



SOUTHEAST ASIA-EUROPE
JOINT FUNDING SCHEME FOR
RESEARCH AND INNOVATION

Mr. Van-Giang Le
Vietnam National University, Hanoi
VIET NAM

**Recovery of Nitrogen, Phosphorus, and
Potassium from Swine Wastewater
using Fluidized-Bed Homogeneous
Crystallization for Application as Slow-
release Fertilizers in Viet Nam**

Topic 1: Wastewater treatment and reuse
(industrial & municipal)

Brokerage Event – 9th Call

03 October 2024



My and my institution's area of expertise

Name: Van-Giang Le

Position: Senior Scientist

Unit: Central Institute for Natural Resources and Environmental Studies

Organisation: Vietnam National University, Hanoi

City: Ha Noi

Country: VIET NAM

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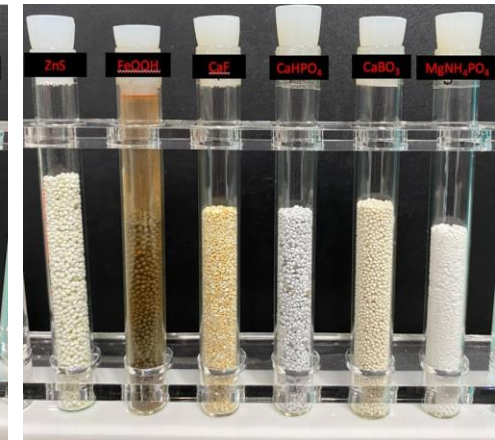
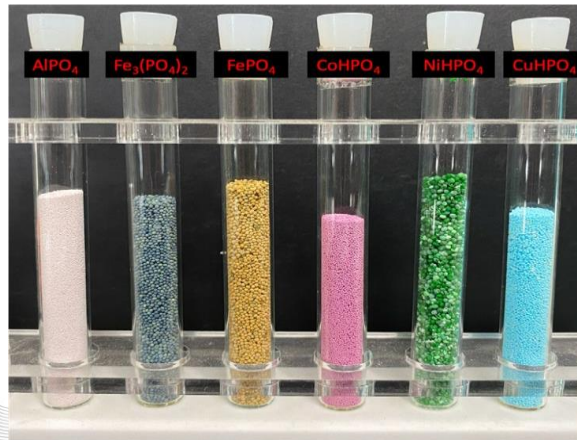
Expertise:

- Carbon Dioxides Capture and Conversion,
- Recovery of Nutrients/Heavy Metals from Wastewater,
- Composting Treatment of Organic Contaminants,
- Dioxin–Contaminated Soil Remediation.



■ FBHC-Application

- Metal-Containing Wastewater Treatment and Resource Recovery
 - ✓ calcium, magnesium, iron, aluminum, copper, nickel, zinc, lead, cobalt, strontium etc.
- Nonmetal-Containing Wastewater Treatment and Resource Recovery
 - ✓ phosphate, oxalate, sulfate, molybdate, tungstate, ammonium, sulfur etc.
- Carbon dioxide capture and resource recovery from flue gas



VNU Strong Research Groups - "Sustainable Energy and Resource Recovery Group"



**Van-Giang Le,
Assist. Prof. Dr**



**The Anh Luu,
Assoc. Prof. Dr**



**Quang Trung Do, PhD
Principal Researcher**



**Phuong Nguyen,
PhD student**



**Gia Cuong Nguyen,
PhD student**



**Truong Huynh Nguyen,
PhD student**



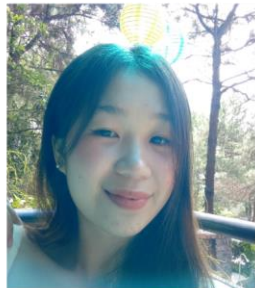
**Dang Thang Nguyen,
PhD student**



**Phuong Trang Ngo,
Research Assistant**



**Le Chi Nguyen,
Research Assistant**



**Xuan Hong Nguyen,
Research Assistant**



**Thai Hai Nguyen,
Research Assistant**



**Ai Quynh Nguyen,
Master student**



**Minh Cuong Nguyen,
Master student**

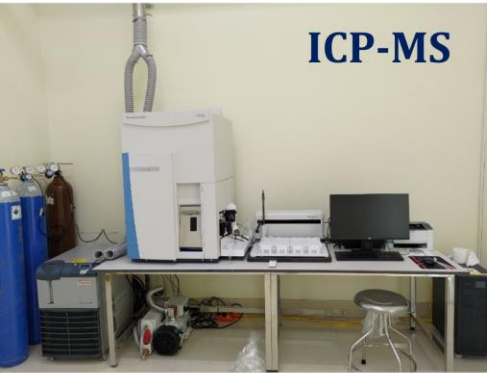


**Kim Yen Hoang,
Master student**

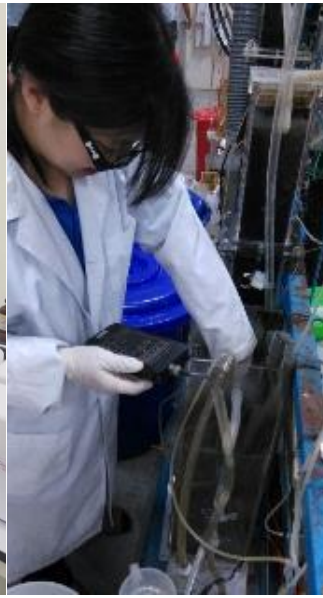
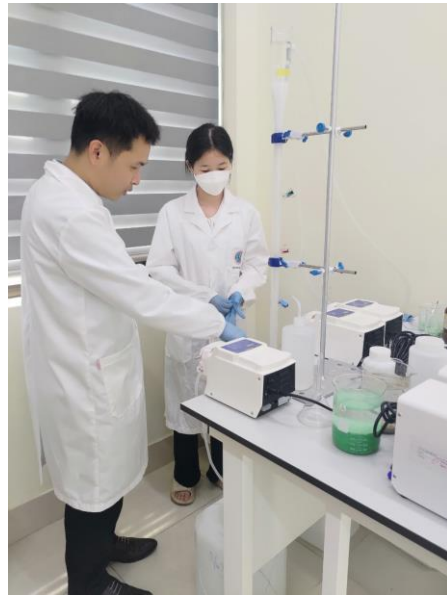


2022/09 ~ present

Space and Equipment



R&D and Achievements



SCI, Q1, IF 16.744

Phosphorus and potassium recovery from human urine using a fluidized bed homogeneous crystallization (FBHC) process

Van-Giang Le ^{a, *}, Chi-Thanh Vu ^{b, *}, Yu-Jen Shih ^{c, *}, Xuan-Thanh Bui ^{d, *}, Chih-Hsiang Liao ^{e, *}, Yao-Hui Huang ^{a, f, g, h, i, *}

SCIE, Q1, IF 7.968

Research paper

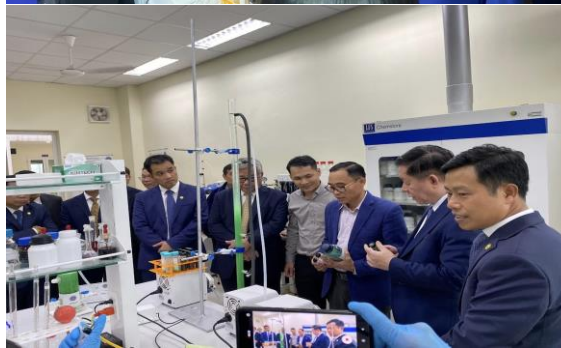
Struvite recovery from swine wastewater using fluidized-bed homogeneous granulation process

Van-Giang Le ^{a, *, b, *}, Dai-Viet N. Vo ^{c, *}, Nhat-Huy Nguyen ^{d, e, *}, Yu-Jen Shih ^{f, *}, Chi-Thanh Vu ^{g, h, i, *}, Chih-Hsiang Liao ^{b, h, i, *, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 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SCIE, Q1, IF 9.224

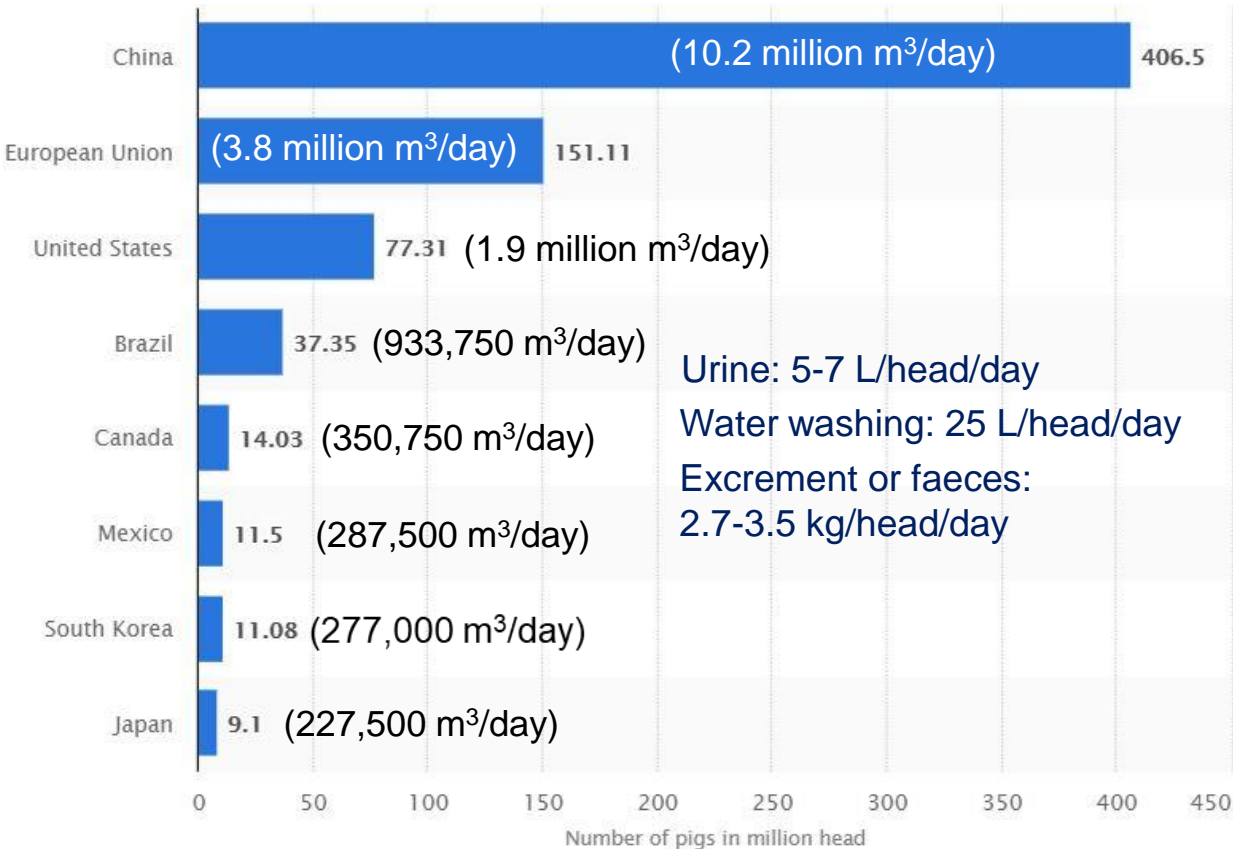
Recovery of Magnesium from Industrial Effluent and Its Implication on Carbon Capture and Storage

Van Giang Le, Dai Viet N. Vo, Huu Tuan Tran, Nguyen Duy Dat, Son D. N. Luu, Md Mofijur Rahman, Yao Hui Huang,* and Chi Thanh Vu



Number of pigs worldwide in 2021, by leading country (in million head)*

Issue of Concern



Composition	Region					
	Viet Nam	Taiwan	China	Japan	Korea	USA
pH (-)	6,92	7,11	8,2	7,4	8,6	7,91
COD (mg/l)	5214	2086	5756,9	-	4152,5	3570
BOD ₅ (mg/l)	2323	-	-	4050	-	1078
TOC (mg/l)	-	-	-	-	-	111
NH ₄ ⁺ -N (mg/l)	540	512,4	477,3	532	2166,0	835
TN (mg/l)	688	-	551,3	-	2302,5	953
PO ₄ ³⁻ -P (mg/l)	92,3	-	-	72	185,6	121
TP (mg/l)	112,5	92,8	236	145	295,5	174
K (mg/l)	308,1	336	-	-	-	-
Mg (mg/l)	-	18,5	-	102	-	-
Cu (mg/l)	-	1,1	-	0,40	-	1,54
Al (mg/l)	-	1,2	-	-	-	-
Zn (mg/l)	-	0,55	-	5,88	-	1,47
Ca (mg/l)	-	25,2	-	80	-	-

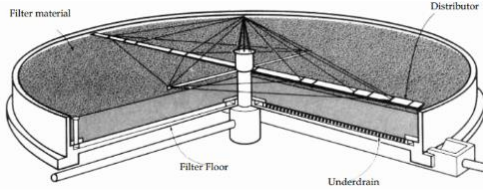
- In Viet Nam: **23,500 Pig farm** (313.2 million m³-SW/year)
- In Ha Noi: 7,528 livestock farm (2.37 million pigs, **59,250 m³ -SW/day**)
- 11.718.391 hectare of farmland, 0,8 tons of fertilizer/ha → **10,5 - 11 million tons/year**
- 700 million tons of P rock in global → **40 million tons** are used for **fertilizer every year**.



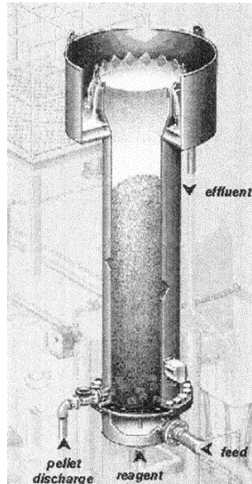
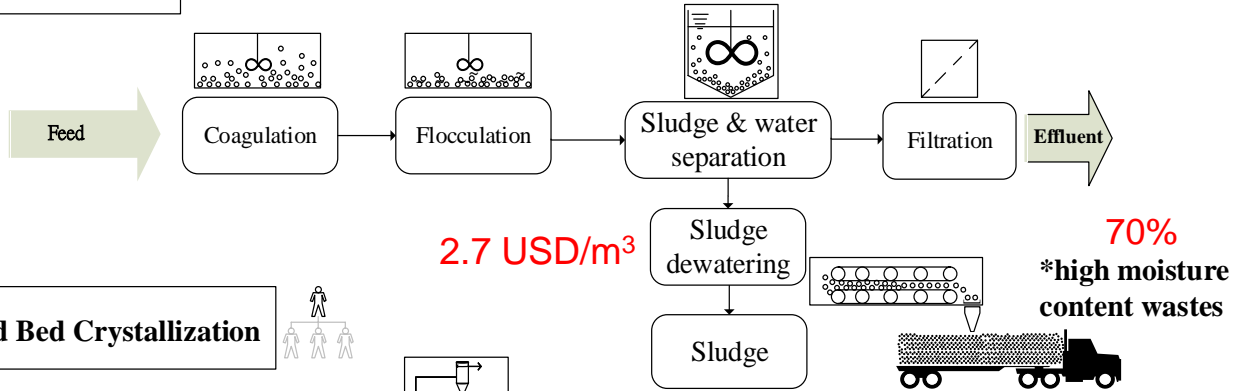
<https://baochinhphu.vn/hiep-hoi-phan-bon-viet-nam-thuc-day-san-xuat-phan-bon-noi-dia-102240802161605281.htm>

<https://www.statista.com/statistics/>

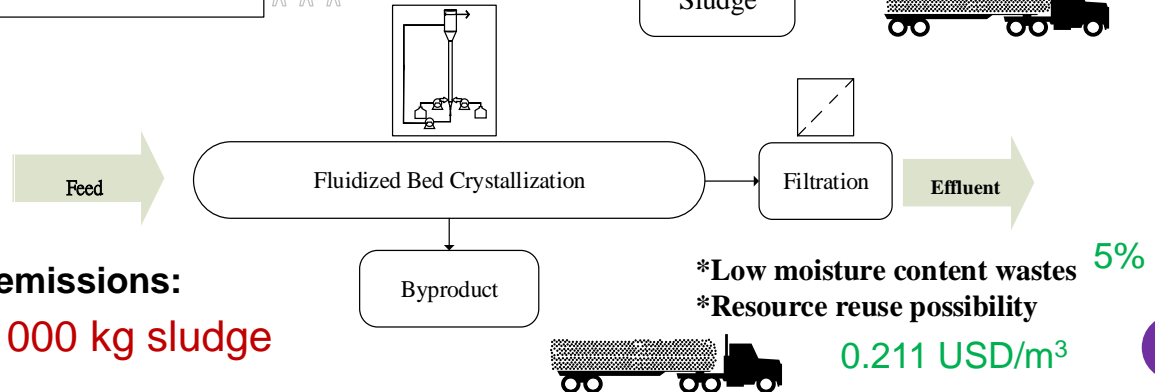
Comparison with Traditional Treatment process and Fluidized bed crystallization



Chemical precipitation



Fluidized Bed Crystallization



Reduce carbon emissions:
>234 kg CO₂/1000 kg sludge





↓
 BIOGAS



CH_4 gas



↓
 FBHG



Struvite (MgNH_4PO_4)



↓
 **DEWATERED
 SLUDGE**



Biosolids

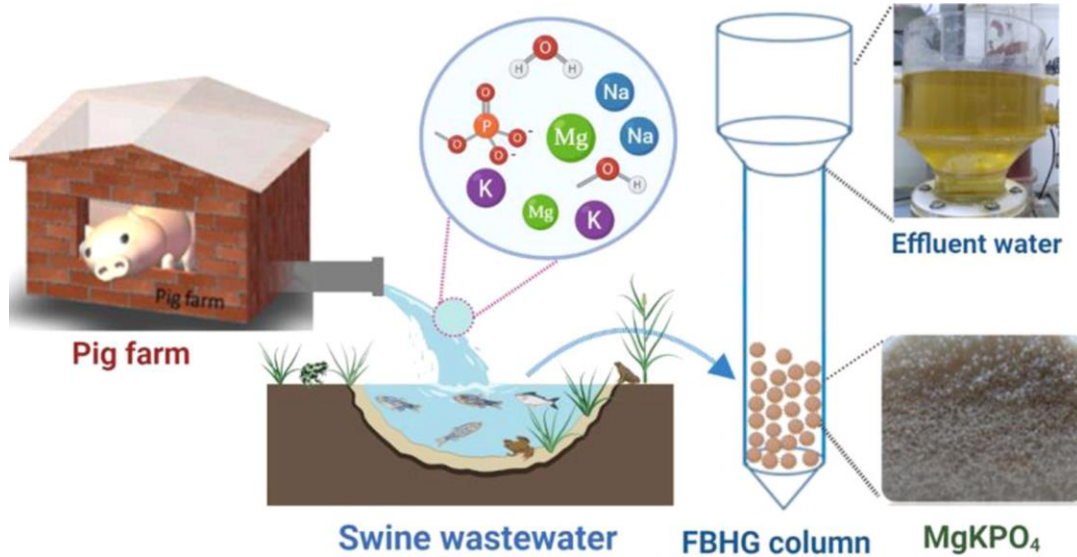


↓
 MBR+RO



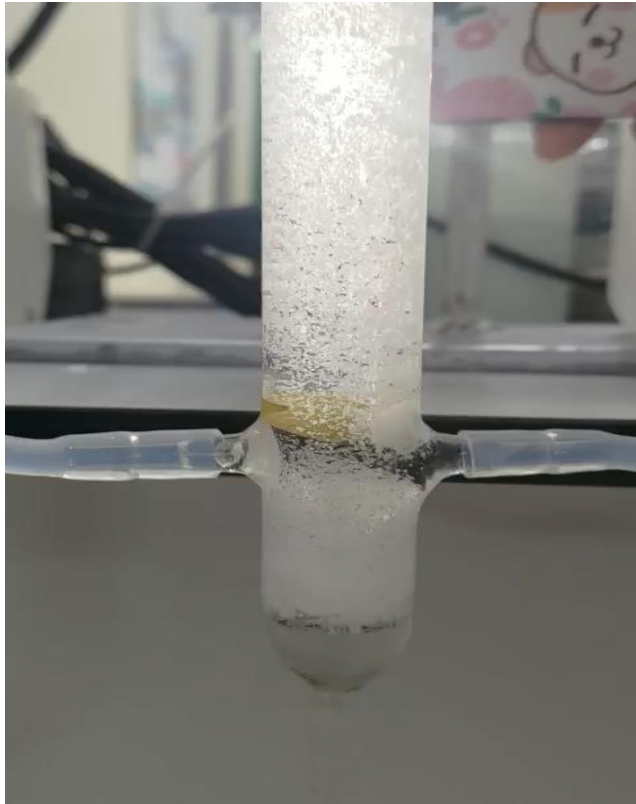
**Swine wastewater
Recycle & Reuse**

Recovery of Nitrogen, Phosphorus, and Potassium from Swine Wastewater using Fluidized-Bed Homogeneous Crystallization for Application as Slow-release Fertilizers in Viet Nam



Organic Fertilizer
 $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$





Recovery of Nitrogen, Phosphorus, and Potassium from Swine Wastewater using Fluidized-Bed Homogeneous Crystallization for Application as Slow-release Fertilizers in Viet Nam

Research Question: How can NPK be efficiently recovered from swine wastewater, while simultaneously treating H₂S gas to recover methane for household cooking, and ensuring the treated wastewater is safe for reuse?

Proposed Project Activity:

1. Nutrient Recovery System Development:

- Design and implement a fluidized-bed crystallization system for the efficient recovery of nitrogen, phosphorus, and potassium from swine wastewater.
- Conduct laboratory and pilot-scale experiments to optimize the recovery process.

2. Post-Recovery Wastewater Treatment:

- Establish a multi-stage treatment process to ensure the wastewater meets safety standards for agricultural reuse.
- Analyze the treated water quality to assess its suitability for irrigation.

3) H₂S Gas Treatment and Methane Production:

- Develop a biogas system to remove H₂S gas and convert it into methane.
- Conduct trials to evaluate the efficiency of methane production and its applicability for household cooking or household electricity.

4) Field Trials and Monitoring:

- Implement field trials in collaboration with local farmers to test the application of recovered nutrients as slow-release fertilizers.
- Monitor the impact of these fertilizers on soil health and crop yield.



My organisation: Central Institute for Natural Resources and Environmental Studies, Vietnam National University, Hanoi, VIET NAM.

Role: VNU-CRES will act as the project coordinator, responsible for overall project management and implementation. The organization will lead the development and optimization of nutrient recovery and H₂S treatment processes, ensuring the integration of technologies for efficient wastewater management. Additionally, VNU-CRES will engage with local stakeholders, including farmers and regulatory bodies, to promote the adoption of recovered nutrients and methane as sustainable resources for agricultural and household use. The organization will also handle data collection, monitoring, and reporting throughout the project lifecycle.

Further existing partners (if any):

Partner 1: Vietnam Japan University (VJU), Vietnam

Expertise: VJU has extensive experience in local agricultural practices, waste management, and environmental sustainability in Vietnam.

Role: The VJU will lead field trials of the slow-release fertilizers in Vietnam, assess their impact on crop productivity, and collaborate with local farmers and stakeholders for technology transfer and application.

Partners that we are seeking for our project consortium:

Partner 1

Region: Southeast Asia

Expertise: Agricultural research and technology focusing on sustainable farming practices and nutrient management in tropical climates.

Role: This partner will help develop and test the application of recovered nutrients as slow-release fertilizers in local agricultural settings. They will also facilitate outreach and training for farmers on the benefits of using these fertilizers.

Partner 2

Region: Europe

Expertise: Renewable energy technologies, specifically in biogas production and gas treatment systems.

Role: The partner will provide technical guidance on optimizing methane recovery from H₂S gas treatment, ensuring that the process is efficient and scalable for household cooking applications. They will also assist in technology transfer and capacity building for local stakeholders.



Partners that we are seeking for our project consortium:

Partner 3

Region: Europe

Expertise: Biotechnology and sustainable agricultural practices, with a focus on bio-based fertilizers.

Role: This partner will collaborate on the formulation and testing of the slow-release fertilizers derived from the recovered nutrients. They will provide insights into the effectiveness of these fertilizers in various soil types and crop systems.

Partner 4

Region: Southeast Asia or Europe

Expertise: Policy development and regulatory frameworks for sustainable agriculture and waste management.

Role: This partner will provide guidance on navigating local regulations and policy frameworks in both Europe and Southeast Asia. They will help ensure that the project aligns with sustainability goals and local government initiatives.





Thank you very much for your kind attention