stage, however, only one irrigation is required at critical stage to increase the yields. The first irrigation should be done after 25-30 days at sowing and the second irrigation should be done after 40-45 days. More number of irrigations must be avoided because the root system is at shallow depths.

Weed Management:

Up to 35 days after sowing, the crop had to be kept weed-free. Within a gap of 15-20 days two manual weedings are performed.

Pest / Disease management :

Name of the Pest / disease	Control
Rust	Seed treatment with 4 gm of *Trichoderma viridae/kg* seed is recommended. 1 kg Pseudomonas fluorescens, 15 kg vermicompost or 10 kg soil should be applied during the final ploughing. Seed treatment with Bheejamrutha and then with 8gm *Trichoderma viridae* can be utilised for effective management.
Shoot fly	Proso millet infested with shoot fly should be completely burnt & destroyed.

Diseases of Proso millet

Healthy

Banded blight

Harvesting & Threshing:

Within 60-75 days, the crop matures. When the grains and leaves turn yellow, it's time to harvest. It can be threshed by hand or with the help of animals.

Yield:

Around 8-9.2 quintals seed and 20-24 quintals fodder can be obtained if efficient management procedures are followed.

Foxtail millet

One of the earliest millet crops used for food and grazing is foxtail millet. It is known for being a short-season, drought-resistant crop. It is high in protein, iron, beta-carotene and other vitamins and minerals. Foxtail millet grain has a lower glycemic index and is utilised as a food for diabetics and those with cardiovascular problems. Andhra Pradesh, Karnataka, Tamil Nadu, Rajasthan, Uttar Pradesh, UttaraKhand and Bihar are the leading producers of the crop in India.

Foxtail millet crop

Ear heads

Seed

Soil type: The crop can be grown in a variety of soil types. It may be grown in locations with little to moderate rainfall. It thrives on well-drained soils, but not so well in waterlogged soil.

Time of sowing: June to July 15th

Varieties: A number of high yielding varieties has been released for different states

S.No.	State	Varieties
1.	Andhra Pradesh	SiA 3088, SiA 3156, SiA 3085, Lepakshi, SiA 326, Narasimharaya, Krishnadevaraya, PS-4
2.	Karnataka	SiA 326, HMT 100-1 and PS-4, Narasimharaya, SiA 3088, SiA 3156, SiA 3085, DHFt-109-3
3.	Tamil Nadu	TNAU 43, TNAU-186, TNAU 196, CO 1, CO 2, CO 4, CO 5, K2, K3, SiA 3088, SiA 3156, SiA 3085, PS-4
4.	Rajasthan	PrathapKangani (SR-1), SR 51, SR 11, SR 16, SiA 3085, SiA 3088, SiA 3156, PS-4
5.	Uttar Pradesh	PRK 1, PS 4, SiA 3088, SiA 3085, Sreelaxmi, Narasimharaya, S-114, SiA 326, PS 4
6.	Uttarakhand	PS 4, PRK 1, Sreelaxmi, SiA 326, SiA 3088, SiA 3156, SiA 3085, PS 4
7.	Bihar	RAU-1, SiA 3088, SiA 3156, SiA 3085, PS-4

Seed rate:

Line sowing: 8-10 kg/ha, Seed drill: 12 kg/ha, Broadcasting: 15kg/ha

Seed treatment: Seed treatment with Beejamrutham followed by *Trichoderma harzianum* @ 5g/kg seed and *Pseudomonas fluorescens* @ 5g/kg seed

Spacing: 22.5 cm between rows and 10 cm between plants within a row

Land preparation: Field has to be prepared thoroughly with the help of country plough or Iron plough for 2-3 times before sowing.

Manures:

- Soil application of FYM @ 4 tones per acre and spray application of 3% Panchagavya and 5% of Jeevaamrutham
- Application of NADEP compost @ 2500 kg/acre
- Application of Ghanajeevaamrutham @ 125 kg/acre at the time of sowing and 125kg/acre near root zone 30 DAS

Intercultural Operations:

- Thinning has to be carried 20 DAS to maintain optimum plant population
- Two inter cultivations and one hand weeding is effective for weed control and good crop growth

Plant protection:

- Selection of resistant varieties
- Seed treatment with Trichoderma viride @ 5g/kg seed
- Spraying of medicinal plant extract to control Pink warm, Termite, Grasshopper, Stem borer and Army worm
- Spraying 5% of Neem seed kernal extract, Agni asthram and 3% of Panchagavya at the time of flowering to control Pink worm
- Spraying of cow dung+ urine+Asafoetida (Inguva) extract near root zone to control Termites
- Spraying of Gobanam (Fungicide) to control Rust, Blast and Downy mildew diseases (or)
- Spraying 6 liters of fermented butter milk by adding in 100 liters of water against all the diseases (or)
- Spraying of wild ocimum leaf extract or Sontipaalukasaya against all the diseases

Harvesting:

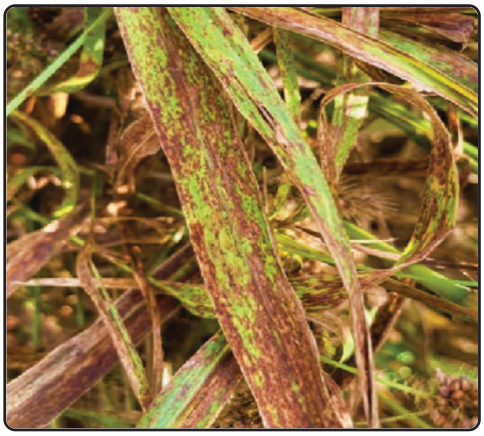
Kharif: September-October

Rabi: January- February

Major diseases of foxtail millet

Healthy

Brownspot



Rust

Kodo millet

Kodo millet is a popular minor millet crop that is drought resistant and suited for growing in low-rainfall areas. It is a high-fiber, high-protein crop with a higher oxidant potential than other millets and cereals, including 8.3 % protein, 1.4 % fat, 65.6 % carbohydrates and 2.9 % ash. Kodo millet diet is nutrient-dense and is advised for persons with diabetes and heart disease.

Kodo millet is mainly grown in India, Indonesia, Thailand, Philippines and South Africa. In India, the major kodo millet growing states are Andhra Pradesh, Rajasthan, Tamil Nadu, West Bengal, Madhya Pradesh and Uttar Pradesh

Kodo millet crop

Ear heads

Seed

Soil Type: It is grown in different types of soils: Gravelly, stony, poor loamy soils, fertile soils, soils with rich organic matter

Time of sowing: June to July 15th

Varieties: A number of high yielding varieties has been released for different sates

S.No.	State	Varieties
1.	Madhya Pradesh	JK 439, RBK 155, JK 13, JK 65, JK 48, JK 137, RK 390-25, JK 106, GPUK 3, JK 98, DSP 9-1, TNAU 86
2.	Tamil Nadu	KMV 20 (Bamban), CO 3, TNAU 86, GPUK 3, RK 390-25
3.	Gujarat	GK 1, GK 2, GPUK 3, JK 13, RK 390-25
4.	Chhattisgarh	RBK 155, JK 439, Indira Kodo 1, Indira Kodo 48, GPUK 3, JK 65, JK 98, Chhattisgarh 2, RK 390-25, TNAU 86
5.	Karnataka	GPUK 3, RBK 155, RK 390-25, TNAU 86

Seed rate:

Line sowing: 10 kg/ha

Seed drill: 12 kg/ha

Broadcasting: 15 kg/ha

Seed treatment:

- Seed treatment with Beejamrutham followed by *Trichoderma viride*@4g/kg seed
- Seed treatment with *Azospirillum brasilense* and *Aspergillus awamouri*@ 25g/kg is beneficial

Spacing: 22.5 cm between rows and 10 cm between plants within a row

Land preparation: Field has to be prepared thoroughly with the help of country plough or Iron plough for 2-3 times before sowing

Manures and Fertilizers:

- Soil application of compost or FYM@ 2000 kg/acre is recommended. Additionally, 4 packets of phosphobacteria mixed with compost/biogas slurry is good for crop growth and yield.

- Before sowing, mix 5 kg seeds in three packets of azophos @ 200g each and mix thoroughly with rice starch and shade dry

Intercultural operations:

- Thinning has to be carried 20 DAS to maintain optimum plant population
- Two inter cultivations and one hand weeding is effective for weed control and good crop growth

Plant protection:

- Selection of resistant varieties
- Seed treatment with *Trichoderma viride*@ 4g/kg seed followed by Beejamrutham
- Soil application of *Pseudomonas fluorescens* mixed thoroughly in 15 kg of cow dung is recommended

Banded blight of Kodo millet



Harvesting:

Kharif: September-October

Rabi: January- February

Little millet

Little millet is a hardy minor grain crop that belongs to the Poaceae family (Gramineae). The name of the species comes from a specimen found in Sumatra (Indonesia). Little millet is a South Asian grain that is grown in India, Indonesia, Burma, Malaysia, China, Pakistan and Sri Lanka. Andhra Pradesh, Madhya Pradesh, Odisha, Jharkhand, Uttar Pradesh, Haryana, Karnataka, Chattisgarh, Gujarath and Rajasthan are among the states in India where it is expanding. It can resist both drought and standing water. It may be grown up to 2000 metres above sea level. Tribal and poor farmers grow the crop in poor soils with little or no cash input for food and feed. In comparison to other cereal crops, it has a high renewing capacity.

It's a beautiful millet that's appropriate for folks of all ages. It aids in the prevention of constipation and the treatment of all stomach ailments. Its high fibre content aids in the reduction of fat deposits in the body. Per 100 gm of small millet, there is 8.7 gm of protein, 75.7 gm of carbohydrates, 5.3 gm of fat and 1.7 gm of minerals. Little millet is high in complex carbs, antioxidantsand phenolic compounds, all of which aid in the prevention of metabolic illnesses such as diabetes, cancerand obesity. The crop is drought resistant and nutritionally and medicinally superior to or comparable to other farmed cereals. Grains are recommended for diabeties and heart problems. Little millet grain has exceptional storage qualities and is referred to as a famine reserve since it can be held for several years without danger of stored grain pests in normal storage circumstances. The crop is suitable for fragile and vulnerable agro-ecosystems because it is environmentally benign.

Little millet crop

Ear heads

Seed

Soil type: It is grown in different types of soils: Gravelly, poor loamy soils, fertile soils, soils with rich organic matter. However, red loamy soil is preferable

Time of sowing: June to July 15th

Varieties: A number of high yielding varieties have been released for different states

S.No.	State	Varieties
1.	Andhra Pradesh	OLM 203, JK 8, BL 6, DHLM 36-3
2.	Odisha	OLM 203, OLM 208, OLM 217, BL 6, DHLM 36-3, DHLM 14 1
3.	Madhya Pradesh	JK 4, JK 8, JK 36, JK 137, BL 6, DHLM 36-3
4.	Tamil Nadu	Paiyur 2, TNAU 63, CO 3, CO 4, OLM 203, OLM 20, BL 6, DHLM 36-3, DHLM 14-1
5.	Chattisgarh	JK 8, BL 6, BL 4, JK 36, JK 137, DHLM 36-3
6.	Karnataka	OLM 203, JK 8, BL 6, DHLM 36-3, DHLM 14-1
7.	Gujarath	GV 2, GV 1, OLM 203, JK 8, BL 6, DHLM 36-3, DHLM 14-1
8.	Maharashtra	Phule Ekadashi, JK 8, OLM 203, BL 6, DHLM 36-3, DHLM 14-1

Seed rate:

Line sowing: 10kg/ha

Seed drill: 12kg/ha

Broadcasting: 15kg/ha

Seed treatment:

- Seed treatment with Beejamrutham followed by *Trichoderma viride*@4g/kg seed
- Seed treatment with *Agrobacterium radiobacter* and *Aspergillus awamouri*@ 25g/kg improves crop growth and seed yield

Spacing: 22.5 cm between rows and 10 cm between plants within a row

Land preparation: Field has to be prepared thoroughly with the help of country plough or Iron plough for 2-3 times before sowing

Manures and Fertilizers:

Soil application of compost or FYM@ 2 tones/acre, 2 weeks before sowing and application of NADEP compost@ 2500kg/acre. Additionally, application of Ghanajeevamrutham@125 kg at the time of sowing and 125 kg at 30 DAS improves crop growth and yield

Intercultural operations:

- Thinning has to be carried 20 DAS to maintain optimum plant population
- Two inter cultivations and two hand weeding at 15 DAS and 40 DAS is effective for weed control and good crop growth

Plant protection:

- Selection of resistant varieties
- Seed treatment with *Trichoderma harzianum* @ 4g/kg seed followed by Beejamrutham
- Spraying of Neemasthra, Brahmasthra, Agniasthra and Gobanam for pest and disease control

Little millet

Banded blight

Alternaria leaf blight

Harvesting:

Kharif: September-October

Rabi: January- February

Sorghum

Sorghum is planted as a *kharif* crop in telugu states with little rainfall, as well as in Chalka soils such as Mahaboobnagar and Kurnool districts. Sorghum is grown in 82.5 thousand acres in Andhra Pradesh and Telangana states during the kharif season and 2.15 lakh acres during the rabi season. In kharif, an average yield of 699 kg is acquired and in rabi, an average yield of 975 kg is obtained.

Sorghum crop

Ear head

Seed

Growing areas: As kharif crop, it is cultivated in low rainfall areas of red chalka soils in Kurnool district include the Nandyal hills of Kurnool and Kadapa districts. It is late sown as rabi crop in Prakasam district.

Sowing time: *Kharif* -June, Maghii-September, *Rabi*- October, Late rabi- November, Summer-january.

Seed treatment:

- Soak the sorghum seeds in a 75-100g Asafoetida + 1 lit water solution and then dry them in the shade. This aids in the treatment of ergotism.
- Aswagandha and Datura plant extracts should be used to treat seeds. 250 gm Aswagandha and 50 gm Datura leaves are crushed, then mixed with 1 kg of seed and dried in the shade. This aids in the production of disease-free nursery seedlings.
- Seed treatment of 1 kg sorghum seed with 100 gm cow dung powder + 250 ml cow urine enhances germination % by breaking seed dormancy.
- Before sowing, the seeds should be soaked overnight in the supernatant lime solution (1 kg lime in 10 lit of water, kept at room temperature for 10 days) and then air dried.

Seed treatment with Bhjeemruth

Soils: Black Soils, light red soils.

Seed rate: 3-4 kg

Spacing: Plant population of 58000-72000 plants per acre should be maintained when sown at a spacing of 40 x 12.15 cm

Manures:

- Apply 5 tonnes of FYM, 2500 kg of NADEP compost in the last ploughing. At the time of sowing, apply 100 kg FYM, 125 kg Ghanajeevamrutha and again after 65 days 200 lit of liquid Jeevamrutha is to be given through irrigation.
- Apply 0.8 tonnes of vermicompost to increase the carbon content in soil.
- Care to be taken to apply 2 kg Azosporillum and 80-100 kg organic manure per acre below the seed 2 kg Phosphobacteria mixed with 200 kg of FYM during ploughing.
- Atleast 5 kg Mycorhize (VAM) per acre has to be applied.
- Once in a month spray 5% Jeevamrutha (5 ml Jeevamrutha in 1 lt of water)
- Spray 10% cow dung and 3 % panchagavya at 30, 45 days of sowing in order to correct the Nitrogen deficiency.

Usage of Jeevamrutha:

Application to field: Jeevamrutha can be applied along with the irrigation water by draining the jeevamrutha from drum into the irrigation channels so that it mixes well with water and reaches roots effectively otherwise fill the jeevamrutha in a large bucket and mix it in the irrigation channel with a plastic mug gradually.

Foliar spraying :

- If Jeevamrutha applied as foliar spray along with field application, excellent results can be obtained.
- After 15 days of sowing spray 5 lit of Jeevamrutha mixed with 100 lit of water per acre.
- Again spray it after 30 days of sowing by mixing 5 lit of it in 150 lit of water per acre.
- After 60 days of sowing, fourth spraying should be done by mixing 20 lit of Jeevamrutha in 200 lit water per acre.

- Spray it after 75 days of sowing (20 lit Jeevamrutha + 200 lit water)
- Spray it after 90 days of sowing (20 lit Jeevamrutha + 200 lit water)
- Spray it after 100 days of sowing (25 lit Jeevamrutha + 200 lit water)

Ghanajeevamrutha Powder:

The micro organisms in Ghana jeevamrutha powder are generally in dormant stage but once applied in field they multiply and get activated. During sowing add 100 kg FYM, 10-100 kg ghanajeevamrutha powder with the seed. This helps in increasing yields when compared with chemical fertilizers.

Water Management: During the kharif season, sorghum does not require irrigation. When necessary, irrigation is provided during the flowering and grain production stages in the black soil regions. Irrigation is to be given once in a week for light soils once in 15 days for black soil crops.

Inter cultivation: During kharif season, jowar and pigeon pea is grown in 1:1 proportion.

Weeding & intercultivation:

Intercultural operation with implements such as Guntaka and danti 30 days after sowing helps to preserve moisture in the soil, which aids plant growth.

Mulching:

The covering of the fields with the waste materials of Jowar, Ragi, Wheat, Paddy, soya, banana, green gram and black gram crops is known as mulching with crop wastages. This helps in building up of earthworms and Microbial environment for microorganisms in the field. This makes the earthworms living in the soil make burrows to come up from deeper soil to surface thereby bringing the nutrients to the surface layers of the roots and helps in nutrient absorption. This process makes a similar view of ploughing.

Growing of small crops such as greengram and cowpea in the fields of large crops which helps in conserving the soil moisture by not allowing the sun rays to fall directly on soil is termed as natural covering or mulching and such crops called as cover crops.

Straw: Organic mulching material

Crop Protection:

- Plant 3 rows of maize around the main field as a border crop.
- Arrange 15 - 20 yellow and white plastic boxes painted with grease.
- Plant marigold and castor crops as trap crops.

Natural pesticides for control of pests and diseases:

Different types of extracts can be prepared from locally available medicinal trees for the control of pests & diseases.

Pest Killers

Neemasthra: (for control of sucking pests and other minor pests)

Five kg of fresh dried neem leaves are to be powdered and mixed in 100 lit of neem seeds. Take 5 lit of desi cow urine and 1 kg desi cow dung and mix in this drum containing neem powder solutions and stir it well in clockwise direction. Cover this with gunny bag for 24 hours and later filter it through transparent cloth and sprayed in the fields.

Brahmastra (For control of major pests)

Leaves of 2 kg Neem, Custard apple and Datura are crushed and mixed in 10 lit of cow urine in a drum and stir it well by using a stick. Later boil this solution and allow it to cool for 48 hours and filter this solution through a cloth and spray this filtered solution by mixing 2-2.5 lit in 100 lit of water per acre. This can be stored for 6 months and used.

Agniasthra (For controlling stem borers)

Take 1 kg fresh tobacco leaves, 5 kg fresh Neem leaves, 1-2 kg of green chilli, 0.5 kg garlic and crush them and take this mixture in a pot and finally add 10 lit of cow urine to it and allow it in boil for certain period and cool it for 48 hours. After 48 hours filter this solution through a cloth and then stored. When needed mix 2 to 2.5 lit of this solution with 100 lit of water and spray it per acre.

Disease Killers

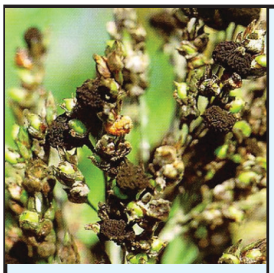
Gobanam: 6 lit of fermented butter milk is mixed with 100 lit of water and sprayed per acre. This helps in control of diseases.

Cultivation of Sorghum in rabi: Instead of sowing sorghum alone, it is advised to sow 2-3 crops as mixed cropping with 4 kg local sorghum varieties seeds + 2kg desi groundnut seeds + 1 kg Coriander seeds are treated with Bheejamrutha and seeds are sown after application of 100 kg FYM which is mixed with 10-100 kg Ghanajeevamurutham.

Pest and Disease management

Name of the pest / Disease	Symptom	Control
 Sorghum Shoot fly	The infected shoots shrivel up and die. If the shoots are removed, a foul odour is released. During the first 30 days after sowing, more tillers are developed and the infestation is severe. As a result, the kharif crop is planted before July 15. This shoot fly assaults the crop until it reaches the fifth week of growth.	✦ Apply 200 kg Neem powder during the last ploughing. ✦ Maintain bunds weed free and spray Agniasthra.

 **Sorghum stem borer**	After 30 DAS this pest attacks the crop. The leaves develop circular holes and the inflorescence dies, resulting in white ear heads and dead heart symptoms. Red colour discolorations can be visible when the stem is split open.	✦ Install 4-5 pheromone traps for pink bollworms. ✦ Spray cow dung+cow urine solution once in a week. This repels the pests hence eggs cannot be laid. ✦ Spray 5% Neem seed kernel extract. ✦ If the pest attack is more, spray Agniasthra.
 **Sorgham ear head bug**	Nymphs and adults suck sap from tender grains in milky stage resulting in shrivelled, unfilled, chaffy grains which initially show red spots on feeding sites and later turn black.	✦ Identify the pest early and spray cow dung + cow urine solution or 5 % NSKE extract.
 **Sorghum + aphids**	Aphids suck sap from the plants.	✦ Spray datura leaf extract for its control. ✦ Spray 5 % NSKE (Neem Seed Kernel Extract) or Neemasthra. ✦ Spray of 2gm of *Verticillium lecanii* per lit of water for controlling aphids
 **Grain smut disease**	Symptoms are more prevalent during the wet season. Rainfall during the blossoming and grain filling stages causes the most damage. Pink in black smut can be noticed depending on the type of fungal or smut spores on grains.	✦ Spray 6 lit of fermented buttermilk mixed with 100 lit of water.

 **Ergot or sugary disease**	A period of high rainfall and high humidity during flowering season favours this disease. Cloudy weather during anthesis encourages the disease spread. Pinkish / whitish honey dew secretions are observed from the infected earheads.	✦ Spray cow dung + cow urine+ Asafoetida twice within a period of 10 days.

Intercrops:

Sunflower can be planted as intercrop in jowar in the proportion of 6:3 ratio

Apply 200 lit of Jeeamurutha once in a month along with irrigation or 10-20 lit of Jeevamurutha can be mixed with 200 lit of water and sprayed.

Harvesting:

Sorghum is harvested when the grains in the ear heads turns from green colour to white and milky earheads turns to powdered form and also harvest after the black spot appears on the grain.

Pearl millet

In general, the most widely grown millet is pearl millet, also known as Bajra. Since prehistoric times, it has been grown throughout Africa and Indian subcontinent. It thrives in drought-prone environments with low soil fertility and high temperatures. It thrives in soils that are highly saline or have a low pH. Because of its resilience to a variety of growing circumstances, it can be cultivated in regions where other millet or cereal crops would fail

India is the largest producer of pearl millet and among the Indian states, Rajasthan is the highest producing state. Pearl millet is a rich source of various nutrients and minerals, which contains 11.65% protein, 68.85% carbohydrates, 2.63% crude fiber, 11.65% fat and 2.75% ash.

Pearl millet crop

Soil type : Bajra may be grown in a variety of soil types. It does, however, grow best in black cotton soil and sandy loam soil with good drainage. This crop does not grow well in acidic and water logged soil.

Ear heads

Seed

Time of sowing:

Kharif: June -July

Rabi: January

Varieties: A number of high yielding varieties has been released for cultivation under different conditions

Seed rate : 3-4 kg/ha

- Seed treatment: Soak the seeds in salt solution (20 g salt in 1 litre of water) for 10 minutes to remove the ergot infected seeds followed by treatment with Beejamrutham
- Soak the seeds in Panchagavya solution (3-5 ml of panchagavya in 1 litre of water) for 7-8 hours to get disease free seedlings
- Soak 1kg seeds in Ashwagandha and Datura extract solution (Mixture; Ashwagandha root extract 250g+Datura leaf extract 50g+1 litre water) for healthy and disease-free seedlings

Spacing : 45 cm between rows and 15 cm between plants within a row

Transplanting : Seedlings should be 15 days old and spaced 45 cm between rows and 15 cm between plants within a row. In one acre, a total of 58,000 - 72,000 seedlings must be planted.

Manures and Fertilizers:

- Soil application of FYM@ 4 tonnes per acre
- Soil application of vermicompost@ 0.8 tones/acre to increase carbon source in soil
- Application of FYM@ 100 kg along with Ghanajeevamrutham 10-100 kg/acre
- Spray Geevamrutham for every 15 days interval

Water management:

- Soil mulching with groundnut husk 30 DAS to prevent moisture loss.
- Irrigation at the time of flowering, milky stage, seed formation and seed setting stage is advisable

Inter cropping : Bajra+ Redgram @ 2:1 ratio

Intercultural operations : Thinning has to be carried 15-20 DAS for maintaining optimum crop population

Plant protection:

- Spray cow dung+urine+Asafoetida (Inguva) solution to control Termites
- Spray wild ocimum leaf extract (or) Sontipaalukasaya to control green year/downy mildew disease
- Two sprays of cowdung+urine+asfoetida (Inguva) solution at 10 days interval controls ergot disease

Major diseases of pearl millet

Leaf spot

Rust

Downy mildew

Ergot

Harvesting:

Kharif: October-November

Rabi: February-March

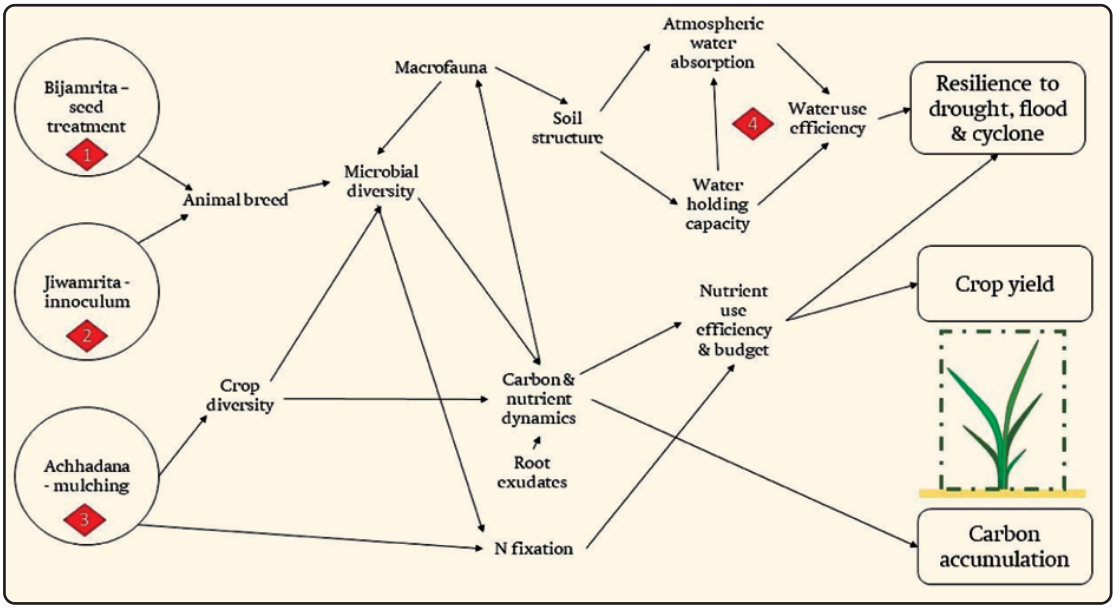
Sustainability of Natural Farming

Performance of natural farming practices can be examined in the light of four key sustainability metrics :

1. Productivity
2. Profitability
3. Environmental impact
4. Social wellbeing

1. Productivity:

The crop yields in natural farming, when FYM is not added along with Jeevamruta, has declined as compared to that of conventional farming. However, when Jeevamrutha was supplemented with moderate quantity of FYM, the economic yields of different crops have shown significant improvement over no FYM application. As soil microbiologists emphasize upon the important roles played by the invisible micro-organisms in the healthy soil, the natural farming practice can be sustainable if it is adopted in true spirits. Natural farming practices may lead to reduced production in high input cropping systems in the short term, but will fetch possible yield benefits over long period of time under specific conditions.



2. Profitability

Though the productivity is less with adoption of natural farming in short run, the economic profitability from farm can be ensured by reduced cost of cultivation and increased price of the product. Barring crop yield issue, inadvertently the natural farming has been successful in reducing the cost of cultivation as it avoids the use of chemical fertilizers, pesticides and insecticides.

3. Environmental impact

Non-judicious use of chemical inputs in conventional agriculture for the long run has led to contaminated soils, water and air; eroded soils and loss of biodiversity; caused pest outbreaks; and in many cases, led to stagnation or reduction in crop productivity. However, in natural farming, soil organisms supplied through Jeevamruta and Beejamruta act as primary driving agents of nutrient cycling, regulating the dynamics of soil organic matter, soil carbon sequestration, modifying soil structure and water regimes, enhancing the amount of nutrient acquisition by vegetation, conferring stress tolerance, resisting pathogens and improving plant health. It promotes biodiversity within the farm and there by encourages growth of beneficial organisms and insects, which are further helpful in reducing the pests and diseases and enhancing the nutrient availability to the crop plants. Natural farming not only improves the soil fertility but also reduce the carbon footprint due to saving of chemical fertilizers.

4. Social wellbeing

Increase in farm income from natural farming has directly influenced the social being of the adopter-farmers. On the other hand, intercropping or mixed cropping practices of natural farming help the farmers in increasing diversity in the household food basket and thereby improve the nutritional health as well as farm income of the farmers.

The way forward to Natural Farming :

Natural Farming (NF) is based on the principles of agroecology. Agroecology based agriculture got its legitimacy in the year 2014, when International Symposium on Agroecology for Food Security and Nutrition was organized in Rome by the Food and Agriculture Organization of the United Nations (FAO). This was followed by the International Forum for Agroecology, held at Nyeleni, Mali in 2015 organized by the International Planning Committee for Food Sovereignty (IPC) to push for food sovereignty. Some state governments in India *viz*., Andhra

Pradesh, Himachal Pradesh, Haryana, Karnataka, Kerala, Madhya Pradesh and Telangana are following natural farming practices. However, there are two very strong and diametrically opposite schools of thought co-existing in the society on natural farming. The proponents proclaim that natural farming practice will eliminate the problems of dependence on costly inputs as well as health and environmental concerns particularly related to use of chemicals.

On the other hand, the critics call the natural farming practice as unproven which cannot bring any tangible benefit to either farmer or to consumer. In this confrontation, the main stakeholders *viz*. Indian farmers are confused about veracity of information of both the parties. Very few systematic research studies are available to support or oppose the arguments. Under such circumstances, it is very important to create scientific evidences from the experimental fields to check the feasibility of the natural farming practices in increasing the farmers' income. Large scale expansion of natural farming practices requires serious constellation of policies, institutions and corporations dedicated to creating and maintaining a healthy economic and policy environment, as has happened in case of Green Revolution technologies.

Currently, most of the farmers do not believe completely about the efficacy of natural farming practices. Once the scientific evidences are generated to support the claim, large scale capacity building programmes need to be organized at local level. All the Krishi Vigyan Kendras (KVKs) may be roped to create awareness through trainings and demonstrations to a group of progressive farmers from each village, who in turn may influence other farmers by practicing themselves at their own fields.

Number of millet-based Farmers Producer Organizations (FPO) were formed across the country in recent times. These FPO member farmers may be trained on natural farming practices. Special incentives may be given to the FPOs promoting exclusively the Natural Farming practices. Such FPOs may be given financial support for value addition and marketing of NF produce. In addition, their cultivation practices and farm produce may be brought under the ambit of Participatory Guarantee System (PGS) for organic certification as PGS-Green or PGS-Organic. It would help the adopted farmers in attracting premium price from the consumers.

Gathering of dung, urine and different species of leaves and preparation of jeevamruta, beejamruta and various concoctions is very laborious and not easy to practice. Hence, branding and marketing of readymade natural farming products like amrutas and concoctions is another area of opportunity to generate additional revenue. This would be more effective if it can be done through Farmers Producer Organizations (FPO).

The Central Government has started giving its nod for implementation of natural farming practices. In the recent budget speech, Hon'ble Finance Minister Nirmala Sitharaman reaffirmed the Centre's commitment to natural, chemical-free, organic and zero-budget farming across the country. However, in the first phase, the centre has reduced the allocation towards the fertilizer subsidy in the coming crop season. States will be encouraged to revise syllabi of agricultural universities to meet the needs of natural, zero budget and organic farming. As 2023 has been announced as the International Year of Millets, the finance minister said the Government will support post-harvest support for enhancing domestic consumption of millet products internationally. As a contribution of Andhra Pradesh state government, an Agricultural Polytechnic on Organic and Natural farming was initiated by Acharya N.G.Ranga Agricultural University at Regional Agricultural Research Station, Chinthapalli.

Challenges in Natural Farming adoption:

Following may be the major challenges in spread of this practice at large scale:

1. Convincing the scientific community:

It will be difficult to persuade different stakeholders to generate broad agreement for its adoption unless scientific data and evidences are created by research institutes. In such a circumstance, stakeholders and farmers will always be sceptical of its effectiveness. Farmers will be greatly confused if a broad network of ICAR institutes, agricultural universities, and KVKs hold opposing view-points. As a result of all aspects of natural farming, particularly the importance of indigenous cow dung and urine, the growth and survival of various useful microorganisms in Jeevamritha and after its application in soil, the impact on soil microorganisms, earthworm activity, fungal and bacterial diseases, the cycling of nutrients from deep increases the soil fertility and the response of different crop varieties under various cropping and agro-ecological systems and the benefits due to reduced use of chemical fertilisers.

2. Adoption by large-size farm holding:

It has been observed that natural farming practice requires regular monitoring of the field for monitoring of nutrient deficiency as well as pests and weed infestation. Further, preparation of huge quantity of Jeevamritha and its application at regular intervals may increase the labour demand, which may increase the cost of crop cultivation. Thus, the practice may be more applicable for smallholder farmers with 1-2 family labour available at home. Therefore, adoption by large farm-size holding would be a herculean task.

3. Doubtful in case of high-input monocropping region:

The ZBNF practice is contemplated to be agroecological approach, in which crop/farm diversity is a must. In case of monocropping, wherein huge quantity of similar types of nutrients are applied, this practice may not give better/same crop yield as compared to existing practices of application of HYV, chemical fertilizers & pesticides. Therefore, in the region like Indo-Gangetic Plains, where farmers cultivate single crop in whole field in a season may not be interested to adopt this. It may have repercussion on total food grain production for the country if adopted at large scale by most of the farmers.

4. Reduced scope for mechanization:

The benefits of ZBNF can only be realized when farmers cultivate several crops together as inter-crop or mixed crops so that demand for specific nutrients don't lead to nutrient exhaustion in the soil. Inter/mixed crops can also be harvested at different points of time. This creates big hindrance in large scale adoption of farm machinery for sowing, harvesting, even other management practices. Achieving economy of scale and farm efficiency may always be the challenge in such case.

5. Continuous improvement in crop yield:

Crop harvest is the first stage of output realization by the farmers. Since the ZBNF practice forbids application of improved cultivars/ hybrid seeds, it would be difficult to keep the farmers motivated to grow the crops with this practice, as possibility of reaching yield plateau is quite imminent. Therefore, it requires experimenting with ZBNF/NF practices with different genotypes/cultivars to get continuous improvement in yield.

6. Setting up institutions for recognizing ZBNF produce:

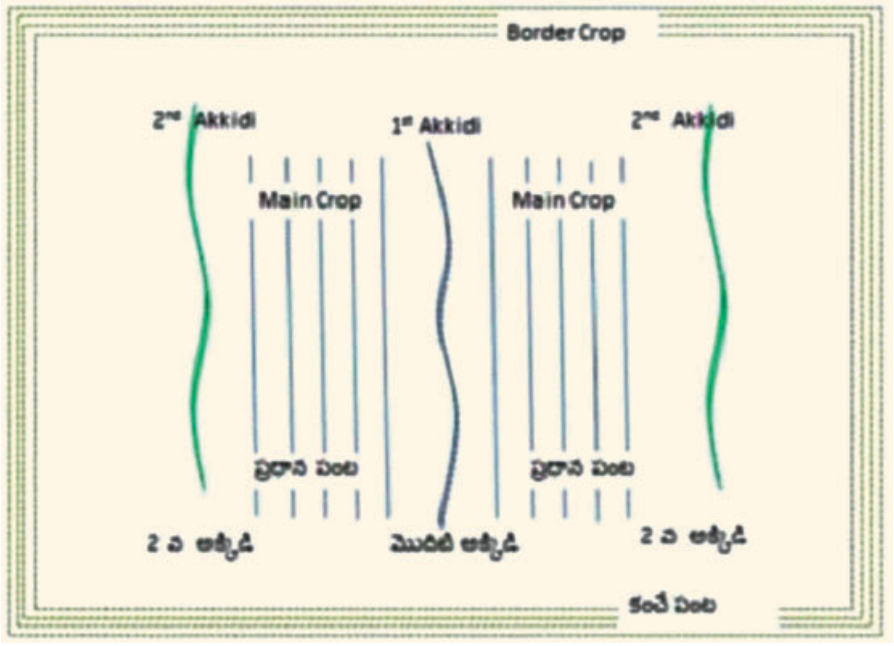
It is obvious that ZBNF products are different than conventionally produced commodities. Unless some mechanism is developed to place this product as niche product in the market, it would be difficult to attract premium price for ZBNF products. Therefore, different institutional mechanisms and policy changes would be required for producing, aggregating, certifying and bringing near to the final consumers. It may be appropriate to encourage the farmers to go for this practice in a collective way, so as to economize the whole process at scale.

NAVA DHANYA Cropping System

What is NAVA DHANYA ?

- One time sowing and multiple harvests
- Crop harvest starts from September- October and continues upto February
- Soil is covered till February / March by crops
- Sun rays do not meet the ground for 9 to 10 months and heavy leaf-litter addition to soil improves quality of soil over time
- Crops are designed in a way with multi-tiered canopy at different points, in times uses every inch of sunshine and land over a period of 9 months
- Makes maximum use of rainfall (SW and NE monsoons and Dew); NE monsoon rainfall is otherwise not used in single rainfed crops

NAVA DHANYA Method Consists of



1. Main crop: Groundnut/ millets/ sunflower etc. harvested in <100 days (3 months)
2. 1st Intercrop Row: harvested in 4 months
3. 2nd Intercrop Row: harvested in 6 months
4. Border crop: Millets on border rows
5. Limited crops: mixed with the rows along with the first 3- small proportions – a diverse array of crops for household consumption or sale.
6. Additional crops: Leafy vegetables, vegetables and others- very small niches mainly for household consumption.

NAVA DHANYA is a traditional mixed cropping system predominantly practiced by the rainfed farmers of Rayalaseema region, which includes the four districts of Anantapuram, Chittoor, Kadapa and Kurnool, in the Southern Indian state of Andhra Pradesh (AP). This cropping system may have evolved over time to effectively use the primary showers of the Northeast monsoon and capture moisture from the winter dew for survival of the crops. With the erratic rainfall every year the farmers are facing drought in the districts. During the past, even under erratic rainfall also the dry land agriculture has sustained in the district during the past. With experiences in their life, the cropping system was evolved as NAVA DHANYA, a dryland agriculture system in the district. The Navadhanya is an intercropping system to sustain crops in erratic rainfall by the farmer's experiments and to rescue from hunger deaths in drought-prone areas. It has also evolved the system for trapping erratic rainfall and utilizing 100% to the crops. The cropping system will keep the land green for 10 months in a year. With this system land utilizes all the erratic rainfall whenever it occurs in the year.

The NAVA DHANYA is a combination of 3 types of crops, millets, pulses and oil seeds. In millets we are having two categories;

1) Small millets : Foxtail millet, little millet, Kodo millet, Finger millet and Barnyard millet
2) Major millets : Pearl Millet and Sorghum.

The millets will be main crops, pulses and oil seeds will be intercrops. With this type of cropping system the agriculture fields will stand in green for about 9 to 10 months in a year. The small millets will be growing up to 3 to 4 feet and harvested in 3 to 4 months only and big millets which grow up to 4 to 5 feet will be harvested in 4 to 5 months. Pulses will be harvested in 6 to 7 months and the oil crop castor will be harvested in 9 to 10 months. Through this cropping system, the farmers had been producing the needed food grains for their families as well as fodder for their cattle. So, the Navadhanya is a cropping system for food and fodder producing. NAVA DHANYA is an excellent diversification in the cropping system for dry land agriculture and it is the only suitable model for drought- prone areas.

The cattle will be playing the main role in NAVA DHANYA, as the crop waste (stems and leaves of the crops) is used as fodder for the cattle and the cattle waste will be used as manure for the farm. The flow of resources will be circulating in between the family, cattle and agriculture land and called as “POLI” in the traditional agricultural system. The district farmers call it traditionally as a slogan that, the ‘NAVA DHANYALA PANTA VIDHANAM VARSHANIKI VALA PANNADAM’ (The system of NAVA DHANYA is a spreading net to trapping even erratic rainfall). Really, it is a wonderful, sustainable and traditionally proven cropping system for dryland agriculture in drought-prone areas.

NAVA DHANYA Crop Cover










Diversity of beneficial insects in NAVA DHANYA cropping system

CASE STUDIES IN NATURAL FARMING

Scarce Rainfall Zone

Regional Agricultural Research Station

Name of the Project :

Influence of natural farming on soil properties, crop protection and production of quality produce of Korra - bengal gram cropping system in Scarce Rainfall Zone

Period of Study : 2016-19

T_1 - Integrated Crop Management (ICM) Package of ANGRAU

T_2 - Natural Farming Package (as per the book* published recently by the Dept. of Agriculture, Govt. of Andhra Pradesh "***Sahaja Mariyu Sendriya Vyavasaya Vidhanalu***")

Influence of natural farming and ICM on Growth, yield attributes and yield of korra-Bengalgram *(Rabi)* 2016-17

Parameter	Natural farming	ICM (ANGRAU)
Korra		
Plant height	89	97.3
Panicle length	14.7	16.8
Plant population/m^2	27.3	28.2
No.of tillers	64.8	80.0
No.of panicles/ m^2	52.2	55.4
panicle weight/ m^2	175.3	246.9
Grain weight / m^2	141.9	204.9
straw weight/ m^2	133.6	231.9
Grain yield (kg/ha)	1263	1767
Straw yield (kg/ha)	1311	1808

Bengalgram		
Plant height	25.5	26.4
SCMR	42.2	42.6
No.of branches/plant	18.2	18.7
No.of nodules/plant	6.5	11.6
No.of pods/plant	21.1	27.8
Days to 50% flowering.	45	47
Seed yield (kg/ha)	1155	1531
Cropping system		
Gross returns (Rs/ha)	1,07,568	1,17,277
Cost of cultivation (Rs/ha)	43,000	37,250
Net returns (Rs/ha)	64,568	80,027
Sale Price (Rs per quintal)		
Foxtail millet	2500	1800
Bengal gram	6500	5500

The grain yield of foxtail millet was 1263 and 1767 kg/ha under natural farming and ICM module respectively. Similarly, the seed yield of Bengal gram was 1155 and 1531 kg/ha under Natural farming and ICM modules, respectively. No much variation was observed with respect to soil fertility status, microbial population and pest and disease control under both conditions.

Soil properties under natural farming vis-à-vis ICM modules (2016-17)

Parameters	Initial values	Final values	
		NF module	ANGRAU module
Soil pH	8.4	8.5	8.3
EC (dSm^{-1})	0.10	0.08	0.09
N (kg/ha)	175	213	137
P_2O_5 (kg/ha)	49.3	35.1	51.2
K_2O (kg/ha)	335	263	317
Organic carbon (%)	0.32	0.36	0.47

Zinc (ppm)	0.64	0.68	1.48
Iron (ppm)	20.8	23.2	48.0
Manganese (ppm)	14.3	12.0	24.4
Copper (ppm)	6.1	5.2	10.6

Influence of natural farming and ICM on Growth, yield attributes and yield of korra- bengalgram *(Rabi)* 2017-18

Parameter	Natural farming	ICM (ANGRAU)
Korra		
Plant height (cm)	93.0	103.0
Panicle length (cm)	11.4	13.0
Plant population/ m^2	25.4	27.2
No.of tillers/ m^2	53.4	60.8
No.of panicles/ m^2	43.2	46.0
panicle weight/ m^2	144.6	187.8
Grain weight / m^2	117.0	155.8
straw weight/ m^2	110.2	176.2
Grain yield (kg/ha)	1041	1343
Straw yield (kg/ha)	1125	1474
Bengalgram		
Plant height	31.7	33.2
SPAD readings	29.6	34.8
No.of branches/pl.	20.4	21.6
No.of nodules/pl	4.4	7.4
No.of pods/plant	14.8	17.4
Days to 50% flow.	38.8	41.0
Seed yield (kg/ha)	852	1094

Economics		
Gross returns	70998	76028
Cost of cultivation	55750	50000
Net returns	15248	26028
BCR	1.27	1.52

Higher yield, yield attributes, Net returns and BC ratio were observed in ICM compared to Natural farming experiment. Slight improvement in terms of yield in Natural farming during second year in comparision with ICM (71.5 % to 77.5 % of ICM on Korra and 75.4 % to 77.9 % of ICM on bengalgram)

Pest incidence

In korra 24.4% reduction in thrips population in Natural farming (Neemastram @ 200 l/ acre) whereas 79.2 % reduction was observed in ICM (Monocrotophos @ 320 ml/acre)

In bengalgram, low pod damage of 4.2% and 2.8 % was recorded in ICM (Novaluron @ 200 ml/acre) whereas 5.7 % and 5.1 % pod damage in Natural farming (brahmastram @2.0 l/acre) at 5 and 10 days after spraying.

Disease incidence and microbial population

- There was no significant disease incidence recorded in both ICM and Natural farming plot of korra and bengalgram
- Soil microbial population was observed to be slightly more in natural farming compared to ICM after harvest of crop.

Microbial population (*Kharif* 2017-18)

Parameter	Natural farming	ICM (ANGRAU)
Before sowing of foxtail millet (Initial population)		
Fungal population cfu/g soil ($x\ 10^3$)	47.3	38.2
Bacterial population cfu/g soil ($x\ 10^4$)	83.7	77.3
After harvest of korra and before sowing of bengalgram (After 70 days)		
Fungal population cfu/g soil ($x\ 10^3$)	49.9	42.5
Bacterial population cfu/g soil ($x\ 10^4$)	98.5	89.7

Diseases

Parameter	Natural farming	ICM (ANGRAU)	Natural farming	ICM (ANGRAU)
Foxtail Millet				
Blast (G) on lower leaves	2.0	2.0		
Blast (G) on upper leaves	3.0	3.0		
Leaf shredding (%)	1.2	1.2		
Micro organisms	Average number of colonies per plate at 15 DAS (Days after sowing)		Average number of colonies per plate at 15 DBH (Days before harvest)	
Aspergillusniger	2	2	3	2
Aspergillus	3	1	2	2
Trichoderma	1	1	2	1
Unidentified fungus	1	1	1	2
Unidentified fungus	2	1	2	1
Unidentified bacteria	1	1	1	1
Total	**10**	**7**	**11**	**9**

Soil properties

Soil available nutrients were more in ICM compared to Natural farming after harvest of the crop No change in organic carbon status among ICM and Natural farming after two years of experiment

Initial Soil Properties (2017-18)

Character	ANGRAU (ICM) package	Natural Farming Package	Remarks
pH	8.20	8.20	Alkaline in nature
Electrical Conductivity (E.C)	0.13 dS/m	0.11dS/m	Non Saline
Available Nitrogen	138 kg/ha	125kg/ha	Low
Available Phosphorous	65 kg/ha	58 kg/ha	High
Available Potassium	418 kg/ha	418 kg/ha	High
Organic Carbon (%)	0.31	0.28	Low

Final Soil Properties after Harvest

Character	ANGRAU (ICM) package	Natural Farming Package	Remarks
pH	8.25	8.28	Alkaline in nature
Electrical Conductivity (E.C)	0.22 d S/m	0.30 dS/m	Non Saline
Available Nitrogen	150 kg/ha	110 kg/ha	Low
Available Phosphorous	58.00 kg/ha	47.55kg/ha	High
Available Potassium	380 kg/ha	320 kg/ha	High
Organic Carbon (%)	0.30	0.28	Low

Grain Quality of Korra and chickpea

Parameter	Natural farming	ICM (ANGRAU)
Foxtail millet		
Nitrogen (N) %	1.72	1.83
Phosphorus (P) %	0.17	0.13
Potassium (K) %	0.42	0.46
Sulphur (S) %	0.03	0.13
Calcium (Ca) %	3.4	1.6
Magnesium (Mg) %	2.4	1.2
Protein %	10.75	11.43
Amino Acids (µg/gm)	0.31	0.40
Carbohydrates(g\100gm)	210	470
Chickpea		
Nitrogen (N) %	2.01	2.36
Phosphorus (P) %	0.27	0.45
Potassium (K) %	1.10	1.17
Sulphur (S) %	0.05	0.04
Calcium (Ca) %	1.8	2.8
Magnesium (Mg) %	1.0	0.8
Protein %	12.56	14.75
Amino Acids (µg/gm)	0.73	0.61
Carbohydrates (g\100gm)	610	540

Grain Quality

Higher N, P, proteins, copper content in grain/seed of korra and bengalgram under ICM
Higher magnesium, zinc content in grain/seed of korra and bengalgram under natural farming
Higher aminoacids and carbohydrates in korra under ICM and bengalgram under natural farming.
Higher iron in korra under natural farming and bengalgram under ICM

Table1: Influence of management practices on growth and yield of korra. *(Rabi)* 2018-19

S.No.	Parameters	(ICM) ANGRAU	DOA	Palekar method	Remarks
1.	Plant height-30 DAS (cm)	39.8	39.0	38.6	
	Plant height-60 DAS (cm)	97.5	91.6	89.7	
2.	Plant population/m^2	27.8	27.2	26.6	
3.	No. of panicles/m^2	47.4	42.6	40.2	
4.	Weight of the panicle/m^2 (gm)	294.6	237.2	209.1	
5.	Length of the panicle (cm)	14.9	12.7	12.0	
6.	Test weight (gm)	2.47	2.25	2.23	
7.	Grain yield /ha	2120	1698	1485	
8.	Straw yield/ha	2175	1761	1606	
9.	Harvest index	49.4	49.1	48.0	

Biological properties of the soil and inputs

Particulars	Total bacteria (CFU/gm)	Fungus (CFU/gm)	Actinobacteria (CFU/gm)
Initial Soil	7×10^6	4×10^3	2×10^6
Beejamrutham	5×10^7	2×10^4	2×10^6
Ghanajeevamrutham	2×10^7	1×10^4	4×10^6
Jeevamrutham	2×10^8	2×10^4	8×10^5
FYM	5×10^6	2×10^4	2×10^5
NADEP	3×10^7	7×10^7	3×10^6

Soil microbial population in korra-bengalgram cropping system

Particulars	Initial Soil	ICM		DOA		Palekar concept	
		Flowering	harvest	Flowering	harvest	Flowering	harvest
Total bacteria (CFU/gm)	7×10^6	6×10^7	5×10^6	6×10^7	6×10^7	6×10^7	7×10^6
Fungus (CFU/gm)	4×10^3	4×10^4	4×10^4	3×10^4	2×10^4	5×10^4	5×10^4
Actinobacteria (CFU/gm)	2×10^6	7×10^6	2×10^6	4×10^6	2×10^6	3×10^6	3×10^7

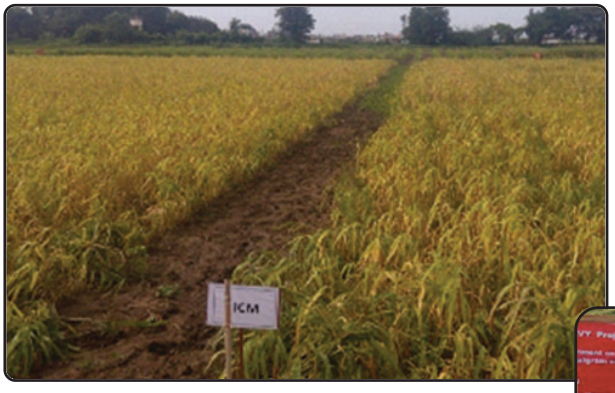
Total bacterial population is high ($7X10^6$) in initial soil, total fungal population is high ($7X10^7$) in NADEP compost and the total actino bacterial population is high ($8X10^3$) in Jeevamrutham. At flowering stage, there is no difference among the three treatments, fungal population is high in Palekar and actino bacterial population is high in ICM treatment. At harvesting stage, total bacterial, fungal & actino bacterial population are high in palekar module. At flowering stage rhizosphere microbiological population has increased tremendously when compared with initial population. At harvesting stage, bacterial and actino bacterial population is more in palekar, when compared to flowering stage. In Natural farming treatment, bacterial population is constantand there is a reduction both fungal and actino bacterial population is decreased when compared with flowering stage. In ICM plot there is a drastic reduction of both bacterial and action bacterial and microbial population but fungal population is constantly maintained.

Nutrient content in korra as influenced by management practices (2018-19)

Parameter	Nitrogen	Phosphorous	Potassium
	%		
Plant samples			
ICM (ANGRAU)	1.23	0.517	1.00
DOA	1.05	0.279	1.19
Palekar concept	0.87	0.217	0.69

Grain quality parameters of Bengal gram as influenced by management practices (2018-19)

Parameter	(ICM) ANGRAU	DOA	Palekar concept
Nitrogen (N) %	1.65	2.00	1.91
Phosphorus (P) %	0.23	0.25	0.07
Potassium (K) %	0.34	0.35	0.35
Sulphur (S) %	0.102	0.088	0.069
Calcium (Ca) %	1.6	1.2	2.0
Magnesium (Mg) %	0.8	1.2	1.2
Copper (ppm)	336	336	263
Manganese (ppm)	5.3	7.3	7.0
Iron (ppm)	29	69	24
Zinc (ppm)	38	46	36
Carbohydrates (%)	0.319	0.195	0.398
Amino Acids (%)	0.611	0.482	0.733



Courtesy : RARS, Nandyal, ANGRAU

System of Millet Intensification in Ragi Cultivation

Farmer's name : Gogada Lakshmi, w/o Bangaru Naidu
Cluster : Lingampeta
Village : Marlapalle
Mandal : Lakkavarapu Kota
District : Vizianagaram
Crop : Ragi/ Finger milet
Area : 30 cents

A progressive woman farmer named Gogada Lakshmi, w/o Bangaru Naidu used to cultivate finger millet with normal practices earlier. From her 30 cents of landholding, she could yield only 100 kg finger millet grain every year. Later, she initiated SMI cultivation of Ragi by adopting the techniques *viz*., Seed treatment with Beejamrit and Spraying of Dravajeevamrut three times on the standing crop. Manual hand weeding was done once before and once after flowering stage. Leveling was done on standing crop at 25 days after planting. This resulted in 20-50 tillers for each hill. She spent only Rs. 2700/- for all the above practices and gained almost 300 kg of yield from her 30 cents land after conducting crop cutting experiments. This produce was sold for Rs. 7500/- at rate of Rs 25/- per kg. With this, she gained profit of Rs. 4800/- from her 30 cents of land compared to conventional method. She expressed her satisfaction about SMI cultivation of Ragi with natural farming practices and motivated many other farmers in the village to follow these techniques.

Courtesy : Sri K. Prakash, DPM, Natural Farming, Vizianagaram

Enhancing farmer's income by natural farming of chilli

Farmer's name	:	Gogada Devudamma, w/o Sanni Babu
Cluster	:	Lingampeta
Village	:	Marlapalle
Mandal	:	Lakkavarapu Kota
District	:	Vizianagaram
Crop	:	Chilli
Area	:	30 cents

Gogada Devudamma, resident of Marlapalle village of L.Kota mandal has intiated chilli cultivation through natural farming practices in 2 acres of land from Kharif, 2018. Earlier she practiced conventional cultivation methods by using chemical fertilizers and pesticides. Later she started following ZBNF practices *viz*., chilli seed treatment with Beejamrurt before sowing and planted in 20 cents area and observed 100% germination and healthy plant stand. Each pre-treated plant yielded 135-190 fruits. Also, there was no incidence of diseases and pests. With this method of cultivation, she could gain profits as that of normal conventional method.

She inspired many farmers to follow the same practices such as seed treatment with beejamrut, soil application of 100 kg of Ghanjeevamrut before sowing, treatment of nursery with Beejamrut, three times spraying of Dravajeevamrut during crop period. Many of the villagers followed all the natural farming practices to raise chilli crop with the information given by ZBNF staff and could raise profits of approximately more than Rs. 10000/- by following these practices .

Use of Organic Concoctions and Extracts are better than chemicals

Farmer's name	:	Choppa Ramarao
Cluster	:	Lingampeta
Village	:	Lachampeta
Mandal	:	Lakkavarapu Kota
District	:	Vizianagaram
Crop	:	Brinjal
Area	:	20 cents

Mr. Ramarao from Lachampeta village practiced brinjal seed treatmet with Beejamruth and planted in 20 cents of his farmholding. He applied 100 kg Ghanajeevamruth as per the suggestions given by ZBNF Staff. Another progressive farmer Allu Muthyalanaidu also practiced same method and could achieve higher yields than the normal. Sri. Ramarao treated the seedlings with Bheejamrut and then followed by Dharva Jeevamruth spraying at 15 days after planting. He observed good and healthy plant stand. He controlled leaf folder by spraying Neemasthara. The crop was observed to be healthy and recorded very good yield compared with neighboring fields where urea and other chemicals were applied. Through the natural farming techniques Sri.Ramarao has gained a profit of almost Rs. 5000/- and also inspired many of the farmers of his village.

Preparation of Neem leaf extract

Ghanajeevamruth

Kitchen gardening for nutritional security using Natural Farming Techniques

Farmer's name	:	Gogada Satyavathi, W/o Appalanaidu
Cluster	:	Lingampeta
Village	:	Marlapalle
Mandal	:	Lakkavarapu Kota
District	:	Vizianagaram
Crop	:	Kitchen garden
Area	:	2 cents

Demonstration on kitchen garden

Smt. Gogada Satyvati from Marlapalle village is trained in kitchen gardnening by using natural farming methods in growing vegetables such as brinjal, tomato, cluster bean along with many leafy vegetables in her 2 cents of backyard. The seedlings were treated with bheejamrut before planting. Pests and diseases were controlled by spraying neemasthra. The plants in her kitchen garden were heathy with luxuriant green colour and with quality produce. Satyvathi expressed her happiness and extended thanks to the concerned officials involved in imparting knowledge on these new techniques to the farmers. She also inspired many of the villagers to initiate organic kitchen garden practices for better health and financial sustainability.

Role of Natural Farming in enhancing earthworm population in the soil

Farmer's name : Gogada Ramana, S/o. Satyam

Cluster : Lingampeta

Village : Marlapalle

Mandal : Lakkavarapu Kota

District : Vizianagaram

Crop : Vegetables and Coconut

Gogada Ramana planted coconut trees with intercropping of forage grass in 50 cents of land. He actively participated in training programmes and demonstrations related to natural farming. With that inspiration, he sprayed dravajeevamrut to forage grass thrice in a month and he observed a luxurious growth of plants. He was more enthusiastic towards natural farming and initiated vegetable cultivation such as bhendi, ridge gourd, cowpea and other leafy vegetables. Further, he observed that the earth worm population was considerably increased after application of Ghanajeevamrut to the soil and spraying Dravajeevamrut to the crop. The farmer is very happy about rapid increasing of earthworm population in his field and he extended complete natural farming practices to his whole landholding of 1.5 acre

Earth worms in Gogada Ramana's field

ZREO BUDGET NATURAL FARMING (ZBNF)

Farmer : Ganivada Ramana, S/o. Suri

Cluster : Lingampeta

Village : Chandhaluru, Kasireddipalem

Mandal : Lakkavarapukota

District : Vizianagaram

Crop : Groundnut

Acerage : 1 acre

Ganivada Ramana has cultivated 2 acres of groundnut during *Rabi*, 2018, one acre by natural farming and another 1 acre by chemical farming. Under natural farming, he applied 300kg of Ghanajeevamrutha followed by Dhravajeevamrutha three times along with irrigation and also sprayed Neemasthra once during the crop period which totally costed him around Rs. 700/-. Under chemical method of cultivation, he applied DAP during ploughing and urea as basal dose which costs him around Rs. 2000/-for fertilizers. He spent Rs.1500/- for levellig the field, Rs. 2200/- for natural farming, Rs. 2000/- for weeding and Rs. 2000/- for harvesting. The groundnut crop cultivated by ZBNF method has yielded 85 pods per plant relative to the chemical method of farming which yielded 35 pods/plant. Finally, the farmer could get a yield of 1200 kg/acre through natural farming in contrast to conventional method (700 kg/acre).

Economic security through natural faming

Farmer : Kasireddy Appalanaidu

Cluster : Lingampeta

Village : Chandhulur, Kasireddypalem

Mandal : Lakkavarapukota,

District : Vizianagaram

Crop : Brinjal

Area : 0.50 cents

A farmer, Kasireddy Appalanaidu has grown brinjal crop during *Rabi,* 2018. The attack of brinjal fruit and shoot borer was very severe, which destroyed the whole crop. Earlier, when he cultivated brinjal crop, he was habituated to spray various pesticides, but could not succeed in controlling all through the year which made him to remove the entire crop.Conversely, spraying of Neemasthra has controlled the infestation of brinjal fruit and shoot borer to a very large extent. Therefore, he recommends every farmer to cultivate the crops under natural farming.

Higher yields from natural farming

Farmer : Gandi Suridhemudu, S/o. Dhemudu

Cluster : Lingampeta

Village : Lingampeta

Mandal : Vizianagaram

Crop : Groundnut

Area : 0.50 cents

A farmer named Gandi Suridhemudu produced groundnut crop using chemical farming methods in 0.50 cents land, in which he used to receive a yield of 10 bags. Later, when he learnt about natural farming from the Sabala organisation, he was sceptical as first, but after adopting the techniques of natural farming procedures, which costed roughly Rs. 2500/- and yielded 13 bags on the same piece of land. As he could produce three bags more than chemical farming, he decided to cultivate his 2 acres of land naturally and spread this technique to other farmers also.

Crop diversification for Better yields

Farmer : Gandi Kannayya, S/o. Rammurty

Cluster : Lingampeta

Village : Lingampeta

Mandal : Vizianagaram

Crop : Browntop millet

Area : 0.30 cents

A farmer named Gandi Kannayya, S/o.Rammurthy, cultivated Browntop millet in his 0.30 cents of land. Previously this piece of land was kept barren, without cultivating any crop. But, during the year 2019, under the programme of ZBNF, he was motivated to cultivate browntop millet in his 0.30 cents. During the crop period, he applied Dhrava jeevamrutha four times and sprayed Neemasthra once along with manual weeding, altogether which costed him around Rs. 2300/-. After conducting crop cutting study in the field, a yield of around 100kg was obtained in his 0.30 cents, with a gross income of 7000/- and net profit of Rs. 4700/- which impressed many of the farmers in the village.

Conclusion:

Natural farming is holistic and bio-diverse system of farming in harmony with nature. It is low-intervention, ecological, sustainable and economically rewarding. In its purest advanced form, it is a 'do-nothing' way of farming, where nature does everything, or almost everything, and little needs to be done by the farmer. The basic tenet of natural farming is that the nutrients required for the growth of crops/plants are available in the soil itself. Hence, there is no need to supplement nutrients to the soil from external inputs. Natural Farming contemplates that facilitation of the release of the nutrients in the soil is enough for the growth of crops/plants. The applications of biological inputs facilitate the process of unlocking of nutrients in the soil. The analysis of the use of biological inputs and external chemical inputs for growing crops provides substantial evidence to the fact that the unlocking of nutrients in the soil through biological inputs has resulted in the yield of crops that are on par with the yield of the same crops grown with the external inputs. The cost incurred in natural farming is far lower than the cost of external inputs used under conventional farming to supply nutrients for obtaining the same level of crop yields.

The microorganisms along with the earthworms play a crucial role in the ecosystem and there is a need to utilize them in the agroecosystem management. They improve the soil fertility in many ways by bringing the nutrients from the deeper layers of the soil which can be easily absorbed by the plants. They also help in aeration, good root penetration, and further improving the soil fertility and crop productivity. But with the modern technologies and the human greed for better yield obtained from indiscriminate use of chemical fertilizers is degrading the ecosystem as well as agroeco system. The degradation of soil fertility is therefore a result of a decrease in the microbial population because of the environmental factors. Usage of natural techniques with fewer disturbances of soil enhances the activity of the earthworms in the soil for improving and maintaining soil health and fertility.

References:

Aakanksha Tiwari and Saravanan Raj (2020). Natural farming: A Game Changer in the Era of Social, Economic and Ecological Crisis, Discussion Paper 11, MANAGE – Centre for Agricultural Extension Innovations, Reforms and Agripreneurship, National Institute of Agriculture Extension and Management (MANAGE), Hyderabad, India.

Galab S,P. Prudhvikar Reddy D. Sree Rama Raju C. Ravi A. Rajani Impact Assessment of Zero Budget Natural Farming in Andhra Pradesh. A comprehensive Approach using Crop Cutting Experiments Report for the Agricultural Year 2018-19

Patro, T.S.S.K., K.E. Georgia, K.B. Palanna, A.K. Jain, et al. (2020). Compendium on Diseases and Pests of Small millets. All India Coordinated Research Project on Small millets and Acharya N.G. Ranga Agricultural University, Andhra Pradesh.

Galab, S., Project Director Dr G. Bhaskara Rao Dr P Prudhvikar Reddy Prof. C Ravi Dr D S R Raju Dr A Rajani (2021). Impact Assessment of APCNF (Andhra Pradesh Community Managed Natural Farming) Consolidated-2019-20, A Report Submitted to RythuSadhikaraSamstha Department of Agriculture Government of Andhra Pradesh

Ranjit Kumar, Sanjiv Kumar, BS Yashavanth, PC Meena, AK Indoria, Sumanta Kundu, M Manjunath (2020). Adoption of Natural Farming and its Effect on Crop Yield and Farmers' Livelihood in India. ICAR-National Academy of Agricultural Research Management, Hyderabad, India.

Sahaja mariyu Sendriya Vyavasaya Vidhanalu (2020). Department of Agriculture, Andhra Pradesh and Acharya N.G. Ranga Agricultural University, Andhra Pradesh.

Sandhya Rani, Y., Triveni, U., Jamuna, P., Anuradha, N., Patro, T.S.S.K., Prabhakar, Tonapi, V.A. (2021). An Insight into Organic Farming in Nutricereals. All India Coordinated Research Project on Small millets and Acharya N.G. Ranga Agricultural University, Andhra Pradesh.

Swedavedam – PrakruthithoRytuKarachalam (2020), Rythunestham Publications.