NATURAL FARMING

OUR EXPERT

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Natural farming is a unique method of agriculture that is completely different from conventional agriculture. Conventional agriculture follows the system of monoculture (one crop in a field) but natural farming follows polyculture (biodiversity-based agriculture). Conventional agriculture is input-based agriculture but natural farming is knowledge-based agriculture. Conventional agriculture is a loss-making business for the farmers so governments have to provide huge subsidies to make it viable whereas natural farming is a highly profitable business for the farmers and entrepreneurs. A natural farming agroecosystem looks like a natural forest and it functions like a natural ecosystem. Natural farming depends on the conservation of natural resources and restoration of ecosystem services to maximize crop production and crop protection. The idea of natural farming originally came from the traditional agricultural knowledge of the indigenous people. Modern farmers have refined that knowledge to design various nature-based agriculture forms. Here we summarised the basic principles of natural farming in a precise manner to clear all doubts and for a clear understanding of the common people. The adoption of natural farming is not only important for the profit maximization of the farmers but also important for the conservation of soil health, plant health, animal health, human health, and environmental health for future generations. Natural farming can be practiced in a small-scale urban terrace garden for home consumption of healthy vegetables and fruits or can be adopted in large-scale corporate farming for earning high ROI and carbon credit.

WHAT IS AGRICULTURE

To understand natural farming the definition of agriculture should be wider. Agriculture should be defined as domestication, breeding, and culture of plants, animals, and microorganisms, in open fields or closed environments, for the production of food, feed, medicine, fibre, and other materials of economic value for the benefit of man. Agricultural systems can vary widely, here we divided them into two basic types: monoculture (anti-biodiversity agriculture) and polyculture (biodiversity-based agriculture).

WHAT IS UNNATURAL FARMING

Growing a single crop in a field is known as monoculture. Monoculture is unnatural and completely anti-biodiversity agriculture because it continuously fights with nature using chemical poisons to keep biodiversity away from the crop plants. Monoculture applies herbicides to kill weeds (plant biodiversity), applies insecticides or pesticides to kill insect pests, predators, and parasites (animal biodiversity) and applies fungicides to kill both harmful (pathogen) and beneficial fungi (mycorrhiza and antagonists), and applies antibiotics to kill both harmful and beneficial bacteria (microorganism biodiversity). Monoculture applies deep tillage to destroy soil structure, soil water holding capacity, soil organic matter, soil microorganism biodiversity, and soil health. Monoculture disrupts natural biogeochemical cycles in soil such as the water cycle, carbon cycle, nitrogen cycle, phosphorus cycle, and potassium cycle to make the soil dead and to make the crop plant completely dependent on the supply of external inputs (seeds, fertilisers, micronutrients, growth regulators and pesticides) for crop production and crop protection. Monoculture is therefore unsustainable in nature and it is a loss-making business for the farmer. Monoculture has many side effects such as deforestation, habitat loss, habitat fragmentation, biodiversity loss, extinction of species, loss of underground water, eutrophication, soil erosion, soil degradation, desertification of land, genetic erosion, emission of greenhouse gases, climate change, an outbreak of insect pests, diseases, and weeds, environmental pollution, food waste, obesity, food-related diseases, hunger, malnutrition, poverty, farmers indebtedness, cancer of the farmer and farmers suicide. Monoculture can be subdivided into four different types based on the inputs used. (1) Conventional agriculture - conventional agriculture uses synthetic chemical inputs. (2) Organic farming - organic farming uses organic and biological inputs such as compost, vermicompost, biofertilizers, sludge, green manures, crop rotation, intercropping, inorganic fertilizers, growth regulators, botanical pesticides, biopesticides, light traps, pheromone traps, yellow sticky traps. (3) integrated nutrient management (INM), integrated pest management (IPM), and integrated disease management (IDM) - INM, IPM, and IDM use both chemical and organic inputs. (4) Integrated farming - integrated farming integrates monoculture crops with animal husbandry or fishery to increase productivity.

WHAT IS NATURAL FARMING

Natural farming or polyculture or nature-based agriculture or biodiversity-based agriculture is nothing but the modernization of the traditional system of agriculture. Modern polyculture systems are known by different names such as Agroecology, Agroecological Symbiosis, Agroforestry, Analog Forestry, Conservation Agriculture, Ecological Farming, Fertility Farming, Food Forest, Forest Farming, Forest Gardening, Korean Natural Farming (KNF), Natueco Farming, Natural Farming, No-till Farming, Permaculture, Probiotic Farming, Regenerative Agriculture, Rewilding Agriculture, Sorjan Farming System, Sustainable Intensification, Syntropic Agriculture, Taungya Cultivation, Vedic Agriculture (Rishi Kheti) and Zero Budget Natural Farming (ZBNF). Out of these names, we used "natural farming" as the generic name for polyculture because it is easily understandable to all. Polyculture means growing more than two crops at a time in the same field (mixed cropping). A natural farming agroecosystem looks like a natural forest and it functions like a forest ecosystem. Natural farming conserves natural resources (natural capital) and restores the natural ecosystem services to minimize the cost of production and maximize crop production, crop protection, and profit of the farmer. Natural farming is a source of a rich nutritional diet and a regular source of passive income for the farmer daily.

WHAT IS NATURAL CAPITAL

Natural farming completely relies on its natural resources for crop production and crop protection. Natural capital includes both abiotic components and biotic components of the agroecosystem. Abiotic components include soil, water, air, solar energy, temperature, relative humidity, and rainfall. Biotic components include the biodiversity of plants, animals, microorganisms, and man. As natural capital varies from place to place, the characteristics of the natural farms also vary widely.

WHAT ARE ECOSYSTEM SERVICES

Natural farming agroecosystems provide a host of direct and indirect ecosystem services to man. These include provisioning ecosystem services, regulating ecosystem services, and cultural ecosystem services.

Provisioning Ecosystem Services

Natural farming agroecosystems provide various direct material benefits to man such as food, medicine, fibre, and fuel. Farm management efficiency is determined by the yield of these provisioning ecosystem services per unit area per unit of time.

Regulating Ecosystem Services

Natural farming agroecosystem provides various indirect benefits to man by regulating various biogeophysical cycles (such as temperature cycle and water cycle) and biogeochemical cycles (such as carbon cycle, nitrogen cycle, phosphorus cycle, and potassium cycle), that provides water and nutrients to plants. The biodiversity of organisms (predators, parasites, and competitors) in the natural farming agroecosystem regulates the natural control of insect pests, diseases, and weeds for crop protection.

Water Cycle (Hydrological Cycle)

Within a natural farming agroecosystem, water moves through the atmosphere (air), biosphere (plants and animals), and geosphere (soil) automatically to form a complete cycle. The plant biodiversity uptakes water from the soil through plant roots, releases water in the atmosphere through stomata in leaf surface (transpiration), induces cloud seeding, induces rainfall, harvest rainwater, reduces runoff, increases infiltration of rainwater in soil, and enhances the recharge of water in the underground aquifers. Animals drink water from freshwater sources and get water from plants. Natural farming uses mulching and cover cropping to moderate soil temperature and to reduce evapotranspiration from soil surface, thus maintaining the soil water level constantly at field capacity throughout the year, to enable optimum growth and development of plant biodiversity. There is no need to apply irrigation water to crop plants in a natural farming agroecosystem.

Carbon Cycle

In a natural farming agroecosystem, carbon moves through the atmosphere, biosphere, and geosphere to represent a complete cycle. Green plants capture carbon from the atmosphere to prepare carbohydrates through photosynthesis. Animals eat plants and carbon transfers from plants to animals. When plants or animals drop the organic matter or die, carbon compounds return to the soil. Soil microorganisms decompose and mineralize these carbon compounds and make them ready for uptake by plants or storing the carbon in the soil. On the other hand, plant and animal respiration and decomposition of organic matter release carbon in the atmosphere in the form of carbon dioxide and methane. Natural farming agroecosystems aim to maximize the synthesis of organic biomass through plant biodiversity and to maximize carbon capture in the soil through mulching and cover cropping, which help mitigate climate change.

Nitrogen Cycle

Nitrogen is an inert gas in the atmosphere that passes through the atmosphere, biosphere, and geosphere, in the natural farming agroecosystem, to form a complete cycle. During lightning in the atmosphere, nitrogen gas is oxidized to form nitrate compounds that dissolve in rainwater and drop on soil or plant leaves. Plant leaves can absorb these nitrate compounds directly from rainwater. Plants belonging to the Fabaceae family (legume crops) form symbiotic associations with Rhizobium bacteria in their root nodules and fix atmospheric nitrogen to form nitrate compounds. Other free-living bacteria in the soil (such as Azotobacter) can also fix atmospheric nitrogen into nitrogen compounds. On the other hand, denitrifying bacteria reduce nitrate or ammonia into nitrogen and release it into the atmosphere. As nitrogen is an essential element for plant growth, natural farming explores all possible means to maximize nitrogen capture from the atmosphere. Farmers maximize plant biodiversity and leaf area index (LAI) in the natural farming agroecosystem to harvest maximum rainwater and absorption of nitrogen through plant leaves. They include legume crop biodiversity to maximise fixing of atmospheric nitrogen in plant roots and they use mulching and cover cropping to create congenial habitat for microorganism biodiversity to maximise the fixation of atmospheric nitrogen in soil, for optimum plant growth and development.

Phosphorus Cycle

Phosphorus occurs only in the geosphere and biosphere. Microorganism biodiversity in soil such as arbuscular mycorrhizal fungi (AMF) and plant growth promoting rhizobacteria (PGPR) can solubilise organic and inorganic phosphorus in soil and help plants to uptake phosphorus. This phosphorus again returns to the soil through the decomposition of plant and animal dropping and dead bodies. Natural farming agroecosystems ensure optimum availability of phosphorus to the crop plants solely from organic sources by recycling organic matter (mulching) through microbial decomposition and mineralization, to avoid the use of inorganic phosphorus from soil minerals.

Potassium Cycle

The potassium cycle also occurs through the geosphere (soil) and biosphere (plant and animal). Plant roots uptake potassium from soil and use it for developing resistance against pests, diseases, and climatic factors. Animals get potassium from plants through their food. Potassium again comes back to the soil through the droppings of plants and animals. Soil microorganisms recycle organic matter through decomposition and mineralization and continue the potassium cycle. Farmers maintain mulching and cover cropping, in the natural farming agroecosystem, to maximise the availability of potassium near the plant root zone soil as well as to reduce potassium leaching from soil, because potassium compounds are highly soluble in water.

Cultural Ecosystem Services

Natural farming agroecosystems provide various non-physical indirect benefits to man such as recreation, aesthetic appreciation, and religious fulfilment which are known as cultural ecosystem services. Farmers monetize these cultural ecosystem services through eco-agritourism.

METHODS OF NATURAL FARMING

Though natural farming agroecosystems are highly complex systems, the methods of natural farming are very simple and effective. These methods were originally invented by the indigenous people, thousands of years ago, out of their own experience and deep understanding of nature and natural phenomena. Since the 1970s, many modern farmers all over the world have experimented with these traditional methods and developed new systems of agriculture, as an alternative solution to the unsustainable chemical input-based agriculture (monoculture). These varied systems of biodiversity-based agriculture (polyculture) have some common basic principles. These methods can be combined to form a complete package of practices for successful natural farming.

No-Till

Tilling or digging the soil always destroys soil structure, soil water holding capacity, soil organic matter, soil biodiversity, and soil health. Tillage overturns the soil layers and exposes the lower soil to sun and air which destroys soil organic matter by oxidation and kills the soil microorganisms (fungi and bacteria) and other organisms (earthworms) by sun drying. As the living components of soil (plants, animals, and microorganisms) are responsible for soil health, the destruction of soil organisms and their habitats destroys soil health and makes the soil dead. Therefore, avoiding tillage (no-till) is always helpful for preserving soil structure, soil organic matter, soil biodiversity, and soil health. However, in natural farming agroecosystems, earthworms do the soil turning most efficiently without disturbing the soil structure, soil mulching, or soil moisture.

No Off-farm Inputs

Natural farming agroecosystems are completely self-sufficient and self-reliant in crop production and crop protection. It restores the natural biogeophysical cycles (such as soil temperature cycle and soil water cycle) and biogeochemical cycles (such as carbon cycle, nitrogen cycle, phosphorus cycle, and potassium cycle) to maintain soil health, plant health, animal health, human health, and environment health in their best conditions. Therefore there is no need for application of any external inputs in natural farming for maximising crop production. Moreover, the application of chemical fertilizers or bio-fertilizers disturbs the functioning of native microorganism biodiversity in soil (Game Theory). Natural farming agroecosystems maintain a carefully planned biodiversity of plants, animals, and microorganisms that automatically maintains natural control among the populations of insect pests, predators, parasites, diseases, antagonists, and weeds in crops. Application of pesticides, biopesticides, fungicides, antibiotics, and herbicides disturb this ecological balance and develop resistance against these pesticides to cause more severe epidemics on crops. Therefore avoiding all sorts of external inputs is beneficial for both crop production and crop protection in natural farming. Elimination of external inputs also reduces the cost of production of crops significantly and helps to maximize crop yield, crop quality, and profit for the farmers. This is why natural farming is also known as zero-budget natural farming (ZBNF) or do-nothing agriculture.

No Irrigation

Natural farming agroecosystems are self-sufficient in respect of their water requirements and there is no need for artificial irrigation for crop production. Natural farming follows no-till, mulching, and cover cropping to maximize cloud seeding, induce rainfall, rainwater harvesting, reduce run-off, harvesting of atmospheric water, infiltration of rainwater in soil, recharge of water to the underground water aquifers, moderating soil temperature, reduce evapotranspiration from the soil surface, ultimately to maintain soil water level constantly at field capacity throughout the year for optimum crop growth and reproduction.

Traditional Plant Breeding

About 10,000 years ago, indigenous people started plant domestication and plant breeding all over the world to ensure the supply of food close to their settlements. They have domesticated more than 7,000 plant species and have developed thousands of unique plant varieties that made agriculture sustainable and resilient for thousands of years. The indigenous method of plant breeding includes (1) collection of better plant genotypes and their wild relatives from other farmers or wild sources, (2) conservation of these plant genotypes in decentralized seed banks (now known as Vavilov Centres), (3) facilitating random open pollination of these genotypes through biotic (such as native pollinator biodiversity) and abiotic factors (such as wind) to achieve natural hybridization of crops, (4) facilitating mutation and somatic mutation of the genotypes, (5) characterization and selection of new elite genotypes by the actual farmers according to their own need and preference, (6) preservation of seed in special containers, (7) seed exchange (free of cost), (8) seed diffusion, (9) seed migration and finally (10) naming the plant varieties based on their useful characters. This traditional system of plant breeding follows a complete cycle of continuous improvements of plant varieties in their place of origin as well as in their place of adoption. Natural farming agroecosystems should follow this traditional system of plant breeding to achieve self-reliance and for the development of unique, exclusive, and exquisite plant varieties for individual farmers.

Traditional Animal Breeding

Man has started the domestication and breeding of animals since 11,000 BCE for sourcing their food, clothing, transport, and protection. They were successful in domesticating more than 50 animal species and developed hundreds of unique breeds of animals that supported sustainable agriculture for thousands of years. They followed controlled mating of animals and selection of better individual animals for the development of distinct and useful animal breeds. Natural farming agroecosystems follow this decentralized and diversified system of traditional animal breeding for the development of unique, exclusive, and exquisite animal breeds for individual farmers.

Water Harvesting

Water is the lifeblood of agriculture. Natural farming uses all possible techniques to maximize rainwater harvesting and conservation of water in the soil to become self-reliant and avoid artificial irrigation in crop production. Natural farming constructs well-designed permanent water harvestings structures such as contour bunds and trenches, wells, ponds, lakes, ditches, and wetlands, using locally available materials such as stones or soils. Natural farming follows no-till, mulching, and cover cropping to maximize rainwater harvesting, dew harvesting, eliminating runoff, infiltration of rainwater in soil, recharge of water in the underground aquifers, reduction soil temperature, reducing evapotranspiration from the soil surface and conservation of water in soil ultimately to maintain soil water level constantly at field capacity throughout the year.

Mulching

Laying out dry leaves or other organic materials over the soil surface and maintaining them throughout the year is known as mulching. Mulching provides several regulating ecosystem services. Mulching protects the soil from soil erosion caused by sun, rain, and wind, helps with rainwater harvesting, reduces runoff, moderates soil temperature, reduces the rate of evapotranspiration from the soil, recycles organic matter through decomposition and mineralization by soil organisms such as earthworms, fungi and bacteria to provide plant nutrients and suppresses weeds.

Cover Cropping

In the natural farming agroecosystems, farmers maintain live green plants all over the soil surface throughout the year, which is known as cover cropping. Similar to mulching, cover cropping provides multiple ecosystem services. It helps protect the soil from soil erosion by sunlight, raindrops, or high winds, helps with water harvesting, check runoff, increases water infiltration and conservation in soil, suppression of weeds, and recycling plant nutrients through the decomposition and mineralization of plant nutrients in the soil by soil organisms and microorganisms. Legume cover crops enrich the soil by fixing atmospheric nitrogen in symbiotic association with Rhizobium bacteria.

Probiotics

Preparation of native microbial culture by fermenting household materials in crude formulations under ambient conditions to use them in soil or on plants for enhancing crop production and crop protection in agriculture is known as prebiotics or probiotics (opposite to antibiotics). The use of probiotics in agriculture is a common traditional practice among indigenous people all over the world. For example, Bokashi, Cohol Amino Acid, Compost Tea, Fermented Fruit Juice, Fermented Plant Juice, Fish Amino Acid, Jeevamrut, Lactic Acid Bacteria, and Nettle. Application of probiotics is optional in natural farming but sometimes it is proved very helpful in quickly restoring the populations of native microorganism biodiversity in degraded or barren lands.

Multilayer Polycropping

Mixed cropping of multiple crops and stacking them in multiple layers of canopies are known as multilayer poly cropping. The number of crops can range from 3 (Three Sisters) to 256 (Forest Garden) and the canopy layers can range from 5 (ZBNF) to 7 (Food Forest). Multilayer poly cropping gives a natural farming agroecosystem the structure and function of a natural forest ecosystem. Multilayer polycropping can harvest maximum sunlight and rainwater, provide habitat to maximum animal biodiversity, can maximise crop yield, crop quality, crop diversity, and farmers' income. The following steps should be followed to establish an ideal multilayer poly cropping system: (1) plant rating and ranking - crop species and cultivars are evaluated based on the valuation of their ecosystem services to assign them a rating and rank them to prepare a priority list of the best crop varieties for each natural farm. The plant varieties are evaluated based on various economic and ecological parameters. Economic parameters are crop yield, marketable qualities of the crop, the season of harvesting, the price of the crop, and market size (price x volume). The ecological parameters are plant height, spacing, canopy density, provision for food and habitat for animal biodiversity (particularly pollinators, insect predators, parasitoids, and birds), inducing cloud and rainfall, fixing atmospheric nitrogen in symbiotic association with bacteria, resistance or tolerance against biotic and abiotic stresses like insect pests, diseases, drought, excess rainfall, and high wind velocity. (2) crop plant portfolio optimization - crop plant portfolio of a natural farming agroecosystem should be optimized by applying Modern Portfolio Theory. This theory states that in the case of any income-generating asset portfolio, diversification always reduces risk and increases returns. For example, monoculture (1 crop) bears 100% risk, intercropping (2 crops) bears 50% risk and polycropping of 20 crops or more bears the lowest level of risk. The crop portfolio is optimized for the uniform production of diversified crops throughout the year and the uniform production of pollen and nectar for the pollinators throughout the year. (3) landscape design - while designing the landscape of a natural farming agroecosystem, two ecological theories should be kept in mind "the area effect on biodiversity" and "the edge effect on biodiversity". A larger area of a natural farm can accommodate a larger biodiversity of plant and animal species. The boundary or edge between two distinct habitats or ecosystems harbors more biodiversity than each of the individual habitats. For example, the boundary of a pond contains more biodiversity than either in water or the land. Therefore the boundaries are maximised by curving the lines of the ecotones to maximise the biodiversity of the agroecosystem.

The position of different components of the farm such as green fencing, farm roads, ponds, fencing, hedgerow, farmhouse, farmstay, car parking, cattle shed, apiary, orchard, and watch tower are laid out carefully to build ecological niches for maximum biodiversity of animals. (4) execution - while planting the trees or sowing seeds or bringing in the farm animals in the natural farming agroecosystem, ecological theories such as "ecological succession" and "carrying capacity" should be kept in mind to design a balanced food web and food pyramid.

Bee Keeping

About 70% of the crops are fully or partially dependent on insect pollinators for biotic pollination of their flowers for fruit setting and to improve their fruit quality. For example, without pollination apple fruit setting will be hampered and fruits will be small and deformed. Honey bees are the best-known pollinators of crop plants. Native honey bee species and other native pollinator biodiversity are more efficient pollinators than imported exotic honey bees but their honey yield is less. Some crop plants, that provide the maximum amount of pollen and nectar to the native pollinator biodiversity throughout the year are called pollinator magnet plants. These pollinator magnet plants are included in the natural farming agroecosystem to maximize the incidence of native pollinator biodiversity and to maximize the biotic pollination of crops. The biodiversity of pollinator magnet plants converts the natural farming agroecosystem into a pollinator sanctuary or pollinator hotspot that serves the conservation of biodiversity. Honey bees also produce natural multiflora honey, a high-value agricultural produce. Natural farming uses native honey bee colonies by attracting them to the box with natural lures such as a piece of an old beehive or Cymbidium floribundum orchid.

Mixed Animal Husbandry

In a natural farming agroecosystem, various living organisms, namely plants, animals, microorganisms, and man remain interrelated with each other by their food relations. All these organisms occupy their respective trophic levels in a complex food web that maintains a balanced food pyramid. Green plants (autotrophs) form the base of the food pyramid, herbivorous animals form the second layer (primary consumer), carnivorous animals form the third and fourth layer (secondary and tertiary consumer) and the microorganisms form the final apex layer (detritivore) of the food pyramid. Therefore creation of the most effective plant biodiversity is the first important step in the natural farming agroecosystem. Subsequently, animal biodiversity (heterotrophs) are introduced within the plant biodiversity in tandem with the increase in the carrying capacity of the green plants. Animal biodiversity in the natural farming agroecosystem is created by man by bringing in domesticated farm animals as well as by allowing wild animals to occupy their respective ecological niches in the agroecosystem. The methods include (1) rating and ranking of animal biodiversity based on the valuation of their ecosystem services, (2) selection of the best breeds of domestic animals, (3) designing the best portfolio of domestic animals, (4) quarantine of animals for diseases and pests, (5) introduction of animal biodiversity in natural farming agroecosystem based on its carrying capacity (after deducting the amount of food harvested for man) and following the rules of ecosystem succession, (6) growing the most favorite food plants of the animal biodiversity, (7) use of poultry birds for control of insect pests and parasites of cattle, (8) use of predators (such as mongoose) for control of snakes and (9) use of medicinal plants as food for prevention of diseases in animals.

Mixed Aquaculture

Freshwater ponds are an essential component of the natural farming agroecosystem which provides drinking and bathing water to the animal biodiversity as well as provide habitat for the aquatic plant and animal biodiversity. These water bodies should maintain a mixed culture of native species of fish, shrimps, crabs, mussels, slugs, oysters, turtles, frogs, and other edible aquatic animals and plants.

Direct Marketing

The products of the natural farming agroecosystems are exclusive and exquisite premium agricultural commodities. The existing system of agricultural marketing has no provision for the price discovery of exclusive and exquisite crops. Therefore, direct marketing is the only option for the farmers to sell these products directly to the consumers, eliminating all marketing intermediaries. Direct marketing can be carried out through agri-tourism, gate sales, farmers markets, home delivery, or online marketplace.

Eco-Agritourism

The appearance of a natural farming agroecosystem resembles a botanical garden, a zoological garden, a biodiversity park, a supermarket of agricultural products, and a tourist destination. Farmers can monetize these cultural ecosystem services by promoting eco-agritourism in the natural farming agroecosystem, which can become one of the main sources of income for the farmers. People living in urban settings love to visit natural farming agroecosystems to experience the beauty and healing power of nature and biodiversity. Tourism helps with the advertising and marketing of natural farming products. Additional provisions for training, workshops, seminars, exhibitions, competitions, paintings, photography, meditation, naturopathy, bird watching, fishing, self-harvesting of fruits, self-cooking, and serving facility can enhance customer experience and success in eco-agritourism.

ADVANTAGES OF NATURAL FARMING

Profit maximization of the farmer

Natural farming is a normal business of the farmer for earning their livelihood therefore, the ultimate goal of natural farming is their profit maximisation. The factors that contribute to the profit maximisation of farmers are (1) minimum risk - agriculture is practised in the open field therefore it faces different kinds of risks such as climate risk (low or high temperature, low or high rainfall, high wind, hailstorm, lightning), biotic risk (outbreak of insect pests, diseases, weeds and wild animals) and market risk (low demand, over supply, low price). Crop diversification in polyculture can reduce risk and increase returns in agriculture. (2) Minimum cost of production - natural farming completely depends on natural capital and ecosystem services for crop production and crop protection. The farmers need not purchase any input from the market, hire any machine or labour for carrying out natural farming, which saves huge cost, (3) maximum crop yield - the aggregate crop production per year is highest in natural farming. Application of advanced methods such as selection of the best varieties, optimization of crop portfolio, and optimization of landscape design to maximise the leaf area index can maximise the aggregate crop yield, (4) maximum product diversity - maximum crop diversity, farm animal diversity and aquatic animal diversity effectively make natural farming agroecosystem an agricultural supermarket with diversified product range. (5) maximum product quality - natural farming produces premium quality products through breeding of exclusive and exquisite plant varieties, breeding exclusive animal breeds, selection of the best plant varieties, selection of off-season or all-season varieties, elimination of chemical fertilisers, growth regulators, pesticides and chemical fruit ripeners and biotic pollination of crops by native pollinator biodiversity, (6) maximum price of crops - direct marketing of crops gives complete liberty to the farmers to fix the price of their own crops and they tend to fix a premium price for their premium products, (7) regular cash flow - crop diversification and use of off-season or all-season varieties help mixed harvesting of multiple crops on a daily basis, generating daily cash flow and passive income for the farmer, (8) Law of increasing marginal returns - the income from the natural farming agroecosystems gradually increase over time but the cost of production gradually decreases over time. As a result, income and profit increase steadily. (9) Sustainability of profit margin - continuous improvement of soil health, plant health, animal health, human health and agroecosystem health increase sustainability in natural farming agroecosystem. (10) Resilience of the agroecosystem - natural farming depends on biodiversity because biodiversity imparts resilience against abiotic, biotic and financial risks in agriculture.

Conservation of natural resources

Natural farming completely depends on natural capital (natural resources) and ecosystem services for crop production and crop protection. The recycling of natural resources (such as water, carbon, nitrogen, phosphorus and potassium) in the natural farming agroecosystem ensures conservation of natural resources and gradual increase in natural wealth.

Conservation of biodiversity

Natural farming depends on the biodiversity of organisms (plants, animals and microorganisms) to maximise its crop production and crop protection. Therefore natural farming agroecosystems intentionally restore and conserve biodiversity of organisms in the best possible way.

Nutritional security of the consumers

Natural farming not only ensures food security of the nation but also ensures nutritional security of the consumers (including the farmers). Extreme crop diversification in natural farming agroecosystems ensure balanced nutrition of the farmers and consumers as well as the chemical-free farming provides the best of health and immunity against diseases. Farmers no longer need to buy any food ingredient from the market.

Restoring Natural Justice for the Farmers

Natural farming ensures complete freedom of the farmers to acquire agricultural knowledge from tradition and personal experiences, to breed their own exclusive and exquisite plant varieties, to maintain and exchange their seeds, to innovate their unique methods of agriculture, to fix the price of their crops, to sell their crops directly to the consumers and to earn as much income from agriculture as they desire.

DISADVANTAGES OF NATURAL FARMING

Knowledge intensive

Farmers need to acquire a specific knowledge to manage the natural farming business, because natural farming is a highly complex agroecosystem.

Hazardous animals

Natural farming agroecosystems provide ideal habitat for native animal biodiversity including hazardous animals such as snakes, scorpions, mosquitoes and leeches.

Mixed harvesting

Mixed harvesting of fruits and seeds and their sorting, grading and detection of damage by insect pests and diseases needs specialised experience of the workers and equipment such as digital sensors and sophisticated machines.

Conflict of interest

The idea of natural farming creates contradictions, confusions and conflict with conventional agriculture and with the vested interest of the industries. People usually mix up between natural farming and organic farming, natural control and biological control, direct marketing and regulated markets. Farmers were made to believe that non-farmers are wiser than farmers in agricultural knowledge, tillage is essential for clean cultivation, poisons are the medicines of agriculture and agriculture is not possible without debt.

EVALUATION OF NATURAL FARMING

Natural farming is a relatively new subject which needs scientific research and innovation for further improvement in its efficiency of ecosystem services. Some of the basic tools of research used in natural farming are discussed below.

Measurement of Soil Health

The word "health" is applicable only with living organisms, and not with any dead or non-living components. Natural soil behaves like a living organism because it has living components and therefore it has its health issues. Soil health is completely different from soil properties or soil fertility and soil health is independent of soil properties or soil fertility. Natural soil is composed of two basic components, non-living components and living components. Nonliving components are sand, silt, clay, organic matter, water and air. These non-living components have physical properties (soil structure and soil texture), chemical properties (pH, electrical conductivity, plant nutrients and micronutrient content) and biological properties (organic carbon content). These soil properties are tested in the laboratory by following standard methods and protocols. The plant nutrient and micronutrient content in soil is known as soil fertility. The living components of soil are plants, animals and microorganisms. Therefore, soil health is the total of plant health, animal health and microorganism health. Soil health is usually measured by visual observation of plant health, animal health and microorganism health. (1) Plant health is measured by the green colour of the leaves (chlorophyll content), normal growth and development of the plant and its immunity against insect pests, diseases and weeds. (2) animal health is measured by counting the number and diversity of earthworms (indicator species) per unit volume of soil. (3) The health of soil microorganisms can be measured by counting the number and diversity of the naturally grown wild mushrooms (indicator species) per unit area of land.

Measurement of Biodiversity

The biodiversity of organisms (plants, animals and microorganisms) in the natural farming agroecosystem can be measured in gene level, species level or ecosystem level. Biodiversity can be measured by using common tools of ecology such as species richness, Simpson index and Shannon-Wiener index. Biodiversity in the natural farming agroecosystem is measured through non-destructive and replenishable sampling methods to keep the natural balance in the population dynamics undisturbed.

Valuation of Natural Capital

Valuation of natural capital of natural farming agroecosystem means assigning monetary or non-monetary values to the various elements of the natural farming agroecosystem, such as soil health, water resources, solar energy, clean air, biodiversity of plants and animals and human resources. (1) Market-based Valuation: This method relies on actual market transactions where natural resources are bought and sold. For example, the value of crops harvested, eggs, milk, meat or fish sold in the market can be directly measured using market prices. (2) Cost-based Valuation: This approach calculates the value of natural capital based on the cost required to replace or reproduce it. For instance, the cost of constructing and maintaining a water purification plant can be used to determine the value of the ecosystem service provided by a natural water source. (3) Benefit Transfer: Benefit transfer involves estimating the value of natural capital by using existing data from similar studies conducted in different locations. This method is useful when primary valuation data is not available for a specific ecosystem but has been studied in comparable contexts. (4) Contingent Valuation: In this method, researchers directly ask individuals or communities about their willingness to pay (WTP) for the preservation or restoration of a particular natural resource or ecosystem service. (5) Travel Cost Method: This technique estimates the value of recreational resources (e.g., eco-agritourism) based on the cost people incur to travel to these areas for recreational purposes. (6) Hedonic Pricing: This method assesses the value of certain natural features (e.g., proximity to a lake, green spaces) by examining how they influence property prices and rental values in a particular area. (7) Ecological Footprint: This method evaluates the sustainability of human activities by comparing human resource consumption and waste generation to the Earth's ecological capacity to regenerate those resources and absorb the waste. (8) Shadow Pricing: Shadow pricing involves estimating the economic value of an environmental resource based on its impact on production or consumption in the economy. It's often used in cost-benefit analysis.

Valuation of Ecosystem Services

Valuation of ecosystem services is the process of assigning economic values to the benefits that ecosystems provide to humans. (1) Market-based methods: These methods use market transactions as a basis for valuation, such as the prices of goods and services directly linked to the ecosystem. For example, the value of agricultural products obtained from the natural farming agroecosystems or the fees charged for ecotourism activities.

Revealed preference methods: These methods analyse actual consumer behavior to deduce the value of ecosystem services. For instance, travel cost analysis examines the number of money people are willing to spend to visit natural areas, revealing their value for recreational purposes.

Stated preference methods: These methods involve asking individuals or communities directly about their preferences and willingness to pay for ecosystem services through surveys and questionnaires. Contingent valuation is a commonly used stated preference method.

Benefit transfer: This approach involves applying values from existing studies to similar ecosystems or regions when primary valuation data is unavailable. It relies on the assumption that ecosystem services have comparable values across similar contexts.

Replacement cost method: This method estimates the value of an ecosystem service by determining the cost of replacing the service with human-made alternatives. For example, the cost of building and maintaining a water treatment plant to replace the natural water purification function of wetlands.

Cost-based methods: These methods assess the costs incurred when ecosystems are degraded or lost. For instance, the expenses involved in pollution cleanup, flood control, or the loss of agricultural productivity due to soil degradation.

Shadow pricing: In this method, the value of ecosystem services is incorporated into decision-making processes by assigning "shadow" prices to the services. These prices are used alongside traditional economic indicators to evaluate projects or policies.

Multi-criteria analysis: This approach considers a range of ecological, social, and economic factors to assess the overall value of ecosystem services. It involves integrating diverse criteria into decision-making processes.

CONTACT

Registration with name and email.

FAQ

(To be updated later on)