

SUMMARY REPORT

India's Soils: Science-Policy-Practice Interfaces for Sustainable Futures

NATIONAL CONFERENCE

Organised by

DST Centre for Policy Research, IIT Delhi

Revitalising Rainfed Areas (RRA) Network,

Watershed Support Services and Activities Network (WASSAN)

Shiv Nadar University

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India's Soils:
Science-Policy-Practice
Interfaces for Sustainable Futures



SHIV NADAR UNIVERSITY



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Rajeswari Raina, *Shiv Nadar University*

Richa Kumar, *DST-CPR, IIT Delhi*

Summary of Recommendations

Framing the "Problem of Soils": Science and Policy Interfaces

Agricultural policies associated with the green revolution have played a dominant role in shaping scientific research on soils and in framing policies to support soil health. Much of this research has singularly focused on chemically enhancing the fertility of soil to promote yields of crops like rice and wheat. Policies such as public subsidies on nitrogen, phosphorus and potassium have encouraged farmers to shift to chemical input-intensive farming.

However, by excluding other parameters of the soil such as organic matter, carbon, soil structure and water retention capacity, that make soils a life-giving entity, this chemical-nutrient based approach has contributed significantly towards soil degradation. The very productive capacity of India's soils is at stake today.

Agricultural policies such as soil health cards for each farmer are an important step towards recognizing this problem. However, even if a farmer understands what chemicals are missing from the soil, there is little policy support to help him or her overcome the problem of soil degradation. Adding more chemical inputs to the soil, without addressing any of the other parameters, is futile.

Realizing that India's soils are battling a silent and losing war, the DST-Centre for Policy Research IIT Delhi, Revitalising Rainfed Areas Network (RRA), WASSAN and Shiv Nadar University came together to organize a conference on **"India's Soils: Science-Policy-Practice Interfaces for Sustainable Futures"** that was held at IIT Delhi from February 26-28, 2017. The conference was designed as a **"trialogue"** between scientists, policy makers and practitioners and brought together three powerful actors in soil health management in India. The conference deliberations came up with a coherent and shared understanding of the public policy problem and its relationship to the scientific research questions, and the practices of using, tending, and conserving soils.

The delegates concluded that the 3 M's—organic **Matter**, soil **Microbes** and soil **Moisture** retention capacity—are the three critical factors that need to be addressed in order to arrest and reverse soil degradation.

Several presentations during the conference showed successful examples of farms and farming agro-ecosystems (~40,000 farmers) where inclusion of the **3M's enhanced soil productivity, improved fertiliser - use efficiency, reduced costs significantly and resulted in higher net returns**. The food produced was healthy and nutritious and ecological services were provided, including carbon sequestration and reduced use of non-renewable energy sources. Many of these experiences have been validated by scientists from the SAUs and ICAR and endorsed by international agencies such as FAO.

Delegates argued for the need to **revitalize disciplines such as soil biology and soil physics**, which can bring their expertise in understanding the problem of soils from the 3M perspective and support its inclusion into the policy framework.

Framing the "Problem of Soils": Practice and Policy Interfaces

Encouraging farmers to add more organic matter by publicly subsidising the production and provision of farm yard manure, in addition to chemicals, has been a proposed policy response to the problem of soil degradation. However, this policy continues to approach the problem of soils as one that can be solved through the addition of standardised fertility-enhancing products—whether biology-based or chemistry-based.

The characteristics and causes of degraded soils in the Malwa plateau, the Cauvery delta, the Himalayan foothills, and the Gangetic flood plains are vastly different from each other. Soil degradation is also linked to local watershed management practices, choice of cropping patterns, nature of tillage, sources of pollution, and other location-specific factors. A single farmer would find it impossible to overcome these problems, which arise at the level of the ecosystem.

However, national level standardised systems of evaluating and understanding soils, through programs like the soil health card, find it beyond their scope to assess the problem of soils at the level of the agro-ecosystem. Much of our formal scientific research on soils has also side-stepped the issue of inter-linkages, instead, choosing to focus on narrow singular factors affecting soils.

Farmers, scientists, activists, NGOs and other civil society actors across India have brought to the table a wealth of evidence on the variety of factors affecting soils as well as on possible pathways of addressing them at a systemic level. As much of this knowledge has remained outside the formal scientific publishing process, it has been labelled as ad-hoc, invalid and even irrelevant. But this knowledge is critical to understand soil degradation. The lab can never be an adequate substitute for on-the-ground reality that is able to bring into the picture a host of other factors beyond the chemical composition of the soil.

Accepting that valid and relevant knowledge can arise from the world of practice requires reshaping the relationship between scientists and farmers, and treating farmers as partners in the knowledge production process, is essential to this shift.

The delegates called for a ***paradigm shift in knowledge production by building capacity at the local level*** (i.e. block level) to undertake research and develop a sound understanding of the problem of soils for that agro-ecological region.

Framework Principles for Policy-Action: Integrating Science and Practice

The delegates proposed the creation of a **National Program for Living Soils (3M's)**, the proposal called for an integrated, location-specific and decentralized approach towards soil health, which is region specific and makes use of local scientific knowledge as well as farmers' knowledge.

This implies a second paradigm shift—from a policy process that defines problems at the national level, and proposes products and knowledge to be provided to farmers from a centralised repository, to a policy process that enables decentralisation of the scientific knowledge building process. Within the

This will bring into the picture a host of other factors affecting soils, including choices of cropping patterns, water management practices, livestock practices, pollution, biomass availability, forest cover, and many more. By examining the inter-linkages of these factors and existing policies associated with these factors, solutions that are scientifically valid, politically plausible and practically feasible for that region can emerge from the same process. By designing policies at the block level for local uptake, these solutions can be propagated in the agro-ecological region (and possibly in other regions, if found relevant).

Changing the knowledge-practice relationships in soils (acknowledging that practice is a vital and valid source of knowledge) will enable a ***change in the knowledge-policy relationships in soils*** (accepting that knowledge can be brought into policymaking from formal science but also from informal practice). ***This necessitates a re-arrangement of the policy-practice relationship in soils*** also—from a national level centralised policymaking process that delegates implementation to the local level, to one that enables local level designing and implementation of policies for soils according to local understanding of needs and priorities.

Public Investments and Action

The delegates called for ***soil health to be understood as a public good***. Individual efforts are simply not enough to protect the soil because what each individual plot of soil contains or behaves like depends not on that particular location or the individual farmer handling that plot alone, but on what everyone in the region is doing. This means that nobody individually has any incentive to look after the soil. ***The state has a crucial role to play in this process in protecting our soils through public action and investment at the agro-ecological level along with supporting farmers at the farm level***. Current policies provide support only for fertilisers and biofertilisers; with a shift in state support and directed public investment, the practices to improve the 3 M's at the farm level can be easily scaled up to reach millions of farmers, and have an immediate positive impact on soil health and productivity.

Brief Overview

India's soils are battling a silent and losing war. Realizing that we no longer have the luxury of time to address this pressing issue, the DST-Centre for Policy Research IIT Delhi, Revitalising Rainfed Areas Network (RRA), WASSAN and Shiv Nadar University came together to organize a conference on **"India's Soils: Science-Policy-Practice Interfaces for Sustainable Futures"** that was held at IIT Delhi from February 26-28, 2017. For more details, visit www.soilsconference2017.com

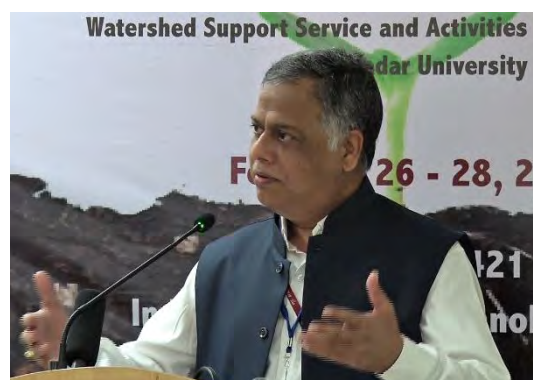
The conference was designed as a *"trialogue"* between scientists, policy makers and practitioners and brought together three powerful actors in soil health management in India: scientists with knowledge within the formal domain of the sciences; policy makers with experience of designing policies, programmes, and choosing between policy instruments; and practitioners with their deep understanding of location-specific, yet highly diverse practices, that may or may not be codified, but are knowledge intensive. The conference deliberations came up with a coherent and shared understanding of the public policy problem and its relationship to the scientific research questions, and the practices of using, tending, and conserving soils.

The idea of the 3 M's—organic **Matter**, soil **Microbes** and soil **Moisture** retention capacity—as the three critical factors that needed to be addressed in order to arrest

and reverse soil degradation, was put forward by the delegates, in a short presentation made before **Ms. I. Rani Kumudini, Joint Secretary (Integrated Nutrient Management), Ministry of Agriculture, Government of India**. Several presentations during the conference showed successful examples of farms and farming agro-ecosystems (~40,000 farmers) where inclusion of the ***3M's enhanced soil productivity, improved fertiliser-use efficiency, reduced costs significantly and resulted in higher net returns***. The food produced was healthy and nutritious and ecological services were provided, including carbon sequestration and reduced use of non-renewable energy sources. ***Many of these experiences have been validated by scientists from the SAUs and ICAR and endorsed by international agencies such as FAO.***

Proposing the creation of a **National Program for Living Soils (3M's)**, the delegates called for an integrated, location-specific and decentralized approach towards soil health, which is region specific and makes use of local scientific knowledge as well as farmers' knowledge. The program would initiate a 3-5 year pilot program in 10 blocks in each state covering different agro-ecological regions to find ways of scaling up the 3M's approach to soil health. Current policies provide support only for fertilisers and biofertilisers; with a shift in state support and directed public investment, the practices to improve the 3 M's at the farm level can be easily scaled up to reach millions of farmers, and have an immediate positive impact on soil health and productivity. ***Soil health is a public good*** and it must be addressed systemically at the agro-ecological level along with supporting farmers at the farm level.

The Joint Secretary asked the conference organisers to make a presentation of a detailed programme plan to the Ministry, and to engage in further discussions on the same. **Neeraj Sharma, Head of the Policy Research Cell of the Department of Science and Technology (DST)**, which was the major funder of the conference, expressed full support for the long term planning and policy engagement that would be required to meaningfully address the problem of India's soils.





Introductory Session

In the welcome address **Richa Kumar of the DST-Centre for Policy Research, IIT Delhi** outlined the idea behind the conference and hoped that the interdisciplinary nature of the conference and the exchange of ideas would help build networks and coalitions, and create the momentum needed to take action to save India's soils. She also acknowledged the generous financial support of the Department of Science and Technology-Centre for Policy Research IIT Delhi and the support provided by the Watershed Support Service and Activities Network (WASSAN), the Revitalising Rainfed Area (RRA) Network and Shiv Nadar University, both financially and otherwise. She further acknowledged the efforts of Dinesh Balam of WASSAN, who was with the RRA



Network in Odisha, in putting the conference together.

S. Natesh, DST - Centre for Policy Research, IIT Delhi, in his opening remarks, reiterated the urgency of such a platform that the conference is providing. The alarming level of depletion of soil

health and its direct, adverse effects on the efforts to fight world hunger and poverty,

have been acknowledged by the UN, which, in response to this, identified 2015 as the International Year of Soils. However, preservation of soil health has not received adequate attention from policy makers. He highlighted the need for it in India quoting relevant statistics. In his view, an interdisciplinary approach was integral to address this issue in a holistic manner, considering all dimensions.

Rajeswari Raina, Shiv Nadar University

put forward the overarching theme of the conference—how to understand the relationships between the science-policy-practice triad, including linkages and barriers among the three. This Conference has been designed to get scientists, policy



makers and practitioners to engage with each other and exchange ideas, problem statements and solutions. She explained how the current agricultural crisis was a reflection of poor soil health. Acknowledging and integrating the existing knowledge from scientists as well as practitioners is important. Practice, in her view, is the site where embodied knowledge is generated, experimented with and nourished. This knowledge needs to be brought forth to inform policymaking and further scientific research to strengthen the excellence and relevance of the sciences.



The keynote address was given by **Abhijit Sen, Professor (Retd.), Jawaharlal Nehru University, and Former Member, Planning Commission** who commented

that the need for such a conference has been longstanding. Through the green revolution, chemical and mechanical mining of the soil has taken place—especially the lowering of carbon content. India's agricultural growth was negative before independence and canal irrigation was the most important driver for agricultural growth post-independence. The government played an important role in it, and green revolution was a major factor in increased growth rate. The agricultural universities that emerged post green revolution started ignoring the voices from the field and got entangled in the system of supplying new varieties and inputs.

Being part of the policy making process for a considerable period of time, he stressed that there is no room for a blame game, and the aim is to find a way

forward, together. How to have enough food along with sustainability? In his words “policy is about stating and choosing priorities”. Citing recent statistics he said that agricultural growth rate has been 3+% over the last decade and population growth rate has slowed down considerably at 1.5%. Agriculture is supplying a lot more now. So we need not think about growth in itself but the composition of that growth.

In his message for policy he stated that, “*soil is a public good* and we need to rise above the individual level to protect it”. Nobody individually has any incentive to look after the soil. The only agency which can act is the state or some other collective. Individual efforts are simply not enough because what each individual plot of soil contains or behaves like depends not on that particular location or the individual farmer handling that plot alone, but on what everyone in the region is doing. This knowledge needs to be diffused and agencies need to take up this task—it cannot be left to individuals. There is a need to work on what ICAR does—the syllabus, the content of teaching in agricultural universities needs to change. There is some agreement on what is the right way of scientific thinking, and on the need to admit knowledge from other sources as valid knowledge.

He also acknowledged that the pricing system of fertilizer and subsidy scheme, introduced to improve soil nutrition actually ended up worsening the nutrient balance. It became a major reason for soil quality deterioration. Introduction of the soil health cards was meant to evoke a sense of individual responsibility. But this converts the soil problem into an individual problem from a public good problem. The approach that was adopted in public health was now adopted in soil health, and this was a big problem.

Agriculture being a state subject, how the state responds to a central scheme is important. Local knowledge and ideas of local organizations must be federated upwards. The central level is important for conceptualizing and framing the larger questions, and for funding. The state is important because agrarian composition is different across the country. And practice is important at the district / block level. Farmers need to be able to come to a place for advice—but that could be very different across 6000 blocks. Further, the Ministry of Rural Development was also an important actor at the local level, with the rural no longer being limited to agricultural alone. Although “soil” was a distant topic for MoRD, it was important to think about how to get them involved. For instance, in MGNREGA, soil conservation was an important component when it was conceptualised as an Act, but this did not

translate into activities on the ground. Ultimately he hoped for the development of a constructive policy agenda through the conference.



Session - 1: Soil Health Management and Soil Husbandry

Moderator: Rajeswari Raina, Shiv Nadar University

This session brought scholars and practitioners together on a platform and showed how knowledge created by different institutions can be significantly different, yet collectively bring about a shared understanding of the problem and possible solutions. An agricultural scientist, microbiologist, representatives of national and international NGOs, practicing farmers and a political scientist all shared their ideas and experiences with an audience that was also composed of representatives from major actors in soil health management.

Deepak Suchde, advocate of natural farming and a farmer advisor to the Government of Madhya Pradesh represented the practicing farming community. For him, farming is like worship of the soil, the product of which is to be considered as a *Prasad*, not to be sold, hinting at the market driven agricultural production system as being exploitative and destructive. The relationship



of the farmer with the soil can be a celebrated one, like a mother-child relationship, where a mother knows how to feed her child. At the same time he argued that farming is a precise science, its pillars being the Soil, Root, Canopy, Seeds and Moisture. He reiterated the fact the soil needs moisture and not water, the overuse of which destroyed the soils of Punjab and other areas that relied on big canals and groundwater. He shared his experience of a sustainable farming method with living soil, which he named as Natueco Farming, using an innovative compost called Amrut Mitti. He shared results of scientific tests that showed the output yield and nutrient content in the soil as well as the produce had improved significantly using this farming method. His experimentation with AmrutMitti was a testimony for how to harness nature's resources for sustainable production without over-exploiting the soil.



Regina Sharmila Dass, a microbiologist from Pondicherry University presented her experience to highlight the efficacy of biodynamic compost for soil restoration and crop health, citing the results of experimental plots for different states. Sustainable agriculture is an umbrella term for many different approaches with

common intention—attaining sustained production with least disturbance to nature. Biodynamic is one such system that follows laboratory based protocols to improve soil health. The approach was shown to have worked for marginal farmers too. According to her, sick soil produces a sick crop and toxic water, in turn, produces toxic food, which will affect human beings as “we are what we eat”. There was significant increase in organic matter content and microbial count after biodynamic compost application and the quantity and quality of coffee crop was improved in the study she presented. Her work clearly indicated that biodynamic farming has produced replicable results in various geographic regions, and at some scale, and can contribute to a comprehensive soil health management programme.

Ishteyaque Ahmed from Greenpeace was representing an international NGO, and he shared how a collective and



collaborative effort could rejuvenate an area of degraded soils in Kedia village (Jamui District, Bihar) using a Living Soils Model. A study undertaken to assess how farmers feel about soil health revealed that farmers were well aware that soil has life, and also aware that chemical fertilizers are causing soil degradation, and have reduced the number of soil organisms. When Greenpeace asked farmers why they were not shifting to ecological farming they responded that they did not have alternatives: enough biomass, ecological fertilizers, lack of knowledge and access to government schemes etc. They requested Greenpeace to show them an alternative model, which led to creating a holistic, comprehensive, replicable model.

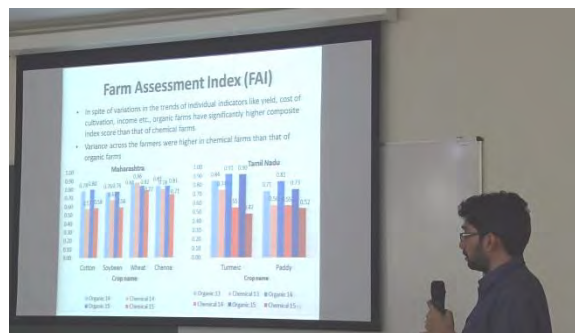
Key elements of the model included co-creating the knowledge involving farmers, agriculture extension personnel, agri-experts and civil society groups; creating the infrastructure to conserve and enhance the quality of biomass residue available in the village; convergence of different central and state government schemes and programmes to reap the maximum benefits for farmers; and enhancing and strengthening agro-ecological diversity. Now farmers of Kedia do not use chemical pesticides and have reduced chemical fertilizers use by 58% without any significant reduction in productivity. As a result, the earthworms, crabs, insects and birds and many other soil organisms have come back. The paper described the model and the process of the transformation from exploitative food production to ecological farming practices through integrating different stakeholders, with Greenpeace India playing the role of a facilitator, and closing the gap between farmers and government agencies. The key challenge they are facing is that there is no convergence of various government schemes at the local level, which demands attention from policy makers—a point this conference is trying to highlight.



A presentation by **PVRM Reddy, Acharya N. G. Ranga Agricultural University (ANGRAU), Tirupati**, on preparation of soil resource inventory using GIS, proposed its use as a technological approach for sustainable soil health management. It showed how ICTs can be

used to determine and map soil nutrient content, macro- and micro-nutrient variability, and this can be used for creating an agricultural action plan. The study revealed the potential and ability of geostatistical techniques in determining and mapping soil nutrient content and how these nutrient maps can be used for balanced fertilization and efficient fertilizer management.

OP Damani and Siva M, Centre for Technology Alternatives for Rural Areas (CTARA), IIT Mumbai, looked at the challenges in large scale soil sampling and testing, especially potential problems inherent in implementing and scaling up scientific soil testing mechanisms.



Strengthening of soil testing facilities, capacity building, and fertilizer recommendations based on the results, are among the major goals of Soil Health Management (SHM, an intervention of the National Mission for Sustainable Agriculture (NMSA)). Since the mission envisages issuance of a soil health card to each farmer, the reliability of soil testing becomes critical to the success of the mission. CTARA's experience of anomalous soil testing results raises concerns about use of large scale soil testing for prescriptive purposes. Soil samples collected from organic and chemical plots under cotton cultivation in Wardha region of Maharashtra showed significant differences among the soil samples collected from the same plot, for most of the parameters, especially phosphorus. Similarly the results from different labs for the same sample and same parameter varied significantly. The heterogeneity of soil properties within the sample plot and subjectivity of soil testing facilities and conditions may not give conclusive results and inferences. In CTARA's case, they took three samples each from an area less than 2 acres in size. The government soil testing program takes 1 sample from a 2.5 hectare area. The reliability of the soil card under such mass testing will vary significantly with physical (variability) and managerial issues in implementation. The study highlighted the need to validate the current approach towards soil cards to enhance their utility and reliability. There was a need to address the trust deficit in the minds of farmers arising from such discrepancies.

Sudhir Kumar Suthar, Centre for Political Studies, JNU added the political dimension in problematizing soil health and addressing it. Building on the keynote address of Abhijit Sen, he put forward the view that *soil is a global commons* and its protection requires *shared responsibility and interconnected interests*.



He asked, "are non-farmers not responsible for conserving soils?" We are shifting the responsibility entirely onto farmers, onto a group that is already burdened with the responsibility for food

production and enhancing productivity. According to him, this was a highly problematic framing. As consumers, it was our responsibility as well.

The Soil Health Card Scheme launched in Suratgarh, Rajasthan, on 19 February 2015 by Prime Minister Narendra Modi was a welcome initiative on part of the government to help farmers in making right assessments about soil fertility. But it reflected certain assumptions upon which the government policy on land in general, and soil in particular, were framed. Rather than protection of the soil, it operated from an emphasis on productivity, thus, demanding maximum extraction of a natural resource. Originally, the location of a village, a "gram" was built upon 3-4 different kinds of lands with 3-4 different kinds of soils, including grasslands (*charnoi*), water bodies etc. This was part of a village ecosystem, which was broken through land reforms by redistributing the *charnoi* to the landless. Other practices and policies at the village level were also the cause of significant soil degradation. However, the soil health card does not recognise the rural or the village as a category; it recognises only individual farmers as a category and pushes the burden of restoration onto them. There is no scope for a village level agency to work with the soils complex.

Quoting two farmers he highlighted how the approach of 'scientism' ignored the cultural-psychological attachments which shaped soil as a resource. There was a need to not only see what was deficient in the soil but also see the strengths of the soil. Moreover, the approach did not bring other actors within the ambit of the policy framework implying its exclusionary nature. Besides, since overall agrarian policy is not linked with the soil question, it has failed to achieve any change in the attitude of farmers with regard to using fertilizers or chemical supplements. The very selection of Suratgarh as the site raised questions of socio-economic inequality. This was the place where the Indira Gandhi canal was inaugurated and also the second stop for the cancer train from Punjab, hinting at the possible spillover effects of the green revolution. However, the fact that a village 10km away has no mobile connectivity, no schools etc. raised concerns about inequality.

Comments during the question-answer session lamented that there were no proper institutions creating compost and in many places fake compost was being sold. A need was also expressed for area-specific recommendations for cropping patterns and especially to highlight which crops were unsuitable. A strong case was made for returning biomass back to the soil and for institutional mechanisms to facilitate this.



Session - 2: Soil - Plant - Livestock Complex

Moderator: Sabyasachi Das, WASSAN

Sabyasachi Das from WASSAN, made an introductory remark regarding the maintenance of soil fertility and its constant dependence on livestock management. A holistic understanding of agriculture is only possible when we can understand the complex mutual interdependence between soil health, plant health and availability/accessibility to livestock. This also affects the livelihood concerns of farmers.

Tarak Kate from Dharam Mitra, Wardha, argued that a complex and diverse set of relations existed between soil health management and livestock planning. Keeping in mind the diversity of soil quality even in one plot of land used for cultivation, one needs to understand how 'healthy' soil (consisting of large quantities of biotic)



largely depends on 'sensible' manure. Farmers themselves do it using waste from existing livestock. An effort can be made for the scientific validation of different forms of liquid manures found from livestock. He highlighted the need for a shift from assessing the level of NPK in the soil to the availability of NPK for plants. He argued that effective scientific validation can only come through continuous participation of farmers and farmer's own knowledge about productive use of livestock waste vis-a-vis agro waste.

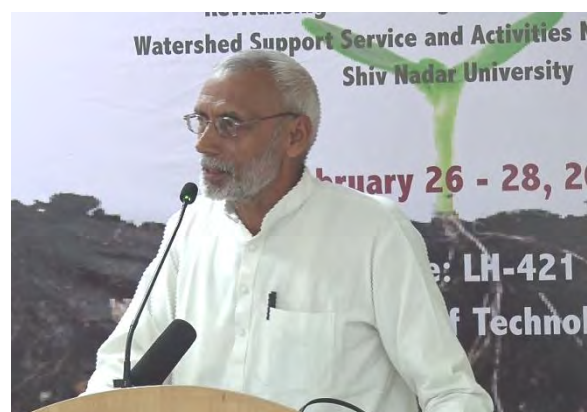


B. Suresh Reddy from the Centre for Economic and Social Studies, citing his empirical work in three different states of India-Uttar Pradesh, Madhya Pradesh and Jharkhand, pointed out possibilities for effective soil fertility management by farmers, even in the most dry, arid regions. This is mostly backed by their pragmatic

understanding of livestock management. This knowledge should also come in the syllabus of the agricultural university. Soil fertility has a direct effect on cattle health as well. State policies should address concerns around the distribution of livestock so that even marginal farmers can get access to livestock. They are being deprived by big-affluent farmers due to less land-holding capacity. He also suggested that the fertiliser subsidy should be such that farmers can choose to use whatever fertiliser they want. Policies should encourage crop rotation processes instead of mono-cropping. This will facilitate, both, soil health and fertility management, and also diverse fodders can be bought for livestock management. He also advocated for community based farming and labour intensive activities like sheep-penning, composting etc. This can ensure an intelligent way of using labour, so that labour shortage can be addressed.

Bharat Bhushan Tyagi, Natural Farming Practitioner from Bulandshahr, UP

pointed out three Ds underlying the practice of sustainable agriculture. These came from the book of farmers—from their own practical knowledge. Diversity [*vividhataa*]
—he pointed out that from nine relevant crops grown in the past, we



are down to two. When nature produces so many things, why do we grow only one,

he asked? Distance or spacing within a cubic system [*ghanakaar*] was the next variable one needs to understand—distance between crops, between different plots of land to be cultivated and their relationship to each other. One also needs to understand the existing dynamics at every layer of the soil. Duration or crop rotation [*aavartansheelta*] was the third—he pointed out that farmers already have knowledge of the suitable temperature and season of relevant crops, the overall time span/calendar, and about different intervals in between cultivating periods. They also have knowledge about long-run and short-run crops, to be cultivated at particular times of the year and in particular combinations. These three Ds formed the basis of a natural multilayer production system that gave output at each level, at multiple points of time, and had a positive impact on soil health. The system did not require composting or tilling / ploughing. It also used 60 per cent less water than normal, and gave a farmer an income of 4-6 lakh rupees an acre without any processing or marketing.

Like Deepak Suchde, the natural farming practitioner from MP, he talked of a shift in paradigm where instead of killing insects, we should make use of them. Killing insects is backed by the modern agricultural paradigm of looking at them only through lens of 'pest'. Instead of getting rid of them, one should understand the possibilities they hold in shaping soil and plant health. 'Let the earthworms do their work.' He also called for a renewed understanding of human labour [*shram*], where labour would need to be used wisely and towards a purpose. He was happy to share that his next generation was in farming and he concluded by saying that there is no need for a soil health card; it is our health which is bad. We need to change our mindset towards the soil.

During the discussion, speakers pointed out the bias of policy towards intensive farming, to the exclusion of other forms of farming, and its implications for soil degradation. One delegate pointed to the irony that in Bihar the left-over straw after harvesting is sold at Rs. 700/quintal while in Punjab, it is burnt. Tarak Kate responded that burning biomass is criminal. Others suggested that policies should stress upon 'indigenous/local' breed cultivation, which would have a long run effect on livestock management.



Session - 3: Gender Relationships and Soil Health Management

Moderator: Anshu Ogra, JNU

The common theme that emerged across the presentation was that though women perform almost two thirds of agricultural labour, most of the control lies with men. Production intensive policies aggravate this condition.

The presenters emphasized that a shift from traditional farming practices to modern methods of farming like chemicals, use of tractors, hybrid seeds, tube wells, pesticides, generally favours men. Women do not have access to landholdings, titles and as a result, to formal credit, markets and technology. This leads to the disengagement of women from farming practices. Even the extension systems are targeted at men. The role of women is pivotal in ensuring food security for the family. The burden of poverty and malnutrition hits them hard in the face of dwindling resources. Women-headed households are especially in a precarious situation.

Women's expertise pertaining to seed management and cultivation of certain crops,

livestock management etc. is often rendered futile as they are seldom a part of the policy design process. Lack of basic infrastructure and poor living conditions in villages leads to migration. One of the presenters said that a shift to a particular technology or practice requires acceptance by a community as a whole.

The participants pointed towards the need to improve the overall living conditions in rural areas. It was noted the addressing the malnutrition problem among women could help in increasing participation. Also, women-oriented training programs were suggested to provide women with agency.

P Srinivas, Head of the organisation

SOIL, emphasized upon the role of women's knowledge, wisdom and experience in ensuring food security. Women's knowledge pertaining to soil, water, and seed factors forms the basis of a Diversity Based Ecological Farming



System. Their practices are targeted at soil and water conservation and increasing soil flora and microbes to retain soil moisture. He also pointed out that the role of women as breeders has been acknowledged in history. He lamented that introduction of tractors, hybrid seeds, bore well, chemicals pesticides has led to the deterioration of soil quality and has been creating health problems, especially among women. The trend of shrinking crop diversity has led to diminishing nutritional value. Further, he said that the introduction of GM seeds has put the traditional seeds and the local genetic pool of crops in jeopardy and the farmers are completely dependent on private companies for all sorts of farm inputs. These factors have affected all the components of traditional farming ranging from traditional practices, local wisdom, beliefs, cultures, health, education as well as interdependence and overall sustainability. He argued against the Nutrition Based Subsidy Policy saying that it continues to promote chemical fertilisers, and also challenged the value of Direct Benefit Transfers, as women would be excluded from



getting access to those resources, since most lands were owned by men.

B. Selvamukilan from MSSRF, Chennai

pointed out the lack of access to training among women related to maintaining soil

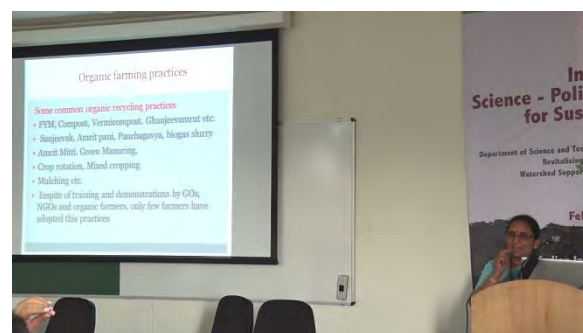
fertility, handling new practices and technologies, crops, varieties. He talked about the focused training programs conducted by MSSRF to fill this gap. The training programs were accompanied by coordination for scale up and engagement with farmers association and women's group federation. Specific programs on Enhancing Soil Organic Content and Crop Management by Women Farmers Groups were conducted emphasizing the use of beneficial microorganisms for improving soil fertility and crop management practices. Women were also trained in inputs production (organic and bio) using locally available bio-resources for ensuring supply of quality inputs. Women sold the organic Bio-inputs to 3500 men and women farmers to enhance soil fertility. He mentioned the 'Low cost soil organic carbon analyzing kit' promoted by Bhabha Atomic Research Center (BARC).

Women farmers were also trained in low cost household level vermi-compost production and this group marketed 100 tons of vermi-compost in a year. The women members run a rural organic input shop, which gives them an additional income of Rs. 3000-5000 per month through the sale. The trained women requested other farmers to allot 20% of their field for the demonstration of organic agriculture and showed the result. They also convinced the farmers by demonstrating the Non Pesticide Management (NPM) practices to improve income (i.e., farmers did not use the chemical pesticide and used bio-pesticide). Women marketed the organic vegetables in the local market with the label (Flex boards) to create awareness among the consumers.

Priti Joshi from the National Organisation for Community Welfare,

Wardha talked of the intensive 1-2 week long training program conducted by her team to promote organic kitchen gardens and the need for 'unlearning' to figure out what farmers want. Under AFVF mission

total 1,626 kitchen gardens in 170 villages and 7 districts have been developed through different NGOs. She emphasized the involvement of women in organic kitchen garden programs had positive outcomes like food security in rural families through an increase in frequency of consumption of fresh vegetables and self-replication of the kitchen garden format by women. This also led to a significant reduction in cases of anemia. Women adopted organic farming techniques for their agricultural crops also.



She went on to note that although much training has been conducted, the adoption is very low. As Abhijit Sen mentioned in his keynote address—what my soil looked like was affected by what others in the area were doing, similarly, Priti Joshi highlighted various community level factors that prevented the spread of organic farming. There were mis-apprehensions of loss of fertility due to withdrawal of fertilizers and myths related to sources of organic matter that discouraged the adoption of organic farming. Problems like labour crises, the lack of education facilities due to which farmers are migrating to urban areas for education, or for taking petty jobs in cities, further aggravated the situation. She also added that farming is being perceived as a non-lucrative activity involving risk and uncertainty. Uncertain, untimely rain, climate and an unchanged routine cropping pattern (in Maharashtra) lead to these perceptions. Further, there is a lack enough organic resources, especially seeds. Only HYV or GM seeds are available in market, which do not give good yield using organic techniques. There is very little guidance and non-availability of easy literature. Expensive certification procedures and absence of established markets for organic produce further complicate the scenario.

Apart from promoting an independent marketing system to establish direct producer-consumer linkages and an easy certification system, value addition and processing of agricultural products should be promoted. She suggested that bulk organic waste like flower waste, food waste and biomass waste produced in urban areas should be recycled through setting up micro-enterprises and compost should be brought to villages for organic farming. Organic farming practices based on soil fertility management should be included in the syllabus of schools, horticulture as well as nutrition rich tree plantations should be promoted, and seed banks developed in rural areas.



Sunita Sangar, National Mission for Empowerment of Women, Ministry of Women and Child Development

pointed out that research in agriculture has ignored the ecological, cultural, livelihood and socio-economic dimensions associated with soil health management, with gender relationships

being one of them. She said that in the modern agricultural framework, women are rarely seen as active agents in managing or regeneration of soil health in their own

ways and women farmers hardly get to contribute to debates /decisions on soil health. Incorporating the gender dimension is important to address long-term health of soils and its capacity to produce sustainability. Several studies have revealed that women farmers adopt agricultural practices of INM, IPM etc. successfully and that there is an active involvement of women in vermicomposting, bio pesticides/bio-fertilizer production, organic farming. Women do not have land titles, which obstruct their access to credit, technology, market, and other subsidies. This necessitates a policy, promoting R&D directed towards crops which women cultivate, based on a better understanding of women's farming systems. Addressing gender inequalities faced by women as workers and farmers shall be a critical part of any strategy for tackling food crisis, natural resource degradation or creating food secure world in a more sustainable manner.

During the discussion it was suggested that production intensive policies aggravate the existing patriarchal burden of women. Women possess the knowledge and do seed management, but since their husbands own the land, the program design does not involve women. Participation of women in policy design process would lead to different insights. Remarks were made highlighting the knowledge of women about livestock, fodder, weeds etc., which has been marginalised. Further, only 12 percent of women have operational land holdings, a major section of women have no titles, no access to credits, markets, technologies. As a result families with women heads are in a particularly precarious situation. Even the extension systems are designed around men. It was suggested that it is important to see women as innovators, rather than victims.

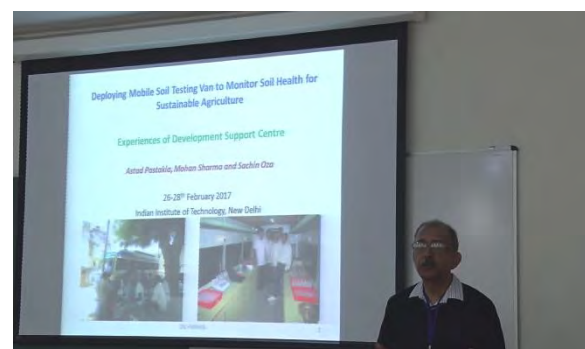


Session - 4: Land Use, Agroecosystems and Conservation of Biodiversity

Moderator: PS Vijay Shankar, Samaj Pragati Sahyog, Madhya Pradesh

This session brought multiple actors together who shared diverse, yet fundamentally unifying, perspectives on saving soils. The moderator urged the participants to have a discussion around the theme “soil is a public good”, which he hoped would be one of the big takeaways from this gathering. He also said that practice is knowledge and one should understand what farmers are doing in their own fields to maintain the soil health. It is important for institutes like ICAR to become a learning institute. The role of policy is to link these two.

Astad Pastakia and Sachin Oza of DSC Foundation, Gujarat began their presentation by describing their astonishment when a study by Sukhpal pointed out that less than 2% of farmers in North-Central Gujarat got their soils tested. This steered the introduction of



LEPNRM, an intervention designed to make agriculture viable for the marginal farmer by restoring soil health through conjunctive use of chemical and organic inputs. Soil testing at farmer's doorstep was a critical component of the strategy, which led to the introduction of a cost-effective and participatory soil testing mechanism. They elaborated on how deploying a mobile soil laboratory, in rainfed as well as irrigated areas of Gujarat and Madhya Pradesh, to monitor soil health for sustainable agriculture came into being, and how it was sustained. A van equipped with state-of-the-art apparatus for soil testing was deployed with a team that included local resource persons, chemist, agricultural expert and computer software for generating soil testing reports. Soil health analysis had three phases—pre-soil testing, soil testing and post-soil testing. Tying up with a farmer producer company, they had both forward and backward linkages and quarterly monitoring. Local youth were trained in soil testing and it was managed by a farmer's organization. A survey of 100 farmers in 2012 showed that farmers saved between Rs. 1500-2000 per hectare by curtailing the dose of fertilizer based on soil testing results. After the introduction of the programme there were significant positive impacts on soil nutrient content and reduction in ranges of pH and EC. They also discussed the socio-managerial and economic challenges faced by the programme.



Natural Farming Practitioner from Karnataka, Kailash Murthy,

presented how the transition from chemical farming to natural farming occurred on his farm, and the ways and means to achieve improved soil health and production without any external input. Though he started as a conventional farmer, within 4 years he shifted to natural farming. Now, he does not depend on modern agriculture and modern medicines. He described modern agriculture as agri-criminology as it involves killing other living beings. He gave a detailed narration on the process of converting his farm, his observations, and the benefits of natural farming. He also narrated how biodiversity was improved, ground water level was increased and how experts, students and foreigners started visiting his farm. He urged that the knowledge gained by farmers like him needs to be considered while formulating policies. Farmers have an uncodified repository of knowledge which can inform the policy process on how to manage the soil health at micro-level. According to him, his ecosystem (his farm) is better than the forest ecosystem. The story of Kailash Murthy was a classic case of how individual

aspirations could be translated into the creation of a sustainable production system which could be replicated with necessary adaptations in other agro-ecological areas. A significant portion of his knowledge through practice was codified through scientific collaborations with local agricultural institutes and even endorsed by experts at the Food and Agriculture Organisation.

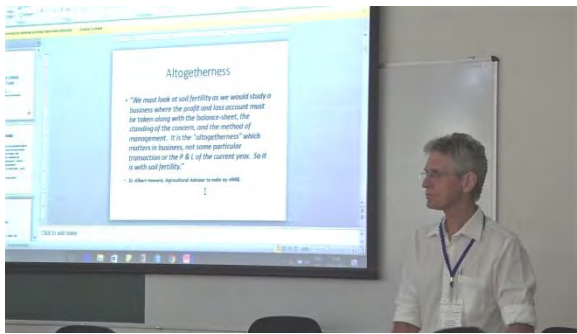
TS Channesh, Centre for Public Understanding of Science, Bangalore

urged the delegates to think about soils beyond chemistry. He explained how in a small span of time, modern inquiry into soil changed the perception of soil as a plant-driven sink into a fertilizer treadmill.



German chemist, Justus von Liebig, who is considered to be the father of chemical agriculture, had confessed that he had “sinned against the wisdom of Creator” when he realised that the N-P-K approach was a mistake, the yield from which could not be sustained. But this confession, explained Channesh, was ignored by modern soil scientists and policy makers. Among the pure sciences, physics, followed by chemistry, dominated over a long period of time, and biology got prominence only by the second half of the 20th century—this may have contributed to the lack of a biological approach in the soil sciences.

Regarding the soil health card scheme, he lamented that from the 1980s till date, over 12-14 crore soil test samples were analysed by the government. But the data was not saved and secured for further analysis, which was a huge opportunity lost. In most cases the soil test was done only because the report was mandatory to get a subsidy loan. He also highlighted the difference in academic and public views about the soil. For instance, many a times, land use decisions are revenue decisions when it is a fact that 33% of cultivated soils are degraded. The soil scientist’s role became limited to fertilizer recommendation and they were not consulted for policy making. For him, soil science must be recognized as responsible, accountable professional science amidst other practitioners of science and engineering for the proper management and use of our soil resources. Also, the learning processes in soil science need to be changed. In his view soil scientists need to be made more responsible and accountable for the soil health of the region.



The paper by **David Hogg, Naandi Foundation, Hyderabad**, called for the vision of a united agricultural field, which includes two communities—that of farmers and that of microbes acting together to build the soil. Quoting Sir Albert Howard, Agricultural Advisor to

India by HMG, he argued that it is the “altogetherness” that matters. For him, low carbon content in soils is only a symptom. A farm or a village is to be seen as an integrated whole, acknowledging and understanding its internal processes and time rhythms. The foundation worked with communities in divergent geographic and agro-climatic regions (Araku in Andhra Pradesh, Wardha in Maharashtra and Moga in Punjab). The village socioeconomic assets assessment was done and the impacts of the approach was also analysed using fertility indices and the classification of soil based on the same. For instance in Wardha in Maharashtra, 1000 acres of land belonging 750 farmer families in 80 villages were adopted and pomegranate orchards were biodynamically grown. In the vast treeless cereal landscape of Punjab, mechanized in situ biodynamic composting of crop residues was done to be put back into the soil to improve soil health as well as water retention capacity for water scarce Punjab; the residue would otherwise have burned, polluting both the village and neighbouring cities. He explained in detail how things can be translated from micro-level to macro-level by involving partners. Quoting the data from a study conducted in Australia, he showed that a four per cent increase of the organic carbon quadrupled the water retention capacity of the soil.

Gurpreet Singh and Bhaskar Mittra, Aga Khan Rural Support Programme, India,

gave a detailed account of how NGOs can facilitate soil conservation mainly through in situ techniques integrated with modern techniques, sustaining soil health with conservation agriculture. They presented in detail how communities were organized to take up soil and water conservation measures for practicing conservation agriculture and how it was implemented. When problems occurred in between, they could find the solutions from the local resources itself.



Amar KJR Nayak, XIM, Bhubaneswar



shared his experience of designing a one hectare waste land into a productive and diverse sustainable agricultural system, integrating the knowledge of experts and farmers in a more or less peri-urban locality, which in his view, would shed some light on how small and marginal farmers could be informed on how to make the transition to sustainable

farming. An attempt has been made to show how to reconstruct in a destroyed setting. Using photographs he shared how the site was transformed, how water storage capacity and organic content were improved. He gave an account of how agro-ecology has taken roots globally and graphically represented the complex interrelationships between the actors involved. As an expert in international business, he said there is a need for a holistic approach, and working together at multiple levels is essential to make communities work.



Session - 5: Managing Soil Pollution and Problem Soils

Moderator: A Ravindra, WASSAN

A Ravindra, from WASSAN, called for a critical approach to understand 'healthy' soil, in relation to problems like quality depletion of soil, soil erosion and most importantly, the effect of different kinds of wastes on soil.

Dileep Kumar from Pesticide Action

Network talked about the strong nexus between chemical fertilizers, pesticide companies, global agencies and the nation-state. This has jeopardised farmers' freedom of choosing fertilizers and pesticides of their own choice. They are

forced to use intensive chemical fertilizers on soil and pesticides on plants, and this creates a vicious circle of farmers' constant dependence on scientists. Most of the synthetic pesticides are toxic and capable of harming all forms of life including soil biodiversity, which is crucial to better soil health. Persistence of toxic chemicals in soil impacts microbial activity and natural nutrient recycling mechanisms, and creates a soil devoid of nutrients required for sustaining productivity and plant health.



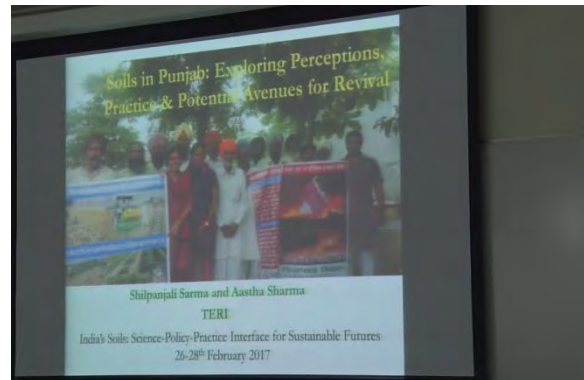
Paradoxically, the state is facilitating more subsidies for chemical fertilizer manufacturing companies rather than subsidies for organic matter used by farmers. Soil health degradation and crisis has to be dealt with holistically in relation with public health as well. Research over the past years has shown that due to persistence, and owing to acute and chronic toxicological capabilities, chemical pesticides have a profound impact on public health, causing communities to bear the burden of a multitude of chronic diseases and disorders making their life miserable. If soil is a global common good, so is the problem and crisis associated with it. The crisis has to be dealt with as a global concern, not simply as a 'scattered' and non-connected problem.



Gopal Krishna, from Toxics Watch Alliance, talks about larger impact of wastes on soil quality. Interestingly enough, much of technological inputs in waste management process have actually produced another set of non-recyclable wastes. Therefore, waste management as a process has to be addressed through its

inter-connectedness with soil, food production and consumption, and health too. Policies should cater to increasing proportion of organic matter in waste composition rather than heavy metal. He points out to the fact of inherent contradiction within policies catered to waste management by Indian state. On one hand, it does argue for more organic waste; on the other hand, the recent data shows there is only 28-30% of organic matter and 78.9% of heavy metal in waste composition. The larger goal has to do with waste minimization instead of waste maximization. In other words, policies should address in increasing the content of organic waste in overall waste composition. One should also address concerns around burning of waste, because it automatically generates another set of toxic waste. Usually, the burning does happen when those category wastes do not get decomposed naturally. The idea of recyclable waste can happen only through farmers' own knowledge about sustainable use of waste.

Shilpanjali Sarma and Aastha Sharma from TERI, through their empirical work in Punjab showed that sustainable soil health management is only possible through research encouraging an interdisciplinary approach towards sustainable agriculture. Current policies treated organic as an add-on—farmers were asked to apply NPK but also do Integrated Nutrient Management (INM) or Integrated Pest Management (IPM). Input substitution policies were being promoted rather than building capacity at the farm level to address the issue of soil degradation and low productivity, systemically and holistically. They urged policymakers to encourage more organic farming and provide a larger market for organic food. Issues around soil fertility have to be dealt with in relation to farmers' livelihood concerns. Soil health issues have to be addressed through constant negotiations between 'growers' and 'scientists'—where nutrient deficiencies in soil need to be corrected using farmers' practical knowledge, not simply, fertilizers made in laboratory and its imposition on farmers.



Anshu Ogra from the Centre for Studies in Science Policy, JNU, talked about knowledge dynamics around soil depletion and its effect on coffee growers in South India. Through her own empirical work in Western Ghats of South India, she tried to show different interfaces at which

practitioner's knowledge is juxtaposed with laboratory/scientists' knowledge. Concerns around soil were central to this. Cultivators were constantly expressing their anxieties around the effect of chemical fertilizers on soil but, at the same time, they also had to comply with their use to push for output maximization in modern agriculture. The anxieties occurred due to existing inabilities in scientific knowledge to address the soil problem, which cultivators constantly pointed out. Scientific knowledge, on the one hand, created a paradigm for profit maximization, but, on the other hand, it was unable to address the accompanying risk, further heightened due to climate change. The separation of the 'modern' from 'traditional' knowledge had only reproduced risky binaries leading to crisis and anxieties. It was possible, however, to deal with some of these crises by the recognition of traditional

knowledge and understanding cultivator's own practices around soil and plant health.

During the discussion it was pointed out that soil scientists are never consulted when land use management plans are made. Further, the problem of the persistence of pesticide residues in the soil needs to be addressed.



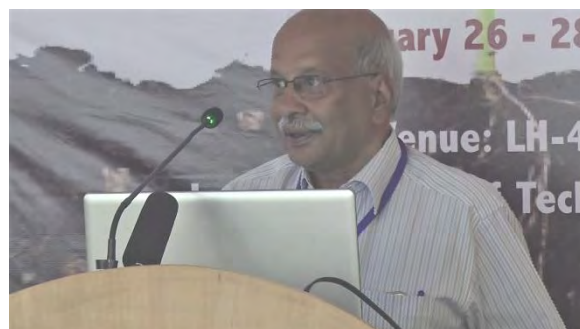
Session - 6: Soil Moisture Management and its Role in Managing Droughts

Moderator: Jagadananda, CYSD, Former State Information Commissioner, Odisha

The moderator, Former State Information Commissioner of Odisha, Jagadananda began by stating that we need to focus on moisture management rather than irrigation management. Apart from working out improved versions of traditional systems, he called for linking together our empirical findings with the intellectual discourse on water.

KS Gopal from the Centre for Environmental Concerns, Bangalore

began with a call for a paradigm shift in thinking about water: from providing surface irrigation to moisture absorbing capacity of the soil and suction by the roots. The science of drip irrigation focuses only on water provision and does not address moisture level. There has been no improvement in the drip system for the last twenty five years. In most cases,



farmers are irrigating to fill the soil with as much water as possible based on the drip theory of "field capacity followed by wilting point" of the plant, thus, killing all microorganisms, and even leading to root diseases. He provided an alternative innovative technology in areas of low rainfall and drought known as System of Water for Agriculture Rejuvenation (SWAR). SWAR works as slow-release moisture centric system to suit root suction needs and builds a rich ecosystem for microbe multiplication. The application of SWAR is for dry land horticulture and it is the only technology to ration water and save adult fruit bearing trees, and for small scale vegetable/flower cultivation.

SWAR is co-created by farmers based on defining "ideal irrigation architecture" to suit areas with low water availability and variations in groundwater, coupled with online research?. This irrigation system uses one third of water compared to drip systems and is sub-surface based with no weed growth. Through measured moisture based on root absorption, assisted by wide capillary spread of moisture and multiplication of soil organisms, it can ration water in times of scarcity, and it is automated i.e. independent of electricity using gravity flow etc.

For policy, Gopal recommends us to revisit the science behind the drip irrigation system, understand and deliver moisture requirement based on soil type and plant species, age and humidity that combines moisture and microbes to work in synergy for plant growth and soil health. He pointed out that while drip irrigation is dependent on government for subsidy, SWAR sells as an independent product on the market and has won two global innovation awards.



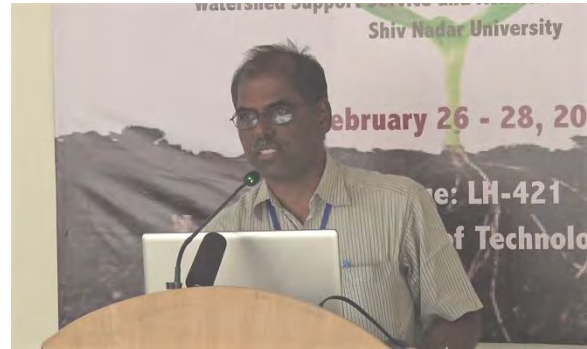
Mukesh Patil from ACWADAM, Pune

focused on a series of soil moisture maps offering information on crops and irrigation, and focusing on the vadose zone. He discussed the roles of and interconnections between rain-fed agriculture and groundwater, explaining

how they work hand in hand. He discussed the ways in which soil moisture conditions and protective irrigation demands vary regionally and the importance of conducting moisture management according to specific needs.

M. Palanisamy from DHAN Foundation

Madurai, focused on the importance of tank silt application in enhancing soil moisture holding capacity, and adapting to climate change. He brought out the need to not only give recommendations to small and marginal farmers but also to



practically support them. He discussed how the Kallupatti area has been facing problems due to lack of rainfall in June and July. Increase in temperature led to evaporation of soil moisture eventually leading to crop failure. The benefits of tank silt application include increased water storage capacity, increased groundwater, reduced global greenhouse effect etc. It would also encourage farmers to engage in inter-cropping. As a policy recommendation he suggested that the government must analyse silt to understand the amount of nutrients or hazardous materials in it.



Ravikant from WASSAN focused on the importance of water management and how drought may often happen irrespective of rainfall. He distinguished between different kinds of droughts such as meteorological and agricultural. He discussed issues such as drought

management alternatives, rain fed agriculture and land as an asset. He had a number of policy recommendations: integrating farmers with the market, diversifying crops, using biofertilisers, spreading awareness about tank silt, green manure, the role of biomass in rectifying soil, and the importance of MGNREGA, especially as a way of organising for rejuvenating water bodies like tanks etc. As a policy recommendation he suggests that the government should issue a separate plan for comprehensive development.



Session - 7: Public Understanding of Soils: Through the Media

Moderator: Rajeswari Raina, Shiv Nadar University

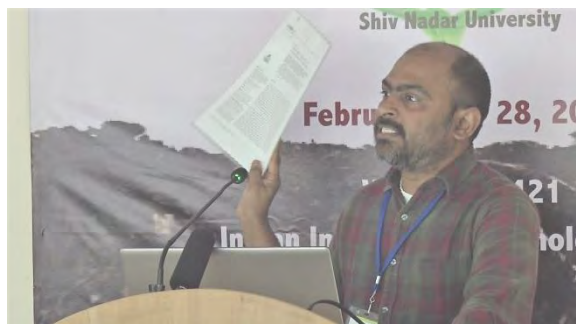
The session brought out themes pertaining to the popular discourse around soils in mainstream media. The panelists articulated views on how practices in soil health management, technologies, and different policy contexts are perceived by the mainstream media. The panelists took a divided stance on the issue of soil health management. Some advocated the relevance of productivity, technology adoption and monetary gains for the farmers and viewed farming as a source of livelihood.

However, there were others who insisted that writing off traditional, community knowledge would be a great folly. It was suggested that it is necessary for the stakeholders from scientific community to engage with the public through the media to ensure transparency and evoke trust in scientific research. It was pointed out that the communication practices of scientific and government institutions were designed to drive certain policies, leading to secrecy and denial, which increases the importance of investigative journalism. The need to develop platforms like websites and portals to communicate positive developments and dynamism at the grassroots was also highlighted.

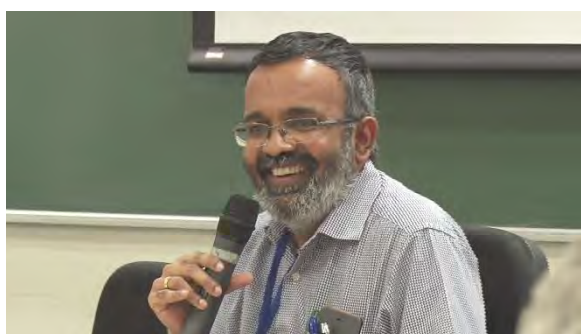
During the question answer session, members from the audience countered the view that anything outside the purview of scientific labs is 'unscientific', and that anything that disagreed with the accepted norms was archaic. The importance of field study was emphasized and it was asserted that the engagement should be bilateral. It was argued that there is a need to question science and its deep-seated assumptions.

Ashwin Chattrre, Res-RA, Indian School of Business

presented snippets of a global graded data set on multiple soil attributes. He argued that soils are a part of a complex adaptive system and research data acts like a backbone, a shared pool of knowledge that can



facilitate discussion across disciplines and bring forward alternative paradigms. The global data set leverages big data technology, satellite data incorporating samples of around 2,00,000 soils. Some interesting features of the data set include precise markers like pixel level bulk density estimates at 60 cm depth, carbon sequestered/stored in soil, carbon stored in terms of per hectare(relevant for climate change mitigation), grams per kg relevant for farmers, clay content, absolute water capacity of soil etc. Soil pH estimation using soil samples is now possible in combination with remote images using pH-cation exchange capacity of the soil. Based on soil data, inappropriate decisions regarding expansion of crops where soils are not supportive can be avoided. He mentioned two important web portals: indiarainfedportal.org and soilgrids.org.



Harish Damodaran, Rural Affairs Editor, Indian Express

began by saying he was most concerned with yields, costs, and returns to farmers. He had no romantic or spiritual conception of soils but would rather think of efficient use of resources. He said the Haber process is

the greatest invention of mankind, to deliver nitrogen in Ammonia form. Without it agriculture, the way it is practiced today won't have been possible. Nitrogen itself cannot be a cause of soil degradation. It matters how you use it. While yields have increased over time (wheat variety SD-2967 yields 7-7.5 tons per hectare), it is true that input usage has also gone up. But the solution cannot be going back to the biological fixing of nitrogen. We can't do away with modern agriculture. The

question is how do you manage it? Water is a serious problem; there are solutions like micro irrigation, drip irrigation. He said, I am extremely cynical about going back to the 16th century. We must use science. There is immense scope for soil testing- pH, conductivity, salinity. If the soil is deficient in sulphur, don't apply urea, apply ammonium sulphate. The question is of designing the right kind of fertilizer, say for the potato farmer in Farrukhabad. Farming requires investment and expertise. We should not rubbish whatever gains we have made.

There is a need for contemplative, sensible reporting in terms of the gains for the farmers. They need to be shown the money, otherwise they won't go for it. Farming is a business. We should look at farmers as a businessmen and try to reduce their drudgery and monotony. Like in Gujarat the modern milking machine and bulk milk cooler revolutionized milk production. Like we as city dwellers go after latest technology like mobile phones, farmers are the same. Farmers have no nostalgia for the past. We should be looking at agriculture as a business, a livelihood, where there is money, where they (the farmers) are trying to move up the ladder.

Vivian Fernandes of smartindianagriculture.in began by saying he supports genetically modified agriculture and seeks to promote the right view of GMOs and science in agriculture. Although, the coverage of agriculture in the media has increased, much of it is gloom-doom sort of coverage. The vibrancy is overlooked. The view of farmer entrepreneurs never finds a place in the narratives. Yes, going to the countryside needs money, but newspapers do have funding and they are in a position to pursue it. Unfortunately, they are more in the business of advertising and grabbing eyeballs.



Moreover, scientists do not want to write for public platforms. There have been instances of contradictory claims by scientific institutions, for example, regarding pesticide residue levels. This creates a trust gap. But scientists from ICAR have refused to engage with the media and disabuse people of the notions they have. There is a need to bridge the trust deficit.

He agreed that we cannot talk about GDP and forget everything else; to live productive lives we need to take care of our resources. In the food bowl areas the soils are now depleted and there is a need to shift to organic. But scientists are not educating journalists. They conduct research but seldom engage with the media. He did not know that soil has different aspects like moisture retention and other physical parameters. Farmyard manure needs to be used to improve texture of the soil. He recently learnt about Conservation Agriculture (CA) done by the Borlaug Institute, where they do not till the soil. This could be an important solution to stubble burning but there is no media communication regarding this in Punjab. *[Rajeswari Raina communicated that there have been media engagements on this in Punjab.]*

But very few reporters are talking about CA, countered Fernandes. The message needs to be amplified. Media engagement may have been episodic. Farmers do not even know about CA. People are skeptical about it.



Sharmila Sinha, Freelance Environmental Educator (earlier with the Centre for Science and Environment) started her talk by saying

there is a problem with the kind of education that is imparted. We are not taught in terms of the connect with the larger environment, in our textbooks and

media. We cannot write off community knowledge at the grassroots and other levels. We need to understand and learn from them. To feed large number of people that we have today, we need different technologies. The question is how to connect? How do you say that you need not do stubble burning, but you can do other things, too? There is this village, five hours from Delhi called Lakoria in Rajasthan, engaging in the practice of natural resource management. Here, traditional and modern ways are integrated quite well. There is a need of building up a repository of successful practices. Websites like The Better India are examples of how to highlight them and talk to future generations about them. The question is how to interlink science with communities, and people who do not understand science. It's time we, especially journalists, go out of our comfort zones. We need to see and experience those things. Science needs to come out of its shell. There is a need to bring uninitiated minds to this forum.

Shubhojit Goswami of Down to Earth

was concerned with the questions of soil degradation and contamination and spoke of a recent study on PCB (printed circuit boards for electronic components) concentration in soils. The government plans to ban PCB. It has been under



scanner since 1994, but only now has it reached an alarming level. Chennai has the worst soil quality due to PCB. Considering how PCB concentration is going to affect us, we may find that long term exposure leads to breast milk contamination and cancer. No media house has covered this story, except Hindustan Times, which did a brief coverage. Most people don't understand science. Connecting soil quality with health could a possible pathway. At Down to Earth we make sure that we are not reporting only the surface level consequences, rather we communicate how soil affects human health. Also, positive stories need to be hammered in, like Kerala farmers preserving 30 diverse crops.

Open Discussion

A vigorous discussion followed the presentations with some delegates pointing out that there are many scientists communicating data to the public but the media and other private actors are not engaging with the science. They also questioned the notion that anything done in the lab is scientific and anything in the field is pitted against it and is labelled non-scientific. There is a need to keep questioning science and let go of deep seated assumptions within science. Field study is equally important, or even more so when it comes to agriculture. Another delegate said that a certain paradigm of research and development has been followed in agriculture, which is not working anymore. An alternative approach is required, and in this, soil health needs to be a central issue. There has been a constant neglect of the concept by the government.

Bharat Bhushan Tyagi, the natural farming practitioner summed it up by saying that science means analysis, institutionalization and dialogue, not dogmatic claims. He argued that the poverty of farmers was a result of human thinking. Nature was bountiful and we had ignored its guidance at our peril. He asked, is the earth ill or are human beings ill [*bimari aadmi ko hai ya dharti ko*]? If the soil is healthy then the food we eat will nourish us.

Another delegate stated that even if you say that chemicals are necessary to salvage an economy from the situation of food insecurity, in the long term, the question of sustainability does arise. But he was countered by others who said that production output is more than what is required to feed the entire nation. Calculating at 7 kg per person per month under PDS, India could feed her entire population using 43 per cent of the food available in 1951 and 41.5 per cent of the food available in 2011. The problems lie elsewhere—we are importing wheat despite good production. Another delegate said that even if one supports GM, there are lessons to be learned from Bt. Cotton could be cropped in a mixed pattern. Bt cotton made that impossible.

Harish Damodaran responded by saying, if we use technologies like mobile phones, farmers should also have the choice to do so. Moreover, if we reduce wheat, milk production today, what will be the effect on prices?

Vivian Fernandes responded that he is advocating sustainable agriculture using organic farming, GM, farm manure, all those things. One should not have a self-righteous attitude. Green revolution has filled our stomachs and also given us something to export. There has been an over exploitation of farm resources, groundwater due to policies. He pointed out that Harish Damodaran's work highlighted the importance of pulses in the Economic Survey and argued that MSP for pulses should be higher due to social impact. The government responded positively. This is an example where media made an impact. There is a need for more such discussions between people who are farming and researchers—people who do not know anything about farming. Conversations are important, where people have equal rights to put forth their opinions. There is a need for engagement with people who might want to work on farming related issues.

Shubhojit Goswami said that as media persons we should scrutinize policy makers; bring out stories of people with indigenous knowledge.

Rajeswari Raina added that the farmers talking of working with nature are also the ones making good money, and in fact, doing much more than just making money.



Session - 8: Soils and the Carbon Policy: Survival Question

Moderator: IP Abrol, Centre for the Advancement of Sustainable Agriculture

The session began with a recorded skype presentation by **Rattan Lal, Director, Carbon Management and Sequestration Center, The Ohio State University** who suggested that the addressing soil health is not static exercise, but a dynamic process, as it keeps changing with every generation, because our demands, needs and scientific knowledge keep changing. Soil quality (fitness for use, capacity to function) and soil health (capacity as a vital living system, affecting plant animal and human health) are distinct and should not be used interchangeably. Rattan Lal defined soil health as the 'soil's capacity, as a dynamic and biologically active entity, within natural and managed landscapes, to sustain multiple ecosystems services which include-net primary productivity, food and nutritional security, biodiversity, water purification and renewability, carbon sequestration, air quality and atmospheric chemistry and elemental cycling for human well-being and nature conservancy.' He discussed the technological options for soil carbon sequestration to create a positive soil carbon budget: Conservation Agriculture, complex farming systems by integration of cropping with livestock, trees, urban ecosystems and biofuel plantations, restoration of degraded lands, use of organic amendments like

compost, manure, biochar, vermiculture etc. He said it's not about what you grow, but what you grow *and* how you manage the soil, and that we should conceptualize soil and agriculture as a solution to the environmental problem and not a cause.

The new global initiative for soil conservation 4/1000 and its relevance to a land constrained country like India was detailed by **Bruno Dorin, Centre de Sciences Humaines, Delhi**. In his presentation, he gave a historical account of how agriculture was positioned within the idea of a model of economic growth with an overarching objective of poverty eradication, and how it resulted in the convergence of labour productivity across sectors. The Lewis path for growth followed by developed countries had an inevitable outcome of sharp decrease in absolute number of farmers and we are moving towards a world without agriculture. India and other Asian countries, who joined the bandwagon comparatively late, ended up in a Lewis Trap—polar opposite of the Lewis Path—resulting in an increase in wage gap between agriculture and non-agricultural sectors, a decrease in per capita land availability for farmers, direct dependence on chemical inputs for increased land productivity and labour productivity; and overexploitation of natural resources like soil and water.

His paper proposed a paradigm shift towards a 2050 vision of “science and farmers managing a mosaic of agroecosystems boosting local synergies amongst many plant and animal species, above and below the ground surface”. After COP21 a new international consortium called “4 Per Thousand: Soils for Food Security and Climate” was launched to scientifically document and take concrete actions towards increasing the carbon content of the soil. As the earth's surface contains two to three times more carbon content than the atmosphere, increasing the carbon content of soil by 0.4% (4 per 1000) can stabilize the climate and ensure food security, at the same time.

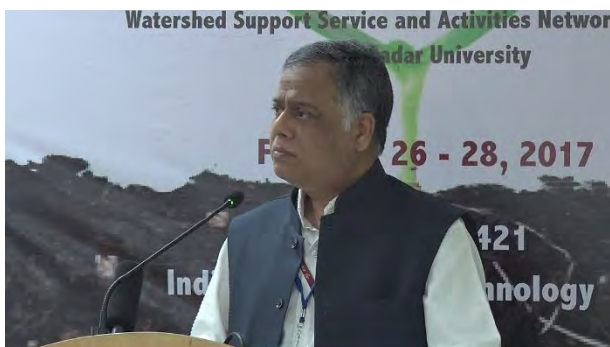
In COP22 a scientific programme was proposed to integrate knowledge, design and co-construction of 4 per 1000 agricultural and forestry practices and boost synergies between climate mitigation and adaptation. It can be called as a move toward a new socio-technical regime based on agro-ecology, as it involves both scientific disciplines and agricultural practice, and calls for a political-social movement. It can also study how labour productivity of very small-scale farmers, especially in land-constrained and labour-abundant countries, could be enhanced. Opportunities for channelling ecosystem service payments to the agriculture sector could also be explored.



Session - 9: Policy Roundtable on Soils

Chairperson: T. Vijay Kumar, Adviser (Government of Andhra Pradesh)

After a brief welcome address by Richa Kumar of IIT Delhi, the delegates were addressed by **Neeraj Sharma, Head, Policy Research Cell, Department of Science and Technology**. He enthusiastically supported the efforts being made to bring together scientists, practitioners and policymakers to deliberate on a pressing



problem facing India's future. He said, this conference should not be considered as an end, but rather, a beginning to create the momentum required to take action on the policy front. He assured the group of DST's full support in taking forward the agenda of saving India's soils.

PS Vijay Shankar, A Ravindra and **Rajeswari Raina** presented the summary of policy issues and the lessons emerging from the conference.

(A) Science-Practice Interface

1. Healthy soils are crucial for producing healthy food and ensuring human health and ecosystem health. Soil health needs to be understood not only

through macro- and micronutrients but more importantly, through three M's:

- Organic **M**atter (Carbon content)
- **M**icrobial Activity
- **M**oisture Retention Capacity



2. Productivity, including fertilizer-use efficiency, of soils depends entirely upon the three M's. Current programs such as soil health cards would need to integrate the three M's and broaden their scope, to provide a realistic diagnosis of soil health.
3. Soil health is a function of highly variable rainfall, topography, crop systems, and local farming cultures across the country. Therefore, **an agro-ecological area approach towards soil health diagnosis and amelioration is needed.**
4. More comprehensive diagnosis leads to comprehensive action. Integrating the 3 M's and building local capacity can positively transform India's soils.

(B) Practice-Policy Interface

1. Several examples at scale (covering ~40000 farmers) were presented over two



days using different practices that increase soil organic matter through multi-crop systems, in-situ composting of crop residues, animal manuring, conservation agriculture, mulching, green manuring, tank silt application and others were presented.

2. **Successful examples of farms and farming agro-ecosystems show that costs reduce significantly and yields are enhanced, resulting in higher net returns with inclusion of the 3 M's in the approach.** The food produced is healthy and nutritious. Ecological services provided include carbon sequestration and reduced use of non-renewable energy sources
3. Many of these experiences have been validated by scientists from the SAUs and ICAR and endorsed by international agencies such as FAO.
4. This directly supports the government's objectives of doubling farm incomes, improving soil health, increasing farm productivity, increasing soil moisture retention (*Har Khet Ko Pani*), promoting public health and nutrition security, **enhance fertilizer use efficiency and potentially reduce the fertilizer subsidy burden**

(C) Knowledge-Policy Interface

The above learnings from the dialogue on India's Soils can be operationalized

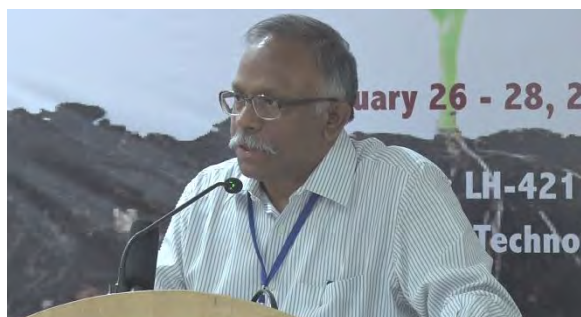
through a **National Program for Living Soils (3M's)** integrated with the Soil Health Management Program. This would entail:

1. Initiating a pilot program in 10 blocks in each state covering different agro-ecological regions to find ways of scaling up the 3M's approach to soil health.
2. **Comprehensively addressing soil health requires an integrated, location-specific and decentralised approach.** The pilots should integrate knowledge from practice and knowledge from formal science to create a comprehensive understanding of the problem and identify appropriate solutions.
3. **Such a process needs significant investment by the state.** Current policies provide support only for fertilisers and biofertilisers. This program would require a shift in state support.
4. As restoration of soil health requires at least three years, the pilot program should have a minimum time period of 3-5 years.
5. With state support, the practices to improve the 3 M's at the farm level, can be easily scaled up to reach millions of farmers and have an immediate positive impact on soil health and productivity.



(D) **Changing Paradigm**

Soil Health is a Public Good: Even if individual farmers want to improve their own soil health, they are constrained by resources, access to services and what everyone else in their village or region is doing. Therefore, the Government has a responsibility to support and **incentivise farmers to maintain soil health *comprehensively***. It must be addressed systematically at the agro-ecological level along with supporting farmers directly at the farm level. We have a responsibility towards our current and future generations to provide them with a healthy environment and good health which can only come through healthy food that comes from healthy soils.



T. Vijay Kumar, Advisor to the Govt. of Andhra Pradesh, in his remarks began by pointing out problems inherent in the practice of science across agricultural universities in India. First, there is enough evidence to prove what damage we have done to the environment in the name of

modern-scientific agriculture. The practice of science over here is wrong science,

which has made farmers' suicide almost an everyday affair. This practice is necessarily based upon a 'zero-sum view', where nature's own logic of replenishing its own soil has almost been shattered. Hence, there is constant effort to put nutrients externally into the soil without ever asking whether the soil really needs that or not. The driving idea remains such that nature is in a vacuum and science needs to fill it up.

However, data has shown that nature already has its inherent logic of replenishing the soil, and soil consists of already existing bio-diversity, which plays a significant role in this process. He pointed towards the sociality of plants and how they attract different organisms for their own sustenance. These views have almost been neglected in the present practice of science. It is high time that scientists accept the blame for this and so do those policy-makers who are still under spell of those scientists.

Second, he argued, there is an inherent politics in the way disciplines are arranged in most agricultural universities—in most of the soil science departments, one hardly gets to see a microbiologist, instead there are only chemists who hold the entire expertise to talk about soil. This politics has almost entirely silenced questions around organisms in soil & different kinds of microbial activities in soil from the coursework.

Third, most policies are catered towards the 'scientific' validation of 'farmer's' knowledge and in the end, scientists hold absolute power in the production of knowledge. But, policies should actually address the challenge of emulating farmer's knowledge, not validating it. If scientific knowledge doesn't encourage public participation in the formation of knowledge, then one should get rid of that science. Finally, Vijay Kumar stressed on the fact that soil health must be treated as a public good and emphasize its pivotal role in ensuring food security and access to 'appropriate/healthy' food.

Ms. I Rani Kumudini, Joint Secretary (Integrated Nutrient Management)

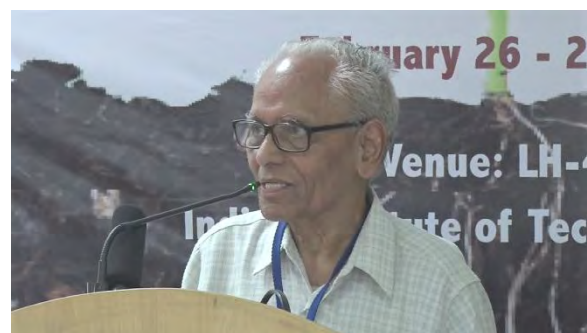
welcomed the views put forth by the conference delegates and said she will be happy to discuss further how to take these ideas forward. She invited the conference organisers to come up with a detailed plan for incorporating these suggestions into the soil policy of the government.





Session - 10: Policy Dialogue and Suggestions

J Venkateswarlu, Former Director, Central Arid Zone Research Institute (CAZRI) began by stating that soil testing is limited to NPK Analysis, organic carbon, at the best some micronutrient analysis. Soil conservation in the US makes use of kits to test parameters like respiration



activity of the soil. Government of India is only concerned about multiplying soil-testing labs, mobile labs, and performing only chemical tests. We need to learn from the models of North America. ICAR, Government of India and State Governments need to change from the concept of the 1950s. There is a need to put emphasis on, not just air and water, but also, soil, which is as important. There is a need to create awareness at the level of agricultural colleges. There needs to be efficient business management rather than more fertiliser subsidies. As a result of external pressure from civil society, there are small deviations here and there. Nitrate and phosphorous are limited in quantity and deplete over time. A process of change needs to be brought about. A farmer becomes independent by using non-chemical options.

There needs to be an emphasis on awareness for the need of healthy soils to keep the nation healthy and move towards sustainable livelihoods.



GS Sidhu, Consultant INM, Ministry of Agriculture, GOI began by saying that he has been working with scientists and policy makers where he learnt soil classifications, working criteria, how cultivation was done on the field etc. The fault lies not only with the scientists but

also the support systems. Findings of reports should be conveyed and scientific work should be percolated. However, very few institutes want to share the information. For soil health cards, only 12 elements are tested, limited to the chemistry of soil. The microbiology is totally neglected. 2-3 visual readings about colour of the soil can be done and quantification needs to be done. Nature of soil and parameters need to be customized region-wise. Soil health card should be renewed every two years and should incorporate natural farming parameters, microbial parameters. There is a need for prioritizing soil health, microorganisms, and organic matter. There are 40 plus varieties of fungi culture, and there is a need for government support for research.

Jagadananda, Former Advisor to Government of Odisha, suggested that if the narrative has to change then there has to be a multi-pronged approach. First there needs to be a change agent group at ICAR and the agricultural universities. We need champions there who can make



efforts to create a new discourse. If the agricultural universities continue in the same way, bringing about changes is going to be difficult. Second, policy must change at the government level. Here too, we need a change agent group and champions. A budgetary pattern analysis needs to be undertaken for the last 2-3 years—in the universe of schemes available, which scheme is given how much budget and receives prominence. A policy deficit analysis is necessary. Third, a critical mass of opinion must be built by creating more coalitions and building alliances across the country amongst practitioners. We need to bring non-converts into the fold and create a change group in civil society.



IP Abrol, Centre for the Advancement of Sustainable Agriculture suggested that a 'State of Soil Resources Report' should be compiled every 4-5 years (in line with the Department of Environment Report on Forests), which must go to the Parliament. Agro-forestry that brings

together forests, trees and agriculture together is an important component of saving soils. Resource conservation (forests and trees) and crop production, which are currently dealt with by separate ministries, need to be integrated at the ministry level. There should be a periodic review of activities like the program on biofertilisers and its impact on the soil health level.

Astad Pastakia, DSC Foundation, Gujarat, said that we need to create a movement at grassroots so that the people who matter are forced to take notice. When vermicompost diffused through SHGs and farmer clubs, scientists were compelled to take note and add value to it. Farmer Producer Organizations are the key to bring this transformation. Farmers require handholding. There is a dearth of professional people who can assist with soil testing and marketing. The elite institutes are of no avail. Talent from local communities needs to be leveraged to fill this gap—by creating a new local cadre for soil testing. There is also a need to create an ecosystem to support innovative farmers. Incubation centers need to be established—the DSC approach of supporting farmers' enterprise can be a model.

Gopal Krishna, Toxics Watch Alliance urged for a complete ban on burning of green waste. In Durgandhamguda, Hyderabad the burning of waste has led to distorted waste management across the country. There should be a parity of subsidy availability for city compost and bio-fertilizers and there should be a standardized quality of compost. Different ministries are involved in promoting wrong science.

KS Gopal, Centre for Environmental Concerns said that the government needs to play an active role in democratizing knowledge creation, to bring to the fore multiple ideas, to facilitate choice between multiple systems. We need to promote science in harmony with nature, with better understanding of what is happening below the soil. The climate change resilience lens is missing from the current analysis, added **T. Vijay Kumar, Advisor, Govt. of Andhra Pradesh**. We have not taken into account what is already known internationally. The U.S. Department of Agriculture has moved on to aqueous extractions and we are still stuck on soil health and soil chemistry.

IP Abrol, Centre for the Advancement of Sustainable Agriculture, responded saying we need to start a linked mega-program—we can learn from the France model—to achieve increased carbon-flexibility for individual farmers. There need to be monitoring and coordination mechanisms. We must take stock of global initiatives.

WASSAN and RRA Network are working towards incorporating the livestock agenda into the soil, informed **Sabysachi Das of WASSAN**. It is important that we integrate livestock and think holistically; it is often the missing component. There is a policy for subsidies and bank loans to buy tractors but nothing for bullocks. This is a disincentive for bullock owners. Grazing resources are also diminishing. There is land besides farming land which is available as commons; however, little attention has been paid to the question of grazing areas, where other plants and bushes, besides crops, grow.

Ishteyaque Ahmed, Greenpeace lamented that there are scattered programs lying under different government schemes forcing farmers to go to different departments. There is a need to converge all the schemes and programs dedicated to soil health at the local level. There are many small initiatives and local realities, which need to be supported. However, centralized knowledge sharing diminishes the value of local knowledge. Farmers are already low in confidence. Prescriptive interventions do not lead to the empowerment of farmers or an empowered ecology and soils.

M Palanisamy, DHAN Foundation stated that we need to be feeding the soil rather than feeding the crop. We need to formulate policies for building up of organic matter locally. The current programs are not comparable with the subsidy for fertilizers. MNEREGA can be utilized for building up organic matter, using tank silt application, for example.

Dileep Kumar AD, Pesticide Action Network informed the group that the FAO is trying to turn to agro-ecology as a tool to replace pesticides. There is a need to enforce a ban on the 115 most hazardous pesticides and all other pesticides over a period of time. It is surprising that certain banned pesticides are still approved by central organizations. **Natural farming practitioner from MP, Deepak Suchde** added that even organic pesticides are not needed.

T. Channesh, Centre for the Public Understanding of Science, Bangalore, pointed out that there is no intellectual freedom in the agricultural sciences. The

agricultural universities are hierarchical and are directed by the bureaucracy.

Bharat Bhushan Tyagi, natural farming practitioner from UP, suggested that there is a need to define soil health and to establish a universally integrated system of nature, trees and livestock. There must be knowledge-based programs besides training, rather than simply pushing a package of practices. There is an urgent need of resource persons. We must understand the production balance of nature, the diversity of nature and its timeliness, rather than imposing practices. Production and nutrition would take care of themselves and farming would be profitable. He suggested that subsidies should be discontinued completely and knowledge based programs should be encouraged. **Poonam Pandey, Centre for Studies in Science Policy, JNU** interjected by asking how much space does the science oriented understanding give to the culture of agriculture?

Regina Sharmila Dass, soil microbiologist at Pondicherry University, brought out the point that there is lack of funding for soil microbiology. Soil testing in the sense of understanding soils regionally needs to be done.



In response, **SS Tomar, Additional Commissioner (INM), Ministry of Agriculture**, suggested that the state government can support the study of microbes. The government runs a scheme called Rashtriya Krishi Vigyan Yojana; it is a flexible scheme for incorporating new projects and innovative ideas. It provides financial grants for projects related to agriculture, environment, organic farming, conservation agriculture etc. He also informed the group that the government is conducting skill development training through specific courses for positions like soil sampler, soil collector, soil and water analyser etc.

A. Ravindra, WASSAN summed up the learnings from the conference. He said soil health cannot be limited to soil testing. Input based subsidies and actions at the farmer level are not the solution for the soils. It is evident that the paradigms of input subsidy led intervention are not working. There is a need for a decentralized approach to soil, which is region specific and makes use of local scientific knowledge and farmer knowledge as a package. The dosages need to be administered according to the nutrient level of soil. An important aspect of the soil is the moisture

content. In conditions where farmers' access to water is limited, they need organic matter to retain soil moisture. This dimensions does not figure in water programs. Investments should not be targeted at the individual farmer; rather they should be focused keeping in mind that soil is a public good. Soil health needs to be preserved, which requires integrating conservation as a production function. Even farmers have developed protocols, which are replicable and broad based. There should be institutional mechanisms, and capacity building efforts to leverage the momentum.

PS Vijay Shankar, Samaj Pragati Sahyog, Madhya Pradesh added that this can be attained through collective action and public investment and need not depend only on agricultural activities. A local level cadre needs to be leveraged to analyse local level problems and help in innovation.

Rajeswari Raina, Shiv Nadar University said we must work with the state. There is enough evidence to start a movement like vermi-composting, for the state to see the change and for investments to be demanded from the state. We need to work with the existing schemes of the state and create alternative social enterprises within the domain of agriculture—bringing science and culture together. International coalitions need to be leveraged. Secondly, there is a need to work without the state as well—leveraging partnerships in civil society and with all the people who have participated over the last three days.

Richa Kumar, DST Centre for Policy Research, said that the conference had provided an opportunity for different sets of actors to bring forward their views into the policymaking space. There is a vacuum in terms of policy intelligence i.e. the knowledge inputs that go into the policy making process. Only mainstream scientific thinking has found its way into policy making, and much of this science has been challenged for its veracity. There are missing linkages between the policy discourse and the knowledge residing with farmers and practitioners and also the knowledge of marginalised scientists in the agricultural sciences. Voices of these diverse actors need to be incorporated in the policy discourse. This conference is the beginning of a much longer set of conversations and actions that the DST Centre for Policy Research will be happy to support.

T. Vijay Kumar, Advisor, Government of Andhra Pradesh concluded the discussion by emphasizing the need for looking at agriculture with a climate change resilience lens—the National Mission on Sustainable agriculture brings this perspective. There is a need to draw upon the work done by the UN, FAO and

others—we should not have programs that go counter to them. We need to correct the way we are looking at soils. For soil testing, as well, there are global standards and global practice. He stressed that research efforts should be directed towards unexplored avenues. One needs to learn from the outliers who are turning to agriculture. He acknowledged the ideas put forth by natural farming practitioner, Bharat Bhushan Tyagi that people turn to agriculture if it comes across as a profitable activity, even if on a part time basis. There is a need to create jobs in agriculture for growth to take place in agriculture. He emphatically concluded that farmer distress is a shameful thing and the persons who are feeding us should not die.



Session - 11: Plenary and Concluding Session

Moderator: S. Natesh, DST Centre for Policy Research, IIT Delhi

The concluding session of the conference began with the RRA Network felicitating **IP Abrol** and **J Venkateswarlu**, two stalwarts in the field of the soil sciences in India with the following citations:



J. Venkateswarlu was honoured for "his contribution to excellence in scientific research on India's soils, and for enabling learning, and policy and practice changes among a wide range of farmers, communities, civil society organizations and policy makers committed to sustainable rainfed agriculture."

IP Abrol was honoured "for his contributions to excellence in scientific research on India's soils, and for promoting the relevance of knowledge vested with farmers,

communities, civil society organizations, and scientists to design better technologies and policies for natural resource management and sustainable agriculture.”

The felicitation certificates were presented to them by S. Natesh, DST Centre for Policy Research, IIT Delhi. This was followed by the N.K. Sanghi Memorial Lecture by IP Abrol.

IP Abrol, Centre for the Advancement of Sustainable Agriculture, started by speaking about Dr. Sanghi, who was a plant breeder but spent most of his life working with farmers and extension services. Building upon what T. Vijay Kumar summarised in the previous session, he talked about what should be the way forward, given that we understand the difficulties, the flaws of green revolution and the farmer’s plight.

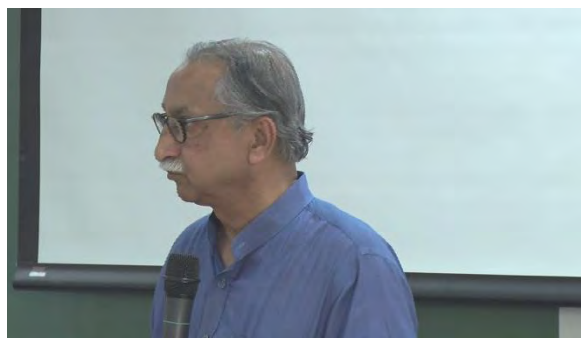


Taking into account principles of ecology and climate change, looking at international findings, global knowledge and the work, practices and recommendations of international organisations like the FAO, he emphasised that any future approach must give enough emphasis to soil biodiversity and soil biology. Based on research conducted over the last 60 years, the principles of ‘conservation agriculture’ come across as a promising paradigm. He explained the three principles: First, do not till the soil, ploughed soil is susceptible to wind and water erosion; second, keep the soils covered with residues as it starts the process of decomposition gradually that improves the capacity of the soil to hold water and prevents evaporation; and third, have a diversity of vegetation and crops. Let earthworms do the job for us. Water moves preferentially through larger and smaller pores. Tillage breaks the continuity of pores.

He emphasised that these are not technologies, but sound, scientifically proven and universally valid principles of science. It is an integrated approach; it involves both nutrient management and integrated pest management and a way towards agro-ecological agriculture. CA can be viewed from different perspectives and different principles can be utilised to solve different types of problems—water conservation, nutrients etc. Also, it is a way to reduce nutrient use through the return of organic

matter to the soil, reduce the use of pesticide and may be, ultimately, even eliminate it.

He said that it is a paradigm promoted by FAO based on rock solid global research. It has to be translated into technologies, which are location-specific depending on how much is the residue, soil type, rainfall and the resources available with the farmer and the resource use pattern. The input based approach of green revolution has to change to a resource-based approach. The farmer is the decision maker but it is necessary to empower him or her to take those decisions more rationally. And that is to be done, not through technology, but through understanding the principles. However, a host of problems are encountered on the field like how do you sow the seed into an untilled soil. This calls for an engagement between scientists and the farmer on the field. Not only will this give feedback to the government for its larger programs, it will also give feedback to the scientific organisations about what is working, and what is not working. In line with this overall paradigm, Obama had passed a US National Soil Policy in 2016 and this is an important component in European Union policy too.



The closing address was given by **S. Natesh on behalf of the DST Centre for Policy Research**. He talked about decision-making processes and what contributes to good decision-making. He suggested that while working on national level projects, different institutions should

work together and forego differences and divergent views. He said that conferences like these provide us with an opportunity to listen to different views and facilitate their assimilation and provide common denominations for decision-making. Governments can be pursued to make policies. However, there is a lack of evidence-based approach. We do not have a rigorous statistical framework. He suggested that the participants may look at the conference as a continuum to make use of the platform provided by DST through its policy research centres.

Annexure - 1

Concept Note

Widespread and continuing **degradation of India's natural resource base** has been established by many scientific studies. Degradation of land in general and **the soil systems** in particular has been highlighted time and again (RCA, 1928; NCA, 1976; Bhumbra and Khare, 1984; NRSA, 1985, NBSS-LUP, 2005). Though soil erosion by wind and water, acidity, alkalinity/salinity and other complex problems are the principal causes for land degradation, historically, loss of 'life in soils' is fast becoming a major challenge to address.

A more recent estimate puts the extent of degraded land in India at 120 million ha, which is about 38 per cent of our total geographical area (NAAS, 2010). In many states in India, **anywhere between 40 to 80 percent of the land area is classified as degraded** in some form or the other. As incremental yield per unit of applied plant nutrients tends to be lower with increasing fertilizer dosage per hectare, there is mounting evidence that soil organic matter depletion is a prime cause for declining soil health and soil productivity (Sharda *et al*, 2010).

Since agriculture uses 141 million ha out of 328.7 million hectares of the country, faulty land and water management practices in agriculture could significantly contribute to land degradation. Intensive irrigation and application of agri-chemicals

(fertilizers, pesticides, soil amendments etc.) adds to degradation (Planning Commission, 2012). Further, resource degrading subsidies such as provision of free electricity, subsidized fuel, and free irrigation water, worsen the situation (Reddy, 2003; Sehgal and Abrol, 1994; Raina and Sangar, 2002). The amount of chemical fertilizer subsidy has grown exponentially in India during the last three decades from Rs. 60 crore in 1976-77 to an astronomical Rs. 70,000 crore in 2016-17. In response to increasing micro-nutrient deficiencies, subsidies are now being extended to micro-nutrients, too, under schemes like "Bhu-Bharati" in Karnataka.

Yet, **this chemical nutrient-based subsidy approach has sidestepped the fundamental crisis facing India's soils: the loss of 'life'**. The bio-dynamic and living nature of soils has often been invisible to policy makers and agricultural scientists. The crisis in agriculture is a reflection of the crisis in soils, resulting from diminishing organic matter. Soils with good organic matter are reservoirs of water, being able to harvest and retain rainfall in their profile. This hydrological dimension of soils has been much less appreciated, especially in mitigating crop failures in rainfed areas.

The research objectives of formal scientific research on soils came from the policies under the green revolution emphasizing fertiliser responsive plants and input subsidies. The resulting research initially focused on NPK (nitrogen-phosphorus-potassium) trials, and now, on micro-nutrients. The policy frame of nutrient subsidies, together with monocultures, ensured that the land-husbandry practices began to die out. Farmers found it uneconomical to take care of soils through this process and practices shifted to replacing organic matter with chemicals. Increasing apathy of farmers towards 'soil-husbandry' (practising monocultures, inadequate addition of organic matter, and poor crop rotation, among others) is now a nation-wide phenomenon threatening the productivity of soils. India's soils are battling a silent and losing war.

Unfortunately, neither researchers nor policy makers have taken up the mandate of evaluating the results of these actions. This process requires recognition of farmers' knowledge and location-specific understanding of soils, as well as an acknowledgement of valuable knowledge and innovations that have arisen from practice (knowledge in practice). The **problem of soil degradation has not been seen as a key objective for research and policy** due to the absence of this feedback loop. Unfortunately, the biggest impact of this is, increasingly, going to be

felt by our farming communities, pastoralists, and our food security and healthcare systems.

In order to arrest and reverse the current degradation of India's soils, **it is imperative to come up with a coherent and shared understanding** of the public policy problem and its relationship to the scientific research questions, and the practices of using, tending, and conserving soils. We no longer have the luxury of time. In order to address this pressing issue, the DST Centre for Policy Research at IIT Delhi, Revitalising Rainfed Agriculture (RRA) Network, WASSAN and Shiv Nadar University, together, are planning an **International Conference on Soils** designed as a "trialogue" between scientists, policy makers and practitioners to be held at IIT Delhi from February 26-28, 2017.

The conference brings together **three powerful actors in soil health management** in India: scientists with knowledge within the formal domain of the sciences; policy makers with experience of designing policies, programmes, and choosing between policy instruments; and practitioners with their deep understanding of location-specific, yet highly diverse practices, that may or may not be codified, but are knowledge intensive. This conference is meant to enable a conversation between these groups to arrive at a **technologically, economically, and politically robust, and ecologically informed** understanding of soils and soil problems, and ways to address them.

The triad of knowledge-policy-practice has shaped the way soils have been understood in India, thus far. Policies have set formal research objectives for scientific enquiry; the results of science have influenced practice and also shaped

The conference has three objectives:

- To put together available knowledge on India's soils, their status, distribution and key problem areas, as understood by policy makers, the sciences, and other local knowledge systems.
- To enable a knowledge-policy-practice synthesis that can ensure that some of the high priority soil problems are clearly defined and understood.
- To facilitate integrated efforts between the three sets of actors to enable appropriate actions and investments for healthy, sustainable soil systems.

public investments in addressing soil health (through chemical-based subsidies, for instance) and incentive structures for farmers and others; these, in turn, have determined practices—such as using fertilisers as the primary means of enhancing soil productivity. However, this has resulted in a **lock-in for farmers, practitioners, scientists, and policy makers, and produced disastrous consequences** for soils in the medium and long-term. The technological and institutional momentum of this lock-in has prevented independent scrutiny of the problem by science, and insulated the system from external feedback from practitioners. The current crisis in soils in India, is a cumulative result of such processes that are not taking due cognisance of the massive ecological degradation of our soils.

The overall purpose of the conference is to develop scientifically valid, politically plausible and practically feasible solutions, placing special emphasis on marginal, small and medium farmers, and make these available to diverse actors and stakeholders such as the Union government of India, state governments, farmers' and women's movements, industry, and health and nutrition coalitions.

THEMATIC SESSIONS

The conference will consist of the following thematic sessions



In each session, policy makers, practitioners, and researchers will be invited to discuss the **relationship between the way policy decisions are made (and programmes designed), and the knowledge inputs that go into the policy-making process**. Knowledge inputs, or policy intelligence, includes evidence from the formal sciences, both natural sciences and social sciences, as well as informal knowledge from the world of practice. Participants will also be asked to reflect upon the relationship between formal and non-formal sources of knowledge production. Papers will be expected to discuss either the knowledge-policy interface or the knowledge-practice interface, or both, as applied to the theme.

THE KNOWLEDGE - POLICY INTERFACE: These papers would reflect on the current processes of knowledge generation and dissemination related to soils (forms of policy intelligence), and the policy responses emanating from this. They would ask how these policy responses shape the production of further knowledge, influence the choice of technologies / other inputs, public and private investments and incentive structures for other actors? In what ways does this lead to technological or institutional lock-in? The critical question is, **what forms of knowledge inputs are brought into the policy-making process, and thus, receive legitimacy?** Is non-formal knowledge, which is outside the domain of the formal natural and social sciences, included as policy intelligence and used in policy formulation? Examples include indigenous practices and location specific understanding of farming communities / pastoralists, women's understanding of the nurture and vitality of soils, farmer's knowledge of soil organic matter and its role in soil moisture retention, to name a few. **What mechanisms can enable non-formal knowledge to be acknowledged and legitimately used in policy design?** Moreover, to what extent are processes of knowledge generation and policy making rooted in local realities and evaluated on the basis of restorative ecological impacts?

THE KNOWLEDGE-PRACTICE INTERFACE: These papers would highlight diverse, location-specific practices that use and sustain healthy soils, present examples of scalable successes and experiences from practice, and reflect on the ways in which the learning from these is used for policy-making and further research. Papers can highlight the bio-physical, social and political contexts in which these practices exist and are nurtured. They may analyse experiences within and beyond the formal domain of science, highlighting areas where scientific evidence through research needs to be generated, and may be absent or inadequate, currently. How can knowledge generation, both within formal scientific research and in policies/programmes, engage with knowledge coming from the world of practice? In what ways can the **formal sciences acknowledge the importance of, learn from, respond to and support practices that are working to enhance the health of soils?**

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Annexure - 2

Program Agenda

DAY 1: Sunday, February 26, 2017

Inaugural Session

9:30 - 10:00 Registration and Tea

10:00 - 11:00	Richa Kumar, IIT Delhi	Welcome Address
	S. Natesh, DST-Centre for Policy Research, IIT Delhi	Opening Remarks
	Rajeswari Raina, Shiv Nadar University	Introduction
	Abhijit Sen, Professor (Retd.), Jawaharlal Nehru University, and Fmr Member, Planning Commission	Keynote Address

11:00 - 11:15 Tea

Session 1: Soil Health Management and Soil Husbandry

11:15 - 1:30	Moderator: Rajeswari Raina, Shiv Nadar University	
	Deepak Suchde, Natueco, Advisor to Govt of Madhya Pradesh	Farming with Living Soil: Natueco Farming (Amrut Mitti)
	Regina Sharmila Dass, Pondicherry University	The Efficacy of Biodynamic Compost for Soil Restoration and Crop Health
	Ishteyaque Ahmed, Greenpeace	Rejuvenating Soils Ecologically: Bihar Living Soils Model Shows the Way
	PVRM Reddy, Acharya N. G. Ranga	Preparation of Soil Resource Inventory

Agricultural University (ANGRAU),
Tirupati

Using GIS for Sustainable Soil Health
Management

OP Damani and Siva M, Centre for
Technology Alternatives for Rural
Areas (CTARA), IIT Mumbai

Challenges in Large Scale Soil Sampling and
Testing

Sudhir Kumar Suthar, Centre for
Political Studies, JNU

Productivity, Scientism & Politics of Soil:
Evaluating Soil Health Card Scheme

Rapporteur: Mini K, IIT Delhi

1:30 - 2:30 Lunch at IIT Delhi Main Guest House

Session 2: Soil-Plant-Livestock Complex

2:30 - 4:00

Moderator: Sabyasachi Das, Watershed Support Service and Activities Network
(WASSAN)

Tarak Kate, Dharam Mitra, Wardha

A Need for Scientific Validation of the Novel
Soil Improving Practices Generated by
Innovative Farmers: Some Field Experiences

Arun K Sharma, Central Arid Zone
Research Institute (CAZRI)

Synergistic Component Diversity for
Enhancing Agro-ecosystem Sustainability:
Practices and Policies

B Suresh Reddy, Centre for Economic
and Social Studies (CESS)

Dynamics of Soil Fertility Management : An
Empirical Analysis of M.P., U.P. & Jharkhand

Bharat Bhushan Tyagi, Natural
Farming Practitioner, Bulandshahr,
UP

Experiences from the Field

Rapporteur: Debottam Saha, IIT Delhi

4:00 - 4:15 Tea

Session 3: Gender Relationships and Soil Health Management

4:15 - 5:45

Moderator: Anshu Ogra, Centre for Studies in Science Policy, JNU

P Srinivas Vasu, SOIL, Chinthamani,
Chikkaballapura Taluk, Karnataka

Empowering Women to Power Diversity
Based Ecological Farming System (DBEFS) to
Address Nutritional Food Security for Soils
with Economic Security and Gender Equity
for Women

Selvamukilan B., MSSRF, Chennai

Strategies Adapted for Strengthening the
Role of Women in Soil Health and Crop
Productivity Through Organic Practices

Priti Joshi, National Organisation for
Community Welfare, Wardha

Revival of Soil Fertility through Peoples
Participation

Sunita Sangar, National Mission for
Empowerment of Women, Ministry of
Women and Child Development, GOI

Thinking about Soil Health - Do Women
Matter?

Rapporteur: Abhigya P., IIT Delhi

8:00 Dinner at IIT Delhi Faculty Guest House

DAY 2: Monday, 27th February, 2017

Session 4: Land Use, Agro-ecosystems and Conservation of Biodiversity

9:30 - 11:45

Moderator: PS Vijay Shankar, Samaj Pragati Sahyog (SPS)

Astad Pastakia and Sachin Oza, DSC Foundation, Gujarat	Deploying Mobile Soil Laboratory to Monitor Soil Health for Sustainable Agriculture: Experiences of Development Support Center in Gujarat and Madhya Pradesh
Kailash Murthy, Natural Farming Practitioner, Karnataka	Integration Efficiencies of Natural Farming in Harmony with the Ecosystem
TS Channesh, Centre for Public Understanding of Science, Bangalore	Understanding Soils Beyond Chemistry
David Hogg, Naandi Foundation, Hyderabad	The Vision of a United Agricultural Field
Gurpreet Singh and Bhaskar Mittra, Aga Khan Rural Support Programme India	Sustaining Soil Health with Conservation Agriculture
Amar KJR Nayak, XIM, Bhubaneswar	Sustainable Agricultural Systems: Soil Health Improvement & its Relationships with Other Variables

Rapporteur: Abhigya P., IIT Delhi and Mini K, IIT Delhi

11:45 - 12:00 Tea

Session 5: Managing Soil Pollution and Problem Soils

12:00 - 1:30

Moderator: A Ravindra, Watershed Support Service and Activities Network (WASSAN)

Dileep Kumar AD., Pesticide Action Network (PAN) India	Agrochemicals Render Soil Biologically Inactive
Gopal Krishna, Toxics Watch Alliance	What's Causing the Sharp Decline in Life in Soils, and Why it Matters?: An Inquiry into Transformation of Nutrients into Pollutants
Shilpanjali Sarma and Aastha Sharma, TERI	Soils in Punjab: Exploring Perceptions, Practices and Potential Avenues for Revival
Anshu Ogra, Centre for Studies in Science Policy, JNU	Fixing Soil to Make the Weather Work: Science, Situated Knowledge and Coffee Growers in South India

Rapporteur: Debottam Saha, IIT Delhi

1:30 - 2:30 Lunch outside LHC 421

Session 6: Soil Moisture Management and its Role in Managing Droughts

2:30 - 4:00

Moderator: Jagadananda, CYSD, Fmr State Information Commissioner, Odisha

KS Gopal, Centre for Environmental Concerns	Irrigation and Soil Life
Mukesh Patil, Advanced Center for Water Resources Development and	Soil Moisture, Protective Irrigation and Kharif Security: Significance of Local Scale

Management (ACWADAM)	Assessments
M Palanisamy, DHAN Foundation	Enhancing Soil Moisture Holding Capacity Through Tank Silt Application to Adapt Climate Change
Ravikant, WASSAN	Drought and Soils
Rapporteur: Suchismita Das, IIT Delhi	

4:00 - 4:15 Tea

Session 7: Public Understanding of Soils: Through the Media

4:15 - 6:00 **Moderator:** Rajeswari Raina, Shiv Nadar University

Ashwini Chatter, Res-RA, Indian School of Business	Data Brief on Soils
Harish Damodaran, Indian Express	
Sharmila Sinha, Freelance Environmental Educator	
Vivian Fernandes, Smartindianagriculture.in	
Shubojit Goswami, Down to Earth	

Rapporteur: Abhigya P., IIT Delhi

8:00 pm Dinner at IIT Delhi Faculty Guest House

DAY 3: Tuesday, 28th February, 2017

Session 8: Soils and the Carbon Policy: Survival Question?

9:00 - 10:00 **Chairperson:** IP Abrol, Director, Centre for Advancement of Sustainable Agriculture (CASA)

Rattan Lal, Director, Carbon Management and Sequestration Center, The Ohio State University	(on skype)
Bruno Dorin, Centre de Sciences Humaines, Delhi	

Session 9: Policy Round Table on Soils

10:00 - 1:30 **Chairperson:** T Vijay Kumar, Advisor, Govt of AP

Richa Kumar, IIT Delhi	Introducing the Policy Round Table on "Soils"
Neeraj Sharma, Head, Policy Research Cell, Department of Science and Technology	Welcome Address
<i>Summary of Policy Issues and Lessons Emerging from the Conference</i>	
Rajeswari Raina, Shiv Nadar University	On Framing the "Problem of Soils": Science, Practice & Policy Interfaces
PS Vijay Shankar, Samaj Pragati Sahyog	Emerging Lessons and Framework Principles for Policy-Action

A Ravindra, WASSAN

Public Investments and Action

T Vijay Kumar, Advisor, Govt of Andhra Pradesh

Chairperson's Opening Remarks for the Policy Round Table

10:45 - 11:00 Tea

J Venkateswarlu, Fmr Director, Central Arid Zone Research Institute (CAZRI)

I. Rani Kumudini, Joint Secretary (INM), Ministry of Agriculture, GOI

SS Tomar, Additional Commissioner, (INM), Ministry of Agriculture, GOI

GS Sidhu, Consultant (INM), Ministry of Agriculture, GOI

Open Discussion

Summarising the Policy Dialogue & Closing Remarks of the Chair

Rapporteur: Abhigya P., IIT Delhi and Mini K, IIT Delhi

1:30-2:30 Lunch at IIT Delhi Main Guest House

Plenary and Closing Session

02:30 -
4:00

Chairperson: S. Natesh, DST-Centre for Policy Research, IIT Delhi

Rajeswari Raina, Shiv Nadar University

Felicitation of IP Abrol and J Venkateswarlu (OP Rupela Award)

IP Abrol, Director, Centre for Advancement of Sustainable Agriculture (CASA)

NK Sanghi Memorial Lecture

Rajeswari Raina, Shiv Nadar University

Closing Remarks

Richa Kumar, IIT Delhi

Vote of Thanks

4: 00 Closing Tea

Annexure -3

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