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25th National Conference
on
Natural Resource Management in Arid and Semi-Arid Ecosystem for Climate Resilient Agriculture and Rural Development
17-19 February, 2016
Organized by
Soil Conservation Society of India
New Delhi
In collaboration with
Swami Keshwanand Rajasthan Agricultural University
Bikaner – 334 006 (Rajasthan)

2015 International Year of Soils

From The President's Desk

Agroforestry, the practice of introducing trees in farming has played a significant role in enhancing land producti-vity and improving livelihood in both rainfed and irrigated ecological. At the same time agroforestry interven-tions in farmland have far reaching environmental and ecological impacts. The role of agroforestry in soil conservation, bio-amelioration and climate moderation is most widely acclaimed and one of the compelling reasons for including trees on farm lands, it is now a proven fact that the global climate is changing and measures for its mitigation and adaptation are essential to face the new challenges. Agroforestry has the potential are essential to face the new challenges. Agroforestry has the potential to mitigate the climate change through micro-climate moderation and natural resources conservation in short run and through carbon sequestration in long run. Thus, the present challenges of food, nutrition, energy and environment security can be met through different agroforestry systems developed for various agro-climatic zones.

Agroforestry is playing the greatest role in maintaining the resource base and increasing overall productivity in the rainfed areas in general and the arid and semi-arid regions in particular. Agroforestry land use increases livelihood security and reduces vulnerability to climate and environmental change. There are ample evidence to show that the overall (biomass) productivity, soil fertility improvement and carbon sequestration potential of an Agroforestry system is generally greater than that of an annual system. Agroforestry has an important role in reducing vulnerability, increasing resilience of farming systems and buffering households against climate related risks. It also provides for ecosystem services – water, soil health and biodiversity. Therefore, Agroforestry will be raising population for food, fruits, fuel wood, timber, fodder, bio-fuel and bio-energy.

Wishing you a happy and prosperous New Year 2016

With the rapid urbanization and economic growth in the country, farming community have witnessed unprecedented opportunities for moving beyond subsistence farming to supplying products needed by urban dwellers. Agroforestry products such as timber, fruit, food, fibre, fodder, medicine and others are progressively meeting the subsistence needs of households and providing the platform for greater and sustained productivity. Now due to change in dietary habits and consumption patterns, it is estimated that there will be less demand for cereals and many times more demand for animal products like milk, meat, pulses and edible oils-fertilizer, bio-pesticides, bio-remediation, bio-fortification, bio-industrial watersheds and applications and nano technology to enhance nutrient and water use efficiency, plant based medicines and increasing demands for wood for house construction. This requires a matching reallocation of lands in favour of Agroforestry. It is in this context that Agroforestry systems offer opportunities to farmers for diversifying their income and to increase farm production. Agroforestry can improve soil fertility, provide fodder, produce tree fruits, expand fuel wood supplies, and produce a variety of wood products for farmers' own use and sale without demanding additional land. Research results from different agro-climatic regions of the country show that financial returns generated from Agroforestry systems vary greatly but are generally much higher than returns from continues unfertilized food crops. The higher returns associated with Agroforestry can translate into improved household nutrition and health, particularly when women control the income. However, monitoring and impact assessment studies need to pay higher attention to understand how agroforestry affects household resource allocation, consumption patterns, nutrition status of household members, and health.

International Conference on Water Resource Management at Shillong

International Conference on Water Resource Management in the Eastern Himalayan Region was organized at St. Anthony's College, Shillong on Nov. 4-5, 2015. The ChangeNgo.Org, Shillong collaborated with the International Conference. The region is blessed with the heaviest rainfall in the world, yet there is scarcity of water for irrigation and drinking purposes in the post-monsoon season, resulting in low cropping intensity and migration. Heavy rainfall, on the other hand during the monsoon, leads to an annual round of devastating floods in the plains. Our focus, therefore, during this session is on the conservation and sustainable use of these two precious resources – Water and Soil. There is an equal concern for the soil erosion in the region owing to prevalence of shifting cultivation, involving deforestation and causing soil erosion up to 17000 t per Sq.km. in the higher slopes, which in turn would mean, shrinking of area under agriculture, loss of productivity, siltation of river beds as well as that of large wetland areas known as the 'Beels' and increasing furry of flood in the plains.

Lack of Integrated Water Resources Management (IWRM) and Integrated River Basin Management (IRBM) is often cited as reasons for these problems. Given the adverse ground realities for implementation of IWRM or IRBM, it is time to evolve alternative water management strategies that are NE Region specific and adopt the same in future. Ms. Deeya Rathore, CEO, ChangeNgo, Shillong appreciated the presenters and of the view that ChangeNgo.Org look forward to implementing programs on soil and water conservation issues in the region. Dr. Sanjay Arora, Vice-President, SCSI was invited as resource person and presentation on 'Sustainable Water Resource Management for crop production in hilly tracts of India'. Dr. K.K. Satapathy, presented his talk on 'Rainwater Conservation and Management for multiple use in the North Eastern Hill Region' in the International Conference.

Feed the Soil to Feed the Humanity

FAO's vision of sustainable food and agriculture is a world in which nutritious food is accessible for all by managing the natural resources such that they maintain ecosystem functions to support current and future human needs.

The approach to socio-economically and environmentally sustainable food and agriculture is based on improving efficiency and conserving / protecting / enhancing natural resources. This is in addition to, protecting rural livelihoods, enhancing resilience to climate change and market volatility, and good governance, for healthy natural and happy human systems.

Healthy Living Soils have an important role in achieving this vision and approach to sustainable food and agriculture.

Soil is a foundation of Agriculture and Plants. The medium in which nearly all plants grow. 95 % of our food is directly or indirectly produced from our soils. Healthy soils supply all essential nutrients & micro nutrients, water, oxygen and root support to the plants to grow and flourish. Soils maintain diverse community of soil organism to control plant disease, insect, weed pests, form beneficial symbiotic associations with plant food, recycle essential plant nutrients, improve soil structure with a positive effect for soil & water and nutrient and ultimately improve crop production. Soil also contribute to mitigate climate change by maintain or increasing its carbon content.

Nutritious and good quality food and animal fodder can only be produced from our healthy soil. Healthy soils are, therefore, to improve to food security and nutrition.

Numerous and diverse forming approaches promote the sustainable management of soil for improving productivity. Thereby to increase yields and food quality in the future by adopting following approaches:

- **Agroecology** uses ecological theory to study and manage agricultural systems in order to make them both more productive and better at conserving natural resources. This whole systems approach to agriculture and food systems development is based on a wide variety of technologies, practices and innovations, including local and traditions knowledge as well as modern science. By understanding and working with the interactions between plants, animals, humans and the environmental within agricultural systems, agroecology encompasses multiple dimensions of the food system, including ecological, economic and social.
- **Organic Farming** is agricultural production without the use of synthetic chemicals or genetically modified organisms, growth regulators and livestock feed additives. It also emphasises a holistic farm management approach, where rotations and animals play an integral role to the system. Soil fertility is the cornerstone of organic management. Because organic farmers do not use synthetic nutrients to restore degraded soil, they must concentrate on building and maintaining soil fertility primarily through their basic farming practices.
- **Conservation Agriculture** practices have significantly improved soil conditions, reduced land degradation and boosted yields in many parts of the world by following three principles: minimal soil disturbance, permanent soil cover and crop rotations. To be sustainable in the long term, the loss of organic matter in any agricultural system must never exceed the rate of soil formation. In most agro-ecosystems, that is not possible if the soil is mechanically disturbed. Therefore, one of the tenets of conservation agriculture is limited the use of mechanical soil disturbance, or tilling, in the farming process.
- **Zero Tillage** is one of a set of techniques used in conservation agriculture essentially, it maintains a permanent or semi-permanent organic soil cover (e.g. a growing crop or dead mulch) that protects the soil from sun, rain and wind and allows soil micro-organisms and fauna to take on the task of "tilling" and soil nutrient balancing – natural processes that are disturbed by mechanical tillage.
- **Agroforestry** systems include both traditional and modern land – use systems where trees are managed together with crops and / or animal production systems in agricultural settings. The combination of trees, crops and livestock mitigates environmental risk, creates a permanent soil cover against erosion, minimizes damage from flooding and acts as water storage, benefitting crops and pastures.

Source: www.fao.org

Soil Matters

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Soil, geoderma of Earth crust, is a bio-geochemically dynamic entity that supports all components of terrestrial ecosystem that include: water flow and retention; solute transport and retention, physical stability and support; retention and cycling of nutrients; buffering and filtering of potentially toxic materials; and maintenance of biodiversity and habitat. Lexically, the term soil is derived from the latin word "solum", which means 'ground or floor'. According to United State Department of Agriculture (USDA) Handbook (1938), "Essentially all life depends upon the soil.

Hindu Philosophy describes soil 'as the origin and destination of life.' While unveiling US Uniform Soil Conservation Policy said Franklin D. Roosevelt (the 32nd President) "The Nation that destroys its soil destroys itself". Soils undergo intense and irreversible changes due to improper land management and application of machinery and techniques in its broadest sense.

In Indian perspective, soil, fertilizer, variety and water played significant role in achieving the self-sufficiency in food production and took out hunger from us (the success of green revolution). But the gain incurred through Green Revolution could not show upward trend on food production owing to deterioration in resource base i.e. soil and that necessitated for rethinking.

Realising the importance of soil and its function, the 68th UN General Assembly declared 2015 as the International Year of Soils (IYS). The Food and Agriculture Organization of the United Nations has been nominated to implement the IYS 2015, within the framework of the Global Soil Partnership and in collaboration with Governments and the secretariat of the United Nations Convention to Combat Desertification. (UNCCD)

The IYS 2015 aims to increase awareness and understanding of the importance of soil for food security and essential ecosystem functions.

The specific objectives of the IYS 2015 are to:

- Raise full awareness among civil society and decision makers about the profound importance of soil for human life;
- Educate the public about the crucial role soil plays in food security, climate change adaptation and mitigation, essential ecosystem services, poverty alleviation and sustainable development;
- Support effective policies and actions for the sustainable management and protection of soil resources;
- Promote investment in sustainable soil management activities to develop and maintain healthy soils for different land users and population groups;
- Strengthen initiatives in connection with the SDG process (Sustainable Development Goals) and Post-2015 agenda;
- Advocate for rapid capacity enhancement for soil information collection and monitoring at all levels (global, regional and national).

The importance of soil can be realized by the quotes of Henry **Lin**

Soil, Not Oil, Is Essential to Sustainability

The unsung hero of our planet is quiet, invisible, and hidden underground yet it gives us everyday food, feed, fiber, and fuel.

The underappreciated gift from nature is fragile, sensitive, and complex yet it is the home to the largest biodiversity on Earth.

The crucible of all terrestrial life is fundamental, conservable, but hard to be renewed yet it suffers increasing wounds from anthropogenic impacts.

The hidden half of the world underneath our feet holds a key to global sustainability yet it has no price tag while oil holds extreme high price.

However, it is soil, not oil that feeds the world and controls environmental quality.

Without soil, there would be no life

Without soil, there would be no oil

Without soil, there would be no sustainability.

Let us work jointly so that soil may remain in harmony with environment and society.

Healthy Soils for a Healthy Life

Precision Irrigation: Sprinkler and Drip

O.P. CHOUDHARY

(a) Individual farmers must adopt water conservation and management practices like water harvesting, introducing low cost precision technologies such as laser land leveling and drip etc. to much allocation as closely as possible to crop water requirement. Awareness amongst farmers for natural resource conservation should be encouraged.

(b) Various forms of precision irrigation- mainly sprinkler, drip irrigation systems can increase yield considerably. In South Asia and Africa, very low- cost bucket and drip sets are offering low cost technological to water use efficiency. They deserve a thought on widespread uptake.

(c) Though many states have been facing the problems of water scarcity except a few states, the technology is not popular. 50% of area under drip irrigation lies in Maharashtra. Due to high implementation cost, theft etc. sprinkler irrigation is also not popular.

(d) In the Vidarbha region of Maharashtra, farmers with the help of NGO started using pipes and micro tubes to water their cotton field for a longer time from open shallow wells. Most striking was the use of low grade, light weight pipes used for making ice candy locally called ! pepsi! Which cost less than Rs. 1,000/ acre as compared to micro- irrigation kits that cost Rs. 12,000/ acre and branded drip irrigation systems that cost Rs. 60,000/ acre.

(e) Cost of micro irrigation systems, which are essential for water use efficiency, could be decreased through abolition of taxes, including VAT. Taxes on use of raw material for the manufacture of micro irrigation systems should also be substantially reduced.

(f) Lease financing for micro irrigation by manufacturing firms to provide credit support, as in case of cars, should be promoted.

(g) Full reduction of expenditure for all investments by private sector in promoting dryland agriculture should be provided to supplement Government's efforts in the field.

(h) There should be contracting and sub- contracting of the distribution system in the command areas to bring in greater efficiency in water distribution.

(i) Drainage line treatment should be encouraged.

(j) Irrigation system needs to be modernized to enable delivery of water on demand basis to farmers through pipes based on crop-water requirements.

(k) Since micro irrigation covers only 2.2 million hectares against potential of 62.5 million hectares, the coverage under this system should be accelerated through public- private partnership.

(l) Channels of water from source to field as well as to creation of water harvesting facility needs inclusion in the Micro Irrigation Assistance Package.

(m) Human resource development, both the farmers as well as for manufactures, needs to be promoted for optimum utilization of the potential for micro irrigation.

Fourth Report,
National Commission on Farmers, April,2006

National and International Conferences to be organised

1. 25th National Conference on "Natural Resource Management in Arid and Semi-Arid Ecosystem for Climate Resilient Agriculture and Rural Development" from 17 – 19 February, 2016 at Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan Organised by Soil Conservation Society of India, New Delhi.
2. Global Ravines Conference 2016 [GRC 2016] on "Managing ravines for food and livelihood security" from March 7-10, 2016 at Gwalior, M.P. organized by Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002 Madhya Pradesh, India.

Events Completed

1. Participated in the World Soil Day, 5th December, 2015 is "Soils a Solid Ground for Life" and the theme for the International year of soils – 2015 is "Healthy Soils for Healthy Life" was celebrated on 4th December, 2015, UN Conference Hall – 55, Lodhi Estate , New Delhi – 110003.
2. Global Agri Connect 2015 Conference Cum Exhibition at Hotel Le MERIDEN, New Delhi from 2nd and 3rd November, 2015 organised by National Skills Foundation of India.
3. National Workshop on "Natural Resource Management for Climate Resilient Agriculture in Lower Himalayas" from 22nd and 23rd December, 2015 at Regional Research Station, Punjab Agricultural University, Ballowal Saunkhri, Nawanshahar, Punjab organised by Soil Conservation Society of India, New Delhi.

Two days National Workshop on "Natural Resources Management for Climate Resilient Agriculture in Lower Himalayas" Organized at PAU, Regional Research Station, Ballowal Saunkhri

Two days National Workshop on "Natural Resource Management for Climate Resilient Agriculture in Lower Himalayas" was organized by Regional Research Station of Punjab Agricultural University at Ballowal Saunkhri in collaboration with Soil Conservation Society of India, New Delhi during 22-23 December, 2015. The National Workshop is being attended by scientists, academicians, researchers and students from six Himalayan states of the country. Sh. Kulwant Singh Ahluwalia, a progressive fruit grower and member, PAU Board of Management, while inaugurating the workshop inaugurated the workshop said that lower Himalayas, rich in bio-diversity is being badly affected by the climate change. There is urgent need to develop innovative, economical and adaptable technologies to manage soil and water resources with the sole objective to enhance the rural livelihood dwelling in the region, said Ahluwalia. He stressed upon the integrated farming system approach comprising horticulture and agroforestry as important components being highly remunerative apart from mitigating the adverse impact of changing climate.

Presiding over the inaugural session of the workshop, Dr. D.R. Bhumbla, Former DDG, ICAR stressed on adoption of resource conservation technologies such as laser land leveler, mulching, green manuring, bed planting and use of micro-irrigation systems. He further said that rainwater harvesting and its judicious use for crop production is very important under changing climate scenario. Soil health management was also emphasized keeping in view the

judicious use of chemical and organic sources for major and minor nutrients. Dr. H. S. Lohan, Vice President, Soil Conservation Society of India, New Delhi apprised about the extensive activities taken up by the society for the conservation of the soil and water resources involving researchers and field functionaries to disseminate effective techniques for soil and water conservation in foothill region. Dr. Ashok Kumar, Additional Director of Research, PAU, Ludhiana in his address congratulated the RRS, Ballowal Saunkhri for developing effective technologies for dryland and limited water conditions. He also highlighted the beneficial outcome of the research on natural resource management to mitigate the adverse effects of climate change on agriculture.

Dr. Manmohanjit Singh, Director, RRS, Ballowal Saunkhri & Convenor of the workshop while welcoming the participating scientists from all over the country, hoped that the deliberations will surely pave a way for

addressing the issues for sustainable agriculture and rural livelihood in Himalayan region.

In this workshop, Dr H.S. Sur, Ex Consultant, Planning Commission of India, Dr S.S. Grewal, Ex Director, RRS, Ballowal Saunkrhi, Dr. H.S. Thind, Head Department of Soil Science PAU, Ludhiana, Dr. A.K. Tiwari, Head, Indian Institute of Soil & Water Conservation, Chandigarh center, Sh. K.S. Sandhu, AGM KRIBHCO, Dr. Sanjay Arora, Vice President SCSI, Officers from NABARD, ESRI also participated. Dr. S.S Kukal, Professor of Soil Conservation while, proposing the vote of thanks to guests and delegates on behalf of the organizers informed that three technical sessions will be held during the first day of Workshop where experts would deliberate on maintaining soil health, conservation agriculture systems and watershed management for rural livelihoods with fruitful outcome for sustaining agricultural productivity in changing climate scenario.

The workshop was attended by more than 70 delegates from 6 hilly states of north India where delegates presented and deliberated through lead papers, oral presentations and poster presentations.

Precision agriculture through drone

SURAJ BHAN AND V.K. BHARTI

Precision agriculture refers to the application of precise and correct amounts of inputs like water, fertilizers, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields. Global Positioning Satellite (GPS) technology is extensively used in precision agriculture. GPS allows precise mapping of the farms and together with appropriate software informs the farmer about the status of his crop and which part of the farm requires inputs such as water or fertilizer. The heavy farm machinery used for all the farm and field operations such as sowing, harvesting, weeding, etc. runs on fossil fuels and uses more than 60% of the total energy employed in farming. Besides, the heavy farm machinery also impacts the soil and makes it unproductive. Precision agriculture is ideal for small farms, on the other hand can use small farm machinery and robots which will not impacts the soil and may also run on renewable fuels like bio-oil, compressed biogas and electricity produced on farms by agricultural residues. For small farms, precision agriculture may include sub-surface drip irrigation for precise water and fertilizer application and robots for no-till sowing, weed removal, harvesting and other operations.

The Drones are becoming the eyes and ears of scientists which is widely used for surveying the ground for crop damage, and even providing knowledge about fertilizing, seeding, multi-spectral imaging capacity to farmers who want to maximize their crop yields and reduce the amount they pay for labour.

It is a beneficial technology for states that have digitized land records or are in the process of digitizing. Pictures clicked by the unmanned aerial vehicles can be superimposed on digital maps of states and we can identify farms and crops sown. Drone helps to keep a track on crop position, control farm subsidies, detect pests, monitor nutritional and water stress on the crops, and they can even spray fertilizer and pesticides on the crops from above. The use of this 21st century technology for the sake of agriculture is commendable and it will directly help farmers in the long run.

Drones can provide farmers with three types of detailed views.

(i) Seeing a crop from the air can reveal patterns that expose everything from irrigation problems to soil variation and even pest and fungal infestations that are not apparent at eye level.

(ii) Airborne cameras can take multispectral images, capturing data from the infrared as well as the visual spectrum, which can be combined to create a view of the crop that highlights differences between healthy and distressed plants in a way that can't be seen with the naked eye.

(iii) Drone can survey a crop every week, every day, or even every hour. Combined to create a time-series animation, that imagery can show changes in the crop, revealing trouble spots or opportunities for better crop management.

It is part of a trend toward increasingly data-driven agriculture. Farms today are bursting with engineering marvels, the result of years of automation and other innovations designed to grow more food with less labour. Tractors autonomously plant seeds within a few centimeters of their target locations, and GPS-guided harvesters reap the crops with equal accuracy. Extensive wireless networks backhaul data on soil hydration and environmental factors to faraway servers for analysis. But what if we could add to these capabilities the ability to more comprehensively assess

the water content of soil, become more rigorous in our ability to spot irrigation and pest problems, and get a general sense of the state of the farm, every day or even every hour. Agricultural drones are becoming an effective tool and better data collected by drone can reduce water use and lower the chemical load in our environment and our food.

Agriculture Insurance Company of India along with Skymet, weather forecasting Company, conducted a brief demo in parts of Gujarat to test how drones can be supportive in the agriculture sector. The test led to the conclusion that drones allow the observation of agronomic indicators for every square meter, something a satellite cannot do. Remote sensing through unmanned aerial vehicles allows nondestructive sampling to observe agronomic indicators every square meter.

Farmers in Gujarat and Rajasthan could soon have an unmanned aerial vehicle flying over their fields to survey their crops, helping them map crop diseases along with assisting insurance companies in settling claims.The technology has been in use in the United States and other developed countries to map crop position, control farm subsidies, detect pests, monitor nutritional and water stress on crops, and even spray fertilizer and pesticides on crops.

Skymet, along with the AIC and Gujarat government, used satellite remote sensing technologies and dronesacross 10 villages in *Morbi* district of Gujarat last year.Satellite's resolutions are less and if a cloud cover comes, then you can't use the images. At a time when land holdings are less and there is multicropping, this technology help Gujarat government in monitoring of the agriculture area and crop yield. The data could help AIC in giving farmers claims.

Drones are now a leading technology in agriculture and set to invade agricultural world. By 2025, "agriculture drones" (farming drones) are expected to take up 80% of the commercial UAV market and generate 100,000 jobs according to a report by the Association for Unmanned Vehicle Systems International. After their successful debut in high-tech war against terrorism in strife-torn areas in the world, now they are coming to the aid of farmers. Agriculture drones are unmanned aerial vehicles (UAV) used for *precision agriculture*, a modern farming method that relies on big data, aerial imagery and other means to optimize efficiency. After the drone collects images of the farm and makes a map that color-codes its areas by their health, the UAV Company analyzes them for the farmer.

When land holdings are less and there is multi-cropping, they will be able to help in monitoring agricultural area and crop yield. The data could help Agriculture Insurance Company in giving farmers their insurance claims. It can be used to check the quality of crop. Health Imaging system, you can view composite video showing the health of your crops. It can be used to spread pesticide on a field. Many countries are using UAV (Unmanned Ariel Vehicle) for precision farming. It can also help in assessing the exact nature/area of crop damage during natural calamities, saving precious time & money.

When commercial drone will be used at common places, it will open new employment opportunity and innovative ideas. Agricultural applications will be one of the most important and popular uses of drones in terms of providing knowledge about fertilizing, seeding, multi-spectral imaging capacity to farmers who want to maximize their crop yields and reduce the amount they pay for labor. Drones will enhance farmer's ability to obtain and utilize multi-spectral and hyper-spectral imagining to detect issues with crops before they harm crop yields. Drones also have the ability to autonomously lay seeds, fertilize soil, and spray pesticides. Since drones will be able to fly at low altitudes too low for manned vehicles, the spraying of pesticides can be more exact, resulting in more precise spraying with less drift beyond the limits of the field sprayed.

"Soil anaemia also breeds human anaemia. Micronutrient deficiency in the soil results in micronutrient malnutrition in people, since crops grown on such soils tend to be deficient in the nutrients needed to fight hidden hunger."

M.S. Swaminathan
Source: www.fao.org

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