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LEISA INDIA

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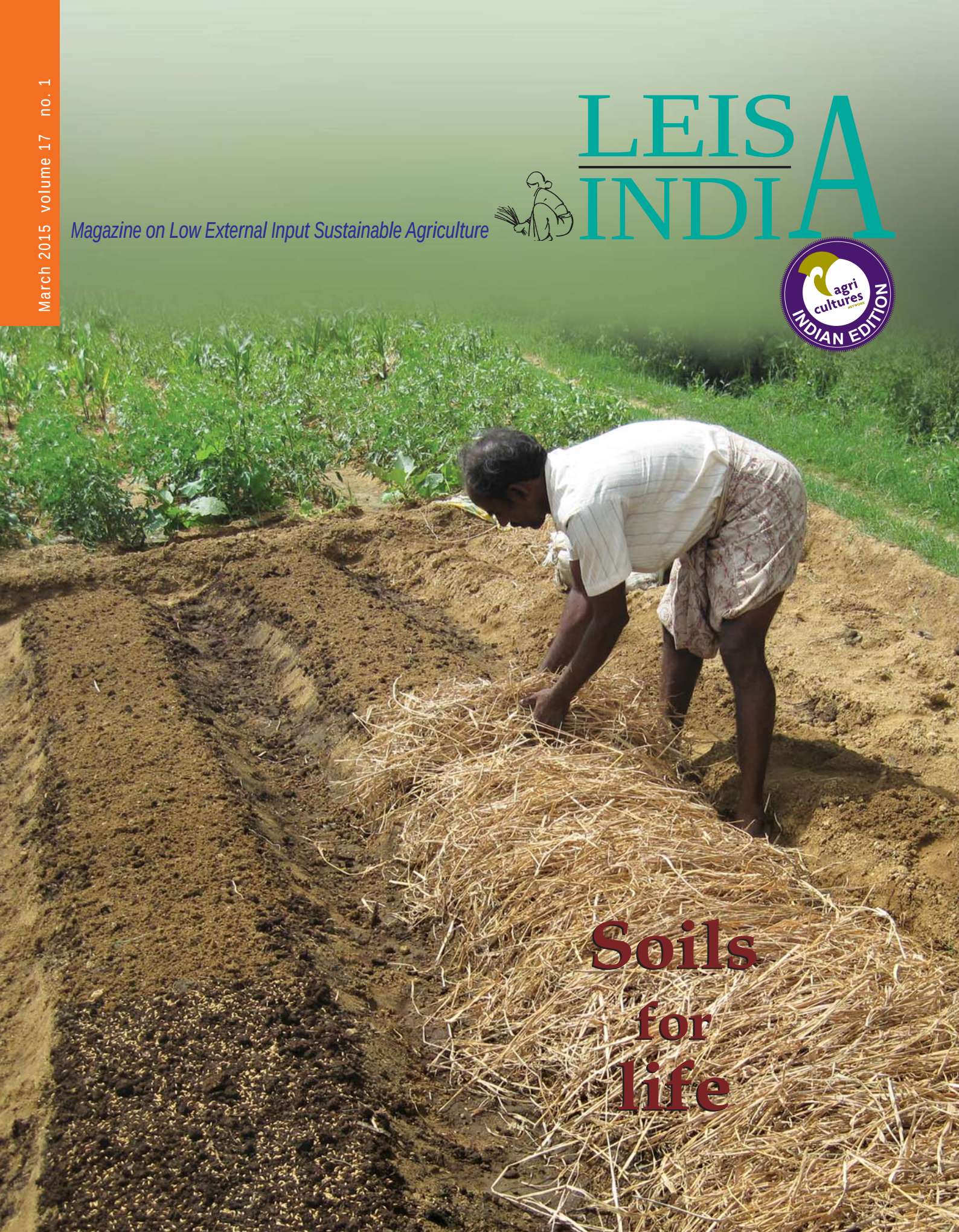

Soils for life

LEISA INDIA

March 2015 Volume 17 no. 1

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COVER PHOTO
A farmer covering the nursery bed with straw as mulch. (Photo: AME Foundation)

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LEISA India is a member of the global Agricultures Network. Seven organisations that provide information on small-scale, sustainable agriculture worldwide, and that publish:
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Dear Readers

More than 90% of the planet's genetic biodiversity is found in soils. A gram of soil can contain as many as 10,000 different species. The various micro organisms in the soil are capable of fixing nitrogen from the atmosphere, make other nutrients accessible to the plants and also improve the physical structure of the soil. However, with agriculture becoming commercialized, farmers have shifted to high chemical agriculture, also supported by government subsidies. Today, soil remains lifeless.

Soil life depends on the continual replenishment of organic matter. Traditionally farmers knew this and adopted organic farming practices, such as crop rotation, composting, green manuring, mulching etc., to increase the soil's organic matter and hence its biological activity. Even today, amidst commercialization, we still find farmers who adopt alternative agriculture practices, preserving soil health. This issue of LEISA India includes a number of such initiatives. While we celebrate the International Year of Soils 2015, hope these experiences inspire many others to think and act differently.

We thank all those readers who have been contributing voluntarily for the magazine. We request you to continue supporting us. To enable us to share a printed copy with you, kindly send your contributions along with the enclosed form.

The Editors

LEISA is about Low-External-Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the bases of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors, to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge and to influence policy formulation to create a conducive environment for its further development. LEISA is a concept, an approach and a political message.

ILEIA – the centre for learning on sustainable agriculture is a member of AgriCultures Network which shares knowledge and provides information on small-scale family farming and agroecology. (www.theagriculturesnetwork.org). The network , with members from all over the world - Brazil, China, India, the Netherlands, Peru and Senegal, produces six regional magazines and one global magazine. In addition, is involved in various processes to promote family farming and agroecology. The ILEIA office in The Netherlands functions as the secretariat of the network.

MISEREOR founded in 1958 is the German Catholic Bishops' Organisation for Development Cooperation. For over 50 years MISEREOR has been committed to fighting poverty in Africa, Asia and Latin America. MISEREOR's support is available to any human being in need – regardless of their religion, ethnicity or gender. MISEREOR believes in supporting initiatives driven and owned by the poor and the disadvantaged. It prefers to work in partnership with its local partners. Together with the beneficiaries, the partners involved help shape local development processes and implement the projects. This is how MISEREOR, together with its partners, responds to constantly changing challenges. (www.misereor.de; www.misereor.org)

AME Foundation promotes sustainable livelihoods through combining indigenous knowledge and innovative technologies for Low-External-Input natural resource management. Towards this objective, AME Foundation works with small and marginal farmers in the Deccan Plateau region by generating farming alternatives, enriching the knowledge base, training, linking development agencies and sharing experience.

AMEF is working closely with interested groups of farmers in clusters of villages, to enable them to generate and adopt alternative farming practices. These locations with enhanced visibility are utilised as learning situations for practitioners and promoters of eco-farming systems, which includes NGOs and NGO networks. www.amefound.org

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J Elango and V M Karunagaran

To enhance the soil carbon content of nutrient poor soils, Tamil Nadu farmers used biochar application on a trial basis. They observed that by applying biochar to soils, the physical structure and chemical properties of the soil improved and the impact remained for three cropping cycles. In this practice, they also found a solution in recycling Prosopis juliflora, which was rapidly invading their fields.

22 Creating a healthy living soil to feed millions with safe food

Deepak Suchde and Om P Rupela

By using an innovative compost called Amrut Mitti, many farmers are bringing life back to their soils. By enriching their agricultural fields with soil organic matter without external chemical inputs, these farmers are producing highly diverse nutrient rich food by harnessing local and natural resources.

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Roland Bunch

Most of our ideas about soils ignore the millions of years since mankind started farming. What happened during the 99.9% of soil's history contains very important lessons. Let us celebrate the International Year of Soils by looking at what that history can tell us – and build on those lessons for the future.

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An innovative approach to spread good practices

Shweta Prajapati and Gazala Shaikh

Spreading a good practice in agriculture on a wider scale has always been a challenge. However, people in Rajawar, a small village in Bundelkhand region in India, have showcased a process of collective change towards 'development' excellently by using community radio. The Rural Reality Show, an innovative show on the community radio became a means for spreading a practice for enriching soil fertility, from an individual to the whole community.

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Soils for life

Soil is an ecosystem full of life. It is neither a lifeless weathering crust of the rocks nor a single organism, but a biological organisation of the plants (with the roots), micro organisms and tiny creatures. It houses a world of tiny living creatures like microbes, bacteria, fungi etc.

Nature does not know any isolated organism, only organised communities. The soil life therefore is very dynamic in nature. The combination of various organisms in the soil keep changing hour to hour and season to season as they constantly multiply, grow, die, disintegrate and decompose.

Understanding soil

In 1951, *Rusch* and *Santo*, unveiled their 'Law of the Preservation of the Living Substance' in the 'Medizinisches Wochenblatt'. According to this article nature cannot afford the luxury of allowing the essential elements of life to decompose (or, as chemists would say, to mineralise) after the death of organisms, tissues and cells. Everything necessary for the building up of an organism is discarded. Mineral becomes mineral again, carbohydrates become carbonic acid and water, complicated proteins are split up into very simple components and everything becomes - if one can say so - earth and dust once more, just as it was in the first place. Everything which was commonly considered to be living obviously has to die and decompose at some point. But life in itself thereby does not come to an end as a result of this; on the contrary, it begins again. Out of the disintegration process something emerges that could be referred to as "new life" from the ruins, namely the *fertility of the soil*.(Erhard Hennig)

Soil life depends on the continual replenishment of organic matter. Most organic farming practices, such as crop rotation, composting, green manuring and keeping the soil covered, help to increase the soil's organic matter and hence its biological activity. No plant or animal is capable of fixing nitrogen, but some bacteria do. Where soil is healthy and moist, bacteria can be found that produce nitrogenous fertilizer from atmospheric nitrogen. Studies have shown that this loss of fertility correlated with decreasing soil organic matter levels and the resulting availability of nutrients. And, humid tropical forests the world over, by maintaining the soil organic matter content, have maintained impressively high levels of biomass productivity for millions of years, with no fertilizers and often on very infertile soils. (Roland Bunch, p. 30). Evidently we need to make an effort to preserve harmony in the soil and not to disturb it. In order to do this, we need to adopt measures which promote and preserve soil life, and above all a healthy cultivation of the humus content.

Alternative agriculture can replenish nutrients and feed soil

Traditionally, farmers were aware and practicing that type of farming which nurtured the biological life in the soil. The shift towards commercial agriculture and the need and greed to grow more in a limited period of time resulted in overuse of chemical fertilisers. With over emphasis on specific nutrients that enhance crop growth, farmers considered soils as a nutrient container that has to be replenished after every crop harvest by applying chemical fertilisers. Over time, the crop wastes were also not returned back to the soil, starving the soil organisms and reducing their ability to transfer nutrients to plant roots. This, in turn, increased the requirement for synthetic fertilizers thus enhancing dependence on external inputs to maintain the production system.

However, there are groups of farmers who are continously trying out alternatives. While some are reverting back to known traditional practices, some are innovating on their own, thus enhancing their soil fertility. Farmers in Deoghar district in Jharkhand, by adopting sustainable agricultural practices like mixed farming, use of organic manure, mulching etc., are reaping rich harvests from their small plots of land. Farmers understand that regeneration of soil health is crucial for better harvests and for retaining soils moisture much better. (Anirudhha Das and Purnabha Dasgupta, p.17)

In Central Asia, unsustainable land management has turned large areas of productive land into wastelands. "Not possible, no water, too hot…" has for a long time been the standard response from locals when asked why there has been so little effort to reverse natural resource degradation. But in recent years, innovative farmers like Ruzimatov Mahmudjon have successfully challenged this perception by clever strategies that use local organic waste materials (Frank Löwen, p.14). Paulose, a farmer from Kerala demonstrated that mulching in cardamom plantation, not only conserved soil moisture,

but also helped in yield increase (S.Varadarasan and P.Vivekanandan, p.12). Farmers in Telangana are going back to traditional practices like sheep penning, which is almost a forgotten practice. Sheep penning is a fascinating cooperative effort between pastoralists and farmers (B Sriveda and B Srihitha, p.28)

Amrut Mitti, is an innovative compost catching up with farmers (Deepak Suchde and Om Rupela, p.22). Many farmers are using this compost bringing life back to their soils. By enriching their agricultural fields with soil organic matter without external chemical inputs, these farmers are producing highly diverse nutrient rich food by harnessing local and natural resources. Its important that such innovations need to be adopted on a wider scale to have a greater impact. While spreading such an innovative practice on a wider scale is always a challenge, a farmer in Rajawar, a small village in Bundelkhand region in India, through a Rural Reality Show, on a community radio has been instrumental in spreading the practice across the whole community (Shweta Prajapati and Gazala Shaikh, p.39)

Efforts to enhance the soil carbon content of nutrient poor soils, has motivated Tamil Nadu farmers to use biochar in their fields on trial basis. They observed that by applying biochar to soils, the physical structure and chemical properties of the soil improved. Not only did the impact remain for three cropping cycles, producing biochar from Prosopis, provided a solution in controlling Prosopis juliflora which was rapidly invasing their fields (J Elango and V M Karunagaran, p.8)

Need for working together

Of late, a number of farmers having found the scientific solutions limited in addressing their local problems, are trying out local traditional solutions with good results. On the other hand, some of these practices followed by farmers are being studied systematically by the scientific community. For example, Paulose, a Kerala farmer started getting better yields after using the fallen leaves in cardamom plantation as mulch. The Indian Cardamom Research Institute studied the soil fertility on his farm and found that the organic carbon/humus content is higher in his garden compared to neighboring area with soil bulk density being very low. Mulching reduced the acidity of soil and increased the organic carbon content. (S.Varadarasan and P.Vivekanandan, p.12).

In another case, Amrut Mitti, a type of compost developed by a group of farmers caught the attention of scientists. Amrut Mitti was scientifically tested at ICRISAT and the results were amazing. The results revealed that some samples of this compost had up to 100 million plant-growth promoting bacteria in every gram of the compost - highest ever measured in ICRISAT lab, in any compost (Deepak Suchde and Om Rupela, p.22).

A farmer in Bellary prepares vermicompost for field application

These examples indicate a positive change in the mindsets as well as approaches in addressing the issue of soil fertility. It is not always necessary that new knowledge has to come only from the scientific community. The reverse is also true. However, these should not be limited to selected farms and activities. It is important that such results are shared, disseminated and adopted widely.

While these few examples of building soil life and health from innovative farmers included in this issue provide hope for the future, large scale adoption, especially by the small and marginal farmers, calls for support from various quarters, particularly an enabling policy support. More importantly, this also calls for a paradigm shift in the way we understand our soils. The UN declaration of the year 2015 as the *International Year of Soils* raises hope that it will serve as a platform for raising awareness and initiating action for building healthy soils for healthy lives.

◆

Reference:

Erhard Hennig, Secrets of Fertile Soils - Humus as the Guardian of the Fundamentals of Natural Life, *2009, OLV, Organischer Landbau-Verlag Lau*, ISBN392220127X, 9783922201274, 204 pages.

Photo: N Venkatesan

Tanksilt collected from the tanks

Bringing back the soil

N Venkatesan

Rainfed lands are less productive and are also subjected to soil erosion. Replenishing such lands with the lost soil by applying tanksilt will not only help farmers improve their soil fertility, but also enhance the water storage capacity of the tanks. Vayalagams, the people institutions in South India have shown that this is possible.

Tamil Nadu is endowed with more than 40,000 irrigation tanks, about 80% of which are small tanks commanding less than 40 hectares each. These tanks were formed many centuries ago as water harvesting structures to offset the vagaries of monsoons. Despite that, more than 60% of the net area sown in Tamil Nadu is cultivated only under rainfed condition due to poor water resources available in the State.

These rainfed agricultural lands form a major part of the catchment area which contribute to the tank's storage. High intensity rainfall leads to heavy surface run off resulting in the erosion of valuable nutrient rich top soil from the rainfed agricultural lands. They are further carried along with the running water and deposited as silt in the tanks adversely affects its storage capacity.

Traditionally, the application of tank silt to rain-fed agricultural lands was a common practice among South Indian farmers, which not only replenished the soil with nutrients, but also improved the moisture retention capacity of the soil. But this practice of applying tank silt to the agricultural lands has slowly vanished during the past decades, owing to several reasons like farm mechanization, excessive use of chemical fertilizers, high costs, and restrictions imposed by the revenue staff at the village level.

Vayalagams- A people's own initiative

DHAN Foundation has been facilitating the rehabilitation of tank systems through Vayalagams. "Vayalagams", are nested people institutions, promoted and maintained by local communities. Vayalagams have their own systems and procedures and implement programmes for the development of the area.

The local community staff at each block promotes and maintains 15 to 20 Vayalagams at one cascade of water bodies within the vicinity of 3 to 5 panchayats. This cascade would have 350 to 500 farmers. One Vayalagam community staff can manage these members organized as 25 to 30 microfinance groups. They regularly meet to carry on savings and credit activities. After 3 to 4 years, the surplus generated would be enough to meet the cost of the staff.

The thrust for the first three years is on social mobilization, then another three years of financial mobilization through

Studies conducted by the Central Research Institute of Dryland Agriculture (CRIDA, Hyderabad) in Nallabelli and Regonda mandals of Telangana reveal that, with tank silt application, soil moisture retention has gone up by 4 -7 days; higher plant population and higher plant height, increased yields (maize by 700 kg/ha and cotton by 1000 kg/ha), savings on chemical fertilizers ranging from Rs.2500/- to Rs.3750/- per ha. were observed.

Studies on several irrigation tanks in Karnataka by the University of Agriculture Sciences, Bangalore, show that the tank silt have plant-nutrients which can enrich the land and increase land productivity.

their savings and credits, the subsequent three years for their linkages mostly for livelihoods interventions and fourth set of three years for civic inter-mediation as four generation concept. Accordingly, DHAN links them with mainstream or other authorities to mobilize resources.

Tank silt application – demonstrating value

During 2008-2009 and 2009-2010, Dhan Foundation conducted demonstrations on the technology of tank silt application along with the soil moisture retainers (farm yard manure/coir waste). These demonstrations conducted in two seasons was supported by the Ministry of Water Resources, Government of India under Farmers Participatory Action Research Program (FPARP).

The demonstrations were conducted on the fields of 30 farmers covering an area of 30 hectares located in Madurai district in Tami Nadu and Chittoor and Nalgonda districts of Andhra Pradesh. While 20 were demonstrated in drylands, 10 were conducted in lands having supplementary irrigation facility. Around 50% of the unit cost of Rs.14000 was shared by the farmers.

The FPARP demonstrations resulted in an additional yield of about 15% in dry lands and about 25% in irrigated lands. Encouraged by the results, farmers from Madurai, Sivagangai, Ramnad, Theni, Tiruvallur, Kanchipuram, Chittoor and Nalgonda availed loan for the application of tank silt in their fields. Around 275 farmers were sanctioned an amount of forty lakh rupees by NABARD under the Umbrella Programme on Natural Resources Management (UPNRM), for applying tank silt on an area covering 228 acres.

Tanksilt applied to farm land

Photo: N Venkatesan

Facilitating use of tank silt in farmers fields

It was largely observed that whenever the desilting of tank bed was taken up and farmers were encouraged to use the fertile tank silt in their fields, their response was poor. Farmers had financial and other constraints in using the tank silt effectively on their fields. Realizing the importance of recycling the tank silt and the nature of constraints, a rehabilitation programme was taken up with the support of Sir Dorabjee Tata Trust (SDTT) in Karnataka in 2009-11. Under this programme farmers were helped to use the entire quantity of silt removed from the tank beds (leaving the gritty soil material for bund strengthening work) on their agriculture lands. More than 900 farmers benefitted by applying tank silt on an area of 1963 hectares. (See Table 1)

Table 1: Application of tank silt by Karnataka farmers

Block	No of Tanks	Volume of silt used in fields (Cu.m)	Area applied with tank silt (ha)	No of farmers benefited
Yadgir	7	19388	1081	587
Gurmitkal	4	13324	882	342
Total	11	32712	1963	929

Overcoming challenges

Farmers in Tamil Nadu faced problems in transporting silt from the nearby tanks as objections were raised by the local Revenue staff. Even after discussing with the higher authorities, the problem did not resolve. At last, one association with the support of Dhan Foundation used the Right to Information Act and found that there were no government orders preventing the transportation of tank silt. Through these efforts farmers were able to desilt tanks and use the tanksilt for field application.

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Biochar for healthy soils

Photo: Elango

Biochar applied to sapota tree

J Elango and **V M Karunagaran**

To enhance the soil carbon content of nutrient poor soils, Tamil Nadu farmers used biochar application on a trial basis. They observed that by applying biochar to soils, the physical structure and chemical properties of the soil improved and the impact remained for three cropping cycles. In this practice, they also found a solution in recycling Prosopis juliflora, which was rapidly invading their fields.

Semi-arid regions are characterized by a climate with insufficient rainfall to sustain agricultural production. Native vegetation is represented by a variety of species, such as grasses and grass-like plants, shrubs and trees. Annual precipitation varies from 200-250 to 500-600 millimetres. Over the last 3 decades, erratic rainfall and relentless invasion of *Prosopis juliflora* (shrub) in the districts of Virudhunagar, Ramanathapuram and Sivagangai has resulted in degradation of cultivable agriculture lands and an increase in fallow land. A drastic reduction in the common traditional grazing grounds has led to a reduction in native livestock population used for agronomic purposes. This has also affected the production and application of farm yard manure (FYM) which was a traditional organic farming practice.

What is biochar?

Biochar is a solid material obtained from the carbonisation of biomass. Biochar may be added to soils with the intention to improve soil functions and to reduce emissions from biomass that would otherwise naturally degrade to greenhouse gases. Biochar also has appreciable carbon sequestration value.

The Organisation of Development Action and Maintenance (ODAM), an NGO working in the area was aware that *Terra Preta*, meaning black earth, in Portugese, and its application to the farming activities could be a better option for enhancing the fertility of nutrient poor soil. Also it was felt that this option could address the issue of rapid invasion of Prosopis juliflora species by converting it into charcoal.

Decades of research in Japan and recent studies in the U.S. have shown that biochar stimulates the activity of a variety of agriculturally important soil microorganisms. The pores in biochar provide a suitable habitat for many microorganisms by protecting them from predation and drying while providing many of their mineral nutrient needs. These studies, experiments and discussions

by the Siemenpuu Foundation representatives prompted ODAM to carry out trials on the application of charcoal as a soil amendment along with different amendments.

Field trials

The field trial was established on the farm site, 8 km northeast of Tiruchuli, near the Biodiesel demonstration unit, established by ODAM. The area is classified as semi-arid with the average annual rainfall between 500 and 600 mm having its seasonal maximum between mid-October and mid-December. The soil might be classified as a weathered oxisol red soil, coarse or medium textured with sandy having poor water and nutrient holding capacity.

Charcoal of *Prosopis juliflora* was purchased from the local charcoal makers for the biochar trials conducted by ODAM. The charcoal pieces were sorted into different grades as per the texture and observing carefully and ensuring that charcoal would be suitable for making char powder. The powdered charcoal was kept in air tight gunny bags insulated with polythene sheets. Otherwise absorption of moisture would affect the quality of the charcoal powder.

Various types of trials were set up. (See Box 1). The pits of 2 x 2 x 1.5 (breadth x width x depth) feet dimension were dug. After digging the pits, top soil was filled up to half the depth of the pit, and then manure was filled in up to 2 to 3 inches. Again top soil was filled for two inches above the manure and manure treated with terra preta soil.

Seed sowing and Plantation

Seeds of bhindi (Lady's-finger), tomato and brinjal were sown in the pits. Four seeds of each species were sown in each pit. During the subsequent rainy days, seeds of tomato and brinjal were washed off from the pit area. The seeds of bhindi germinated and survived. After 15 days, the seedlings of tomato and brinjal borrowed from the neighbouring vegetable farmer were transplanted in the same pits. After transplantation, each pit contained 12 plants altogether (4 each of vegetable species).

Approximately 50 cents was used for all the crops such as red chilli, onion, tomato, lady's finger, brinjal, kidney beans and cluster beans. Apart from these, individual plants of drumstick were also applied with biochar soil amendments.

The fields/plants were watered at frequent and appropriate intervals, manually. Growth of the plants was also observed closely, and the gap filling was carried out during the early stages. Initially, application of raw charcoal powder in the soil caused mortality of seedlings. Later, the charcoal powder was saturated with farmyard manure and de-oiled seed cakes of different non-edible oil seeds by adding water. The mixture was stirred periodically and kept covered with gunny bags for fermentation.

Yield and harvesting

The total yield for bhendi was harvested over a period 3 months but for tomato and brinjal, was completed in less than two months. In charcoal based treatment, the maximum yield was about 4.70 kgs for tomato during peak harvest season, and around 1.4 kgs towards end of the harvest. Bhendi showed maximum yield in the second harvest after with the yield gradually decreased.

Among the non-charcoal soil amendments, the mixture of de-oiled seed cakes of Jatropha and neem yielded maximum harvest of 1.32 kg and 2.5 kg for lady's finger and tomato, respectively. De-oiled seed cake of Jatropha amendment yielded a maximum quantity of brinjal of about 1.15 kg. The average yield of bhendi, tomato and brinjal in the control plots were 338, 100 and 55 gms respectively.

As expected, many of the soil amendments with charcoal powder yielded more vegetables when compared with control plots. This could be attributed to the large surface area available for the storage of nutrients and increased water retention capacity of the soil amendment prepared with charcoal powder.

Box 1: Types of trials and terra preta combinations

1. De-oiled seed cakes of Pongamia, Jatropha, Neem, Silk cotton were made into small pieces and applied to the pits after applying top soil at the bottom of the pit. Again after applying the de-oiled seed cake into the pits, top soil was filled up in the pit.
2. Mixtures of two de-oiled cakes were made in 8 combinations in the ratio of 1:1. E.g. One portion of Jatropha de-oiled seed cake + one portion of Neem de-oiled seed cake. The cakes were made into small pieces and mixed well together. The application process is the same as previous one. In this type of mixture, additionally one more species, *Calophyllum inophyllum* was added.
3. Mixture of four de-oiled cake was made in one combination. All the seeds used in the single combination were used for this amendment.
4. Charcoal of *Prosopis juliflora* of big pieces was also applied as such in one of the pits in the first row.
5. Charcoal granules (small pieces size ranging from 0.5 cm to one cm) collected after sieving the charcoal powder was also applied in one of the pits in the first row.
6. Dry charcoal powder was applied in two pits of the first row.
7. Charcoal saturated with water kept for 15 days before application into the pit.
8. De-oiled seed cakes of neem, silk cotton, Calophyllum and Pongamia were mixed altogether with charcoal powder in the ratio of 1:1:1:1.
9. Jatropha de-oiled seed cake was mixed with 1:2 ratios with charcoal powder and saturated with water. This saturation process was periodically carried out at regular interval of 3 to 4 days for first month and later once in a week in the next month and kept in a closed condition for facilitating to undergo fermentation.
10. Charcoal powder from agriculture wastes such as dried banana leaves, cluster beans, outer shells of Jatropha pods, dust and cones of minor millet, dried palm fruit shells, dried sugarcane straw and sugarcane waste (after extracting the juice) were subjected to make char using a tar drum by pyrolysis method.

Photo: Elango

More pods per plant in biochar applied groundnut plots

The process of saturating the charcoal with de-oiled seed cake of Jatropha using water as medium, exhibited better result than any other soil amendments. In contrast, mixture of de-oiled cake with charcoal powder without undergoing for any saturation processes yielded moderate output. But certain amendments like de-oiled seed cake with charcoal showed poor yield or no yield, particularly for tomato and brinjal. This could be attributed to their accumulation of toxic characters or availability of such de-oiled seed cakes in overdoses.

Further, the saturated biochar soil amendments were applied to various vegetable species such as onion, chilli, kidney beans and moringa, oil seed – ground nut, and fruit species such as Sapota and Amla and jasmine plants. After application of biochar soil amendments, all the species exhibited even growth, increased plant height and formation of more roots than the regular practice of vegetable cultivation with chemical fertilisers and farm yard manures.

When incorporated into soil substrate, biochar and local organic manures altered the soil physical structure (bulk density) and modified the soil chemical properties (pH, CEC and nutrient supply). The impact extended over three cropping cycles.

In the groundnut experimental plot, the structure of the soil was also visibly altered and uprooting plants in the biochar amended soil was much easier than in the case of the non biochar-amended soil. The loss of groundnut pods was greatly reduced due to improved soil condition after the addition of biochar continuously for three times. This could be attributed to the reduced bulk density of the soil and improved soil structure for enhanced water holding capacity. When incorporated into soil substrate, biochar and local organic manures altered the soil physical structure (bulk density) and modified the soil chemical properties (pH, CEC and nutrient supply) and the impact extended over three cropping cycles.

Initially, one of the groundnut farmers nearby to the trial plots was provided the biochar soil amendment to apply in the standing crop of groundnut. He applied the soil amendment during the flowering stage. After the harvest, the farmer himself expressed that the number of pods were more in the biochar applied plants whereas the pods were less in the plants which were not applied with biochar. Another farmer who is involved in jasmine cultivation also encountered similar kind of experience that of groundnut farmer. The jasmine farmer observed that the bigger buds of the jasmine flower in the plants applied with biochar and during the later stages, the size and weight of the matured flowers also increased and fragrance of the flowers was superior to the other flowers. These two factors inspired the farmer to prompt to apply the biochar soil amendment to the remaining crops.

The yield of onion in the plot with the biochar soil amendment was 25% more than the control. The yield of beans showed 30 to 50% increase, and tomato yield increased by 30 to 40% when compared to the yield of control plots. Also, the farmers informed that the size and weight of jasmine flowers increased considerably in the biochar soil amendment applied plots.

Farmers spread biochar application

Based on the results, farmers were invited to observe the yield in the trial plots. Since the water holding capacity of the red loam soil is very poor in the semi-arid region, the farmers were asked themselves to compare the water holding capacity of black and red soil. They were able to understand that if the charcoal is buried in the red soil it would act like black soil in retaining water in the top soil.

After seeing the results, they came forward to adopt the trials on their lands. Fifty farmers from 10 villages were selected based on the following criteria – family farmers, own lands with red loamy soil, have access to irrigation, growing vegetables, interested in organic methods of farming and stay closer to the area where charcoal was available.

Samples of biochar soil amendments were provided to apply in their own lands during cultivation of vegetables and flowers. Among those 50 farmers, 26 farmers were provided with 10 kgs of biochar soil amendment samples to the farmers to apply in 2 sq. meters of trial plots in their land. Among these 26, 3 farmers are involved in jasmine cultivation and the remaining are vegetable cultivators. These farmers also experienced better results after application of biochar soil amendments in their fields.

Future spread

If the progressive or innovative farmers are encouraged to apply the biochar to other crops and share the results with other farmers, this new technique will spread among other farmers. However, cost effective method of preparation of biochar soil amendments will go a long way in adopting the practice, especially by the small farmers. Process of forming organic farmers' associations is in progress. Participatory learning process, like the Farmer Field Schools are being used to promote the biochar application.

Biochar application during land preparation

Photo: Elango

Acknowledgements

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Paulose showing fertile soil at plant base

Mulching

Harvesting many benefits in cardomom

S Varadarasan and **P Vivekanandan**

Intensive cultivation of cardamom, ignoring the traditional cultural practices, has resulted in repeated losses for cardamom farmers in the Western Ghats region. Paulose, an innovative farmer, has shown that by practising mulching, not only can the soil carbon content be improved, but better yields could be harvested on a sustainable basis.

Small cardamom (*Elettaria cardamomom*) cultivation in the Western Ghats of southern India has largely contributed for minimizing the denudation of evergreen forest to a greater extent. Cardamom has been cultivated over a century in India with traditional methods. It has helped in preserving the serene western ghat ecosystem with least disturbance to soil and its microbial biodiversity.

However, intensive cultivation of cardamom in the recent past, has lead to crop loss due to diseases and pests attack, increased demand for labour and increased cost of cultivation.

Experimenting with new ideas

Mr.K.V.Paulose in Kajanapara village in Idukki district of Kerala, a cardamom grower is an innovative farmer who tries out new ideas in a small area on his farm before accepting or discarding them. He discarded many practices of using chemical inputs and slowly made progress towards ecofriendly and low cost cultural practices which reduced

Mulching increased the organic carbon content while lowering the soil acidity and the bulk density.

the cost of inputs in cardamom cultivation and maximized the yield.

Trees such as jackfruit, silver oak etc., were grown in cardamom plantation for providing shade. These trees are normally thinned or pruned before or on the onset of monsoon. But, Paulose pruned the trees during end of north-east monsoon, i.e. Dec – Jan, to minimize the damge caused to tillers by falling twigs / branches. Since the soil is fertile and heavily mulched, the roots are not exposed to extremes of temperature in summer months and hence plants are not affected. Instead, new shoots emerge in large numbers. The tall trees facilitate better aeration as well as allow copious indirect sun light fall on the tillers resulting in better photosynthesis and reduced canopy temperatures facilitating growth of tillers, better panicle, capsule and fruit set.

Mulching in cardamom

Paulose observed that those areas where soil is covered with fallen leaves of trees, the crop stand was good with less pest/ disease incidence. The fallen leaves and twigs is made into a thick cover of mulch over the soil. These leaves decompose by *in-situ* composting process. The Indian Cardamom Research Institute (ICRI) studied the soil fertility on his farm and found that the organic carbon/humus content is higher in his garden compared to neighboring plantation. The soil bulk density is also very low. Mulching reduced the acidity of the soil and increased the organic carbon content. With increased carbon content, Paulose restricted the application of chemical fertilizers to single application. Usually farmers in the region apply 4 -7 rounds of fertilizer application.

It was observed that mulching resulted in several advantages - the plant growth is healthy and the damage due to thrips on capsules and stem borer is negligible; the height of the 17 year old plant is 15 – 20 feet tall and there are about 100 tillers in each clump. Usually cardamom fields are replanted with new suckers in 8-10 years of cultivation. But Paulose has retained the plantation successfully for 17 years with compact clumps. The old suckers decompose faster instead of rotting, which is also due to reduced soil acidity. Lateral roots are noticed even in the interspaces. There is no need for weeding as the soil is not exposed and self shade of cardamom clumps discourages weed growth.

Reaping several benefits

By practicing mulching and other soil fertility enhancement practices, Paulose was successful in harvesting better yields. On an average he harvests about 2 - 5 kg of dried cardamom / clump (of 100 tillers). The size of fruits (capsules) are bold and round in shape and the seeds are bold (dry capsule liter weight is 420-460 g). Seed weight percentage is more than 83! He was awarded first prize by Spices Board for getting highest yield of cardamom during 1995 and 2009- 2010.

Other benefits included lesser costs of cultivation as labour costs reduced owing to no weeding. The costs also reduced as minimum external inputs were applied. Also, with lesser use of chemicals, the natural enemies of pests, particularly the shoot borer, was very high. A survey conducted in August 2012 revealed that there was 47% parasitization in his plot as compared to 12% in ICRI farm and 2% in a farmers plot, where more insecticides are used. This also encouraged colonization of honey bees which helped in enhanced pollination.

Paulose is now a role model to many in ecofriendly cultivation of cardamom with low investment. Several farmers visit Paulose farm to learn the methods he has been following.

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Measuring panicle length in cardamom plant

Photo: Varadarasan

Making dry farming the second front of agriculture development

R Dwarakinath

Farming is no more a simple "way of life." It is now a key economic segment, under development. The first goal of development is poverty alleviation. But, this development has not found the right track. For, there is no development without change. There is no farming without a farmer. Changes in farming result only when farmer begins to change. And, farmer is not yet the focus of development.

There is a pervasive impression among the concerned that the pace of agricultural development in the country is rather slow. Poverty is still unacceptably high. Most of this poverty persists in the rural areas. This poverty cannot be alleviated, as some people think, just by transfer of income from other sectors. The reality is that in India, the farm sector is much larger than the nonfarm sector. A better route for alleviating rural poverty is not merely the rapid development of the non-farm economic segments like industry, trade and service, but also the rapid development of the farm sector. This ensures better farm incomes. India seems to have missed the steps here. A perusal of policy and programme making, that overlook the ground realities, confirms this view.

Then, are there some blind spots?

1. Assumption that Green Revolution (GR) suits the entire farm sector. Of course, GR did enhance food production in the country, which is a historic reality. But, one must not miss the point that it did not benefit the entire farm sector. The revolution did not reach the middle and lower level farmers, nor did it benefit the dry farming segment. Thus, there is now a big development gap. Attention to dry farming seems to be the present need. To tap the potential in dry farming, a different bunch of technologies is required. In fact, if focus on *assured farming* is the ***first front*** of agricultural development, improving *rainfed farming* is the ***second front.***

2. Belief that GR extension approach suits all segments of farmers. Those who are handling agriculture development without the basic knowledge of rural society easily assume that the adoption behavior of farmers is the same at different levels in the farming community. While the top level farmers are mostly innovators, the middle level farmers remain as conservatives and imitators and develop a mind-set of living "within the means" as their destiny, having low levels of aspiration. Hence, working with these two levels of farmers requires different extension education approaches. To reach the middle level farmers, not known to be keen "information seekers", a different kind of extension approach is necessary.

3. Means of reaching farmers with external knowledge sources is not setup. With the green revolution, external source of knowledge has become important. The absence of an **agriculture extension system** to relate external knowledge to the local needs, problems and opportunities, is felt more keenly now. Tapping the potential in dry farming is more difficult, while preparing middle-level farmers needs keen extension efforts. Also, the literate farm youth who form the bulk in the general education stream, do not get initiated into present-day farming. Also, there no District Agricultural Schools and Farmers Training Centers now.

4. Ignoring the role of mixed cropping in dry farming. Since dry farming is totally dependent on the rainfall, the traditional farming evolved with ages of experience, a mixed cropping system. **It included short and long duration crops, deep and shallow rooted crops as well as cereals and pulses.** These mix of crops was mainly designed to cope with an unpredictable rainfall, enrich soil fertility and provide a diverse, balanced and nutritious food for the family and fodder for the livestock. These ideas are rarely found in present day projects.

Is there a more rational approach to dry farming development?

Any development strategy is really a process of adopting solution to a problem. Thus, it is necessary that the problems in rainfed farming are properly defined along with goals and strategies. The public projects in this regard, generally, ignore

the ground conditions, seeking to push "technology demonstrations", unmindful of cost-effectiveness or manageability. Also, there is no in-built approach in public undertakings to look around and learn from people's own initiatives. Karnataka has some considerable experience with some NGOs (MYRADA and BAIF). In the last two decades, AME (Agriculture, Man, Ecology) Foundation, an Indian NGO emerging from an European venture, has established, in a NABARD supported Project, some **simple measures** to improve dry farming. Rainfed farming, (known to be a fragile eco system in contrast with irrigated farming), depends heavily on the environmental conditions. Hence, the dry farming development strategy leans more heavily on rebuilding the ecological conditions. The dry farming conditions are quite harsh in Karnataka. An approach found useful here can be an adjustable basis elsewhere.

Development of rainfed farming in Karnataka, as a case

In 2010, AMEF with NABARD's support, implemented a dry farming development project in Bangarpet taluk in Kolar district with an overall goal of augmenting productivity in lead crops. The specific Project Objectives are:

1. Organising Eco Farmer Groups (EFGs) as entry points to the village community
2. Organising quality seed production of the selected crops, locally
3. Promoting Low External Input Sustainable Agriculture (LEISA) reducing costs.
4. Selecting and training literate farm youth as Promoters of Eco Farming.

The project which was implemented initially in five villages was later expanded to ten villages. **Since yield improvement was the keen desire of the participating farmers,** it became the central goal.

Kolar is the eastern-most dry district in Karnataka, with a low rainfall pattern. Bangarpet is a well-known dry taluk of the district with an average annual rainfall is 701mm. The taluk experienced drought in the last two years of the Project. Even then, the eco farming system performed better than the conventional farming system. The details are given in Table 1.

Table 1: Performance of the LEAD CROPS in the Project period

2010-11 *Normal year* (Rain fall 1016/701mm)

	Villages	Farmers	ac	Local Yld q/ac	Project Yld q/ac	gain%
Ragi	10	208	221	8.5	12.5	48
Redgram	7	40	15	3.5	6.0	71
Groundnut	5	10	5	3.5	5.5	57
Rice-SRI	5	70	40	25.0	32.0	28

2011-12 *Drought year* (Rain fall 613/701mm)

	Villages	Farmers	ac	Local Yld q/ac	Project Yld q/ac	gain%
Ragi	10	387	485	6.30	9.50	50
Redgram	7	23	16	1.25	2.75	120
Groundnut	5	105	71	1.36	2.89	112.5
Rice-SRI	5	78	52	18.80	30.33	61

2012-13 *Drought year* (Rain fall 619/701mm)

	Villages	Farmers	ac	Local Yld q/ac	Project Yld q/ac	gain%
Ragi	10	606	505	6.5	8.5	30.7
Redgram	10	32	18	NA	NA	NA
Groundnut	10	302	128	1.25	2.5	50
Rice-SRI	10	30	20	NA	32.5	NA

What was the strategy adopted for these gains?

Professionals working with farmers will quickly perceive two basic conditions, here. One, the farmers here are considered "localites," being conservative, inward-looking farmers. They generally are not very familiar with the larger world beyond. They like to live within their means. With their low aspirations, to get them to adopt modern practices in farming is quite difficult, since they believe firmly in destiny. It is critically important to convince them about the value of the advocated practices. Also, since dry farming means working with a ***fragile eco system,*** where the returns are not assured, and large investments either in the form of land-shaping activities or purchased inputs are not easily acceptable, to begin with. In these circumstances, the development approach has to walk on two legs – **ONE,** simple ***alternative farming practices in relation to known limitations.*** This includes three on-farm and two off-farm measures. **TWO,** building the social capital in terms of institutionalized abilities ***to seek and adopt changes for development,*** including raising vegetation within the terrain for cooler atmosphere and creating surface water bodies.

Under these circumstances, AME in consultation with university scientists formulated a tentative approach to dry farming development, in the shallow, un-retentive soils in the project area. This approach was further discussed with the farmer groups in PRA meetings for their consideration and acceptance.

Limitation one: Moisture stress in the root zone of shallow rooted seasonal crops during the dry spells.

Measure 1 – Ploughing across the slope, starting with early rains, minimising runoff and maximizing infiltration.

Limitation two: Depleted soil productivity due to continuous cropping and erosion.

Measure 2 – Upgrading the soil quality with application of tank silt for one part of the farmland at a time.

Measure 3 – Adding, year after year, copious quantities of organic manure.

Measure 4 – Re-doing anti-erosion measures on a yearly regular basis.

Limitation Three : Monsoons being erratic, unable to predict the rainfall pattern

Measure 5 – Adopting a resilient mixed cropping system evolved over ages. It combines early-maturing with late maturing crops; shallow-rooted with deep-rooted crops; and legumes with cereals.

Limitation Four: Degraded environment in dry farming areas.

Measure 6 – Increasing the tree crops in the terrain, trees being nearly 60% water, helps in maintaining humidity in the air. Also, the bee and bird population helps in pollination and pest control. Further, creating within the terrain, small surface water bodies by impounding rain water in the depressions helps in maintaining humidity for a few weeks beyond the rainy season.

In adopting these six measures there is a definite rationale. Two factors count, here. One, as already stated, dry farming is a fragile eco system. Apart from poor soils, rainfall is also erratic, causing crops to suffer. Therefore, the development measures must be taken in relation to these facts. Otherwise, even the lower yields which the farmers were getting earlier will be lost. This nobody likes. Hence, too sophisticated technologies, that are expensive and risky, and also beyond the easy comprehension of farmers, are carefully avoided. Second, these are middle level farmers. In their social status, economic resources and management abilities, they are not equal to the GR farmers. If they lose one harvest, they may face starvation for two years. As such, the farmers prefer no-cost or low-cost and non-risky measures. Hence, the improvements suggested here are mostly low-cost ***alternative farming practices*** and just one step beyond what the farmers already know. This approach is deliberately formulated for working with resource-poor dryland farmers.

Lessons learnt from the Project

1. Rapid agricultural development is not only necessary but is also possible.
2. The farm sector is not one uniform production base. It has two distinct production segments, ***Irrigated and Assured farming area*** and the ***Rainfed dry farming area.***
3. Dryland farmers are not equal to the top-level innovative farmers. They require as middle level farmers a different package of practices and extension education approach.
4. Development of dry farming requires the formulation of ***separate vision and mission,*** different from that of GR era.
5. To start with, no high-sounding technologies are suitable. Farmers are shown a couple of ***Alternative farming practices*** to be tried in combination with their own farming practices in an exercise called ***Participatory Technology Development (PTD).*** From this experience they gain confidence in the new practice and share with others.
6. Having no regular Extension Agency, AME formed Eco farming Groups (EFGs) to start with and trained local educated farm youth as Sustainable Agriculture Promoters (SAPs) and used Lead Farmers (having above average comprehension and articulation), made use of them as village volunteers.
7. Opportunities need to be created throughout the project period for farmers to collectively discuss, evaluate and accept the suitable new practices in their regular farming system.
8. Focusing on development of dryland farming serves many purposes: supporting better livelihoods for the farming majority, better household access to nutritionally rich millets and pulses in the food basket, and an eco-friendly farming system.
9. A further noteworthy point is that the dryland farmers are mostly small and poor farmers, and it is seen that the public programmmes generally link up these farmers with some external corporate agencies for seed, fertilizers or farm machinery which may degenerate into an exploitative relationship, where farmers suffer. On the other hand, the approaches of NGOs have been generally to **empower the farmers** to upgrade their farming practices within their circumstances, which is sustainable.
10. Agricultural development is a practical solution to rural poverty in India.

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Participatory soil health restoration

Anirudhha Das and **Purnabha Dasgupta**

At a time when agricultural extension services are not reaching millions of farmers, and while the cutting edge technologies are not affordable, working on a participatory mechanism using local knowledge and resources is a must for the development of farmers' lives and livelihoods. A sustainable agriculture practice through regeneration of soil health is the need of the hour.

With the ideology of developing the rain-fed agriculture system of Deoghar district in Jharkhand, Pravah, a non-profit development organization has been working with the farmers in the region promoting sustainable agriculture practices. Supported by Welf Hunger Hilfe of Germany, Pravah implemented the SIFS programme, an initiative to promote sustainable agriculture practices through regenerating the soil health by promoting Integrated Organic Nutrient Management (IONM). The idea was to enhance microbial population in the soil, improve the availability of plant nutrients, and enhance the crop productivity.

The SIFS initiative

Initially, around 25 young farmers from 10 villages were intensively trained in low cost organic crop production using eco-friendly systems approach. They were further trained in the preparation of liquid organic manure, botanical pesticides, NADEP compost, vermi compost, mixed cropping, line sowing, scientific live fencing with agroforestry model, multi-tier horticulture, etc. These trained farmers, along with Pravah staff, co-facilitated organizing the farmers in each village into groups like the NABARD's farmers' club. Later, around 300 farmers got trained in integrated organic nutrient management, cultivation using sustainable agricultural practices, for almost an year.

Participatory processes were adopted. A large number of farmers, men and women participated, assessed the soil situation and explored opportunities for future growth with existing local resources and organic practices. Initially, farmers learnt to prepare 5 types of liquid organic manure in their backyards. They gradually increased the use of bio-digesters for preparing organic manure. As an entry point, farmers were supported to produce more organic manure by constructing low cost bio-digesters like Nadep compost pit, bio-gas chambers, vermicospost bed, Azolla bed, etc.

Changes on the field

Farmers made a lot of changes in their production practices. They started growing 3-4 crops – some as intercrops and some as border crops, replacing the monocultures of paddy. Moreover, cow dung and crop residues were recycled as organic manure, which met the demand of plant nutrients. Liquid manure was used as a growth promoter for plants in main farm and also in the homestead. For instance, use of *neem spray* as pest repellent helped reduce 75% use of chemicals in crop fields. Further, seed preservation technique helped farmers reduce dependency on external seed materials.

Use of neem spray as pest repellent helped reduce 75% use of chemicals in crop fields.

Setting up nutrition gardens

Around 300 farmers established organic vegetable gardens following the integrated process, e.g.- preparation of seed bed with organic manures like vermi compost and cow dung cake, broadcasting azolla and applying green manure before the commencement of cultivation in the main field, and basal dose application after 15 days after sowing with the combination of FYM and vermi compost. For vegetable cultivation with little available water, mulching method was introduced along with pitcher irrigation and multi-tier horticulture structures. Multi-tier horticulture was used mainly for two reasons. One, bamboos are plentiful in the region and two, it also uses the aerial space of the land and produces more vegetables from the same piece of land.

After the initial enthusiasm in cultivating organic, farmers were faced with water shortages during critical periods of cultivation. Vegetable growing was also highly dependent on rainfall and the failure of monsoons affected crop cultivation. Nevertheless, to sustain the initiatives, low cost water harvesting structures were constructed to ensure continuous availability of water for vegetable gardens.

Initial results and impacts

Farmers by adopting sustainable agricultural practices like mixed farming, use of organic manure, mulching etc., are reaping rich harvests from their small plots of land. Farmers are also happy that now their soils retain moisture much better.

By using the homestead areas for producing vegetables, farmers had continous supply of nutritious and safe vegetables all round the year. In a month, each family could harvest 25-30 kg Madua (Ragi); 7-9 kgs of ribbed gourd; 10-14 kgs of brinjal; 4-6 kgs of bitter gourd in their organic fields. Little surpluses were shared with the neighbours and also sold in the local markets. Around 40% of this was sold by which they received an additional income of Rs.1800-2000. With the growing access to vegetables on a daily basis, these families stopped buying vegetables from the market, particularly in the dry season, helping them save around Rs.2600 every month.

With increased use of organic manures and enhancing the crop diversity on the farm, these farmers started harvesting better yields, resulting in better food security, better incomes and nutrition as well. The farming area served the production of food, fodder, fruits and fuel. Seeing these farmers, many other farmers in the villages, started adopting IONM with systematic approach. Nandalal Singh has not only done input substitution and reduced his market dependency, but also generated profits from selling considerable amount of produce after meeting the necessities of his family. The practice of integrated organic farming has given his family food security and reduced his dependence on the market.

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Nandlal Singh, a 46-year-old marginal farmer from the Janjhi village was facing losses from farming since ten years. Until 2011, he used to grow traditional paddy and maize during Kharif and wheat in Rabi season.

With project intervention, Nandlal divided his 2.5 acres into two parts-homestead and main field. He prepared two compost pits, one vermi and another NADEP. Nandlal cultivated local paddy in 50 decimal lands and got 16 quintals which matched the yield of a conventional HYV Paddy. Moreover, he followed the mixed cropping technique and cultivated maize and redgram with cowpea as outer line live fencing. The additional yields from other crops were - 4 q maize, 5 q redgram and 1.75 q cowpea. He also kept a traditional cereal of the region named Madua (Ragi millet) in his 15 decimals of relatively low fertile land and harvested 1 quintal production. In Rabi 2012, he cultivated SWI wheat in 40 decimal lands and produced 3.5 quintal wheat.

In his 30 decimals of homestead land, he cultivated vegetables like- cabbage, cauliflower, spinach, coriander and beetroot. He realized the importance of using aerial space and established Multi-tier horticulture structure in his nutrition garden on one decimal of land. His vegetable production was 1.5 times better in the homestead due to interventions like mulching, multi-tier horticulture structures, pitcher irrigation, organic liquid manure application, botanical pesticide application.

Nandlal has been increasing the crop diversity on his main land and kitchen garden too, harvesting improved yields. This helped him to increase his annual income by 30%. He also realized that the soil was retaining more moisture than before. The vegetable intake by the family has improved considerably providing good nutritional support.

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"Healthy soils give family farmers autonomy, resilience and long-term productivity"

Interview: Janneke Bruil

"If you have a healthy, living soil, you have healthy plants and healthy people. These three things are closely linked." Irene Cardoso, professor of soil science is passionate about soils and family farmers. She advocates for greater support for family farmers to take care of their soils in her role as president of the Brazilian Agroecology Association. Living between Brazil and the Netherlands, she is also a member of ILEIA's board. "Sustainable agriculture, or agroecology, requires a soil that is alive. If we feed the soil, we can feed the world."

What links family farmers and soils?

This depends on the type of agriculture you are looking at. In industrial agriculture, the soil is regarded as little more than a substrate to which fertilizer and seeds are added. In this type of agriculture, which requires expensive inputs and creates an unhealthy environment, family farmers may lose everything.

However, in sustainable agriculture or agroecology, the soil is very important. Good soil quality gives farmers autonomy, resilience and long-term productivity. This is why healthy soil is important for family farmers. But family farmers are also important for soils, because building and maintaining healthy soils requires work – exactly what family farmers do. Many farmers all over the world tell me "the land has to function" and they know *they* have to make it function. As they work *with* nature all the time, they see the difference between living soil and degraded soil. They see that a plant growing in healthy soil does not need fertilizer. But very few of them use the word soil, and talk only about land.

Photo: Roberta Monteiro

Irene Cardoso

Why? 'Soil' is a more scientific word. The term 'land' implies a more integrated approach, referring to political and social debates around access, ownership and control. For example, farmers don't ask for soil reform, but for land reform.

Family farmers live *from* the soil, but they also live *on* the soil. Their children will inherit the soil with the quality they

> The President of Zambia once told me that with what they spent on fertilizer subsidies, they could have built a school in every village.

leave it. The soil is almost part of the family. And you can hear farmers all over the world saying that "the land is our mother". What is also important about family farmers, are the women. Women family farmers tend to have a stronger connection to the land, and a better awareness of the importance of food sovereignty and food security than men.

Can you give a good example of how farmers improved their soil?

In 1993, me and other people from the University of Viçosa worked with CTA, an NGO promoting agroecology in the Zona da Mata, in contacting the union of coffee farmers in the nearby town of Araponga. Using Participatory Rural Appraisal methods, we identified the main problems and needs. The farmers were clear that their biggest problem was poor soils: "The land is weak" they said. Technical staff already knew this, but the important thing was that farmers also recognised this explicitly. We set up a committee called 'Strong Land', and farmers came up with some very effective solutions to increase soil organic matter, including green manure, cutting and not uprooting weeds. The technical staff proposed agroforestry systems (planting trees in and around their fields). And it worked. The soil, once recovered, became alive again, and the practices are spreading. The success was helped by using participatory methods, discussing the problems and planning actions together with farmers. What also helped was working with their ideas. The only *new* practice we proposed was agroforestry, the rest they knew, or at least some of them remembered it from the past.

What makes this story so relevant?

Extension services and universities usually tell farmers to follow new, 'modern' techniques. What we see in our region though, is that farmers who want to follow another path can do so if they have the opportunity. We noticed that participation is important: the most experienced farmers sharing their knowledge with others and taking decisions together. This was significant in the historical context. The farmers wanted to use better farming practices to repair their 'poisoned' land after decades of applying excessive amounts of fertilizer and pesticides. Such practices were part of the Green Revolution technologies that started in Brazil during the 1964-84 dictatorship. The government supported these technologies with new policies, changing agricultural university curricula and reorganising extension services. As a consequence, university research and research-based extension promoted the use of pesticides, fertilizers, mechanisation, irrigation, and hybrid seeds that later developed into GMOs. All these supported monoculture production, further encouraged by the banks who offered farmers low-interest credit for investing in these technologies.

> "The farmers were clear about their biggest problem: The land is weak, they said."

How did the Brazilian agroecology movement start?

With the Green Revolution, production increased in some places, but not in others. And the rate of increase declined too, as the soil became degraded. Our agronomists said: if you switch from food crops to producing monoculture coffee, you will earn more money to buy your food. But what happened is that farmers got into debt and went bankrupt. Production of only one crop makes farmers entirely dependent on international commodity markets. Those farmers who switched to coffee could not afford to buy food when the price went down, and they no longer produced their own food. Small-scale farmers could not pay their debts, and many abandoned their farms and moved to the cities. And there were other consequences: land became poisoned, soils died, food and water quality deteriorated. So these Green Revolution approaches went against food security *and* food sovereignty. Some farmers resisted this, however, and continued to farm the way they used to – at least on part of their land. This became a *cultural* resistance because it was about the way people live and about being respectful to the efforts and investments of their parents and grandparents. These few farmers kept the traditional knowledge about soil health alive, and this later fed a new way of thinking. With the re-democratisation of Brazil, we looked for better practices, and we turned to these farmers, with the unions, grass root organisations linked to churches and other groups, and we saw the start of the agroecology movement in Brazil.

Does Brazil's national agroecology policy support soils sufficiently?

Our National Plan for Agroecology and Organic Production (PLANAPO), launched in 2012, supports family farmers and biodiversity. But the link with soils is only indirect, and this is a mistake in my view. We are now discussing the second PLANAPO, and it is good that this is happening in the International Year of Soils, as the role of soils in agroecology should be highlighted, with explicit reference to what measures are needed for good quality soil. In that way, PLANAPO can raise awareness and support better practices. For example, we do not want heavy machines that damage soil structure but lighter machines, and PLANAPO can support the development of such technology, as well as

> "They wanted to repair their 'poisoned' land after decades of applying fertilizer and pesticides."

launch a credit programme for soil conservation.

How does the global food system impact soils around the world?

There are many worldwide policies and practices that connect our soils, in good and bad ways. Our soils in Brazil are red and yellow because of the iron oxide they contain. As iron oxide locks up phosphorus, there is less of this available for plants. So we import thousands of tonnes of it, for example from Africa, and add it to our savannah soils to produce soya beans. The soya is then exported to Europe for livestock feed. But European soils do not contain high levels of iron oxide, so the excess phosphorus we originally imported from Africa is leached out and ends up polluting European soils and water. This is an example of how the nutrient cycle is not closed in the global food system, and this has severe impacts on soils worldwide. In another perverse example, Brazil imports 92% of the potassium used in its agriculture, including for coffee production. But coffee bean skins contain a lot of potassium which could be a great ecological fertilizer if returned to the soil. What was happening in recent years was that foreign companies were buying coffee skins to produce 'clean' energy in Europe. The argument was that Brazilian farmers were polluting the environment as the skins were put into piles and left to rot. This is true, but there would have been another solution: to process the coffee locally and leave the skins on the land, so that Brazilian coffee skins could fertilize Brazilian soils.

How can we change power imbalances between farmers and big business?

In the name of productivity, policy makers are protecting the sectors that produce the most. There are few possibilities to question this. This will change, but only with time. Private companies are not more important than citizens. We have to start a new cycle of development, based on deepened democracy and participation, which looks beyond elections every four years. It is a long process, but there is no other way. And we are already seeing some changes, in empowered farmers, in some companies being open to discussion, and in progressive individuals within certain companies.

"I call mycorrhiza the Facebook of the soil."

Photo: Daniel Mancio

Farmers came up with some very effective solutions to increase soil organic matter.

So what is your message for the IYS?

Everybody wants to see healthy soils, but few want to talk about what degrades the soil in the first place. And we have to do so in order to change things. The real cause of the problem is the way we have been treating soil as a mere 'container' to add fertilizer, pesticides and GMO seeds. We must understand that the soil has to be kept alive, whereas pesticides kill soil life. When you think of it, soil life needs the same as a human being: a house (a good soil structure so that organisms can live there), a clean environment (no chemicals), water (but not too much), air and food. To get these conditions, farmers have to work with biodiversity, there is no other way. And a healthy soil has lots of life, each organism doing its own job. Some of them fix nitrogen, others decompose, some aerate, and so on. So we must take care of our networks, above ground and below ground. For example, I call mycorrhiza, which are soil fungi, the *Facebook of the soil*. They have the information about the soil and they are constantly engaged in exchanges with plant roots. We need to support these networks and use organic matter, no poison, and little or no tillage. Heavy tillage and heavy machinery destroy soil structure, destroy the house of the soil organisms. And even if chemical fertilizers are used, organic matter is needed. But with good soil quality and enough organic matter, you can decrease or stop using chemical fertilizers. If we feed the soil, we can feed the world."

Creating a healthy living soil to feed millions with safe food

Deepak Suchde and **Om P. Rupela**

By using an innovative compost called Amrut Mitti, many farmers are bringing life back to their soils. By enriching their agricultural fields with soil organic matter without external chemical inputs, these farmers are producing highly diverse nutrient rich food by harnessing local and natural resources.

Soil is a huge storehouse of all the plant nutrients (at least 30) needed for balanced growth of a plant. But much of their concentration is in bound form and only a small fraction is in available or water soluble form that gets taken away by the plants. Human-edible parts are removed for consumption and we further give away other plant parts to animals as fodder or burn it after harvesting, if it is not edible. But if the same inedible plant residues are fed back to the soil, and the soil humus is built and maintained, the soil can rejuvenate itself to take care of her millions of micro organisms, macrofauna and other life forms ('Soil Life' or Jeev-Tatva). The added plant biomass is the food for the Jeev-Tatva which works day-in day-out and converts bound form of nutrients to plant available form. A mug (used widely in India for taking bath) of undisturbed healthy forest soil may contain 2000 crore bacteria, 20 crore protozoa, 1 lakh meter fungi, 1 lakh nematodes and 50 thousands arthropods (centipedes, milipedes, insects and spiders). It is believed that the humus in the form of moisture retained by the healthy soil, is the second big reservoir of natural water after the oceans. If quantity of this humus is reduced, the soil then needs all the external inputs, including water for plant growth and thus, the sustainability cycle of farming starts breaking down.

Natueco farming

Natueco farming is a method of holistic farming to meet the needs of farming and food today. Its goal is to maximize carbon or biomass and not necessarily maximize economic gain in the narrow sense. It is also about maximizing output with minimum input in energy terms.

The fundamental belief system in Natueco concept is that it is a science of life and life is all about energy. Natueco is not about farming and definitely not about farming for production and distribution. It is a lifestyle (See Box 1).

Amrut Mitti is the key ingredient of the Natueco farming. Also called as 'Nursery' Soil, 'Masala Mitti' or 'Living Soil', Amrut Mitti is a form of compost which forms the basis of the Natueco process of building fertile soil. While Nature

> Life in the form of microbes and plants are incubated in the soil, exactly as a child is incubated in a mother's womb. Unlike humans and animals, soil nourishes it's babies as long as they live.

Box 1: Natueco method

The Natueco Science was conceived by late Prof. Sripad A. Dabholkar and the word "Natueco" is born from a combination of two words: "Natural" and "Ecological"! Natueco method of farming is in fact a culture of farming based on observing, understanding and collaborating with Nature through critical scientific methods, to strengthen the produce and the ecology of a farm. It addresses typical issues in farming like how to work in synergy with Nature without burdening it, how to reduce dependency on external inputs to a farm, how to work scientifically and within the local resources available in the surroundings of a farm, how to farm without harming its ecology and, at the same time, gain the highest benefits from it. The features of Natueco culture distinguish it from other forms of "Organic Farming".

takes centuries to produce fertile soil, a farmer can create this soil in his own farm in the form of Amrut Mitti in less than five months (See Box2). It is the process of accelerating the creation of top soil in nature, through positive human involvement to reduce nature's time cycles. Amrut Mitti has all the qualities of a typical fertile soil – presence of living organisms, adequate moisture and aeration.

The key characteristics of this 'Natueco Farming' technology of growing crops are (a) plants are grown on small 'heaps of Amrut Mitti' covered with mulch, hence no ploughing, (b) the heaps are always kept moist (watering with rose cans at the rate of 1000L water per day per 10 Gunta), (c) need-based sowing and harvesting of crops – overall it looks like

Box 2: Preparation of Amrut Mitti

Preparation of AMRUT JAL:Mix 10 litres of water, 1 litre of cow urine, 1 kg of fresh cow dung and 50 grams of jaggery. Keep this solution for 3 days. Stir this solution twice or thrice each day – stir 12 times each, clock wise and anti-clock wise, on each occasion. On the 4th day, the concentrated solution is ready. Mix one part of this concentrated solution with ten parts of water.

↓

Preparation of Amrut Mitti: Collection of green and dry plant biomass. Both are dried till it reaches a stage of being easily crushed and the waxy coating on veins of the leaves is broken. Immerse the dried biomass as much as possible in AMRUTJAL in a container like structure. It is kept for 24 hours in this condition.

↓

Preparation of Beds. (Dimension – 10ft in length, 3ft in breadth, 1ft in height)

Form first layer of the soaked biomass by spreading it on the selected area. Sprinkle a thin layer of topsoil over it. Repeat the above procedure by alternating the layers, pressing them downwards tightly by gently walking or dancing over the heap until a height of One (1) ft. is reached. After the heap is ready, keep it mulched with plant biomass and allow it to compost.

↓

First composting for thirty days.

On every seventh day mix the heap. Ensure mulching after every mixing. Sprinkle with Amrut Jal from time to time to maintain the moisture and the microbial activity. After about thirty days which depends on leaf type and weather conditions, it gets composted.

↓

Assemble different varieties of seeds on the basis of different tastes that the plants offer such as sweet saunf, carrot, sour – tamarind, tomato, ambadi, pungent – chilli, astringent – gowar, salty – spinach, rajgara, bitter- karela, methi, etc. (Note: Soak the collected seeds of different plant species in Amrut Jal for 8 hours before sowing. Mulch with plant biomass. Sprinkle Amrut jal occasionally for maintaining the moisture in the heap and enhancing the microbial activity. Continue for 21 days after sprouting of the seeds).

↓

First pruning after 21 days upto 25% of the seedling to ensure collection of tender shoots.

↓

Second pruning on the 42nd day; Prune the saplings upto 25% to ensure collection of matured plants.

↓

Third pruning on the 63rd day at the flowering stage. Prune the entire plant leaving approx. half inch (1/2") of the stem above ground without disturbing the roots. Keep the cuttings for drying for 3-4 days. After fully dried crush/break/twist for better absorption and immerse it in Amrut Jal for 8 hours. Mix into the heap. Keep the heap mulched with plant biomass and allow to compost.

↓

Second composting. The heap resulting from Greening has to be kept for 30 days for composting. Every seventh day till (mix) the heap. Ensure mulching after mixing. Sprinkle with Amrut Jal from time to time to maintain the moisture of the heap and microbial activity. After 30 days, nutrient rich living soil, Amrut Mitti is finally ready. Keep the Amrut mitti mulched with plant biomass.

↓

Add magic touch. [Your Magic Touch (Positive Attitude & Gratitude) =Positive Energy in Amrut Mitti].

AMRUT MITTI is now ready for use

a 'constructed forest', (d) does not need any external input in terms of the agro-chemicals like fertilisers, insecticides, pesticides etc.(e) weeds are allowed to grow until flowering and are seen as a resource, (f) high diversity on a small piece of land- over 125 crop species with a mix of annuals and perennials on 10 Gunta, (g) trenches around the farm for rain water harvesting and (h) live fencing around each farm created for multiple purposes.

The trial and the spread

In 2005, the ten Guntha (one acre is 40 Guntha) experiment was carried out on two farms - Yusuf Meherally Centre (YMC) in Panvel district of Maharashtra, and in Krushi Teerth farm in village Bajwada, Dewas district in Madhya Pradesh from 2006 onwards. It was strongly believed that by using Natueco farming methods, 10 Guntha land is enough for not only feeding a family of four, but also providing other items of livelihood through selling the excess produce.

The high productivity of crops on these farms, though on a small piece of land inspired many farmers across the country to adopt Natueco methods. Natueco farming is being followed by many farmers with diverse backgrounds in various parts of India (See Box 3). Interested farmers learn the Natueco Method by participating in trainings and workshops, which are regularly conducted at Krushi Teerth in Bajwada, from time to time.

It may be noted that this method does not require any cultivation (no tractor, no bullock-drawn implements and therefore is most relevant to small-holder farmers. Also, application of Amrut Mitti is a once in life-time operation for a given field, provided good agricultural practices such as surface mulch, recycling of crop residues, multi-tier farming involving trees are followed. Productivity over time has been noted to improve and not reduce.

Box 3: Some notable examples of Natueco farming

Farmer/Farm	Crop yields
Arunachalam, Coimbatore, Tamilnadu	Rice (40 q/acre, without flooding the field!) Banana (45 kg/plant)
Deepak Suchde, Bajwada, MP	Wheat (30 q/acre), Tomato (120 tons/ acre) Potatoes (40 tons/ acre)
Dr. Katariya, Jamnagar, Gujarat	Ground nut (24 q/acre)
Suresh Desai, Bedkihal, Karnataka	Sugar cane (100 tons/ acre)
Bhaskarbhai Save, Umbergaon, Gujarat	Coconut (400 fruits/tree/yr on maturity)
Vasudev Kathe, Nasik, Maharashtra	Grape (16 tons /acre)
Jitubhai Kutmutiya, Malegaon, Maharashtra	Papaya (180kg/tree/ annum)

Some results, some impacts

Amrut Mitti contains number of micro and macro fauna. Its use for high productivity without agro-chemicals should be viewed as use of starter for making curd from milk. Its use along with surface mulch creates conducive environment for regeneration of 'soil life' indicated above. And together, functioning as a 'soil food web' results in a slow release system of all the different nutrients needed for plant growth. Amrut Mitti has been analysed in many laboratories and the results were surprising. For example, the tests done at ICRISAT (O.P. Rupela unpublished) revealed that the Organic Carbon (OC) in the soil below the planted heaps of this farm was 2.61%, at least 3 times more than the reference soil (from uncultivated neighbouring plot). For the presence of micronutrients in the available form, in Natueco soil the following was noticed: Boron 8 times, Sulphur 2.64 times, Iron 1.5 times and Zn 7.3 times more than the reference soil. In addition to these elements, Microbial biomass C, Microbial biomass N and Dehydrogenase were present in much more quantities indicating the presence of lot of microorganisms in the Natueco soil. ***Some samples of this compost had up to 100 million (10 crore) plant-growth promoting bacteria (siderophore producers) in every gram of the compost - highest ever measured in the ICRISAT lab, in any compost.*** The study also indicated that by using Amrut Mitti in heap method, bound form of nutrients were converted into soluble form plausibly due to the soil life.

Plants after 21 days of germination

With in-situ nutritional management and without tilling, wheat crop yielded 38 quintals an acre

The productivity of crops per unit area is also high where Amrut Mitti is being used. (See Box 3). High yields are generally noted from the very first year of operation, unlike in other forms of organic farming where people generally report yield reduction in year 1 and then increase after 3 years. It has been successfully shown for several years that productivity using Amrut Mitti is high.

The vegetables grown on Amrut Mitti have high nutritional value. When analysed, it was found that bottle gourd from a Natueco farm had 5 times more protein and 20% more calcium as compared to market sample, besides the presence of Magnesium and Iron. Surprisingly the analysis revealed the presence of Vitamin B12, which is normally manufactured by animals and microorganisms in soil and not by vegetables/ trees. Presence of this vitamin in bottle gourd is perhaps due to its absorption from a healthy soil. This is in stark contrast with the reducing nutrition levels in conventionally grown vegetables. According to a report, "The Healing Power of Minerals" by Paul Bergner, the amount of Iron present in spinach in 1914 was 64mg/100 gm which reduced drastically to 2.70mg/100gm in 1992.

Conclusion

To address the issues of food security, nutrition and poverty, there is a need to increase food production without causing harm to health of consumers and that of the environment. Designing agro-ecosystems mimicking the structure and functioning of natural ecosystems is necessary to have sustainable high yields. Amrut Mitti is one of the ways to achieve this goal while providing a dignified life to the farmer.

Amrut Mitti and Natueco farming have an untapped potential to elevate the present economic and social status of our farmers, particularly of the small-holder farmers. It also has an immense and untapped potential for the scientific community to study, assimilate and evaluate the agro-ecosystem based farming systems such as Natueco system. Policies that support farmers who shift from conventional farming to ecological farming will go a long way in food security of millions and improving the health of the nation.

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Revival of soil fertility in Vidarbha region

Priti Joshi

Vidarbha, the region known for farmer suicides, fortunately has few farmers who have been successful in reviving their soil fertility through organic means. Subhash Sharma is one such farmer.

Photo: Author

Sharma in his green farm

Strangely, in spite of being the source of all life and all food, the soil remains a medium that is poorly understood. In Vidarbha region of Maharashtra, many farmers have experienced repeated failures in agriculture with loss of soil fertility due to excessive use of chemical fertilizers and pesticides. Vidarbha, the region known for farmer suicides, fortunately has few farmers who have been successful in reviving their soil fertility through organic means. Subhash Sharma is one such farmer.

Subhash Sharma, an organic farmer from Yavatmal district of Vidarbha started farming in 1975 using chemical methods. Though he got good yields initially, after 1986, the land productivity declined rapidly and he suffered great loss. In 1996, he started natural farming focusing on seeds, soil, water, cropping systems and labour management. He strongly believes that cows, trees, birds and vegetation are four important factors which make agriculture sustainable. Sharma has been using some techniques for improving soil fertility which have resulted in increasing the productivity.

Soil fertility improvement methods

Fortification of FYM: Sharma says that one cow can fulfill the demand of 3 acres of soil. Sharma prepares fortified manure by mixing 3 tons of FYM manure with 800 kgs of tank silt or fertile soil under the tree. The soil under the tree is preferred as it is very rich in micro flora and nutrients due to decomposition of leaf litter and bird droppings. To this mixture, a mixture of 100 kgs of pigeonpea, straw (waste generated in pulse processing factory), and two liters of groundnut oil are added and mixed thoroughly. To this, a solution made with 25 kgs of jaggery is mixed. This mixture is well soaked in water and piled into a heap for 2 months. The heap is turned upside down and again well soaked with water after a month. Fully mature compost is ready after one month. Handful of compost can be applied in the root zone of each plant as local application or can be sown through seed drill along with the seeds. It enriches the soil with organic matter, rich microflora, a mixture of pulse flour and jaggery provides protein and sugar to accelerate microbial activity.

> For a farmer, it is extremely essential to understand the basic science of soil formation.

His second fertilization technique is preparation of **Go- Sanjeevak,** which is a liquid manure. This can be spread in the soil in winter season along with the irrigation water. It is the mixture of 10 kg of fresh cow dung mixed with 10 litres of cow urine, 1 kg of pulse flour and 250 gms of jaggery. The mixture is fermented for 8-10 days along with 50 liters of water. The final solution is diluted to 200 litres water

before applying to land, along with irrigation water. This mixture is sufficient for one acre of land. The increased microbial activity of the soil helps in rejuvenating the soil while providing essential nutrients to plants in water soluble form. From a handful of soil in Sharma's farm, one can find hundreds of earthworms.

Green Manuring or Aurogreen: Sharma has sown pigeonpea as his first crop on the degraded land. Between the rows of pigeonpea, he had sown the mixture on Auro-green. The combination of seeds in aurogreen is as follows.

1. Dicot seeds like green gram/black gram (2kg), beans (2kg) pigeonpea (2kg) in equal proportion.
2. Monocot seeds like bajra (500gms),sorghum (500gms) and maize (3kg).
3. Oil seeds like til (sesame 100gms), soyabean or ground nut or sunflower (900 gms).

All these various types of seeds are mixed thoroughly and sown between the rows of pigeonpea in the rainy season. After 50-55 days of growth, this mixed biomass grown in the soil is cut and spread between the rows of pigeonpea as mulch. After one- two months as this green matter gets half decomposed, it is turned into the soil with the help of cultivator. It not only provides organic matter to soil, but also protects the land from weed growth and helps in retention of moisture in soil for a long time.

Sharma adopts **crop rotation** with legumes to enrich the soil fertility. He starts with a legume crop (like chavali-black-eyed bean) as his first crop for the season. The leafy biomass, which fall from the plants enriches soil organic matter and root nodules enriches the soil with nitrogen content. His cropping pattern on the same patch of land is as follows.

(1) Chavali- June to September (2) Fenugreek/Spinach/Green onion- October to November (3) Wheat- November to March (4) Pumpkin –April to June.

He cultivates pigeonpea crop every year in one or two acres of his land and says that this crop provides 1-2 inches of biomass cover to the soil through leaf fall, which adds to the organic matter of the soil. He considers coriander as a crop which maintains the ecological balance of his farm. The smell of fresh green leaves of coriander is a repellent to pests. Secondly, the white luxuriant flowers of coriander invite honey bees on his farm which facilitate cross pollination and help in the process of development of good seeds.

Besides soil fertility enhancing techniques, Sharma practices many other practices which make his agriculture sustainable. For example, he follows contour method of sowing for preventing soil erosion and retaining soil moisture; has dug trenches on the field to conserve water, grows crops like marigold and coriander to keep the pests away, has planted a number of trees around the farm which act as wind breaks and prevent soil erosion.

The turnover from his 13 acres of farm is approximately 18-20 lakhs, of which he realizes about 50 percent as profits (See Table 1).

Conclusion

In this era of globalised agriculture, where chemical farming is widespread, farmers like Subhash Sharma are an inspiration to many. Having understood the nature of the soil, such innovative farmers are showing to the world that practices based on agro-ecology is the only way to enhance the health of the soil and farm sustainably.

Table 1: Yield and income from various crops

Crop sown	Productivity per acre	Cost in Rs.	Approximate Total income In Rs.	Expenditure
Chavali beans	30 quintals	30/kg	90,000	25%
Green Onion	150 quintals	10/kg	1.5 lakh	40%
Fenugreek(Methi)	30 quintals	10-20/kg	60,000	30%
Spinach(Palak)	30 quintals	20-30/kg	75,000	25%
Coriander green	60 quintal	10/kg	60,000	30%
seeds	04 quintals	150/kg as seeds	60,000	10%
Wheat	14-15 quintals	40/kg	60,000	30%
Chick pea	10 quintals	3,500/quintal	35,000	10%
Pumpkin	10tons/acre	15/kg	1.5 lakh	20%

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Sheep Penning

Need to sustain this unique practice

B Sriveda and **B Srihitha**

Sheep penning is one of the traditional methods of enhancing soil fertility. Penning is a fascinating cooperative effort between pastoralists and farmers. Sheep penning which is almost a forgotten practice, is still being followed by some farmers in Telangana.

Jowli Osman Saheb is a 55-year-old native of Devanakonda village, Kurnool district in Andhra Pradesh. He owns 7 acres of agricultural land out of which 4 acres are irrigated and remaining are rainfed. His livestock includes a pair of bullocks, 3 buffaloes, 4 goats and 2 hens. Dairying is an important secondary livelihood for this family.

Osman prefers to have crop diversity on his farm. He says "*patti yegili, mirapa yegili and shanaga yegili valla aakurali bhoomiki balam vasthundi*" (mixed cropping systems of the region where groundnut, chillies and cotton crops are predominant, soil fertility is improved through leaf fall). *"Stubble incorporation along with roots adds fertility to soil"*, says Osman. According to him, when crop stubbles decompose well in the soil, the increased fertility is as good as the fertility provided by complex fertilizers.

Like other farmers, Osman has his own method of assessing soil fertility using a wide range of parameters including feel, colour and touch. For instance, a fertile soil when touched by hand gives a soft feel; in less fertile soils when ploughing is done, the clods break and become powder whereas, in fertile soils the clods do not disintegrate easily. Soil fertility is also reflected by the type of grass which grows. While grasses like *thunga, pedda gunaka, jonna aakula gaddi etc*., indicate fertile soil, the presence of grasses like *uppu gaddi, boo amma gaddi, banka gaddi* indicates that soils are less fertile.

Osman adopts a wide range of soil fertility management practices which are organic in nature. These diverse practices include more number of summer ploughings (*seduvu cheyuta*), Sheep penning (*gorlu aapadam)*, application of Farm Yard Manure (*pashuvula yeruvu*), fertility improvement through groundnut cultivation to facilitate leaf drop (*verushanaga yegili*), crop rotation (*panta marpidi*), ploughing back crop leftovers after harvesting (*magi dunnatam*), mixed cropping *(Mishrama pantalu),* green leaf manuring in the paddy fields (*Vari madilo aakulu thokkedi*). The farmer also uses small quantities of pig manure, mixes it with neem cake and makes into a shape of a ball and places it near "*Madu bhai*" (i.e., water entry point for each plot) so that it enriches the fertility and controls pest. Sheep penning is the most favoured practice and commonly practiced by Osman.

Sheep Penning

Penning is a fascinating cooperative effort between pastoralists and farmers. Sheep penning is usually done between November and June and can be adopted both in irrigated and dryland conditions. According to Osman, 25 percent of the cultivable area (400acres) in Devanakonda village is covered by penning every year.

The number of sheep in one flock will be ranging between 1000-4000. Bigger flocks have 4000 sheep and owned by 10-15 people. The penning time starts at six in the

evening. Before it gets dark sheep are brought to one place as the kids have to be left with their mothers. Penning can be adopted in all kinds of soils. Any crop can be grown after sheep penning.

In Devanakonda village, farmers mostly cultivate groundnut after penning. The groundnut crop of penned fields is of different colour as compared to the crop in unpenned field which looks white in colour. "*D.A.P yentha power undho, gorreleruvukooda antha birruna andisthundi*", says, Osman (The fertility given by penning to the soil is quick in nature and is equal to the fertility given by DAP to the soil). The yield of penned field is 25-30 bags/acre where as in unpenned field it is 15-20 bags/acre. Based on his experience, Osman says, "*If sheep manure and FYM is applied to groundnut crop, the weight of the pods will be more.*"

Osman highlights the role of sheep penning in improving soil structure and pest management by saying, "*Tuvva chenlo aapithe gorrelu thokki bhoomi biguvosthadi, varshamlo kooda aapithe veru purugu kottadi.*" (In the soft soils, if the trampling is done with sheep due to penning, the soil particles get bit closer giving grip per plant, and if penning is done in rains it kills the root grub). The root grub dies due to the power of sheep urine. In tuvva (soft) soils after penning, horse gram is grown which acts as a good fodder for animals. "We just sow the seeds of horse gram, and no weeding is done. But, we still get 5 quintals of grain," says Osman Saheb.

Penning agreement

There is a tradition of compensating the shepherds during the penning, either by cash, kind or both. The farmer in whose field penning is being done, would supply food materials, two times a day. Shepherds cook on their own. In the morning, they are given 20 kgs of foxtail-millet (Korra) and tamarind chutney. More quantities are given in the evening as they have to feed the dogs as well. During penning, dogs guard the sheep during night. These dogs watch over a radius of 1 km when the sheep graze in the fields. The dogs live along with the sheep from the beginning. The dogs are raised with a power to kill fox, wolf and rabbits.

If one owns large number of sheep, the owner needs to feed the care taker of the sheep for just one month. For the remaining 11 months, the farmers who invite sheep for penning will be feeding the care takers.

Sheep penning – merits and impacts

- The penned field will be fertile. Due to the manure of sheep, activity of 10 different type of organisms increase in the soil which makes it more porous.
- There will be less grass except for few acacia plants which can be easily pulled off.
- Sheep can identify the saline patches. It's urine reduces salinity in the soil.
- The hibiscus grown in farmyard manure applied fields and the sheep penned fields, when cooked even without using any oil, is tastier and unique as compared to the chemically grown hibiscus.
- The weight of the grains from the penned fields is more.
- The crop in the penned field looks different compared to unpenned fields.

The cost of penning varies between Rs 1,000-1,200 per acre. Besides the advantages of improved soil health, the sheep are also considered as a source of quick cash and can be sold when in need of money. Speaking about the significance of sheep rearing, Osman says "*padi yekarala bhoomi undedhokate, nalpai gorlundedhokate*" (40 sheep give equal benefit as that of 10 acres of land). Osman feels that it is high time that policy makers give due attention to safeguard such practices and also effectively propagate several indigenous soil fertility enhancement methods.

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Soil fertility is also reflected by the type of grass which grows. While grasses like thunga, pedda gunaka, jonna aakula gaddi etc., indicate fertile soil, the presence of grasses like uppu gaddi, boo amma gaddi, banka gaddi indicates that soils are less fertile.

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Restoring our soils by learning from history

Roland Bunch

Most of our ideas about soils ignore the millions of years since mankind started farming. What happened during the 99.9% of soil's history contains very important lessons. Let us celebrate the International Year of Soils by looking at what that history can tell us – and build on those lessons for the future.

In the tropical world, fallowing kept farmers' soils fertile for thousands of years by providing 70 to 95% of their soil organic matter. But today, since most smallholder farmers possess less than 2 hectares of land, in a large part because of population growth, fallowing is dying. As a result, the developing world is experiencing a severe soil organic matter crisis.

The soil organic matter crisis is critical because soils are being so rapidly damaged and depleted, becoming the primary limiting factor for the world's smallholder farmers. If a farmer adopts a new cassava variety, it may improve his or her cassava production, but it will do almost nothing for the farmer's maize, bean, vegetable or animal production. But if the farmer successfully improves her or his soil, it will have a major impact on everything else, too. 'Foundational technologies' such as soil restoration, can therefore provide the basis for the sustainable, long-term development of an entire farm.

Three myths

Looking at soil history will debunk three commonly held myths about soil restoration. The first myth is that productive soils will inevitably deteriorate over time. For instance, in all long-term experiments carried out in Africa, even those including chemical fertilizer, decreasing fertility was found. This loss of fertility correlated with decreasing soil organic matter levels and the resulting availability of nutrients. But humid tropical forests the world over, by maintaining the soil organic matter content, have maintained impressively high levels of biomass productivity for millions of years, with no fertilizers and often on very infertile soils.

> Soil restoration can provide the basis for the sustainable, long-term development of an entire farm.

Photo: Author

Soil fertility has become the primary limiting factor for the world's smallholder farmers.

The second common belief to go out the window is that soils need to be ploughed to stay friable and productive. Tropical forest soils were never ploughed, yet after millions of years they are far more friable and naturally productive than most agricultural soils. In fact, family farmers who convert forest land rarely plough it during the first year. Doing so would be 'like ploughing the sea', as Simón Bolívar once remarked. Rarely do we need to plough land unless we have previously degraded it.

The third myth is that good modern farmers must use monocrops. But tropical forests maintain biodiversity and thereby increase soil quality *and* productivity. And the oft-repeated claim that phosphorus will limit productivity because of the phosphorus lost in grain harvests is based on seriously faulty nutrient assessment studies. Furthermore, crops grown with a biodiverse mulch will feed directly from the mulch, just as tropical forests do. In this situation, most phosphorus in annual crops spends 1-8 months in the mulch before being taken up by the crop, and after less than a year, will once again return to the mulch. In contrast, only 10% of chemical phosphorus applied to soils is used the first year, about 5% the second year, and less each year thereafter. Therefore, with a biodiverse mulch, each atom of phosphorus can produce about 15 times more biomass than it can from fertilizer.

A movement that transformed agriculture

Interestingly, and not at all by chance, three of these lessons from history coincide with the three principles of the Conservation Agriculture movement that began in Brazil in the early 1980s. These are (1) plough the soil as little as possible, (2) keep the soil covered, and (3) maintain biodiversity. In 35 years, this movement has transformed the agriculture of 3 million farmers on 30 million

hectares in Brazil and Paraguay, and has spread to some 30 other nations. Farmers' yields have doubled or tripled, reaching up to 8 tonnes per hectare of maize. Between 1992 and 2012, the same 1 litre of diesel came to produce seven times more grain. Over a 22-year period, Conservation Agriculture has resulted in soils with higher levels of organic matter and available nitrogen, phosphorus, potassium, calcium and magnesium, and with lower acidity. In the meantime, the per-hectare use of nitrogenous chemical fertilizer has fallen. In long term experiments, Conservation Agriculture produced a 64% increase in organic carbon in the top 10 cm of the soil. Needless to say, the world desperately needs more such successes.

Conservation Agriculture's increasing yields also show that we do not need to resort to subsidised chemical fertilizer – subsidies that are tremendously expensive. The current President of Zambia told me that with what the government spent on fertilizer subsidies in the last few years, they could have built a school in every village across the country. Furthermore, cheap fertilizer reduces the incentives of farmers to produce the biomass that will improve their soil in the long-term. That is, all this wasted money not only cannot solve the basic, underlying problem of soil depletion, instead, it makes it worse.

Legumes as green manure/cover crops

Green manure/cover crops are crucial. It is often said that nature can only produce a few centimetres of topsoil in 100 years, but experience in country after country has shown that farmers using green manure/cover crops can produce a centimetre of topsoil every three to four years. In fact, when using edible legume species, the value of the grain often exceeds the costs of production, so the net cost of restoring soil fertility over decades is actually negative. Chemical fertilizer will never compete with that price! But fertilizer *can* supplement green manure/cover crops. When smallholder soils reach a productivity of about 3 tonnes per hectare, fertilizers can be profitably used. At this level of soil productivity, the fertilizer will produce a greater yield response with lower risks.

Experience around the world shows that it takes about 20 to 25 tonnes per hectare per year (green weight) of leguminous biomass to maintain soil fertility over time. Never in 40 years have I heard of a smallholder farmer using 20 tonnes of fresh compost or animal manure each year. Most smallholder farmers don't have enough animals to produce this amount of manure, and composting requires too much labour to be cost effective for most subsistence crops. But dozens of legumes can produce double or triple this amount of biomass. Runner beans (*Phaseolus coccineus*) and mucuna (*Mucuna spp.*) can easily produce 70 tonnes per hectare per year, lablab beans (*Dolichos lablab*) and jackbeans (*Canavalia ensiformis*) 50 to 60 tonnes per hectare per year, and pigeon peas (*Cajanus cajan*), densely planted, can produce about 30 tonnes.

> The President of Zambia once told me that with what they spent on fertilizer subsidies, they could have built a school in every village.

> Farmers using green manure/cover crops can often produce a centimetre of topsoil every 3 to 4 years.

Dispersed shade

Some farmers are adding trees as 'dispersed shade' to their Conservation Agriculture. The trees' light shade reduces the excessive midday heat that decreases crop productivity in the lowland tropics. Trees are also extremely drought resistant because of their deep root systems; the fertilizing leaves are out of reach of free-grazing animals; trees preserve moisture in the soil through lowered soil surface temperatures and reduced wind velocity; and they can provide firewood and fodder. Furthermore, as climate change occurs, farmers can merely cut fewer branches off their trees, so the crops underneath will continue to enjoy optimum ambient temperatures. Two important species are mother of cacao (*Gliricidia sepium*) and *Faidherbia albida*.

Interestingly, Conservation Agriculture with trees is ecologically about as close as one can get to producing food in a forest. In 35 years of intensive learning, we've travelled right back to where mankind started thousands of years ago.

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The three principles of Conservation Agriculture

Plough the soil as little as possible. This is also known as no-till, zero tillage or minimum tillage. This practice maintains soil structure, reduces damage to soil organisms, reduces soil losses to erosion, reduces loss of organic matter and nitrogen and saves labor and expenses. On the other hand, weed control will suffer without ploughing, and farmers using animal traction may need to start using new equipment.

Keep the soil covered. Mulching prevents erosion, provides a constant, well-balanced source of nutrients, protects the soil from the hot sun, greatly reduces soil moisture losses, and helps control weeds. The main problem in maintaining year-round soil cover is that crop residues are seldom sufficient.

Maintain biodiversity and use green manure/cover crops. In Conservation Agriculture, farmers use rotations and intercropping to maintain biodiversity. These practices reduce the risk of pests and diseases, support soil micro-organisms and use water and nutrients in the whole soil profile more effectively. An essential component of such a system are green manure/cover crops. These are defined as any plant, whether a tree, bush, vine or crawler, that fertilizes the soil or controls weeds. They include multi-purpose grain legumes and can often provide high-protein food for sale or consumption. Unlike traditional green manures, they are rarely cut down in the flowering stage and are rarely ploughed into the soil. They can thereby control the increased weed problem caused by lack of tillage and produce plenty of *in situ* biomass to keep the soil covered.

Nurturing natural ecosystems

Photo: Author

Sujata Goel

Western Ghats, a hotspot of biodiversity

Any system which provides for cycling of nutrients and energy within the system becomes sustainable and will continue to support life for future generations. While use of chemicals and pesticides have degraded lands and water bodies all over the world, it is essential for survival of human and other species to revert to holistic farming practices.

The Western Ghats in Southern India are one of the oldest hill ranges located about 30-50 km inland, and stretch from Gujarat to Kerala, spanning 6 states across a length of about 1600 km. These ranges harbor some of the richest tropical rain forests which are recognized as one of the world's few hot spots of biodiversity with high levels of endemism unique to this region. At least 325 globally threatened species occur in the Western Ghats. While wildlife has survived alongside humans for centuries here, continued development, population growth and intensification of chemical agriculture have increasingly put a huge pressure on the declining richness of biodiversity. The introduction of modern farming systems have drastically reduced genetic diversity within the crops while the heavy use of chemical fertilizers, pesticides and herbicides has destroyed the natural balance in the fields. These rain forest tracts are studded by large and small farms predominantly growing plantation crops like coffee, cocoa, cashew, rubber and spices. The quantity of toxic pesticides being pumped into some of the bigger farms and plantations is so huge that not only has it impacted the ecology and biodiversity of the Ghats, but has also made agriculture unsustainable. Since agriculture is a dominant human activity and occupies over 40 percent of available land space, the decisions that agriculturists make dramatically effect landscapes. It falls upon these farmers to adopt agricultural practices that are ecologically sustainable and nurture the soils instead of destroying the fragile ecosystem.

Mojo Spice Farm, a family farm

Our family farm, Mojo Spice Farm, is located at an altitude of 1100 meters in the Kodagu district of Karnataka. The land stretches across hills and valleys, fragmented by streams and underground springs, all of which contribute to a habitat rich in a variety of plants, insects, birds, mammals, fungi and microbes which together, contribute to a healthy agri-ecosystem. We cultivate crops which can be grown under the canopies of the rain forest trees, and are adapted to surviving the heavy rainfall which often exceeds 200 inches (5 meters) annually. Our crops are cardamom and black pepper which are indigenous to this region, and coffee and vanilla which have been introduced. We also grow spice trees like clove, cinnamon and nutmeg, fruits and vegetables in open areas. Multi-cropping is not only the first step to keeping pests and pathogens in check in the agri-ecosystem, but also enables a vital exchange of nutrients between the plants through enhancing rich diversity in the soil. The heavy rainfall results in severe runoff of the top soil and good composting practices can enable the land to recover its nutrient and humus balance. Our endeavor has been to adapt our agricultural practices to the natural balances in the forest ecosystem, and encourage conservation of the biodiversity in our fields.

Building soil fertility

Many traditional practices in India are based upon sound ecological principles and while they remain low input, their relevance cannot be undermined. Traditional farming focuses on enriching the soil. The tropical rain forest soils, though fragile, are extremely rich in microbial diversity and other forms of life. Whereas grubs of insects, earthworms and other similar soil inhabitants breakdown large particulate matter, the fungi and bacteria mineralize and provide nutrients to the plants.

Composting enhances soil microbial diversity and contributes to an active buildup of humus and organic matter. On our farm, composting all farm waste and weeds is an intrinsic part of agricultural practice. To make a compost heap, we mix hand cut weeds, dry leaves that have provided a bed for the cattle and goats overnight (and are drenched in animal urine, a rich source of nitrogen), cow dung, neem or Pongamia (Hongae) cake, and wood ash. Composting is enhanced by soil bacteria supplemented with EM (Effective Microorganisms). EM is a mixture of soil bacteria and yeasts that can be cultured (extended using molasses and its addition to the compost significantly speeds up breakdown of organic matter. We dilute the extended EM with water in a ratio of 1: 200, and use it to drench the compost mix. The heaps are turned after 2 days and then again after 5 days, and left covered to retain moisture and heat. Excellent quality, fragrant compost becomes available within 2 months. This is applied to the base of the crops, or used in pits (mixed with top soil) before planting new seedlings. Each batch of compost we make ranges from 3-5 tons, and we apply it around the base of the plants after sloughing the soil once or twice a year, before the onset of monsoon rains. Annual applications of compost to the plants ensures optimal yields.

> We cherish the termite colonies in our valleys as they are important in the carbon cycle, and release energy from organic matter, otherwise unavailable to other insects as well as plants.

Biochar-activated Compost: Since our farm is surrounded by forest, there is ample supply of wood fragments. We use this to make biochar which is produced by controlled, incomplete combustion of the woody biomass in an oxygen-limited environment. This process also allows for sequestration of carbon and if buried underground, reduces the concentration of greenhouse gases in the atmosphere. We pulverize the biochar to increase its surface area, and soak it in nutrient–rich solutions like panchgavya, EM, cow urine or liquid manures. This allows a high concentration of nutrients to adsorb to the biochar which is then mixed into the compost to enhance its efficacy before being applied to the field. On paddy farms, the husk of paddy can be charred in a similar way and added to the compost. About 5-10 percent biochar in compost is sufficient. Supplementing compost with biochar increases the ion-exchange capacity of the soil, improves soil porosity and texture, as well as enhances beneficial mycorrhizal populations, and results in a slow release of minerals and nutrients to the plants over time. Having observed the improvement in soil texture, we now try to add biochar to all the compost made on the farm.

Panchgavya is a traditional preparation made from 5 basic ingredients from the cow: cow dung, cow urine, ghee, curd and milk. Lab analysis of the preparations 15 days into the fermentation period has shown significant increase in concentrations of major and micronutrients, of available Nitrogen (>65%), Phosphorus (>45%), Potassium (>75%), Organic carbon (>22%), increase in plant growth-promoting hormones like gibberellins, and IAA (indole-acetic acid). Populations of beneficial bacteria like azotobacter, azospirillum, phosphobacteria, and pseudomonas increase rapidly during the fermentation. We use such preparations as liquid manures by drenching the root zone, or as a foliar spray to protect the plant against fungal or bacterial

infections. We have found that annually, 2-3 foliar applications of Panchgavya to the crops keeps them disease free and contributes to better yields. Panchgavya's regular use at dilutions of just 3% has shown significant increase in yields across a range of crops from spices, fruits and vegetables, to cereals and tubers.

Photo: Author

Panchgavya can be used as a liquid manure to enrich soil and for crop protection

Termites contribute to soil fertility

Although it is popularly assumed that termites are pests and voracious consumers of wood, most termites have positive effects on tropical forests as they contribute to soil fertility. Additionally, their nests provide shelters and food for numerous associated organisms. We cherish the termite colonies in our valleys as they are important in the carbon cycle, and release energy from organic matter otherwise unavailable to other insects as well as plants. We have several termite mounds scattered across our hill sides and we protect these by avoiding these areas for cultivation. Termite tunneling and foraging redistributes soil and increases the surface area available to bacteria and fungi, which in turn enzymatically breakdown the lignin and cellulose, making these nutrients available to plants. The fungi also liberate minerals like P, K, S, Fe, Mg and Zn. The ability of termites to influence the physical and chemical structure of the soil also impacts the vegetation and other components of the ecosystem. Termites also play an important role in the nitrogen cycling. Their guts are host to a range of nitrogen-fixing bacteria (*Citrobacter, Enterobacter, Treponema and Spirochaeta*).

Nurturing self sustaining ecosystems

The rain forest, if left undisturbed, is a self-sustaining ecosystem with cycles of life and death of numerous diverse organisms. With the various species of insects, grubs, worms, fungi and bacteria contributing to this detritus, the soils offer an excellent matrix for cultivation of crops adapted to growing under the shade of the rain forest trees. We supplement the soil nutrients which are used by the crops, or lost due to heavy monsoon rains, with compost prepared from organic matter on the farm. Most crops have surface feeder roots and these are mulched with dry leaves which fall from the rain forest trees. The trees tap into the lower reaches of the soil and through their leaf fall, bring the nutrients to the surface again, which in turn are used as substrate by saprophytic fungi and bacteria, releasing nutrients for the plants. Any system which provides for cycling of nutrients and energy within the system becomes sustainable and will continue to support life for future generations. While use of chemicals and pesticides have degraded lands and water bodies all over the world, it is essential for survival of human and other species to revert to holistic farming practices.

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Soil health

Key to improved yields

Purshottam Jangid, Monu K Rathore Ranveer, S Shaktawat and **V Khatana**

Farmers in Rajasthan are addressing the issues of yields and income by focusing on improving the soil health. By increasing the organic carbon content in the soils, these farmers, especially women, are able to grow nutrition gardens with high yield, resulting in better nutrition and better incomes for the family.

Soil health holds the key for the income and livelihoods security in the rural areas where the economy is predominantly agriculture based. There are various studies, which show that the soil health has deteriorated over time owing to faulty land use and soil management practices. Lack of organic matter reducs the water retention capacity of the soils, which also affects the crop productivity. Practices of applying farm yard manure, crop rotation, mixed cropping, inter-cropping, keeping land follow, and summer ploughing gradually stopped/reduced over time as increased attention was given to the use of chemical fertilizers and monocultures aided by government policies.

The initiative

Joint Initiative for Village Advancement (JIVA), a project implemented by PYXERA Global and funded by John Deere Foundation, has agriculture and income security as one its three main focus areas. The project is being implemented from January 2013 in three villages of Sakrawas panchayat in Ralmagra Block of Rajsamand district in Rajasthan, which lies in semi-arid tropical zone.

Vermi compost is prepared and applied to the gardens. In turn, waste leaves from the vegetable production are recycled back to produce vermi-compost.

Healthy harvest from manure rich kitchen garden

Realizing the importance of soil health in bringing sustainable improvement in the agricultural income of the rural households, efforts were made to improve the soil quality. Demo-plot based trainings were provided to farmers. Training revolved around three main crops in the area. A total of 18 demo farmers were selected during 2013 and 2014 and on an average 25 farmers attended each of the training.

Awareness was created on activities like summer ploughing and integrated soil nutrient management. Farmers were trained in collecting soil samples and have been helped in understanding the results of the soil tests. Awareness on the importance of use of manure was created.

After the training, farmers have started showing increased interest in activities like summer ploughing, soil testing, composting, vermi-composting, vegetable production and crop rotation. Farmers, including the women farmers have learned the process of collecting soil samples. They collected 132 samples in 2013 and 208 in 2014 and sent it for testing. Soil tests showed that the soils are rich in Potash and slightly deficient in Phosphorus. Most of the soil samples were low in organic carbon content. The average organic carbon content was 0.354 percent and none of the 132 soil samples taken in May 2013 had more than one percent organic carbon content.

Farmers were encouraged to convert the cattle dung and agricultural waste into compost and/or vermi-compost. All the demo farmers were supported by paying part of the cost of constructing Nadep and vermi-composting pits. Another 34 farmers installed vermi compost pits on their own.

Presently, 52 farmers in three villages have produced 100 kgs to 4550 kgs vermi-compost and more farmers are showing interest. Some of the farmers are using their existing places like abandoned manger for getting an experience of producing vermi-compost before increasing the scale of production. Women are taking lead role in making vermi-compost. However, some women farmers, were not comfortable in touching the earthworms with their hands and this became a constraint for scaling-up as even the interested farmers were not opting for it. JIVA introduced a simple tool which can be used to stir the compost without hurting the earthworms and farmers do not have to worry of touching the earthworms. This is also comparatively a more hygienic practice.

Women are also being trained on nutrition gardens. They grow vegetables for household consumption and sell surplus quantities, if any. Around 25 women have set up nutrition gardens with vegetables like cabbage, cauliflower, spinach, tomatoes, chili and brinjal. Some women have also grown carrot, radish and coriander leaves. Vermicompost is being applied to the gardens. In turn, waste leaves from the vegetable production are recycled to produce vermi-compost.

Results

Results of the 208 soil samples taken in May-June 2014 showed that the average organic content has increased to 0.457% from 0.354% in the previous years. The increase in carbon content could be partially attributed to the various measures taken to improve soil fertility, especially the application of vermicomposting. Also women who raised nutrition gardens using vermicompost harvested good yields. Around six women harvested more than 500 kilograms of vegetables.

One year of project experience shows that soil health is central to improve yields, which the farmers do recognize and scaling-up of such practices is faster if promoted in a participatory manner.

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Applying vermicompost to fields

State of India's Livelihoods Report 2014

ACCESS Development Services, *December 2014*, 124 p., Rs. 545.00, Paperback, ISBN: 9780199458271

The State of India's Livelihoods Report (SOIL Report) is an annual publication that documents recent trends and challenges faced in the sphere of livelihoods promotion of the poor. It is one of the few annual documents that aggregates the experiences and challenges of the livelihoods sector, analyses case studies, and reports on policy paradigm, new initiatives, and evidence on results of both government and privately run programmes.

The 2014 edition of the SOIL Report looks at the changes taking place in the sectors that are generating livelihood opportunities for the poor. Analysing the major patterns and shifts in policies and programmes that are impacting livelihoods of specific communities that suffer from social exclusion, marginalization, and multiple deprivations, it discusses important government policies centring around livelihoods promotion and protection and analyses the depth and width of two flagship poverty reduction programmes—the Mahatma Gandhi National Rural Employment Guarantee Programme and the National Rural Livelihoods Mission (Aajeevika). It attempts to give a glimpse of growth of collective action fuelled by the growth of Farmers' Producers Organization and global experiences including the 'theory of change' and recommends possible improvements for greater effectiveness. The report also captures the new developments in the realm of Corporate Social Responsibility consequent to the introduction of a new policy and its implications on livelihoods promotion. It looks at the role of livelihoods finance to bridge the difference between Bharat and India. Most importantly, the report captures the gradual shift in policy direction with a new government in power at the centre.

The Political Ecology of Climate Change Adaptation

Livelihoods, agrarian change and the conflicts of development

Marcus Taylor, *2015, Routledge, Routledge Explorations in Development Studies*, 206 p, $140.00, ISBN:978-0-415-70381-9

This book provides the first systematic critique of the concept of climate change adaptation within the field of international development. Drawing on a reworked political ecology framework, it argues that climate is not something 'out there' that we adapt to. Instead, it is part of the social and biophysical forces through which our lived environments are actively yet unevenly produced. From this original foundation, the book challenges us to rethink the concepts of climate change, vulnerability, resilience and adaptive capacity in transformed ways. With case studies drawn from Pakistan, India and Mongolia, it demonstrates concretely how climatic change emerges as a dynamic force in the ongoing transformation of contested rural landscapes. In crafting this synthesis, the book recalibrates the frameworks we use to envisage climatic change in the context of contemporary debates over development, livelihoods and poverty.With its unique theoretical contribution and case study material, this book will appeal to researchers and students in environmental studies, sociology, geography, politics and development studies.

Ecocultures

Blueprints for Sustainable Communities

Steffen Böhm**,** Zareen Pervez Bharucha**,** Jules Pretty (Eds), *2014, Spon Press, www.TaylorandFrancis.com*, $59.95, 296 p, ISBN: 978-0-415-81285-6

The world faces a 'perfect storm' of social and ecological stresses, including climate change, habitat loss, resource degradation and social, economic and cultural change. In order to cope with these, communities are struggling to transition to sustainable ways of living that improve well-being and increase resilience. This book demonstrates how communities in both developed and developing countries are already taking action to maintain or build resilient and sustainable lifestyles. These communities, here designated as 'Ecocultures', are exemplars of the art and science of sustainable living. Though they form a diverse group, they organise themselves around several common organising principles including an ethic of care for nature, a respect for community, high ecological knowledge, and a desire to maintain and improve personal and social wellbeing.

Dirt: The Erosion of Civilizations

David R. Montgomery, *May 2007*, 295 p, $42.00, £28.95,

ISBN: 9780520248700,

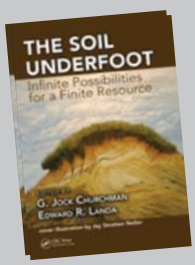
Dirt, soil, call it what you want – it's everywhere we go. It is the root of our existence, supporting our feet, our farms, our cities. This fascinating yet disquieting book finds, however, that we are running out of dirt, and it's no laughing matter. An engaging natural and cultural history of soil that sweeps from ancient civilizations to modern times, *Dirt: The Erosion of Civilizations* explores the compelling idea that we are—and have long been—using up Earth's soil. Once bare of protective vegetation and exposed to wind and rain, cultivated soils erode bit by bit, slowly enough to be ignored in a single lifetime but fast enough over centuries to limit the lifespan of civilizations. A rich mix of history, archaeology and geology, *Dirt* traces the role of soil use and abuse in the history of Mesopotamia, Ancient Greece, the Roman Empire, China, European colonialism, Central America, and the American push westward. We see how soil has shaped us and we have shaped soil-as society after society has risen, prospered, and plowed through a natural endowment of fertile dirt. David R. Montgomery sees in the recent rise of organic and no-till farming the hope for a new agricultural revolution that might help us avoid the fate of previous civilizations.

Bio-charculture: Biochar for Environment and Development

N. Sai Bhaskar Reddy, *2014, MetaMeta Paardskerkhofweg 14 5223 AJ 's-Hertogenbosch, The Netherlands* www.metameta.nl http://biocharindia.com

Biochar research inspired the development of a revolutionary technology that can have tremendous impact on agriculture, water, habitats, energy, health, sanitation, livelihoods, environment, and carbon sequestration. This book contributes to the understanding of biochar as a resource. Although the term "biochar" has only recently been adopted, it is a very well known concept. Biochar has long been part of some of the best practices in traditional agriculture in different parts of the world. People have used it for many purposes, including soil fertility management. Recently, biochar has attained greater importance as a result of discoveries about biochar use in the past and ongoing scientific research about its characteristics. This book highlights the diverse uses of biochar.

Biochar is a traditional, cultural, sustainable, and adaptable practice and is not just a product for soil amendment. The term biochar culture was coined by the author. The application of biochar to soil enhances its fertility and enables long-term carbon sequestration. And also offering an innovative opportunity to enhance the living conditions of rural families. Additionally, these effects counteract deforestation, protect biodiversity, increase crop production, improve agricultural waste management, and remove carbon from the atmosphere-functions that are crucial to a carbon-negative strategy to fight global warming.



The Soil Underfoot

Infinite Possibilities for a Finite Resource

G. Jock Churchman, Edward R. Landa (Eds), *2014, CRC Press*, 472 p., $99.95, ISBN: 978-1-46-657156-3.

The largest part of the world's food comes from its soils, either directly from plants, or via animals fed on pastures and crops. Thus, it is necessary to maintain, and if possible, improve the quality-and hence good health-of soils, while enabling them to support the growing world population. **The Soil Underfoot: Infinite Possibilities for a Finite Resource** arms readers with historical wisdom from various populations around the globe, along with current ideas and approaches for the wise management of soils. It covers the value of soils and their myriad uses viewed within human and societal contexts in the past, present, and supposed futures. In addition to addressing the technical means of maintaining soils, this book presents a culturally and geographically diverse collection of historical attitudes to soils, including philosophical and ethical frameworks, which have either sustained them or led to their degradation.

Rural Reality Show

An innovative approach to spread good practices

Shweta Prajapati and **Gazala Shaikh**

Spreading a good practice in agriculture on a wider scale has always been a challenge. However, people in Rajawar, a small village in Bundelkhand region in India, have showcased a process of collective change towards 'development' excellently by using community radio. The Rural Reality Show, an innovative show on the community radio became a means for spreading a practice for enriching soil fertility, from an individual to the whole community.

Bundelkhand is a semi-arid region located in central India, consisting of six districts of the Madhya Pradesh state and seven districts of the Uttar Pradesh state. This region has always witnessed low rainfall resulting in persistent drought over the years. Moreover, due to rugged and rocky terrain of Bundelkhand, even the short amount of rainfall received runs off the land surface. Thus, there has always been an acute water shortage and poor agricultural activities. In the recent past, changing climatic condition, with erratic and unpredictable rainfall, has further worsened the plight of farmers.

The continuous drought years in Bundelkhand have affected the agricultural productivity and subsequently weakened the livelihood systems. Climate change has resulted in a 58% decline in agriculture based livelihoods and food grain production in Bundelkhand. Once a dense forest, today, Bundelkhand suffers from acute ecological degradation.

To address the issues of climate change in Bundelkhand, Development Alternatives (DA), a social enterprise dedicated to sustainable development, designed an innovative approach called Rural Reality Show (RRS) for rural communities, based on adaptation approaches to decrease the impact of climate change on communities. RRS used community radio as the tool for engaging with local communities and communicating simple adaptation practices in an entertainment-education format.

Prakash Kushwaha demonstrating preparation of AmritMitti at Krishi Vigyan Kendra

The Reality Show

Kaun Banega Shubhkal Leader' is India's first Rural Reality Show broadcast on Radio Bundelkhand, a community radio based in Orchha. Radio Bundelkhand is jointly managed by DA and the community, where the programmes are produced with the participation of people. This show, helped in creating awareness on climate change and adaptation options in drought prone regions in Central India.

Expert and community interviews, talk shows, activity based reporting, folk songs, radio dramas and competitions were interwoven to make the programmes interesting and informative. The competition included capacity building of participants on using climate change adaptation options, elimination rounds to select good performers, hand-holding of selected individuals for ensuring sustainability. In RRS, climate champions from local villages were selected and trained in various adaptation practices. These champions were assessed and led through selection rounds based on the number of people they have been further able to influence and train on the particular adaptation practice in their village. This methodology helped in spreading the message to the larger community in a much more effective and faster way.

Out of 25 climate change adaptation options promoted in villages during Rural Reality Show, use of *Amrut Mitti* was one of the methods promoted to increase soil fertility and

Vermi compost is prepared and applied to the gardens. In turn, waste leaves from the vegetable production are recycled back to produce vermi-compost.

decrease the use of chemical fertilizers. *Amrut Mitti* is organic manure made from crop residues, animal waste and water with a small quantity of jaggery. This manure is very high in nutrients and is known to increase soil fertility and water retention capacity. Thus, it is one of the best practices suited for farming in a semi-arid region like Bundelkhand.

Prakash Kushwaha, a 25 year old farmer from Rajavar village in Tikamgarh district learnt about preparing and using *Amrut Mitti* during RRS. Ever since, he is not only using *AmrutMitti* on his farm, but has also spread this information to everyone in his village. Prakash understands environmental issues, and is also open to experimenting with new techniques and farming methods which are beneficial for farmers as well as the environment. Prakash's story has emerged as one of the most impactful climate change adaptation case studies and he is one of the final awardees of RRS.

Spreading the impact

After participating in RRS, Prakash has become very popular in his village and people respect him for his in-depth knowledge of environmental issues. People of all ages in the village seek his advice on farming related matters now.

"Prakashji is the one who has motivated me and my sisters to plant trees in our house." Babli, a 20 year old girl in the same village said. Adding to this, Babli's father says "Prakash is an inspiration, an information source, a consultant and also an evaluator for every farmer in Rajawar. He has become a change agent for everyone else in the village".

As one enters Prakash's village, Rajavar, lush green fields can be seen at the foot of a mountain with people working enthusiastically in their fields.

"Our land was not so fertile earlier and it was very difficult to grow any crop due to scanty rainfall and the rocky land. So, farming was not an easy job here," says Santosh Kushwaha, a villager engaged in farming since his childhood. Now, Santosh beams with joy when he shows off his fields and says that the productivity of the land has increased after using *Amrut Mitti* in his fields. Santosh and other farmers first experimented with *Amrut Mitti* in a small area of their fields for one cropping season. They observed that the area where *Amrut Mitti* was used, required much less quantity of water and the grains were also healthier.

Lush green crop fields in Rajawar village after using Amrit Mitti for two years

Today, approximately 90 percent of farmers in Rajawar use *Amrut Mitti* on their fields. Farmers are saying that use of *AmrutMitti* has decreased the amount of water required for irrigation and has enhanced the quality of crops produced. It also helped them to save the cost on chemical fertilizers which was earlier a large farming expense for farmers. Not only this, but now, farmers are able to grow water intensive crops like vegetables in their fields which were earlier not possible in this village.

People in Rajawar also understand the correlation between growth of trees and their own prosperity. From planting trees for a good rainfall, to crop-rotation practice and use of Amrut Mitti, various methods are being practiced by people to have a fruitful relationship with Mother Nature. The prosperity of this small village is reflected on the faces of its proud farmers.

Thus, Rajawar village has showcased a process of collective change towards 'development' excellently. Community radio, here, has not only proven to be successful in giving information to individuals, but has also led to a dialogue among community on climate change issues. It is an interesting model that this village represents, in which, the action for change sprouts from one individual and has reached out to other community people bringing a community level impact and RRS has played the key role in initiating this process.

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