

FRANCIS ASARE, Ph.D.

Biochar Systems, Forest Products & Sustainable Biomass Utilization

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RESEARCH PROFILE

Forest products and sustainability scientist with a Ph.D. in Forestry and Natural Resources, specializing in biochar and pyrolysis systems, value-added utilization of agricultural and forestry residues, and application-specific carbon materials. More than eight years of research and field experience spanning biomass conversion, techno-economic analysis, wood utilization, soil and environmental applications, carbon management, and technology adoption. Designed and built three pyrolysis kiln prototypes, conducted research across more than ten agricultural and forestry feedstocks, and authored seven peer-reviewed publications with additional manuscripts under review. Research integrates engineering, economics, material performance, and extension to translate biomass and biochar science into practical solutions for agriculture, forestry, environmental management, and sustainable resource utilization.

EDUCATION

Ph.D., Forestry & Natural Resources Jan. 2023 – Aug. 2026

Purdue University, West Lafayette, IN.

Dissertation: Integrated Biochar Systems: Engineering, Economics, Material Specification, and Adoption Across Global Contexts

M.S., Forestry & Natural Resources

Jan. 2021 – Dec. 2022

Purdue University, West Lafayette, IN.

Thesis: Sustainable Biochar and Charcoal Production Technologies. [ProQuest](#)

B.Sc., Forest Resources Technology

Aug. 2015 – Jun. 2019

Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana.

Thesis: Alternative wood species for charcoal production at Pru West District in the Bono-East region of Ghana.

Graduate Funding & Assistantship Support. Competitively funded throughout graduate study at Purdue University through research and teaching assistantships across the **Wood Research Laboratory**, **Department of Agronomy**, and **Department of Forestry & Natural Resources**, including graduate stipends, tuition remission, and university-supported research and teaching appointments.

PEER-REVIEWED PUBLICATIONS

1. Asare, F. *, Gazo, R., Owusu, F.W., Saraugi, S.S., Routray, W., Mo, J. & Rahmani, S.R. (2026). Operational performance and cost–performance trade-offs of low-cost, farmer-scale biochar kilns. *Biomass Futures*, 100059. [doi](#)
2. Saraugi, S.S. *, Asare, F., Gazo, R., Mohanta, T.R., Saha, P., & Routray, W. (2026). A comprehensive characterization of tender coconut waste biochar produced through slow pyrolysis at different temperatures and heating rates. *Biomass and Bioenergy*, 207, 108728. [doi](#)
3. Asare, F. *, Gazo, R. & Owusu, F.W. (2026). Charcoal production and rural energy in Ghana: A case study evaluating alternative tree species in the Pru District. *Sustainable Forestry*, 1–24. [doi](#)
4. Saraugi, S.S. *, Asare, F., Gazo, R., & Routray, W. (2025). Advances in sustainable production of biochar and biochar-based nanocomposites: A critical review. *Journal of Cleaner Production*, 145752. [doi](#)

5. Damnyag, L., Owusu, F.W., Bampoh, A.A., Adutwum, O.J., Gazo, R., & Asare, F.* (2025). Assessing tree-level lumber value in smallholder plantations in Ghana using the modified Taungya system. *Scientific African*, 27, e02448. [doi](#)
6. Owusu, F.W., Apetorgbor, M.M., Korang, J.K., Alorbu, C., Appiah-Kubi, E., Gazo, R., & Asare, F.* (2024). Natural durability of *Eucalyptus* species harvested as electricity transmission poles in two ecological zones of Ghana. *Scientific African*, 26, e02414. [doi](#)
7. Asare, F.*, Owusu, F.W., & Gazo, R. (2022). Sustainable charcoal production drive in rural communities in Ghana. *Energy for Sustainable Development*, 68, 364–372. [doi](#)

* Corresponding/lead author

MANUSCRIPTS UNDER REVIEW & IN PREPARATION

1. Asare, F.*, Owusu, F.W., Gazo, R., & Adjei, P. Developing sustainable biochar systems in Ghana: Technologies, training, and adoption opportunities. **In press:** *Purdue Journal of Service Learning and International Extension*.
2. Asare, F.*, Gazo, R., Mo, J., Haviarova, E., Quesada, H.J., Rahmani, S.R., Owusu, F.W., Saraugi, S.S. & Routray, W. Techno-economic analysis of farmer-scale biochar production from agricultural residues in the U.S. Corn Belt: a comparison of three low-cost kiln architectures. **In press:** *Bioresource Technology*.
3. Asare, F.*, Rahmani, S.R., Haviarova, E., Quesada, H.J., Owusu, F.W. & Gazo, R. No two biochars are the same: a specification-driven engineering framework linking feedstock, pyrolysis, and post-processing to application-specific performance in water remediation and soil health. **Under review:** *Biochar*.
4. Saraugi, S.S., Asare, F., Gazo, R., & Routray, W.* Design and development of a multi-tube micro-kiln for biochar and charcoal co-production: Product characterization, performance, and techno-economic analysis. **Under review:** *Cleaner Production*.
5. Asare, F.*, Owusu, F.W., Rahmani, S.R., Haviarova, E., Quesada, H.J. & Gazo, R. Comparative field-scale performance of three locally fabricable biochar kilns on agricultural residues under humid tropical conditions in Ghana. **In preparation:** *Biomass and Bioenergy*.
6. Asare, F.*, Owusu, F.W. & Gazo, R. Techno-economic assessment of farmer-scale biochar production from agricultural residues in Ghana. **In preparation:** *Biomass and Bioenergy*.
7. Asare, F. Social media as an extension platform for biochar education and early adoption: a six-month case study of the Biochar Innovators Society Inc. **In preparation:** *Extension*.
8. Asare, F.*, Rahmani, S.R., Libohova, Z., & Gazo, R. Carbon stock dynamics at Purdue's Agronomy Center for Research and Education: Two decades of soil management impacts on soil organic matter and nutrient status. **In preparation:** *Agronomy*.

AWARDS, FELLOWSHIPS, GRANTS & HONORS

1. **Selected as One of Early Biochar Producers and Adopters Worldwide** — *GECA Environnement, Canada*; selected by Suzanne E. Allaire for inclusion in a forthcoming international publication profiling biochar producers and their impacts; 2026.
2. **Fischer Forestry Fund — Graduate Student Scholarship** — *Dept. of FNR, Purdue University*; 2026; **\$3,000**.
3. **Small Research Grant** — *Purdue Graduate Student Government (PGSG)*; 2025; **\$375**.
4. **Center for Instructional Excellence (CIE) Teaching Academy Graduate Teaching Award in FNR** — *Purdue University*; 2025; Certificate of Excellence.
5. **Charles H. Michler Scholarship for Outstanding Graduate Student Researcher in Forest Biology** — *Dept. of FNR, Purdue University*; 2025; **\$5,000**.

6. **FNR Research Symposium — PhD Extension Poster Award Recipient (5x First Place Winner)** — *Dept. of FNR, Purdue University*; 2026, 2025, 2024, 2023, 2022; **\$1,500 total**. [link](#)
7. **Joshua E. Neimark Travel Award for Distinguished Early-Career Scholars (1 of 5 nationally)** — AAAS; 2024; **\$900 + 1 year membership**. [link](#)
8. **Robert F. Seeburger Fellowship for the Most Outstanding Applicant to Purdue** — *Dept. of FNR, Purdue University*; May 2023; **\$14,617**.
9. **Purdue Graduate Student Travel Grant** — *PGSG*; 2023; **\$750**.
10. **Community Service–Learning Grant** — *Office of Engagement, Purdue University*; 2022; **\$1,500**.
11. **Dr. Dagnatchew Yirgou Endowment Travel Award** — *College of Agriculture, Purdue University*; 2022; **\$500**.
12. **Forest Products Society Student Scholarship** — *Forest Products Society*; 2022; **\$695**.
13. **Fischer Forestry Fund — Graduate Student Scholarship** — *Dept. of FNR, Purdue University*; 2022; **\$3,000**.
14. **Frederick N. Andrews Environmental Travel Grant** — *Purdue Graduate School*; Jan. 2022; **\$1,500**.
15. **Best Graduating Student** — *Dept. of Wood Processing & Marketing, KNUST*; 2019.
16. **Best Final Year Student** — *FFRT, KNUST*; 2019.
17. **Best Third Year Student** — *Dept. of Wood Processing & Marketing, KNUST*; 2018.
18. **Student Personality and Student Leader of the Year** — *FORTSA–KNUST*; 2018.
19. **Student Leader of the Year** — *FORTSA–KNUST*; 2018.

RESEARCH & PROFESSIONAL EXPERIENCE

Post-Doctoral Research Associate — Purdue University, Wood Research Laboratory Aug. 2026 – Aug. 2027

- Support the **Indiana Wood Utilization Team (IWUT)** through discovery-driven research, extension, outreach, and statewide engagement aligned with the **USDA Forest Service Wood Innovations** grant.
- Advance value-added utilization of Indiana wood resources and forest and agricultural residues under the supervision of Prof. Rado Gazo.
- Translate applied findings into demonstrations, practice guides, and stakeholder engagement across landowners, industry, and public agencies.

Graduate Research Assistant — Purdue University, Wood Research Laboratory Jan. 2021 – Aug. 2026

- Lead researcher on interdisciplinary projects in wood utilization, value-added use of forest and agricultural residues, and biochar and bioenergy systems.
- Designed and built **3** pyrolysis kiln prototypes and generated controlled comparative datasets across multiple agricultural and woody feedstocks as part of a broader research program spanning more than **10** feedstocks.
- Integrated research with extension and outreach, translating findings into field demonstrations, practice guides, and stakeholder engagement.
- Conducted quantitative, mixed-methods, and participatory research spanning technical, economic, and social dimensions.
- Mentored undergraduate and graduate researchers and supported research design, data analysis, and dissemination.

Research Scientist (Remote) — CSIR–FORIG, Ghana Oct. 2020 – Present

- Direct applied studies in wood products, biochar production, and natural resource management.

- Lead community-engaged field trials, demonstrations, and participatory research.
- Co-supervise undergraduate theses and contribute to collaborative publications.

Laboratory Assistant — Furniture Testing Center, CSIR–FORIG Oct. 2019 – Dec. 2020

- Conducted mechanical, strength, and durability testing of wood and wood-based products to national and international standards.
- Produced design and safety recommendations based on empirical testing.

Undergraduate Research Assistant — KNUST Sept. 2019 – Aug. 2020

- Supported data collection, analysis, and field logistics for faculty-led research projects.

EXTENSION, OUTREACH & STATEWIDE ENGAGEMENT

Biochar Systems Research Lead — Biochar Innovators Society (BIS) Inc. Oct. 2025 – Present (Global)

- Lead applied research in biochar production systems, carbon-negative materials, and biomass-based environmental solutions, connecting feedstock selection, pyrolysis technology, material properties, and end-use performance.
- Design and evaluate mobile and decentralized pyrolysis systems; assess agricultural, forestry, and other biomass feedstocks; and coordinate field demonstrations and technology-development activities.
- Coordinate scientific collaborations, supervise research volunteers, and manage applied research projects with academic and industry partners, including ongoing work on biochar-enhanced cement and construction materials.
- Advance application-specific research on biochar for soil improvement, durable carbon storage, water and stormwater treatment, compost enhancement, filtration, composite materials, and other emerging high-value applications.
- Translate research findings into practitioner-facing guidance, demonstrations, and training programs through a global learning and engagement network active in **27 countries** and reaching **500+ households**.

Regional & Eco-Club Coordinator — GAYO, KNUST May 2020 – May 2022

- Led a campus/regional network of **250+** students delivering climate action and circular-economy programs.

Disaster Risk Reduction Consultant (Intern) — GAYO Ghana May 2020 – Dec. 2020

- Coordinated a nationwide DRR Quiz across **5** locations.
- Engaged **2,000+** youth and **20+** partners (UNDRR, UNESCO Ghana, Mastercard Foundation, NADMO, AYAB DRR, FES Ghana).

Intern — Samartex Timber & Plywood Co. Ltd. Sept. 2018 – Dec. 2018

- Conducted quality control, verified specifications, and completed export documentation for wood products.

TEACHING EXPERIENCE

Graduate Teaching Assistant — Purdue University Jan. 2021 – Aug. 2026

Courses Taught and Supported

Sustainable Forest Product Manufacturing (FNR 30110) Fall 2022 (**30** students)

- Facilitated design-for-manufacture labs and industry-linked experiential learning activities.

FNR 23000 — World Forests & Society Fall 2025 (**104** students)

- Facilitated case-based learning on global forest governance and sustainability transitions.

Environmental Sci. & Conservation (FNR/AGRY/EAPS/NRES 12500) Spring 2025 (**204**), Spring 2022 (**235**)

- Coordinated assessments and grading operations for **200–235** students per term.
Landscape-Level Planning (FNR/NRES 27000) Fall 2024 (**60** students)
- Guided team-based scenario planning projects integrating ecological and policy dimensions.
Soil Science (AGRY/NRES 255/270) Spring 2023 (**127**), Fall 2023 (**198**)
- Served as Lead TA for **8** teaching assistants; coordinated lab operations and safety.
Undergraduate Teaching Assistant — KNUST Sept. 2019 – Aug. 2020
- Supported instruction for **850+** students across multiple courses.

LEADERSHIP & SERVICE (SELECTED)

Founder — Biochar Innovators Society (BIS) Inc.	Sept. 2025 – Present
Ambassador for Ghana — Purdue Graduate Student Government	Feb. 2024 – May 2025
Grant Reviewer — PGSG Grants Committee	May 2023 – May 2025
Board Member — Purdue Agriculture Alumni Board	Aug. 2023 – Apr. 2025
Vice President — FNR Graduate Student Association	May 2022 – May 2024
President — GAYO, KNUST Chapter	May 2020 – May 2022
President — INLI, KNUST	Jul. 2018 – Aug. 2019
President — FORTSA, KNUST	Aug. 2017 – Aug. 2018

CONFERENCE PRESENTATIONS (SELECTED)

Oral Presentations

1. Asare, F. *, Gazo, R., Owusu, F.W., Saraugi, S.S., & Routray, W. *Unleashing the power of biochar: revolutionizing Ghanaian agriculture*. STHISD 2025 — Sunyani, Ghana, Aug. 2025.
2. Saraugi, S.S. *, Asare, F., Padhi, S., Gazo, R., Singh, A., & Routray, W. *Effect of pyrolysis temperature and heating flow rate on biochar synthesized from tender coconut waste*. ASABE 2025 — Toronto, Canada, Jul. 13–16, 2025.
3. Asare, F. *, Gazo, R., Owusu, F.W., & Haviarova, E. *Wishes vs. reality in sustaining reliable technologies for charcoal and biochar operations*. 75th FPS Conference — Madison, WI, USA, Jun. 2022.

Poster Presentations

1. Asare, F. *, Gazo, R., Owusu, F.W., Saraugi, S.S., & Routray, W. *Evaluating organic digital strategies for global engagement: a six-month case study of BIS's volunteer-driven network*. Purdue FNR, Sept. 2025.
2. Asare, F. *, Gazo, R., Owusu, F.W., Saraugi, S.S., & Routray, W. *Scaling sustainable biochar markets in Ghana through farmer engagement and field trials*. Purdue University, Sept. 5, 2025.
3. Saraugi, S.S. *, Asare, F., Gazo, R., & Routray, W. *Advances in sustainable production and applications of nano-biochar*. Purdue University, Sept. 5, 2025.
4. Asare, F. *, Gazo, R., Owusu, F.W., Saraugi, S.S., & Routray, W. *Unleashing the power of biochar: revolutionizing Ghanaian agriculture*. STHISD 2025 (Virtual), Sunyani, Ghana, Aug. 20, 2025.
5. Saraugi, S.S. *, Asare, F., Padhi, S., Gazo, R., Singh, A., & Routray, W. *Advances in the sustainable production of biochar and biochar-based nanocomposites*. ASABE 2025 — Toronto, Canada, Jul. 13–16, 2025.
6. Asare, F. *, Gazo, R., Owusu, F.W., Haviarova, E., Saraugi, S.S., & Routray, W. *Evaluating user-friendly and portable kiln technologies for sustainable biochar production in Ghana*. FPS & SWST Joint Conference

— Fort Collins, CO, USA, Jun. 15–20, 2025.

7. Asare, F. *, Gazo, R., Owusu, F.W., & Haviarova, E. *From production to practice: scaling sustainable biochar markets in Ghana through farmer engagement and field trials*. FNR Research Symposium — Purdue University, Apr. 11, 2025. (First Place)
8. Asare, F. *, Gazo, R., Kenley, C.R., Owusu, F.W., Patel, R., Carpenter, D., Ratcliffe, L.R., Anane, A.A.A., & Adjei, P. *Developing sustainable biochar markets: strategies, challenges, and opportunities in Ghana*. FNR Research Symposium — Purdue University, Apr. 12, 2024. (First Place)
9. Asare, F. *, Gazo, R., Kenley, C.R., Owusu, F.W., Patel, R., Carpenter, D., Ratcliffe, L.R., Anane, A.A.A., & Adjei, P. *Developing sustainable biochar markets: strategies, challenges, and opportunities in Ghana*. Engagement & Service-Learning Summit — West Lafayette, IN, Feb. 29, 2024.
10. Asare, F. *, Gazo, R., Owusu, F.W., Adjei, P., & Anane, A.A.A. *Biochar production from agro-industrial residues using three kiln technologies*. AAAS Annual Meeting — Denver, CO, USA, Feb. 16, 2024. [link](#)
11. Asare, F. *, Gazo, R., Owusu, F.W. *Small-scale production and application of sustainable biochar and charcoal production technologies*. 66th SWST Convention — Asheville, NC, USA, Jun. 25–30, 2023.
12. Asare, F. *, Gazo, R., Owusu, F.W. *Small-scale production and application of sustainable biochar and charcoal production technologies*. Agricultural Engineering Joint Poster Networking Event — Purdue University, Sep. 8, 2023.
13. Asare, F. *, Gazo, R., Owusu, F.W., & Haviarova, E. *Biochar research communications and strategies: a guide to the sustainable adoption of three kiln technologies*. FNR Annual Research Symposium — Purdue University, Apr. 11, 2023. (First Place)
14. Asare, F. *, Gazo, R., Owusu, F.W., & Haviarova, E. *An industrial collaboration toward improving advanced technologies for sustainable charcoal and biochar operations in SSA*. 75th FPS Conference — Madison, WI, USA, Jun. 13–16, 2022.
15. Asare, F. *, Gazo, R., Owusu, F.W., & Haviarova, E. *Promoting the use of advanced technologies for sustainable charcoal and biochar production in developing countries*. FNR Annual Research Symposium — Purdue University, Apr. 2022. [link](#) (First Place)
16. Asare, F. *, Owusu, F.W., & Gazo, R. *Promoting the use of advanced technologies for sustainable charcoal and biochar production in SSA*. Agricultural Engineering Joint Poster Networking Event — Purdue University, Apr. 2022.
17. Asare, F. *, Owusu, F.W., & Gazo, R. *Sustainable charcoal production drive within rural communities in Ghana*. 74th FPS International Conference (Virtual), Jun. 14–17, 2021.
18. Asare, F. *, Owusu, F.W., & Gazo, R. *Sustainable charcoal production drive: beyond caloric value and yield recoveries*. FNR 2021 Virtual Conference — Purdue University, Apr. 2021.
19. Asare, F. *, Owusu, F.W., & Gazo, R. *Caloric value and yield potential of three wood species for charcoal production in Ghana*. Graduate Students Association of Ghana in USA Conference (Virtual), Jul. 24, 2021.
20. Asare, F. *, Gazo, R., Owusu, F.W., Adjei, P., & Anane, A.A.A. *Enhancing biochar production: an evaluation of kiln technologies and feedstock efficiency*. FPS Conference — Knoxville, TN, USA, Jun. 4–6, 2024.

INVITED PRESENTATIONS

1. Guest Presenter — *Building a national biochar ecosystem: lessons from BIS's work across Africa and the diaspora*. Minnesota Biochar Initiative (MNBI), May 2026. Attendance: 33.
2. Guest Lecture — *Tropical forestry and sustainability in Africa*. FNR 23000, Purdue University, Oct. 2025.

3. Guest Lecture — *Deforestation and sustainability in Ghana*. FNR 30200, Purdue University, Oct. 2025; Apr. 2025; Nov. 2023.
4. Recurring Guest Lectures — *Forest products and uses in Africa*. FNR 30110, Purdue University, 2022–2026.
5. Research Seminar — *Towards sustainable biochar production in Ghana*. Purdue System Thinkers, Nov. 2023.
6. Invited Talk — *Small-scale biochar production in Africa*. ICFEP-23, Accra, Ghana, Jul. 2023.
7. Institutional Seminar — *Integrating biochar education into global curricula*. CSIR, Ghana, Aug. 2023.

SEMINARS ORGANIZED (SELECTED)

1. *Pathways to global forestry graduate programs*. FNNR LT, KNUST, Ghana, Jul. 2024. Attendance: 212.
2. *Innovative kiln technologies for sustainable biochar production*. CSIR–FORIG, Ghana, Aug. 2023. Attendance: 59.
3. *Biochar production by preference and choice of materials*. Bono & Ahafo Regions, Ghana, Jul. 2023. Attendance: 41.
4. *Sustainable biochar production technologies*. Virtual Seminar, Jul. 2023. Attendance: 33.
5. *Biochar and business for climate change mitigation*. Virtual Seminar, Jun. 2023. Attendance: 131.

SKILLS & EXPERTISE

Biochar, Pyrolysis & Sustainable Biomass Systems

Biochar and pyrolysis system design; distributed biomass conversion; feedstock evaluation; value-added utilization of forest and agricultural residues; application-specific biochar engineering; carbon-management pathways; techno-economic and feasibility analysis.

Wood Utilization & Forest Products

Wood utilization; forest-products research; wood machining; wood products testing to national and international standards; value-added utilization of underused wood resources and residues.

Extension, Program Development & Stakeholder Engagement

Applied research, extension, and outreach; design and coordination of multi-site field trials and demonstrations; community-based and participatory program design; partnership development across landowners, industry, universities, NGOs, and public agencies.

Leadership & People Management

Nonprofit founding and organizational leadership; coordination and mentoring of research, teaching, and volunteer teams; scientific collaboration and project coordination; training and capacity building; grant review and committee service.

Wood Machining, CAD/CAM & Manufacturing

SolidWorks; Fusion 360; Mastercam 2022; G-code/CNC post-processing; toolpathing; jig/fixture design; wood machining; wood products testing.

Quantitative Methods & Data Science

Statistical modeling; experimental design; survey design; QA/QC; ANOVA; regression; mixed models; R (tidyverse, ggplot2); Stata; SPSS; GenStat; PAST; Excel (Power Query, Solver).

Mixed Methods & Participatory Research

Community-based research; co-design workshops; qualitative coding; field-based data collection; stakeholder-informed research design.

Visualization, Communication & Digital Platforms

BioRender; diagrams.net; poster and slide design; data storytelling; WordPress; basic HTML/CSS; Meta Ads; social media analytics; GA4; Looker Studio.

REFEREES

Available upon request.