Jawahar Nagar got submerged under several metres of water. The real blame should go to unchecked urbanization and absence of surface and subsurface drainage rather than only to heavy rainfall. Imagine the benefits, if the local government would have spent a tiny fraction of the relief packages and the management cost in cleaning up the clogged drains, improving drainage and empowering communities to protect themselves. Only a few days ago, I saw the whole of the road network of Kaushambi in Ghaziabad under a thick carpet of running sewerage. This was waiting to happen because of the non-functional sewers, clogged drains, and the ugly spread of solid waste and construction debris all over. Despite this, 10 out of 10 people I spoke to, failed to see their own blunders and placed the blame squarely on the heavy rain that lashed the area just for a few hours. And the life in Kaushambi once again became normal as the flood waters receded!

As I begin to conclude this piece, I am reminded of the famous 80/20 principle – the secret of achieving more with less. Richard Koch, a British investor, wrote a whole book on it, attributing the principle to the Italian economist Vilfredo Pareto. Pareto had proposed a mathematical formula to conclude that 20% of the people in his country owned 80% of the wealth. Inspired by Pareto, Joseph M. Juran gave the slogan 'vital few and trivial many'.

Disaster managers in most developing countries seem to mistake small as trivial. Further, they chase 'trivial many' at the expense of the 'vital few'. We will be able to find lasting solutions, if we learn to fight small problems on a day-to-day basis and all big problems on a war footing until the war is won. In the process, we must reject cosmetic, populist and outmoded technologies and grow the culture of safety, innovation and speed effectiveness in our actions.

In John Steinbeck's last novel *The Winter of Discontent*, he writes 'I shall revenge myself in the cruellest way you can imagine. I shall forget it.' We have suffered disasters far too long and the time has come when the blood in our hands will not allow us to forget disasters any more. Let us all pay homage to the victims of the great flood tragedy in Kashmir by declaring 2015–2024 as the decade of Disaster Prevention in India. By the end of the decade, we must aim to achieve the shift of national focus on prevention, preparedness, capacity building and timely corrective action. If we show zero tolerance against mindless urbanization and ensure fully functional network of drainage, at least 80% of our flood problems will vanish at 20% of the money spent on relief, rescue and reconstruction.

R. K. BHANDARI

e-mail: rajmee@yahoo.com

Biochar as carbon negative in carbon credit under changing climate

Biochar, also called soil conditioner or zero waste, is a carbon-rich charcoal-like substance formed by heating the biomass in limited oxygen condition by a process called 'pyrolysis'. Greenhouse gas emission is reduced by the conversion of biomass to biochar as this process locks up the carbon from the biomass into the biochar and thereby delaying the release of this carbon back to the atmosphere. If biochar produced is buried into the soil for carbon credits and crop enhancement, pyrolysis process can be carbon negative. Annual net emissions of carbon dioxide, methane and nitrous oxide could be reduced by a maximum of 1.8 Pg CO_2–C equivalent (CO_2–Ce) per year (12% of current anthropogenic CO_2–Ce emissions), and total net emissions over the course of a century by 130 Pg CO_2–Ce, by utilizing the maximum sustainable technical potential of biochar to mitigate climate change, without endangering food security, habitat or soil conservation[1]. If a pyrolysis facility is financially viable, then the potential revenue from C emissions trading alone can justify, optimizing the plant to produce biochar for application to the land[2].

When the use of the process of biochar sequesters more carbon than it emitted, it is carbon negative. Biochar holds 50% of the carbon biomass and it sequesters that carbon for centuries when applied into the soil, removing the CO_2 from the active cycle and thus reduce overall amount of atmospheric CO_2. Plant growth is also enhanced by this process as it absorbs more CO_2 from atmosphere. Overall, these benefits make the biochar process carbon negative as long as biomass production is managed sustainably. Biochar system also needs to be taken into account, viz. emissions resulting from biomass growth, collection, pyrolysis, spreading and transport, to consider it a truly carbon negative. Due to its capability to actively reduce the atmospheric concentrations of greenhouse gases, biochar technology may be considered as geoengineering solution. It may also be considered as a long wave geoengineering option for climate change mitigation as it plays a role into the removal of CO_2 from the atmosphere and enhances the level of long wave radiation leaving from the planet. A biochar system is a carbon sink, where agricultural crops are grown and is subsequently pyrolysed to produce biochar, which is then applied to soil[3]. This means that CO_2 from atmosphere is sequestered as carbohydrates in the growing plants and that conversion of the plant biomass to biochar stabilizes the carbon. The stabilization of carbon in biochar delays its decomposition and ensures that carbon remains locked away from the atmosphere for hundreds to thousands of years. In addition, biofuels can also be made by utilizing the gases released during biochar production. In carbon cycle, plants remove CO_2 from atmosphere via photosynthesis and convert it into biomass. But all of that carbon (99%) is returned to atmosphere as CO_2 when plants die and decay, or immediately if biomass is burned as a renewable substitute for fossil fuels. In biochar cycle, half (50%) of that carbon is removed and sequestered as biochar and the rest half (50%) is converted to renewable energy co-products before being returned to the atmosphere. The carbon cycle which makes biochar carbon negative is shown in Figure 1.

A carbon offset credit is a payment made by an emitter of carbon (a power plant, mine, oil refinery, etc.) to the developer or owner of a carbon sequestration process (owner of a forest reserve, biochar project developer, etc.). Carbon credits which are sold by sequestering carbon in biochar are economically competitive[4]. Application of higher amounts of biochar to the soil may increase the carbon credit benefit to the farmers. Carbon which is applied to the field in the form of biochar could provide the farmer carbon credits that could be sold in a C credit market for additional income[5].

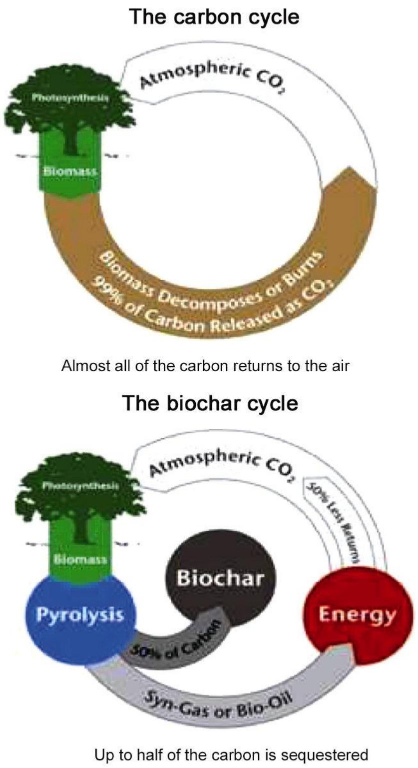

Figure 1. What makes biochar carbon negative[6].

Increasing the C sink in soil will help reduce the amounts of CO_2, CH_4 and N_2O emission in environment. Increased soil aeration from biochar addition reduces denitrification and increases sink capacity for CH_4. Biochar is able to reduce N_2O emission due to inhibition of either stage of nitrification and/or inhibition of denitrification, or promotion of the reduction of N_2O. Indian government initiatives may allow the farmers and land managers to earn carbon credits by reducing greenhouse gas emissions and storing carbon in vegetation and soil through changes in agricultural and land management practices (carbon farming). Besides this, it may also allow Indian agricultural landholders to generate offset credits from activities that reduce emissions or sequester carbon, including biochar application (carbon farming initiatives). The huge emitters will be able to utilize credits generated through the carbon farming initiative to meet their emission reduction targets. Huge volume of crop residues are produced both on-farm and off-farm in India. Most of the wastes are either burnt or end up in landfill, which produces large amounts of GHGs and also degrades the environment. The production of biochar from farm wastes and their application in farm soils may offer financial and environmental benefits. Once environmental cost of carbon-based greenhouse gas emission have been suitably internalized, we can expect market forces and the price mechanism.

Assuming that the science of biochar addition in soil is 'unambiguously beneficial', the soil scientists support the view that agriculture should be rewarded for carbon sequestration through biochar. However, before considering biochar eligible for any kind of carbon credit, the exact volume of carbon sequestered, and for how long, has to be verified. If a carbon market that recognizes the avoided emissions and carbon sequestration due to the application of biochar to agricultural soils exist, then the market price of biochar will be low enough for a farmer to earn profit by applying biochar to the crop field, and then biochar will start being promoted as a technology for carbon sequestration in India.

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SHAON KUMAR DAS*
R. K. AVASTHE
RAGHAVENDRA SINGH
SUBHASH BABU

ICAR Research Complex for NEH Region,
Sikkim Centre,
Gangtok 737 102, India
**e-mail: shaon.iari@gmail.com*

Research and policy disconnect for heat wave deaths in India

India has a large population extremely vulnerable to heat wave-related deaths. Climate change weather projections highlight increasingly hot temperatures with increase in frequency, intensity and duration of heat waves. Additionally, the projected increases in atmospheric humidity will contribute to the difficulties in adjusting to increased temperatures. Heat stress indices like wet-bulb globe temperature (WBGT) and Humidex place a premium on atmospheric humidity in the estimation of thermal comfort. In the US, mortalities due to heat waves currently outnumber deaths due to all other climate change weather-related deaths combined. The recent IPCC report on adaptation paints a grim future picture with parts of the world experiencing temperatures exceeding physiological limits, making it impossible to work or carry out other physical activity outdoors. This risk will be borne by poor and disenfranchized groups, on poor countries, and/on poor children[1]. For an effective adaptation response, they call for disease surveillance, and strengthening the resilience of health systems to extreme weather events[2].

Limited studies have been done analysing heat wave-related mortalities in India and most of the information is from newspaper reports. International studies, however, show far higher mortalities at much lower temperatures than those routinely found in heat wave situations in