Mapping UNSW Impact

Global Development

Primary SDG	**15: LIFE ON LAND**
Broad theme	Burning waste to create soil fertiliser
Research	Converting biowaste, such as rice husks, chicken or yak manure, into biochars, a rich source of carbon for soil and crops
Impact region	Nepal, Tibet, Vietnam, Ethiopia, Rwanda, Dubbo (NSW)
Faculty	Science
School/Institute	School of Materials Science & Engineering
Academics	Paul Munroe, Stephen Joseph (Visiting Professor, non-paid)
Project partners	Norwegian Institute of Bioeconomy Research, Lanzhou University, Nanjing Agricultural University
Related SDGs	14: Responsible Production and Consumption
	3: Good Health and Wellbeing

Elevator pitch

UNSW research has developed the science to burn waste from animal poo and leftover crops to create biochars, a rich, soil fertiliser that makes arid soil farmable and can help to reclaim degraded land in developing countries where rising populations are pressuring food supplies.

The Challenge: How can we turn lacklustre soil into crop-producing soil?

Soils in developing countries, like Nepal and Vietnam, often lack fertility. Over-farming, high rainfall, and drought are common causes of soil degradation. Populations in these countries are expanding, increasing the pressure on food supply. More farming land is required but poor soil quality limits options for farmers.

Using traditional farming techniques, some native famers burn waste from crops or plants to create carbon-like ash that is then seeped into soil to increase its fertility. These techniques typically create a lot of smoke and produce varying degrees of fertility, depending on the cooking techniques used and the kind of waste burned.

At the same time, farmers are often faced with large amounts of waste from animals or crops. Waste is often heavy with water, making it costly to transport and difficult to manage. It is usually left on the land or moved to a part of the farm out of the way to slowly erode.

UNSW's solution: Create biochars out of natural waste that fertilises soil for up to 100 years

Inspired by age-old fertilising techniques and its potential for arid soils around the world, Stephen founded the biochar research field in 2002. Given the type of waste being burnt determines the quality of the biochar, Stephen teamed up with Paul in 2007, an expert in electron microscopy, and the two developed a process to test and improve biochar quality in new countries where different kinds of waste and materials are available.

To create a biochar waste, such as animal poo, bamboo, rice husks, tea clippings and algae, is cooked in a stove, or pyrolysis chamber, at 400-500 degrees without oxygen for two hours. The result is a mineral-rich form of charcoal called a biochar.

When placed in the soil, biochars are an effective form of carbon sequestration that enrich soil for the next cropping soil and potentially the next 100 years. Minerals, such as iron oxide or calcium-rich clays, can be added to the heating process to create supercharged biochars and super crops.

The Impact: Improve soil fertility anywhere, restore and reclaim degraded land

Biochars not only produce better crops and reduce waste on the land, they can restore degraded land and provide incentives for reforestation in developing countries. When applied to soil in China laden with heavy metals at dangerous levels, biochars produced by Paul and Stephen reduced the presence of lead and other harmful elements, making the soil healthy to farm.

Because a broad range of waste can be used in the pyrolysis process, the biochar technique can be used anywhere in the world. Once setup, Paul and Stephen can modify and add properties to maximise the quality of the biochars. Established contacts with key organisations, like the World Bank and NGOs, enable them to quickly identify areas that need the most help and get small-scale projects up and running.

Researchers

Professor Paul Munroe is Head of the School of Materials Science & Engineering and former Director of the UNSW Electron Microscope Unit. While Paul prefers to stay close to home, Professor Stephen Joseph enjoys being out in the field working directly with disadvantaged communities and the NGOs and organisations supporting them. Stephen has a BE in Metallurgy and is PhD graduate from UNSW's Built Environment faculty. He received an Order of Australia medal in 2017 and has been visiting academic at UNSW since 2007.

Ben Falkenmire 11.09.17