The Chain Reaction

Humanitarian Solutions Worldwide

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Spotlight on a Supporter - Meryt Catalysts & Innovation

BY HEIDI DOAK
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If you follow Chemists Without Borders on social media, you might have seen recent posts on Facebook or Twitter about Dr Meritxell Vila, owner and founder of Meryt Catalysts & Innovation. Meritxell has promoted the work of Chemists Without Borders through her company website, on LinkedIn and with a conference presentation.

MERYT Catalysts & Innovation is passionate about their double mission: to help customers to increase their benefits by reducing their catalyst and energy costs and optimizing production processes; and to grow the business of the companies that they proudly represent. These missions always have as their premise the improvement of our environment. The main projects of MERYT Catalysts & Innovation are focused on the reduction of energy consumption and reduction of CO2 emissions of its customers. Thanks to this work the company has been awarded "Best Oil & Gas Energy Saving Technology Provider 2019 - Spain" by Corporate Vision Magazine.

Building on more than twenty years of expertise in process development, MERYT Catalysts & Innovation helps both customers and suppliers to reach their respective objectives. Meritxell started the company in 2016 after gaining extensive experience in the field of catalysis across the petrochemicals industry.

Meryt will support Chemists Without Borders to deliver its humanitarian projects. Support from sponsors like Meritxell and Meryt is vital, and we look forward to a long and successful collaboration. Learn more about Meryt here or visit the new contributing sponsors section on the Chemist Without Borders website.

Did you know that Chemists Without Borders has a team of people reaching out to companies and organizations who can support projects? Heidi, Franco, Margherita and Eleonora are looking for sponsors and

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Our Mission

Chemists Without Borders solves humanitarian problems by mobilizing the resources and expertise of the global chemistry community and its networks.

Our Vision

A global support network of volunteers providing mentoring, information and advice to ensure every person, everywhere, has affordable, consistent and persistent access to:

- Essential medicines and vaccines
- Sufficient safe water
- A sustainable energy supply
- Education in green chemistry and business which people can apply in their daily lives and teach to others
- Safe processes in work environments where chemical hazards exist
- Emergency support, including essential supplies and technology

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partners to join the Chemists Without Borders network. If your organization can help, why not reach out to us on social media or send us an email and introduce yourself?

For more information on joining the Chemists Without Borders network, contact heididoak@chemistswithoutborders.org.

The importance of youth in fighting climate change

BY TOMMY LI
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Our future is dependent on the youth and children of today. Instead of directing all of our resources into research and development for existing foundations, we should be investing in the leaders of tomorrow. Based on the United States Census, there are just as many people between the ages of 15-29 as people between the ages of 40-54, who are the majority of the decision makers. Why are less than 5% of our resources directed to the youth population when in reality it represents 50% of our population?

Chemists Without Borders is an international non-profit organisation that embraces change and diversity. A Chemists Without Borders branch was started at a high school in Taiwan. We attempted to promote the use of biochar in Taiwan through our knowledge of chemistry and global warming. Biochar is a charcoal used as a soil amendment, it is a stable solid rich in carbon and can endure in soil for thousands of years. We sent samples of biochar from a supplier we collaborated with in Taiwan to the US for an ultimate analysis of coal. The results reflected the "payback" period of biochar. The results have been made confidential, but biochar can aid us achieve carbon neutrality.

During our meetings, we started looking for non-profit organizations in the public and private sector in order to find a channel to promote biochar in Taiwan. We found numerous organizations around Taiwan. Our mutually beneficial partnerships will improve livelihoods and general worker well-being through the principles of organic agriculture. We'll do this in partnership with the Taiwanese government, businesses, communities, and individuals.

Apart from non-government organisations, we have also contacted departments from Executive Yuan that are related to our field of work. Executive Yuan is an executive branch of the Taiwan government. They have many departments which aid in environmental protection and agriculture. In fact, some departments in Executive Yuan have already begun to purchase biochar for use. However, Biochar currently is only purchased and distributed to farmers without educating or informing them of the usage and benefits of biochar.

The lack of information and education provided to farmers is a shame; so much effort has been put into providing a better and more environmentally friendly farming technique to the farmers. Despite that, the majority of the farmers are ignorant of it. We believe that through proper introduction and promotion of biochar. Taiwan's agriculture could become both more abundant as well as environmentally friendly.

The progress and efficiency of youth is in no way weaker than adults and legislators. In fact, based on my personal experience, diligent high school students and young adults can have major impacts upon the world and our global society. Since the pressing issue of global warming will impact the youth the most, their incentive to take action is strong. They're an essential demographic of people whose influence should not be taken lightly.

Fire, Soil, and Post-Fire Recovery

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The California fires of 2018 and the Australian fires of 2019 have raised awareness about the risk of large scale catastrophic fires. Unfortunately, it has also resulted in a great deal of conjecture about the occurrence, control and impact of fires. The purpose of this short summary on fire effects on soil is to inform readers about the role of fires in ecosystem function, discuss the primary legacies of fire, describe the influence of fire on nutrient cycling, and briefly describe the process of soil recovery after fire.

Fire: A Natural Disturbance in All Ecosystems

First it is important to keep in mind that all biomass has the potential to burn, the difference is how frequently are different ecosystems exposed to fire and how does fire behave in those ecosystems. Great Plains prairies burned every one to five years, western ponderosa pine burned every 10 -- 35 years, higher elevation lodgepole pine every 100 -- 200 years and spruce hemlock forests perhaps every 400 years. Fire is a naturally occurring disturbance in all forest ecosystems. In high fire frequency systems such as ponderosa pine, the fires tend to be low severity and rarely kill the large legacy trees. The net effect of the fire is one of rejuvenation of the forest, reduction of live and dead fuels and resprouting of plants and germination of seeds that were otherwise dormant.

Over the last century the USFS pursued a program of active suppression of fire, which at start proved to be exceptionally good at controlling low severity fires, achieving about 97% success in suppressing fires over the years. That combined with extensive timber harvest in the 60s to 80s followed by a period of limited timber harvest and the fact that 1950 - 1988 was an unusually wet and cool period resulted in an unusual buildup of live and dead fuels that are ripe for large scale stand replacing fires across a variety of forest types in the west.

More recently, anthropogenic climate change has resulted the lengthening of the dry, hot seasons in which fires take place. The net effect of intersection of these factors is that we are experiencing longer, hotter, drier fire seasons that yield larger, higher severity fires than had been seen since Europeans arrived in the western US in the late 1800s (https://royalsocietypublishing.org/doi/10.1098/rstb.2015.0345).

Fire Effects on Soil and Fire Legacies

When a fire burns a forest, one might ask what is left behind after the fire? The forest initially is left with dead organisms (trees, shrubs, herbs, microorganisms), surviving living organisms, charcoal, and ash. Importantly, fire volatilizes some nutrients (nitrogen and carbon volatilize at relatively low temperatures) where alkaline metals, transition state metals, and oxyanions are concentrated in the ash. Carbon (C) and nitrogen (N) are primarily lost from the needles, twigs, and leaves of trees, shrubs and herbs, and from the combustion of the forest floor (or soil organic horizon, the layer that sits on top of the mineral soil). Charcoal remaining after fire can remain in the soil for decades serving as C storage and it can have a direct and indirect influence on various soil processes (https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/070070)

A Scots pine seedling thrives amidst moss and charcoal fragments five years after fire in a research forest in northern Sweden (photo: T.H. DeLuca)

The surface mineral soil remains surprisingly intact during wildfires. Soil is highly porous (generally in excess of 50% porosity) and thus is an amazing

insulator against heat transfer into soil. A wildfire with surface temperatures of 500˚C burning for an hour will have mineral soil temperatures of 50˚C at 20 cm deep or perhaps 30˚C if the soils are moist (https://www.sciencedirect.com/science/article/pii/S0048969717313621). This means that most microorganisms and roots in the mineral soil are tolerant of the temperatures reached at those depths during wildfire. In extremely hot fire events where surface fuel loading is great, surface soils can lose a lot of organic C and N making recovery a slower process.

Post-fire Ecosystem Nutrient Cycling and Recovery

During a wildfire event in a boreal Scots pine or lodgepole pine forest, approximately 150-450 kg N ha-1 are lost to volatilization. In spite of this net loss, N availability in the mineral soil is actually increased after a fire event. Inorganic N (NH4+, NO3-) are the two mineral forms of N most readily available for plant uptake. The plant availability of these two forms of N increases significantly after fire (https://www.sciencedirect.com/science/article/abs/pii/S0038071701001808?via%3Dihub). And charcoal left behind after fire helps stimulate nitrification years after being deposited in soil (https://acsess.onlinelibrary.wiley.com/doi/abs/10.2136/sssaj2005.0096). Nitrate is an important form of N shortly after fire as it is highly soluble, and anionic (repelled by clay particles) and thus can move by mass flow (rather than diffusion) satisfying the N uptake demand of young tree seedlings that rely on a soluble N source prior to establishing their mycorrhizal networks. After a fire event, many people look at the forest as dead, but a closer inspection will reveal a rapid recovery of microbial activity. Even after particularly hot fires, microorganisms recolonize the soil from above (dust inputs) and below.

Obviously, if N lost during every fire event isn't replenished, the ecosystem would eventually run out of N. However, as it turns out, fire tend to simulate the growth and development of N2 fixing plants and microorganisms. Only bacteria and archaea are capable of fixing N2 from the atmosphere. Legumes and actinorhizal species are common in temperate and tropical systems, whereas feather mosses and their partner cyanobacteria fix N in boreal forest ecosystems. The feather mosses can rebuild the N lost during a fire event in 100 -- 200 years in a Scots pine boreal forest (https://www.nature.com/articles/nature01051) where there are few woody or herbaceous N fixing species. In temperate and tropical forest systems, light loving legumes and actinorhizal species can rapidly grow after fire and rebuild soil N pools in 30 to 100 years.

Some take away messages from this article: Fire is a natural form of disturbance in forest ecosystems. Fire stimulates rejuvenation in forests. Climate change and fire suppression are changing fire severity and fire behavior. Fires do not "sterilize" mineral soils. Fires tend to reduce total N but increase N availability.

Hand Washing in Refugee Camps

BY HEIDI DOAK
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As the world faces the COVID-19 crisis, hand washing is a key strategy to prevent the spread of the virus. Access to hand washing facilities is vital, but it varies greatly across countries and communities. In refugee camps, COVID-19 adds more urgency to a longstanding challenge: how do you provide hand washing facilities where there is little or no water and sanitation infrastructure?

Designs for hand washing stations in refugee camps need to be low cost, low maintenance, and easy to assemble and transport. They have to work with limited water supplies in harsh environments and cater to large numbers of people. The following are a few of the designs available.

The "tippy tap" design was "officially" first used in the 1980's. Oxfam uses a jerry can held up with three sticks. A

fourth stick and a piece of string make a foot pedal to tip the jerry can and deliver a flow of clean water. A bar of soap can be attached to the station for a simple, cheap and effective hand-washing solution.

But the design posed a number of problems. Water collects around the base (a mosquito and disease risk), users get wet and the foot pedal can be hard to use for people with disabilities. Oxfam's new design is more expensive than the tippy tap, but expected to last longer. Users operate the tap with their hands, and the water comes out of the top and sides, cleaning the tap as it is used and reducing contamination risks. A basin collects the water so it can drain away rather than create puddles. The first prototypes were tested in Nduta refugee camp in Tanzania in 2017, with successive prototypes improved based on user feedback. The new tripod design supports a 24L water tank with lid and a 4.5L liquid soap dispenser, with space for bar soap as an alternative.

A system designed by Arup and partners is based on observations at the Kyangwali refugee camp in Uganda to understand user needs. This design is modular, and different components can be assembled to create a system to suit different situations. The design can connect to a water tank or a mains supply, there are different options for soap and the height can be adjusted. Initial trials were carried out by the British Army on training weekends before being deployed to Kyangwali refugee camp.

Graviteau has developed a system that recycles the water used for hand washing using only gravity and a foot pump. It includes a membrane filter to remove pathogenic micro-organisms and an activated carbon filter to take out soap and other contaminants. Once the system is filled it can cater to up to 100 people every hour for many weeks. Pilot-scale lab tests were successful, with the next phase of tests to focus on refugee camps and hospitals.

The solutions differ, but the aims are the same - to enable hand washing, prevent sickness, and ensure no one lacks vital water and sanitation infrastructure.

Biochar and 2030 Agenda for Sustainable Development

BY MIKE SHEEHAN
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In September 2015, the United Nations adopted the 2030 Agenda for Sustainable Development, which includes seventeen Sustainable Development Goals (SDGs). Building on the principle of "leaving no one behind", the new agenda emphasizes a holistic approach to achieving sustainable development for all.

Looking at the seventeen goals, it was surprising to see how biochar and its carbon cascades are uniquely suited to forward twelve of the SDGs.

Balancing the carbon cycle is critical to climate sustainability. Visualizing the carbon cycle is a bit like watching a juggler. Each ball represents the carbon atoms that are constantly cycling from the air to the plants, and back into the air. Just like the juggler with too many balls, the carbon sources are outproducing the carbon sinks pushing us toward a climate crisis.

Here are several ways biochar supports the SDGs:

ZERO HUNGER: The developing world teeters on the edge of food catastrophe. Climate-driven floods, droughts or wildfire are all it takes to leave millions without enough to eat when the local food supply is their only choice.

Revitalizing the soil with biochar grows healthier plants with roots in soils that hold more water, deliver more nutrients and require less fertilizer. Biochar is a highly effective part of a multifaceted approach to ensuring no one on the planet goes hungry.

GOOD HEALTH AND WELL-BEING: In many parts of the world, good health is not an option. In the developing world, cook fires expose everyone to constant air pollution. The smoke is detrimental to human health. Depressing the immune system and directly contributing to respiratory diseases.

Adopting clean burning "ROCKET STOVE" technology alleviates the smoke pollution while producing biochar as a valuable by-product. These stoves efficiently converting twigs and branches into usable heat for cooking and Biochar for farming. This reduces stress on the local forests and makes gathering firewood much easier.

CLEAN WATER AND SANITATION: Too much of the world is forced to drink untreated and impure water. Oftentimes, human waste is a major contributor to groundwater contamination. Biochar is effective as a water filter medium that removes pollutants from water.

Biochar from a "rocket stove" cascades to a filtration medium to produce potable water then cascades once again to improve soil fertility. I know of no other system that can effectively solve multiple problems as a natural cascade taking advantage of its unique properties at each step.

In a future article, we will explore additional SDGs and how biochar promotes the goals and ensures a sustainable future.

My vision for the future is: carbon will be recognized as a commodity and financial markets will grow up in partnership with government regulators. Industries will adapt to new regulations and adopt new technologies. Consumers will demand more and vote with their pocketbooks. This circular economy will ensure property for future generations.

Stop Selling, Start Helping with Honest

BY BADAL SYED
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Back in 2017, we started a charity shop called Honest. We were motivated to help lower income groups meet their living expenses. In order to do this, I implemented a radical business concept never seen before in Bangladesh.

Honest exists as a retail and online store and operates similar to thrift stores like those in Canada. Honest has three major differences compared to traditional thrift stores: on top of selling necessary goods at nominal prices, Honest also gives them away. In addition, 22,000 people from lower, lower-middle, and middle income brackets are getting income from the store and nearly 19,000 people recieve free medical help from it. The shop is hugely popular in Bangladesh and sells a product on average every eight minutes.

Honest is run as a "Business for Humanity". Here, the investors invest capital as a pure charity mission; they do not make profit and never take back their investment. What's unique is that clients who directly purchase from our online shop get back 60% of what they paid. We keep the other 40% for operating expenses and for other charities.

The target groups of this business are students and lower to middle income groups. They become partners of this platform automatically after their first purchase, get back 60% from their purchases, and are named as partners in the memoradium article. They get a huge profit payback from their daily needs purchases. Since Honest's incep-

tion in 2017, it has distributed almost two hundred US dollars profit to its members. We hire university/college students to help them meet their student living expenses.

Our new "Donate It Forward" program offers necessary goods to needy people totally free of cost. Additionally, the program provides free medical help to deserving candidates. It has almost 19,000 members now, who recieve regular benefits.

The project is mostly run by three means:

1. Selling donated items at very nominal price.
2. Selling necessary goods at lesser price than the market price, even at a loss. The loss is burdened by our sponsor investors.
3. Distributing free goods to those who can't afford them even at the nominal price.

How is profit is distributed? We have devised a very simple but "sure shot" method to distribute profits.

Suppose a donated t-shirt is sold at 1 dollar. The purchaser has a stake of 60% of this one dollar. Since it is a donated item, Honest has no cost price, so the whole one dollar is its profit.

Since 60% of the profit belongs to the purchaser, they only have to pay only 40 cents to Honest; they get 60 cents of that dollar to keep as their slice of profit. It's a hassle and confusion free system. All they have to do is hit the order button and they get a 40 cent t-shirt with 60 cents cashback.

We take the 40% profit we get to fund these initiatives:

1. Scholarships to underprivileged students
2. Donate It Forward's distribution of free goods to needy people and free medical service to needy patients
3. Distribution of free school bags full of stationary
4. Operating expenses
5. Providing small capital to young and needy entrepreneurs

Improving access to care: Moving beyond the pharmaceutical barriers of HIV treatment

BY KATELYN STEBBINS AND DR. ROLANDE HODEL
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Every day, 8,500 people die in sub-Saharan Africa due to lack of access to therapeutic drugs. Scientists are making breakthroughs to prolong the lives of those infected with HIV and finding more effective and accessible ways to prevent transmission (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4893541/). Still, tens of thousands of new HIV infections and deaths occur each year despite recent advances. Even with these alarming statistics, malaria remains the top cause of death in Sub-Saharan Africa. Though seemingly unrelated, malaria and HIV can exacerbate the effects of one another when occurring as a coinfection (https://pubmed.ncbi.nlm.nih.gov/23327493/). We will explore malaria as a hidden barrier to HIV treatment in Cameroon and possible programs to combat infections. As a country with a tremendous need for a solution to the HIV/AIDS crisis, we are hopeful that organizations will pay attention to the underlying obstacles in order to incite the greatest change.

HIV/AIDS in Cameroon and Current Treatment Options

Following malaria, HIV/AIDS is the second leading cause of premature death in Cameroon. Nearly half of Cameroon's HIV-infected population has access to antiretroviral therapy, but less than 20 percent of these individuals have suppressed viral loads (https://www.unaids.org/en/regionscountries/countries/cameroon). In addition, an estimated 74 percent of pregnant women with HIV have access to pharmaceuticals to prevent transmission to their children. However, approximately 27,000 new HIV infections are projected to occur annually, and nearly 25,000 deaths from AIDS occur each year. HIV is particularly susceptible to coinfections, which can lead to increased viral load and increased transmission in areas with geographic overlap with other diseases (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3564906/).

The hidden variable

A highly preventable infection, malaria continues to claim numerous lives. In a three-month period, 180,000 cases of Malaria were reported in the North region of Cameroon, causing nearly 60,000 deaths (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5376676/). Studies have shown that, although malaria and HIV are each devastating in their own rights, the death rate increases greatly for someone with malaria who then contracts HIV-AIDS and vice-versa. In addition to the geographic overlap, the bidirectional interactions of the diseases make malaria and HIV coinfections an often lethal combination (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6067790/). HIV infected patients have a higher risk of severe malaria and malaria-related death, and the pharmacokinetic interactions between commonly used antimalarials and antiretrovirals is largely unknown.

Inciting Change

As the threat of HIV infection continues, it is apparent to AIDSfreeAFRICA that health organizations must continue to advocate for efforts to increase access to treatment as a means of mitigating the harmful effects of malaria-HIV coinfection. HIV immune suppression raises the risk of clinical malaria, and malaria infection may lead to decreased efficacy of antiretroviral therapeutics (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3375742/). Projects like AIDSfreeAFRICA's Malaria Free Zone (MFZ) provide education and installation of bed nets in windows and doors for malaria prevention. In order to correctly understand and control both infections and their particular interactions, better communication and inclusion of concerned citizens and activists is necessary and encouraged as much as possible. In this way, Cameroonians and other Africans can be empowered to improve health at the individual and community level and help move closer to an Africa free of these devastating diseases.

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All donations are tax-deductible as permitted by law.

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