Mooting one per 1000 policy initiative to rejuvenate coconut soils

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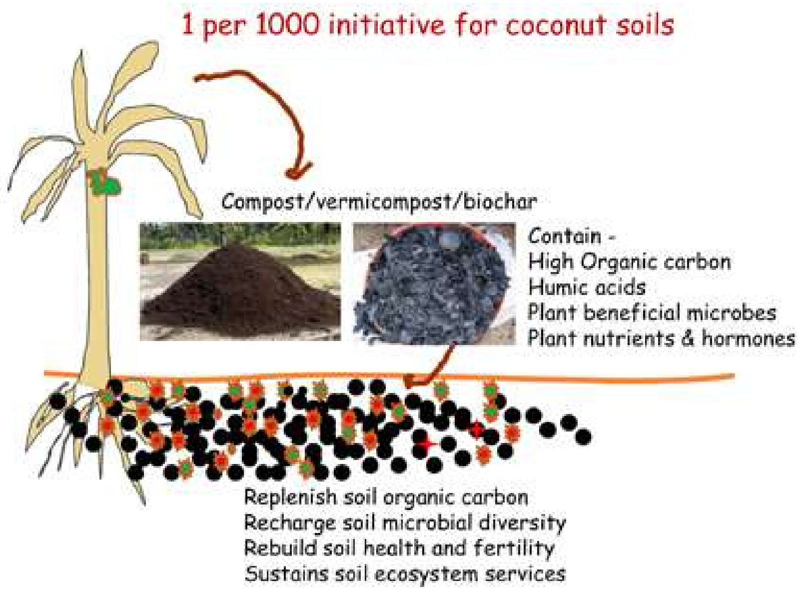
Coconut cultivation and soil organic carbon

Coconut palm is widely grown in coastal and hinterlands of India where the soils are predominantly characterized with low organic matter and thus, poor organic carbon. The soil organic carbon (SOC) content is a good indicator of soil fertility as it is directly related to nitrogen supplying capacity of the soils (Baert and Van Rast, 1998). The SOC also is the food for millions of diverse soil microorganisms and correlates to the soil microbial biomass content which is a key driver of the soil ecosystem services (Gopal et al., 2013). Higher SOC helps soil to retain more plant nutrients and water while it improves the soil physical parameters for better root growth resulting in good crop stand. In an elaborate study conducted in Kerala where the area under coconut is highest in India, it was reported that the soil organic carbon was low (below 1 to 0.5%) in surface soils and lesser (mostly <0.5%) in sub-surface soils (Nair et al 2018b). Low SOC coupled with sub-par pH are some of the main reasons for poor coconut productivity of about 40 nuts palm-1 year-1 in India (Jnanadevan, 2013; Nair et al., 2018a). Studies in some parts of southern Karnataka have also shown that the organic carbon content ranged between 0.10 to 1.49% with electrical conductivity (EC) ranging between 0.01 to 0.22 dS m-1 indicating low status of anions and cations which are critical for nutrition of coconut palms (Avinash et al., 2019).



Low productivity could drive millions of Indian coconut farmers to extreme distress as they depend on this crop for their livelihood. Future of several industries that require essential raw material from coconut palm could also become bleak because of poor coconut productivity. The humid tropic conditions prevailing in coconut growing tracts hasten the loss of soil organic carbon due to high temperature and humidity. Moreover, heavy and ill-distributed monsoon precipitation influenced by climate change also adds to loss of soil organic carbon due to erosion of precious top soil. The 2018 floods in Kerala had indicated an increase in 80% rate in soil erosion with low organic carbon being one of the main reasons for the high soil erodibility factor K in the range of 0.10 to 0.17 (Chinnasamy et al., 2020). Senility of one-thirds of the palms in Kerala and 20% of palms in India acts as a compounding factor driving to poor nut productivity (Murthy, 2017). Overall, coconut cultivation is beset with multiple challenges that hinder the overall production and productivity of the palm.

Keeping soil alive

This year's World Soil Day-2020, themed 'to keep soil alive' and 'protect soil biodiversity' through enrichment of soil organic carbon and micro/macroflora and fauna is but the right time for proposing a policy initiative to recharge the organic carbon content of soils of coconut cultivated throughout India. The long standing committed work and awareness creation of Prof. Rattan Lal, Ohio State University, USA for rejuvenating the soil through improving soil organic carbon which fetched him The World Food Prize-2020 caught the attention of the world of the organic carbon as the currency for sustaining soil's crop production ability. In line with Prof. Lal's tenet and the pioneering International initiative of France to improve soil organic carbon through the '4 pour 1000' programme (4‰ i.e., improvement of 0.4% carbon year-1) (www.4p1000.org/), a modest 1 per 1000 (0.1% carbon year-1) increment of soil organic carbon can be planned and executed for coconut soils in India. Because, even a small increment of 1 mg C ha-1 in organic carbon pool in root zone of crops has shown to increase yields by 20-70 Kg ha-1 for wheat, 10-50 Kg ha-1 for rice and 30-300 Kg ha-1 for maize (Lal, 2006). In other words, if the soil organic carbon pool can be increased above critical level (10-15g/kg soil), it will help significantly in restoring the soil's crop production ability (Lal, 2015).

Returning carbon to soil through coconut residue management

There is a good scope for implementing 1 per 1000 in coconut farming, because, coconut palm, grown in about 2 million ha in India is known to generate close to 25 million MT of highly recalcitrant lignin-rich biomass residues annually. ICAR-CPCRI has developed pioneering recycling technologies of the recalcitrant biomass residues from coconut such as vermicomposting of coconut leaves (Prabhu et al., 1998; Gopal et al., 2019), urea-free coir-pith composting (Thomas et al., 2013; Gopal et al., 2016), biochar production from different residues of coconut palm (Gopal et al., 2020) and presently standardizing tender and mature coconut husk composting. The final products of the recycling technologies are rich in organic carbon (above 20%), above 6.5 pH value and possess wide diversity of microbiota. For example, coconut leaf vermicompost was found to have rich and diverse populations of plant beneficial microbiota when analyzed by culture-dependent (Gopal et al, 2009) and next-generation 16s rRNA sequencing method (Gopal et al., 2017); its application had clearly showed temporal enhancement in soil microbial community, microbial biomass and nutrient availability (Gopal et al., 2010, Gopal et al., 2012). Being an output from lignin-rich biomass, the manures/biochars have the ability to add less easily decomposable organic carbon leading to higher carbon sequestration in soil. Application of FYM+vermicompost+coir-pith compost along with vermiwash spray and Azotobacter has recently been reported to enhance significantly the carbon sequestration potential in coconut based cropping system (Naveen Kumar and Maheswarappa, 2019, Shinde et al., 2020). The microbiome addition via manures takes care of widening the microbial diversity of the soil as well as improving the soil ecosystem services (Gopal et al., 2010; Khadeejath Rajeela et al, 2016; Gopal et al., 2020). The manures are also an important source of macro and micronutrients as well as plant growth promoting hormones, albeit in lower quantities. They improve the water holding capacity of the soils which results in better water retention and aid in drought management. Several studies in CPCRI have confirmed the above qualities of the manures/biochars produced by recycling of the coconut biomass residues. Thus, adoption of the recycling technologies will help coconut farmers in multiple ways: improve critical organic carbon content in soil, enhance yield of coconut palm in sustainable manner, keep area clean which helps to reduce pest and pathogen load resulting in improved economic returns.

1 per 1000 initiative to rejuvenate coconut soils

With this background, it is not implausible to moot the 1 per 1000 (0.1%) annual increase in organic carbon in coconut soils through the application of recycling technologies developed by ICAR-CPCRI as mentioned above. This can be initiated through the collaborative efforts of ICAR-CPCRI, Coconut Development Board (CDB), local government agencies including Start-up mission, non-profit organizations and coconut farmers. To run a pilot programme, Farmer Producers Company (FPO) can be selected to implement the 1 per 1000 initiative. It will broadly involve the following important steps:

i) aggressive awareness creation in coconut farming community regarding the knowledge on soil organic carbon (SOC) and its importance to coconut cultivation and productivity,

ii) generate benchmark values of organic matter and organic carbon content of coconut soils in selected FPO garden using advanced analytical procedure,

iii) develop integrated soil maps of plant-nutrients and microbial indices to demarcate the low, medium and high SOC tracts of coconut,

iv) correlate the yield and quality (oil and tender coconut water) parameters of the coconut in the different SOC tracts,

v) initiate 1 per 1000 strategy to improve the SOC content of coconut soils as a mass movement taking advantage of the palm-residue recycling technologies developed by ICAR-CPCRI,

vi) Periodic estimation of organic carbon (long term carbon) along with soil properties (nutrient and microbiological) post implementation of 1 per 1000,

vii) Correlation of nut yield with the improvement in soil organic carbon,

viii) Developing a coconut carbon bank passbook for the FPO.

To begin with, the 1 per 1000 initiative can be implemented for three or five years on project basis with funding from the Government. This will help coconut farmers realize and experience the importance of adding organic matter for improving the overall soil ecosystem services. Then onward, to adopt it voluntarily by FPOs, an incentive based approach should be espoused to promote the 1 per 1000 drive. Good incentives by the Government in the form of PES (payment to ecosystem services) to FPO which can show best improvement in carbon bank pass book records (validated by empirical data) will help to convert the initiative into a movement. This initiative will also help establish decentralized production of quality organic manures via recycling of coconut biomass residues, improve the cleanliness of coconut gardens and impact the overall health of society in a positive manner. Thus, the 1 per 1000 needs a policy push for implementation and adoption by coconut farming community which will help Indian agriculture and the farmers to achieve food security in an environmentally sustainable manner. ■

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