

VERMI-TREATMENT SOLUTIONS

**ENHANCING AIR QUALITY AND TOXIC CHEMICAL REMOVAL THROUGH
SUSTAINABLE ORCHARD WOOD UTILIZATION AND VERMI-TREATMENT
FILTRATION SYSTEMS**

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Introductions



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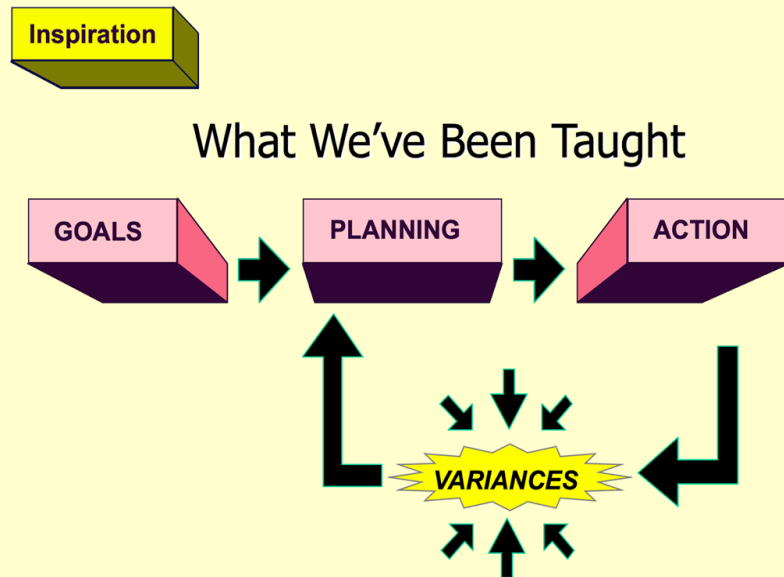
Drawn 2 Solutions

Business and Communications
Consultant

An Applied Research Project as an Alternate Approach to Reduce / Eliminate Emissions from Agricultural Burning

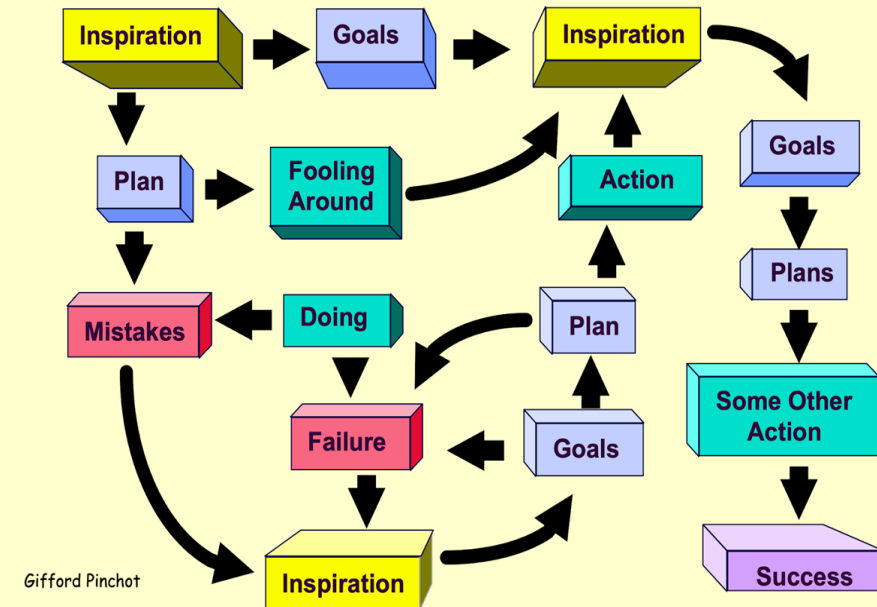
Barriers to Innovation

Misunderstanding how Innovation Happens



Gifford Pinchot

How Innovation Actually Happens



Gifford Pinchot

The Project So Far



CHALLENGES

SPECIFIC EQUIPMENT NEEDED

The availability of the right size and kind of chipping equipment (i.e. grinder versus disc)

SPECIFIC WOOD CHIP SIZES

The correct size of wood chips for the BIDA system to run optimally

AVAILABILITY OF WOOD CHIP TYPES

The type of wood chips – what was available and easily accessible at the time the equipment was available to use

PLAN FOR NON-USABLE WOOD CHIPS

What to do with large amount of smaller wood pieces (fines) that could not be used in the BIDA system

DISCOVERIES

REDUCTION IN TOXICS

Data was showing a 90%+ reduction in toxins in wastewater after being filtered through the BIDA system. Shavings were used as filter media for this system

TWO CHIP SIZES USABLE

Two markets for wood chips might be possible, thus utilizing more of the waste from orchards

FINES ARE USEABLE

Smaller wood shavings – or orchard fines – could be used in systems where lower total suspended solids were being processed

CHIPPING IS EFFECTIVE FOR ORCHARD WASTE DISPOSAL

Orchard waste can be chipped effectively, and if incentivized, the orchardists would utilize this method for disposal of their waste

LEGISLATION IS PRO INDUSTRIAL SYMBIOSIS

The concept of Industrial Symbiosis is now being embraced by legislative leaders

The Unexpected Discovery

PCB REDUCTION RESULTS - Using Worms / Biology			
Picograms/liter (parts/quadrillion)			
<u>DATE</u>	<u>PRETREATMENT</u>	<u>POST TREATMENT</u>	<u>REDUCTION</u> %
5/1/22	16,800	753	95.5%
6/1/22	172,400	908	99.5%
7/20/22	144,300	265	99.8%
8/2/22	12,100	254	97.9%
9/6/22	69,400	485	99.3%
10/5/22	14,000	388	97.2%
11/2/22	92,200	2,710	97.1%
12/13/22	53,000	288	99.5%
1/10/23	24,100	22	99.9%
2/7/23	303,100	737	99.8%

Confirming what we found

Vermitechnology is emerging as an environmentally sustainable, economically viable and socially acceptable technology all over the world consisting of several categories....

- **vermifiltration** = treatment of municipal and several industrial wastewaters
- **vermi-remediation** = treatment and clean up of contaminated lands
- **vermi-agro-production** = production of chemical-free foods by worms and vermicompost....

We have successfully experimented with these technologies for management of municipal solid wastes, treatment of municipal and industrial wastewater, remediation of polycyclic aromatic hydrocarbon (PAH)- contaminated soils...by use of vermicompost at Griffith University, Australia, with excellent results.

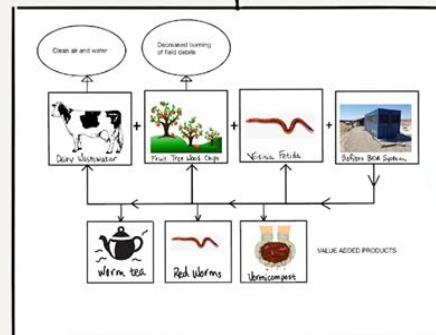
BioFiltro Response

- Objective was to test chips for feasibility in the Biofiltro system
- They found using apple wood chips to be effective in use in dairy systems
- They are pleased with the results and looking forward to expanding the use of their system

PROJECT #1

Using orchard wood
in dairy waste treatment

- economic feasibility
- Market development



Royal Dairy / Allred Orchards



Specific
Chip Size



Unused
Fines



Can Worms + wood remove toxins from waste water?

Do the worms or substrate continue
to hold the toxins?

Depending on the toxin load, in what ways
might each be utilized?



PROJECT #2

Utilize unused fines
and worms to clear
toxins from waste water

- economic feasibility
- Market development



VERMITREATMENT



INDUSTRIAL
SYMBIOSIS

Juice
Plant

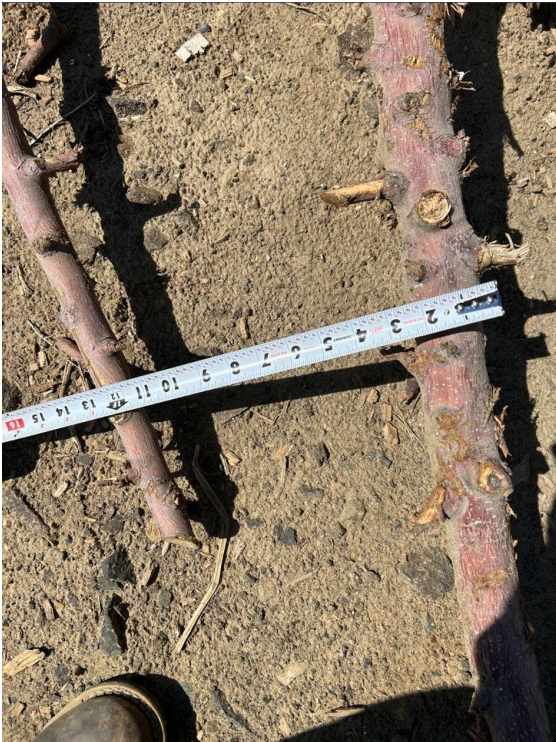
WA
DOC

Yakima
Nation

Others

The Economics

- Determine the production costs of chipping an apple orchard tear out and the yield of large and fine wood chips.



The Economics

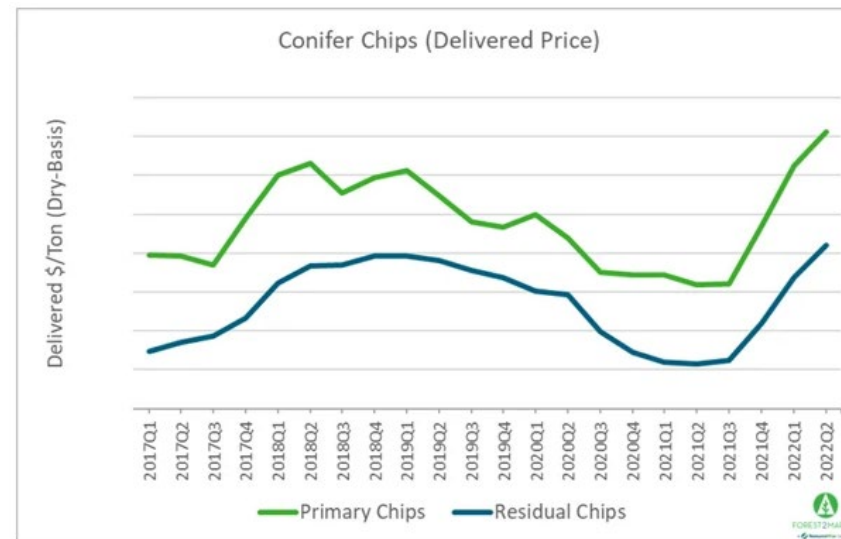
- Separated yield measurements of large vs fine not known because need to incorporate screen separating system or need to presort trees versus prunings



- Screen used at Royal dairy and chips produced demonstrated overall feasibility of using apple wood chips for vermifiltration beds
- Chip demonstration cost was \$600 per hour plus transportation to job site at \$3 per mile

The Economics

- Evaluate the transportation costs of moving chip products from an orchard or chipping site to the vermi-treatment systems.
 - Trucking cost not as critical as sourcing chips.
 - Trucking cost quotes - \$1,000 to \$1,300 Yakima to Sunnyside
 - Columbia Basin orchards and dairies in close proximity
- Chip market price remains high
 - Institutional buyers
 - Truck driver supply
 - Decreased timber harvest
 - Energy markets





The Economics

Vermitreatment outlook with WA Climate Commitment Act Incentives

- **Biogas Generation** (capture methane)
 - Anaerobic Digestion and covered lagoons
 - Gas company managed facility collecting manure from multiple dairies
 - Sales to low carbon fuel standard markets, gas company collects carbon credits
 - Profit sharing back to dairy producer
 - Compost and lagoon effluent back to the dairy
- **Implement Alternative Manure Management practices** (reduce methane)
 - Vermitreatment approved by California Air Control Board for cost share
 - Reduced methane that can be sold as carbon credits
 - Vermifiltration of water to reduce nutrient content of lagoon effluent
 - Vermicompost sales or back to farm soil amendment

What About the Toxics?



- Toxin vs. Toxic – What are they? PCBs, PFAs, others ???
- Do the worms and wood fines remove them from water?
- Do the worms or substrate hold onto the toxins?
- How do we handle the worms and substrate?

Possible Uses for Worms & Substrate

very low or no toxins present	vermicompost substrate is a product that can be sold and applied to any cropland for soil enhancement & remediation
low / acceptable toxins present	vermicompost substrate may be applied to non-food crops such as Christmas trees or used in brownfield remediation
moderate to high toxins	substrate goes to hazardous waste landfill

Project Objectives and Approach

Operations	Economics	System Support
Identify areas where PCB removal has the most impact on the Columbia River (i.e., identified brownfields) and work to place systems there	Record progress and continue to collect data on the costs related to sourcing, chipping and transporting wood chips from orchard tear-outs to vermi-treatment sites	Work with trade organizations and agencies to share information to promote chipping versus burning orchard debris
Collect samples at regular intervals on the substrate, worms and water in the operating vermi-treatment systems and perform toxicology tests	Utilize data to forecast wood availability and accessibility for a viable market	Collaborate with CSI to build awareness and partnerships that support Agricultural Industrial Symbiosis

Additional Data Needed for Vermittreatment System Placement

- Cost per gallon of H₂O for treatment
- Testing the removal of different toxics
- Feedback to determine the data clients need

On the Horizon

- Need a testing Incubator
- Collaboration with Haley Aldrich



Collaborations



- Haley & Aldrich Engineering
- Center for Sustainable Infrastructure
- Walla Walla Community College – Environmental Water Center
- Department of Corrections
- Department of Commerce
- City of Walla Walla
- WSU – various people and departments
- EPA & Compliance Experts
- Subject Matter Experts

Industrial Symbiosis

- Statewide industrial waste coordination program will provide expertise, technical assistance, and best practices to support local IS projects
- Supported by the Center for Sustainable Infrastructure (CSI) with grant program available through the Department of Commerce
- CSI will create a statewide waste resource database
- Work with CSI to create a Legislature-supported incentive program for waste repurposing or restorative practices - perhaps beginning with orchardist incentives linked to reduced burning / better air quality
- Utilize CSI, trade organizations & conferences as well as appropriate media sources to share the worm-wood-water success story

Thank you



Questions and Feedback

