ANUBHAV PRATISHTHAN TRUST

Present Understanding

of

Sustainable Agriculture

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ANUBHAV PRATISHTHAN TRUST PRESENT UNDERSTANDING OF SUSTAINABLE AGRICULTURE

1) Sustainable Agriculture – An Understanding

Sustainable Development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The term sustainable is used in the strategy to mean improving the quality of human life while living within the carrying capacity of supporting ecosystems.

It is very difficult to define Sustainable Agriculture since there is no generally accepted definition of a sustainable agriculture system.

Agricultural Sustainability means different things to different group of people. The concept being 'organic farming', or other terms as 'natural farming', 'ecological farming', 'Biological farming', 'alternative farming', 'low input farming' and 'regenerative farming' in contrast to "high input, maximum production", SRI and intensive agriculture.

Sustainability is feeding people both today and tomorrow as well as preservation and maintenance of natural resources and productivity by developing land use systems that are both economically viable in short run, yet not environmentally degrading in long run. It thus conveys the idea of balance between human needs and environmental concerns.

The ultimate aim of sustainable agriculture is to develop farming systems that are productive and profitable, conserve the natural resource base, protect the environment and enhance health and safety over the long term. Effective soil and water conservation practices are essential for sustainable agriculture.

Sustainability has several dimensions - ecological, economic, social and cultural. The concepts of ecological and economic sustainability have implications for those engaged in packages of technology, services and public policies for farmers. Economic sustainability can be ensured through public policies based on remunerative marketing opportunities and equity for economically and ecologically disadvantaged sectors of farming community. Integrating the dimension of sustainability with productivity, profitability and stability in technology development and dissemination is however, no doubt a more difficult and challenging task. The traditional methods have been developed with the sole objective of maximising the available water for crop, and minimising soil erosion.

Living Soils

Directly or indirectly all food comes from soil. If it is not a living system, it can't continuously produce. Just as any other living thing, soil possesses physical, chemical and biological properties. It has physiological systems like digestion, respiration, circulation and excretion.

Soil organic matter is an essential component of the soil and in association with the soil fauna, contributes to the soil fertility. Soil is said to have "life" only when it is holistically looked upon along with its inhabitants, in the form of flora and fauna. Soil faunal density and diversity is also partly due to the C: N availability in soils. Though the soil is rich in microflora, it remains inactive and inefficient when there is lack of organic carbon. Sources of carbon in the form of cellulose are mainly contributed by plants. Practices like mulching and incorporating crop residues into the soil helps build up the soil carbon. Integrating livestock with agriculture enables access to animal waste which can be converted to organic manure.

Most living things in soils, including plants, insects, bacteria and fungi, are dependent on organic matter for nutrients and energy. Soils often have varying degrees of organic compounds in different states of decomposition. Many soils, including desert and rocky-gravel soils, have no or little organic matter; while soils, that are all organic matter are infertile.

Organic matter that has decomposed to a point where it is resistant to further breakdown or alteration. Humic acids and fulvic acids are important constituents of humus and typically form from plant residues like foliage, stems and roots. After death, these plant residues begin to decay,

starting the formation of humus. Humus formation involves changes within the soil and plant residue, there is a reduction of water soluble constituents including cellulose and hemicellulose; as the residues are deposited and break down, humin, lignin and lignin complexes accumulate within the soil; as microorganisms live and feed on the decaying plant matter, an increase in proteins occurs.

Humus formation is a processes dependent on the amount of plant material added each year and the type of base soil; both are affected by climate and the type of microorganisms present. Soils with humus can vary in nitrogen content but have 3 to 6 percent nitrogen typically; humus as a reserve of nitrogen and phosphorus, is a vital component effecting soil fertility. Humus also absorbs water, acting as a moisture reserve, that plants can utilize; it also expands and shrinks between dry and wet states, providing pore spaces. Humus is less stable than other soil constituents, because it is affected by microbial decomposition, and over time its concentration decreases without the addition of new organic matter.

2) An Understanding of Climate Change

(Dr. Suman Sahai – Gene Campaign Foundation)

Climate change is likely to have a long term impact on social, environmental, economic, technological and political process. Most destructive influence will be on agriculture and food production in the poor. Changes in rainfall patterns and temperature regimes will influence the local water balance and disturb the optimal cultivation period available for particular crops, thus throwing food and agricultural production out of gear.

The biggest blow to food production is expected to come from the loss of multiple cropping zones. The worst affected areas are predicted to be the double or triple cropping areas, where two to three crops are produced in a year. To offset this loss, an effort must be made to convert single cropping areas into two crop zones. This can be done by efficient rain water harvesting and developing micro watersheds and water bodies so that in rain fed areas where crop is being harvested today, water can be made available for a second crop.

Coping with the impact of climate change on agriculture will require careful management of resources like land, water and biodiversity. Food production can be stabilised and livelihoods secured if the impact of climate change is factored into the design and implementation of development programmes. Large scale awareness programmes are necessary to prepare farmers, who are today bewildered by the rapid fluctuations in weather conditions that are affecting their farming. Their traditional knowledge does not help them to manage the current anthropogenic changes.

It is necessary to develop and demonstrate successful, replicable models to enable agriculture and food production to both adjust to the changing climate as well as mitigate the emissions from crop production.

To introduce the fundamental changes that are necessary to make agriculture sustainable and high yielding.

Practices in agriculture will need to shift from intensive, mechanized, water demanding agriculture to more sustainable, conservationist methods that give higher crop yields using less water. 'More crop per drop of water' is the strategy recommended to tackle drought. The approach is applicable in a wider sense when addressing the challenges posed by climate change.

Sustainable practices like conservation agriculture can keep carbon fixed. Conservation agriculture is a system of farming that conserve, improves and make more efficient use of natural resources through integrated management of available soil water and biological resources. The reduced till agriculture advocated by conservative agriculture means more carbon can remain trapped in the soil instead of being released when the soil is ploughed extensively before each planting. Important interventions include proper land preparation to minimize soil erosion, making contours and water channel to maximize water use, keeping overall water use low. Micro irrigation and drip irrigation are effective but expensive. Other helpful actions are planting trees and fodder crops on contours and watersheds, agro forestry and reforestation, crop rotations, green manure crops and intercropping as well as mulching and keeping a cover of crop residues on the surface.

Replacing agrochemicals with bio-organic substitutes, leads to a significant reduction in the carbon footprint. Reducing the application of nitrogenous fertilisers like urea will have a great impact on nitrous oxide emissions. Indian agriculture which is largely manual, as against the highly mechanized agriculture of the west, has a low carbon footprint because it does not use fossil fuels.

System of Rice Intensification

Some (relatively) new agronomic intensification practices are showing promise as adaptive strategies and are yielding good results, particularly in rice, wheat, maize & sugarcane cultivations.

The System of Rice Intensification (SRI) is a water saving, methane emission reducing rice cultivation strategy. Instead of flooding paddy fields as in current rice cultivation, the SRI consists of watering and draining the fields in a manner that significantly reduces the amount of water required. Essentially, SRI changes agronomy practices in a manner that enables prolific root formation and tilling that leads to more panicles and hence more grains per plant. This has an obvious impact on raising crop yields. This strategy increases weeds in the fields which have to be dealt with but apart from reducing the use of water in crop production, SRI also reduces the build up of methane by doing away with standing water in rice paddies.

3) An Understanding of Crop & Tree Intensification

Improving Crop Productivity –

Crop productivity is a function of a range of factors. These may be classified as:

1. **Land & water related factors (such as farm/watercourse location, quality of land, source of water, quality and quantity of water and timing of water application, etc.)**
2. **Climatic factors (rainfall, temperature, sunshine, etc.)**
3. **Agronomic factors such as quality, quantity and timing of input application (seed, fertilisers, labour, etc.)**
4. **Socio-economic factors (such as farmer education level and experience in farming, farm size, land fragmentation, availability of credit)**
5. **Farm management factors (adoption of modern production technologies, farm planning and management practices, etc.)**

Increasing Agricultural Production

The principal technical programmes for increasing agricultural production, around which intensive work is to be organised, are : (1) irrigation, (2) soil conservation, (3) fertilisers and manures, (4) seed multiplication and distribution, (5) plant protection, (6) better ploughs and improved agricultural implements, and adoption of scientific agricultural practices.

Steps in Raising Improved Agricultural Produce

To increase our food production we can sow good quality seeds and improve the methods of sowing. We can make the soil more rich and even use better techniques for harvesting the crops. Some of the agricultural practices which scientists have developed and which our farmers have started are explained here.

1. Preparation of soil & farm land management

This is an important practice of land preparation with organic manuring, green manuring, system of retaining soil moisture, which helps to enrich the soil and make it more fertile and aerated. It involves addition of manure followed by turning, loosening and leveling of the soil, using agricultural implements like plough, weeders and other mechanical farm implements. Each farm land is advice to have a detail soil analysis conducted and enrichment of soil is done in order to meet the deficiency.

2. Seed selection & treatment

Good quality seeds are essential to grow a strong and healthy crop. Healthy seeds can be brought from trusted sources or farmers can produce their own seeds. In that case, seed selection can be used to improve the quality of seeds.

Seed treatments refers to the application of fungicide, insecticide, or a combination of both, to seeds so as to disinfect and disinfect them from seed-borne or soil-borne pathogenic organisms and storage insects. It also refers to the subjecting of seeds to solar energy exposure, immersion in conditioned water, etc.

3. Nutrient rich raised bed nurseries

In certain crop plants like cereals, minor millets, pulses and some of the vegetables, seeds are not sown directly in the main field. First these seeds are sown in a nursery bed. Once they grow to a certain age they are transferred and planted in the main field. These small plants are called seedlings or saplings.

The raised beds are made in high rainfall areas. Raised bed of 10-15cm above ground level are made of bricks , stones, bamboos or stands which prevent edges of beds from crumbling during rains or while giving irrigation the beds. These beds prevent waterlogging and drainage is also easy.

The raised bed nursery requirements are a layer of healthy soil mix arranged on a raised firm surface. It uses less land, requires fewer seeds and inputs, such as organic fertiliser and water, reducing nursery costs by up to 50%. After 8 to 12 days, the seedlings reach the two-leaf stage—which favors quick establishment in the field and rapid growth—and are ready for transplanting. This is much quicker than the 25–35 days required for traditional wet-bed nurseries.

Raised Bed Nurseries are basically nutrient-rich and un-flooded raised nurseries, which is one of the major requirements.

How to establish Nutrient-rich and un-flooded raised nursery:

i. **Use good-quality seeds. It is important to use good seeds because they result in higher & more uniform germination, less replanting, fewer weeds, healthy seedlings and 5–20% higher yields.**

ii. **Pre-germinate your seeds. Soak your seeds in salt water for 12 hours (some varieties may need a longer time to bud). Drain the water after 12 hours, and keep the seeds moist by covering them for another 24 hours. By this time, the seeds will have sprouted buds and the first seed root will be about 2 to 3 millimeters long.**

iii. **Prepare the soil mixture. You need 4 cubic meters of soil mix for every 100 square meters of nursery area. Mix 7 parts soil with 2 parts well-decomposed and dried cow & chicken manure, green manure, vermi compost and 1 part fresh or charred rice hull.**

iv. **Prepare the raised firm surface nursery area by increasing & raising the height of the soil by 4 to 6 inches (provide canals to facilitate drainage). Prepare a 100-square-meter nursery area for every 1 hectare that will be planted. Select a level area near or in the main field. Level your seedbed and spread banana leaves or plastic sheeting on top to prevent the roots of the seedlings from penetrating into the soil.**

v. **Lay the soil mixture. You can do this with or without using a wooden frame/bricks/bamboo or wooden sticks above the plastic sheets. For those using a wooden frame or frames (bricks, bamboo, wooden sticks, etc.) place the frame on top of the plastic sheets. The frame should be half a meter long, 0.3 meter wide, and 4 centimeters deep, divided into equal segments (or one small frame 12 x 12 inches). Smaller segments are required to facilitate transplanting the seedlings to the field without damaging the roots. Then, fill the frame almost to the top with the soil mixture you prepared.**

vi. **Sow the pre-germinated seeds uniformly. Sprinkle soil and pat gently to embed them at about 2–3 centimeters into the soil, mulch with paddy straw and then sprinkle water immediately. Cover the nursery area with plastic sheets.**

vii. **Remove the wooden frame or sticks and repeat laying the soil mixture and sowing seeds until you have finished the whole nursery area. For those who prefer not to use a wooden frame, you can use bricks, bamboo or wooden sticks instead. Simply create a fence around the nursery using bamboo pegged with wooden sticks, pour the soil mixture inside the frame and level before sowing. Cover the nursery with rice straw then sprinkle water and then cover with banana leaves or plastic sheetnig once you're through.**

viii. **Water the nursery twice a day for 5 days and keep it covered with rice straw, banana leaves or plastic sheets to keep the soil moist in. Make sure that you protect the nursery from heavy rains for the first 5 days after seeding.**

ix. **Five days after seeding, remove the cover and continue the water twice a day.**

(If your seedlings show yellowing after 7 days, it means that they lack nitrogen. You can solve this by sprinkling the seedlings with 0.5% urea solution (if green manure fertilizers were not used). Simply dissolve 1.5 kilograms of urea in 300 liters of water to sprinkle over 100 square meters.)

x. About 8 to 12 days after seeding and transport them to the field, along with soil. A metal / bakelite (2 mm) / wood / aluminum (1 mm) boards could be used for lifting the seedlings along with soil and transplanting in the field, without any disturbance to the roots.

4. Transplanting

The process of removing the seedlings from the nursery bed along with soil and planting them singly with wide spacing 10-12 inches square in the main field is called transplanting. When we transplant, we must select those seedlings which have 2 healthy leaves. These are sowed at proper distance from each other. The main field must be ploughed and manured before transplanting. Transplanting of seedlings is a very important practice. Plants roots are able to go deep into the soil and get more nutrients. When seedlings get good food, they grow into healthy plants and give a better yield.

5. Fertilizers

Crops need nutrients like phosphorus, calcium, nitrogen etc. *Farmyard manure*, as the name suggests is a mixture of decomposed cattle dung (excreta) and urine, left over fodder (cattle feed) and litter (bedding provided to cattle in the farm). *Compost* is manure made from vegetable and animal refuse collected from domestic waste, straw, weeds etc., dumped in a deep pit to decompose. *Vermicompost* is compost broken down by earthworms. Like fertilizers manures too add nutrients to soil.

6. Starter Solutions for Crops

Cow dung and cow urine are the sources which are cheapest and most accessible for farmers to increase the biological activity in their soils. The cow dung and urine mixed with a small quantity of jaggery is being extensively used in India under different names like Jeevamritam, Amritapani, starter solution, Janjeevani and so on. This solution is mixed with the irrigation water or spray, is a most effective way.

7. Watering

Water is necessary for proper development of plants. Roots fail to develop and penetrate in the dry soil. Water is essential during the seedling, flowering and grain filling stages of the crop.

System of Fruit Tree Intensification

The objective of fruit tree intensification is to create conditions to increase the productivity and competitiveness of targeted sectors, thus contributing to economic growth and the reduction of poverty.

The system of fruit tree intensification will target, the intensification and rehabilitation of rainfed fruit trees and the expansion of fruit tree production. Ultimately, it aims to increase and stabilize farmers' income in target areas by facilitating the shift to more valuable tree crops. Intensification and rehabilitation of existing trees, expansion of tree crops by converting hillsides planted with annual cereal crops to new high value, terraced, perennial trees.

Intensification of fruit trees help in improving vegetative cover, reduce soil erosion, help in maintaining soil moisture and overall help in maintaining livelihood and environmental security.

Tree intensification will involve fruit / horticulture plantations, forest home gardens, horticulture wadis, agro-forestry and regeneration of traditional tree covers including forest varieties, bamboos, timber, fodder, medicinal plants, shrubs, creepers and grasses.

4) An Understanding – Kisan Sheti Shala – empowering farmers, landless and women

Group Approach to be followed – An Understanding of Kisan Sheti Shala (KSS) for enhancing the knowledge, skills and collective/group approach for Sustainable Agriculture, Livelihood and Environmental Security:

KSS Learners – Famers, Landless and Women

The KSS is a group-based learning process that brings together the concepts and methods for rainfed sustainable agriculture, farm planning, water management, livestock, agroecology, experiential education and community development for livelihood and environmental sustainable development.

KSS approach should lead to a deeper understanding of the problem, its causes and appropriate actions by farmers. Sustainable agricultural development required more than just the acquisition of agriculture & ecological knowledge by individual farmers. It also required the development of a capability for generating, adapting and extending this knowledge within farming communities. The weakness in the earlier agricultural development programmes that fostered a dependency on external sources of expertise. Now, the KSS enables farmers to organise new groups, alliances, networks and associations and became involved in planning and implementing their own interventions. These interventions were highly diverse, ranging from self-research, training, sharing, actions, marketing and advocacy work. The landless and women will be trained the new system of agriculture intensification – crop & tree intensification, basic concept of farming, other agricultural systems & methods. KSS further enables the landless and women to initiate their own Service Centres to give services to farming communities such as nursery raising, tools and equipments for agriculture such as weeders, markers, treadle pumps, etc., services for value addition, marketing the finished products, etc.

Technically strong facilitator: The Person/Facilitator must have certain skills at growing the crop concerned. Training the field staff in season-long courses, which provide basic technical skills for growing and managing the crop. Facilitation skills and group dynamic/group building methods are also included in this season to strengthen the education process in the Farm Schools.

Based on crop phenology and time limited: The Farm Schools and season long training for trainers are based on the crop phenology; seedling issues are studied during the seedling stage, fertiliser issues are discussed during high nutrient demand stages, and so on. This method allows to use the crop as a teacher, and to ensure that farmers can immediately use and practice what is being learned.

Group study: Most Farm Schools are organised for groups of about 25 persons with common interests can support each other, both with their individual experience and strengths, and to create a "critical mass". The number of 25 is roughly the number that can comfortably work together with one facilitator. Usually these 25 are sub-divided into groups of five persons so that all members can better participate in field observations, analysis, discussion, and presentations.

KSS Site: The Farm Schools are always held in the community where farmers live so that they can easily attend weekly and maintain the Farm School studies.

Building groups: One of the jobs of the facilitator is to assist the Farm School to develop as a support group so that participants can support one another after the Farm School is over. This is done by having elected officers (head, treasurer, and secretary), and group identity. The Farm School needs its own name. During the season, the Farm School includes group building exercises to build group trust and coherence.

Basic science: Farm Schools try to focus on basic processes through field observations, season-long research studies, hands-on activities. It has been found that when farmers have learned about basics, combined with their own experiences and needs, they make decisions that are effective.

Study fields: The **Live Farm Demonstration for group study. This farm is essential for a Farm Schools, for farmers to carry out studies, allowing them to take implementation & management decisions. This provides other farmers a way of observing, learning, testing a new method before applying it to their own fields.**

Evaluation and Certification: All Farm Schools include field based pre- and post-tests for the participants. Farmers with high attendance rates and who master the field skill tests are awarded graduation certificates.

<u>Follow-up</u>: All Farm Schools normally have at least one follow-up season. Follow-up has been known to be a little as monthly support sessions for farmers to discuss their own problems in implementing, to as much as farmers running a complete Farm School for other farmers.

Developmental Impacts of the Kisan Sheti Shala		
Domain	***Immediate impact***	***Developmental impact***
Technical	Knowledge about ecology	More sustainable production
	Experimentation skills	Improved livelihoods
	Improved crop management	Ability to deal with risks, opportunities
	Pesticide reduction	Innovation
	Yield increase	More cost-effective production
	Profit increase	Reduced water contamination
	Risk reduction	Reduced frequency of farmer poisoning
		Reduced public health risks
		Improved biodiversity
		Improved marketability of produce
		Poverty reduction
Social	Group building	Collaboration between farmers
	Communication skills	Farmer associations
	Problem solving skills	Community agenda setting
		Farmer study groups
		Formation of networks
		Farmer-to-farmer extension
		Area-wide action
Political	Farmer-extension linkage	Stronger access to service providers
	Negotiating skills	Improved leverage position
	Educational skills	Awareness campaigns
		Protests
		Policy change

Training and Visitation comparison with Farm Schools

Point	Classical Training and Visit	Farm School evolution
Field-level extension officer's job	Deliver pre-packaged "messages" from a research-extension linkage. Primary job is information transfer, not technical expertise, which is reserved for Specialists not at the field level.	Technical Facilitator: Every KSS trainer should have basic technical skills (at least able to grow the crop, or rear animals, etc.). Secondly, every KSS trainer should have group oriented training and management skills. These skills are typically learned in a season-long Training of Trainers where they learn what they will teach.
Experience of trainers	Variable, but most often lacking basic farming skills and experience. Field level staff given communication skills.	Master trainer with farming experience gained during Training of Trainer programmes in which each person is required to grow crops and carry out field studies so that they test what they will use in Farm Schools later.
Information	Primarily top-down messages from distant research stations about situations presumed to be representative of farms.	Recommendations are tested against conventional practices and new information about to the site emerges. Promotes local creativity.
Contact point	Contact farmers that are supposed to train other farmers by passing on external information.	Groups of interested farmers that farm on a daily basis through generating local study circles.
Time frame	Continuously, forever, on a two-week regular cycle not based on any natural phenology.	A pre-defined period. Usually on a weekly basis over a season. KSS may be longer than a season, but never less than one season integrated with the crop phenology.
Pedagogy	Training: Use of static pre-determined demonstrations and in field examples to show and tell.	Education: A focus on underlying principles that allow farmers to derive and adopt recommendations within their own dynamic their ecological, social, and economic realities.

Evaluation	At best indirect: based on measuring delivery and funds spent.	Pre- and post-testing. Community self-surveying. Identifiable indicators defined in terms of system-critical factors. Internal rates of return.
Training site	Demonstration field, training centers, home of Contact Farmer, static not revisited in time or observed in terms of any on going process.	A shared farm in which the KSS uses to dynamically validate and test new management methods over the entire season (e.g. decisions during one part of the season can be verified by yield cuts)
Long term objectives	Increase food production, etc. "Farmer's attitudes, lack of knowledge, and practices are an object/constraint of a development process"	Nurture groups that will continue to address agricultural and community problems on their own and with technical backstopping. "Farmers as the subject of development"
Research	Primary source of information is research stations assumed to develop representative models that are widely applicable.	A process and consequence of local testing and within-community/ecosystem learning.

After successful organising farmers associations and KSS process and field demonstrations, it is visualised that the farmers would promote their own local "Farmer Producer Organisations".

It is visualised that the Farmer Producer Organisation (FPO) would be farmers own organisation actively involved in – local knowledge hub and centre, promoting value addition in order to increase shelf-life, post harvesting, extension service centres, hiring of agricultural equipments & machines, collective & group marketing and leveraging on behalf of all members & other farmers the agricultural government programmes and schemes.

The KSS should also train landless, women and Self-help group members in order to build up the capacities in activities of agriculture development, services, special sustainable development activities as Crop & Tree Intensification, inter & multi cropping, system of rice intensification (SRI) and other services in order to increase the crop and tree agriculture production.