Brainstorming Session on Regenerative Agriculture for Soil Health, Food and Environmental Security

Concept Note

Background

Regenerative Agriculture (RA) is a comprehensive system of farming practices that focuses on regenerating topsoil to restore degraded soil biodiversity, rebuild soil organic matter, improve water retention and nutrient uptake, and reverse the climate change while allowing farmers to maintain productivity growth, and ensure bio-sequestration of organic carbon (OC) and farm income. It helps in climate mitigation by removing carbon dioxide out of air by fixing it in aboveground crop biomass and depositing in the soil organic carbon (SOC) pool. Fundamentally, RA 'does no harm' to the land, rather improves it, using innovations that regenerate and revitalize the soil and environment through conservation agriculture (no-till, soil cover, crop diversification) along with emphasizing on increased use of compost/animal manures and recycling waste to ameliorate soil biology, regulating grazing, mixed cropping/intercropping, etc. leading to healthy soils to produce nutrient rich and high-quality food. Globally, RA is being propagated as a holistic approach for improving soil and environmental health and increased biodiversity leading to productive farms, healthy societies and better economies of the farming community.

During the twentieth century, the low yield indigenous nature-based agriculture transformed progressively into new high intensity, energy-demanding and productivity-led agriculture called industrial farming to cater food demands of burgeoning population. The exceptional productivity surge of mid 1960s - popularly known as Green Revolution (GR) - was the response of dwarf varieties and application of high intensity energy-centric input technologies including irrigation systems and chemical fertilizers. This development transformed India's image of a begging bowl to food self-sufficient country. This rosy response to intensification seemed, however, transitory since growth in food production gradually became unsustainable. The compound rates of growth that peaked at about 3 per cent at initiation of GR plummeted to less than one half within three decades due to dip in partial factor productivity (PFP) of GR inputs like irrigation water, agro-chemicals (inorganic fertilizer nutrients) and energy. This brought to fore the concerns on falling farming efficiency and farmers' income. Further, the infusion of improved genotypes was found inadequate to arrest rate of productivity fall. Also, the industrial agriculture became less productive, profitable, and resilient and more unsustainable due to factors like: i) exclusive reliance on high yielding varieties (HYVs) causing depletion of biodiversity, ii) overdependence and misuse of agrochemicals leading to neglect of nature -based recycling as manures, residues, etc., iii) repeated tillage diminishing soil organic carbon (SOC) and physical health,iv) selective focus on increasing fossil fuel energy spurring global warming, and v) misuse of irrigation water driving surfacing of secondary soil health problems as salinity.Overdependence on chemical inputs and intensive tillage-based management practices along with limited use of native manures, led to soil health problems in all its elements (fertility, integrity, biology), plateauing SOC, depleting biodiversity, plummeting productivity growth lowering farm profitability and high greenhouse gas emission. The climate change, in one or the other way, is the economic and environmental

aftermath of diminishing soil health and land degradation. Above all, sustaining soil health is a powerful link to reach the goal of 'One Health' concept proposed by One Health Commission[1]. Incidentally, 'One Health' recognizes that optimum well-being of people is intensively connected to optimum health of soil as on it depends the peak health of animals, food plants, and their shared environment. Overall, RA is a holistic approach to achieve "One Health" objective by integrating and building on the components of conservation agriculture, organic agriculture, LISA, etc.

Soil Health and SDG Challenges

Since early 1970s, the above adverse events resulted in world-wide loss of 75 billion tons of fertile topsoil annually[2], corresponding figure for India being 5.4 billion tons; global warming roughly at a rate of 0.15 to 0.2^0C every 10 years since 1975[3]; a risk of extinction of one third of terrestrial plants since 1950. Whether it is weakening of soil health due to erosion of topsoil, climate change due to global warming or reduction in biodiversity coming in the wake of these negative developments; emerging threat is the disruption in the fundamental services that land ecosystem provides to humanity. These events endanger incessantly the prospects of needed growth in food grain production from a nearly non-expandable cropland area. For instance, annually: man's injudicious use of inputs and mismanagement of land continues to degrade quality of ~ 240,000 ha farm area in India[4]; comparable global figure is 12 mha[5]. Translated into food grain production, land degradation deprives India and world annually of ~0.36 million tons[6] and ~ 20 million tons, respectively[7]. In 2014-15, India lost about Rs 3.2 billion– (equivalent of 2.54% of GDP), to land degradation and land use change[8].Global Environmental Change Agency revealed that the total value of the World's Ecosystem Services provisioning amounted to twice as much as global aggregate GDP – US$124.8 trillion per year[9]. Keeping in view the global dimensions of influence of land degradation on food security and sustainable development of agriculture, a multi sectoral and transdisciplinary collective action across nations is necessary. Otherwise, within 50 years, apart from damaged food supply, the world (India included) will suffer with poor nutrition and loss of vital trace elements. Without protecting, regenerating, and securing the quality of soil on the top of ~ 1.6 billion ha cropland area, 3.2 billion ha pasture land, and 4 billion ha forest land, it will be impossible to meet the SDG targets by 2030 on feeding the world (SDG 2), reaching the goal of land degradation neutrality (SDG 15), maintaining aquifers in sound health (SDG 6), keeping global warming below 2^0C (SDG 13), or halting the loss of biodiversity[10]. India has committed to restore the health of 26 mha of its degraded land by 2030, informed Hon'ble Prime Minister Shri Narendra Modi during the 14th COP[11]. In fulfilment of the purpose of sustaining the quality of existing/recovered land, FAO emphasized that "Agriculture must, literally, return to its roots by rediscovering the importance of healthy soil, drawing on natural sources of plant nutrition, and using mineral fertilizer wisely" [12].

RA for Soil Health: CA is an immediate steppingstone

In India where growing population (annually ~17 million out of world's ~90 million) is to be fed from a non-expanding land area, hunger and malnutrition are the other prevalent problems in the society. India has slipped from 95th rank to 102nd rank in hunger index during the past one decade. Unquestionably, a healthy soil is the driver that props present and future of sustainable growth of agriculture, food security and balanced nutrition to the society. In turn, SOC stocks regulate soil health and maintaining a reasonable level of SOC improves soil health and consequently helps crops to grow to their maximum productive capacity with favorable economics – the first pillar of sustainable agriculture. It also enhances the innate ability of soil ecosystem of provisioning environmental services to farmers and farms (e.g., regulating nutrient and water cycles, containing climate change, filtering contaminants, bio-sequestration for maintaining biodiversity) – the

second pillar of sustainable agriculture. A healthy soil is also the mainstay for nutrient dense food production. Therefore, restoring the soil health is important for sustainable and nutritional food production system.

For improving soil health and reversing the negative trends of industrial inputs, GOI is promoting various natural farming practices such as organic farming and Zero Budget Natural Farming (ZBNF). It is an agricultural practice that espouses natural growth of crops without adding any agro-chemical. Mainly, cow dung plus urine-based decoctions smeared on seed or applied to soil replace fertilizers. Low Input Sustainable Agriculture (LISA) proposed by the USDA during 1980s seeks to optimize the management and use of internal production inputs (on-farm resources) and to minimize the use of off-farm resources (fertilizers) as is feasible and practicable to lower production costs and save the health of soil. More recently, FAO promotes sustainable agriculture via induction of CA[13]. Tenets of CA - zero till, diversification, and residue mulching, parallel, *albeit* partially, the proposed scheme of building bridges between industrial and conventional nature-based models of farming. Proposition on zero till corresponds to minimum tillage followed in nature's way of farming with under-developed tools. Both systems depend on organic cover (mulching) as in either case crop residues are left to shield soil from forces of degradation (mainly erosion). Crop diversification in CA refers mainly to legume intercrops raised between monocrop rotations. In pristine way of farming mixed cropping – raising together of several crops varying in duration and stature, resuscitates soil health as an intercrop does. Additionally, latter provides multi-strata soil cover which lasts longer and is thus more effective against erosion. Diversification *via* multiple cropping is also a tool moderating adverse consequences of unknown biotic/abiotic stresses. Though application of CA ensures being 'non-degradative' of natural resources, it does not necessarily guarantee of restoring of those[10]. It is, thus, the integrated farming system (combining crop cultivation and livestock husbandry) of the indigenous agriculture inculcating the conservation agriculture principles that can make incredible contribution to auto rejuvenation of soil and environment as well as providing nutritious food. A harmonious blend of chemical inputs based industrial agriculture techniques and natural sources blended with indigenous farming methods would be a better option. Infusion of holistic application methods as part of this alliance is the essence of a proposed scheme of 'modern day nature's way of farming' *aka* 'sustainable agriculture'. This approach is possibly seen to ensure required growth in food production without compromising soil health or land quality. At the root of this new normal is sustenance of healthy soils, which fundamentally support sustainable intensification along with nutritious food to the society. The RA shows a way forward of integrating the CA with integrated farming system and develop a hybrid model between industrial and primitive agriculture which is more sustainable and will provide better nutrition to society.

Regenerative Agriculture: Way Forward

The RA, a new integrated farming concept inspiring ecological enhancement is being espoused. It was proposed for the first time in early 1980s by the Rodale Institute[14].The RA is a process that focuses specifically on restoring health of soil ecosystem that has been degraded, damaged, or destroyed by successive application of industrial agriculture technologies. The RA approach does neither exclude use of industrial or chemical inputs nor it undermines the effectiveness of CA practices. According to Rhodes[15], RA is a method of farming that improves the resources it uses, rather than destroying or depleting them. An outstanding feature of RA is the integration of crops and livestock farming, which are otherwise treated separately by the modern agriculture. In essence, depending upon the dominance of a production system specific to an agro-eco-region, RA combines individual components of CA plus integrated farming by adopting regulated grazing, mixed cropping, organic farming, and necessary use of purchased inputs. With emphasis on

building soil biology for C farming, RA focuses on right-tracking C, N, and water cycles. Dr. David Johnson of New Mexico State University - a strong proponent of RA, stresses that RA is a way of C farming as it helps capturing atmospheric C and sequestering it in soil. Research published by him and his colleagues show: "a 4.5-year agricultural field study promoted annual average capture and storage of 10.27 metric tons soil carbon/ha/year while increasing soil macro-, meso- and micro-nutrient availability offering a robust, cost effective carbon sequestration mechanism within a more productive and long-term sustainable agriculture management approach."[16]. In simple terms, sequestration of 10.27 tons of carbon translates into an SOC growth of 0.514%/ha/year; an exceptionally high rise of SOC ! In pursuance of these goals and depending upon matching of biophysical attributes of NRs and socio-economic situation of farmers, selected version of a RA system combines all or some practices listed as i) zero/minimum tillage, ii) maximum-time soil-cover (longer rotations involving agroforestry, cover/inter crops, live or synthetic mulches, relay cropping), iii) high crop diversity index farming (no monocropping, mixed/multiple cropping), iv) organic farming (exclusive use of organic inputs in farming practices), v) building soil microbial diversity (regular compost/manure application, microbial inoculants, turning of crop residue, mixed cropping, integrated farming), vi) integrate livestock and livestock-based products and cropping (specific to rainfed areas, rotational/regulated grazing, livestock pen/holding paddock, in irrigated regions infusion of legume fodders or dual-purpose cash legumes as intercrops),vii) encourage water percolation (for minimizing water logging and maximizing groundwater recharge, reducing compaction), and viii) rationalized/minimized use of synthetic inputs.

Multitude of practices constituting RA points out that one size would not fit all farming conditions and state of farmers. Also, choosing from a bouquet of practices facilitates transformation of RA paralleling the goal and vision of an expanded food production system (site-specific alliance of crop agriculture, organic farming, horticulture, dairying, fishery, etc.) for food, nutrition, and livelihood security. Accordingly, the choice of all or some among the practices listed above will have on the one hand, to be sensitive to varying locations (biophysical attributes of land and climate) supporting a production system and farmers' situations (socio-economic state). Hence, an expanded food production system, representing RA must serve the cause of soil health provisioning of food that is available in sufficient quantity, is accessible, affordable, nutritious, and is achieved without any cost to NRs/environment. However, it is also true that there is insufficient experimental data to conclusively confirm their accrual on quantitative and temporal basis.

A Brain-Storming Session

In view of above, the Trust for Advancement in Agricultural Sciences (TAAS), New Delhi, a neutral 'Think Tank', in collaboration with the Indian Council of Agricultural Research (ICAR), National Academy of Agricultural Sciences (NAAS), International Maize and Wheat Improvement Center (CIMMYT), and International Fertilizer Development Centre (IFDC), planned to organize a Brain-Storming Session on **"Regenerative Agriculture for Soil Health, Food and Environmental Security" on 26 June 2021**. About fifty diverse stakeholders including science leaders, NR/social/animal scientists, functionaries of development departments, NGOs, farmer representatives are expected to participate and deliberate on this important issue.

Objectives

- To discuss potential role of organic farming, zero budget natural farming (ZBNF) and conservation agriculture (CA) towards regenerative agriculture (RA) so critical for improving soil health, mitigating climate change and long-term food security
- To assess the expected returns (social, economic and environmental) over the investments towards AR4D on RA
- To have better understanding for prioritizing R&D efforts on modern and traditional agricultural practices that contribute to RA

Expected Outputs

- Regenerative Agriculture (RA) well defined that ensures higher agricultural production in the long- term
- A Road Map developed for efficient and integrated RA which helps in sustainable use and management of natural resources (soil, water, biodiversity, and environment) so critical for our food, nutrition, and environmental security

Organizers

- Trust for Advancement of Agricultural Sciences (TAAS)
- Indian Council of Agricultural Research (ICAR)
- National Academy of Agricultural Sciences (NAAS)

Co-Organizers

- International Maize and Wheat Improvement Center (CIMMYT)
- International Fertilizer Development Centre (IFDC)

Participants

About 50 participants from the National Agricultural Research System (NARS), CGIAR Centers, scientific societies, private sector, Ministry of Agriculture and Farmers' Welfare (MOA&FW), NITI Aayog, civil society organizations (NGOs, FOs), entrepreneurs and policy makers are expected to attend.

Venue

Webinar

Date and Time

26 June 2021; 3.00-7.00 PM

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