My name is John Culpepper and I am a co-founder of Compost for Good. Our primary mission is to help individuals, businesses, organizations, and communities upcycle their food scraps and other organics. Our work is primarily focused at the community scale, somewhere between the backyard composter and large commercial/industrial operations. We work with people from many parts of the United States and others around the world.

As a side project we are also working on ways to convert human urine and a carbon source into a biologically complete compost that could have a significant impact on climate mitigation.

At Compost for Good we are huge proponents of using human urine to replace commercial fertilizers. The use of urine as strictly fertilizer is a fantastic idea, and of course many research groups around the world are working on ways to do this in an efficient and cost effective way, and many of you are attending this conference.

In this talk I suggest that we can go a step beyond the idea of urine as fertilizer, to create a local product that can stimulate the growth of soil microflora, and under the right land management conditions, have a significant impact on sequestering carbon from the atmosphere.

How might this work?

Well, urine contains a reasonably high amount of nitrogen. That nitrogen can be combined with a high carbon material to produce biologically complete, US EPA Class-A biosolids compost. Class-A compost has no restriction on use. This means that it can be used on vegetable gardens, children's playgrounds, lawns, sports fields, etc.

When biologically complete compost, or a slurry made from that compost, is incorporated into soils, and under the right conditions, that compost or slurry inoculates soils with trillions of different types of soil microflora. These include bacteria, fungi, and many other types of microbes.

In many plant/soil systems, plants are capable of, and will export up to 50% of the sugars that they produce through photosynthesis. Those sugars are pumped out of the roots and into the soil adjacent to the root.

Think about that. To what advantage would a plant expend all of the energy to produce photosynthates, primarily sugars, then pump those high energy, high carbon compounds out through their root systems?

As it turns out, soil microflora take advantage of this process to form a close association with the plant roots, thereby benefiting from those photosynthates.The plant is literally spending lots of energy to feed the trillions of different microbes that are close to their roots. The big star in this story, at least in terms of climate mitigation, is mycorrhizal fungi.

Mycorrhizal fungi form symbiotic relationships with a wide variety of plants, fusing with plant roots, shunting water and nutrients into the plant, thereby increasing plant growth, which stimulates the plant to produce more photosynthates that further stimulate the growth and development of more mycorrhizal fungi.

This symbiotic relationship is so successful that in some soils, the biomass of the underground biota far exceeds the above ground biota. That biomass contains a huge amount of carbon that originally came from the atmosphere through the process of plant photosynthesis.

In forest systems, mycorrhizal fungi can form structures that are many times more massive than the combined biomass in all of the trees to which they are attached. In fact, it is thought that the largest single organism on the planet is a mycorrhizal fungal mass named Pando in Oregon which covers almost 2,400 acres and is estimated to be several thousand years old.

If land practices are employed that do not oxidize the carbon in those managed soils, then both the living fraction of the underground mycorrhizal colonies, and the decomposed portions of past colonies can lock atmospheric carbon away for hundreds, to thousands of years.

Many who study carbon sequestration put soils as the second largest carbon sink on the planet, the first being oceans. The difference is that it takes millennia to cycle carbon into carbonaceous rock, but we can develop land management practices that turn soils from carbon emitters to carbon sinks in a few short years.

It’s worth mentioning other potential benefits from using diverted urine to make compost.

The process of converting human urine into biologically complete compost can utilize low quality wood products. There is currently a large amount of low quality woody material from forestry operations that is left on the forest floor.

Finding a market for this low-quality woody material could be a significant way to reduce forest floor fuel loading, and therefore the frequency and severity of wildfires, along with providing additional jobs in the forestry industry.

This process involves thermophilic composting. Many studies have shown that most pharmaceuticals are broken down into simpler, less harmful compounds in a high temperature environment.

In our work, we have test results that suggest that the original nutrients contained in the urine are largely stabilized and maintained in the finished compost.

Diverting urine from conventional wastewater treatment plants reduces the cost of operations to those plants, especially plants that have high phosphorus and nitrogen removal requirements.

Our work has also shown that urine can be used to speed up the decomposition of food waste within in-vessel composting systems. Reducing the retention time of food scraps in composting systems even by a little could have a significant positive impact on those systems.

At Compost for Good we have developed a simple, safe, and effective approach using urine, water, and densified wood pellets in which aerobic microbes bring the mix up to about 140 degrees Fahrenheit for more than four days. To date in those experiments, we have processed over 500 gallons of urine into a beautiful finished compost that looks, smells, and feels just like compost that you might purchase from your local garden center.

SHOW EXAMPLE OF COMPOST

We have funding for a feasibility study to determine what it would take to build out a research and demonstration facility, with the idea of processing approximately 25,000 gallons of urine per year. The goal of this buildout will be to demonstrate the permitting requirements (at least in the state of New York), the logistics of urine collection and transport, and the economic viability of this process. If successful, then we can imagine an economic incentive to motivate entrepreneurs to replicate this model in other places.

Doing so could have a potentially positive impact on the forest industry, reduce the carbon footprint and cost of urine treatment in conventional wastewater treatment plants, reduce the environmental issues when pharmaceuticals enter water bodies, build soils and local, circular economies, and mitigate the negative impact of climate change.

We have developed a design for an open source community-scale in-vessel composter that is free and available to anyone, along with an operating manual, and other composting resources. There are currently five of these composters in operation in New York and New Jersey, with others being constructed. We are currently working on refining our existing in-vessel composter design to make it easier to build and therefore even more affordable. It is in this in-vessel composter that we will turn the mix of urine,water, and wood pellets into finished compost.

Please feel free to check out our website and the resources on there at the link below:

https://www.adkaction.org/project/compost-for-good/

Or contact us at compostforgood@adkaction.org

Thank you very much.