CSAM
Centre for Sustainable Agricultural Mechanization
ESCAP

Advancing Low-Carbon & Circular Economy Solutions in Rice Straw Management

Dr. Nguyen Van Hung
Senior Scientist; Lead – Mechanization and Postharvest Team
International Rice Research Institute (IRRI)
IRRI team and related partners

Eleventh Regional Forum on Sustainable Agricultural Mechanization
Climate-smart Agricultural Mechanization for Sustainable Crop Residue Management and Resilient Agrifood Systems
26-28 October 2026 – Tianjin, China

Rice straw: Globally annual production >500 million tonnes/year

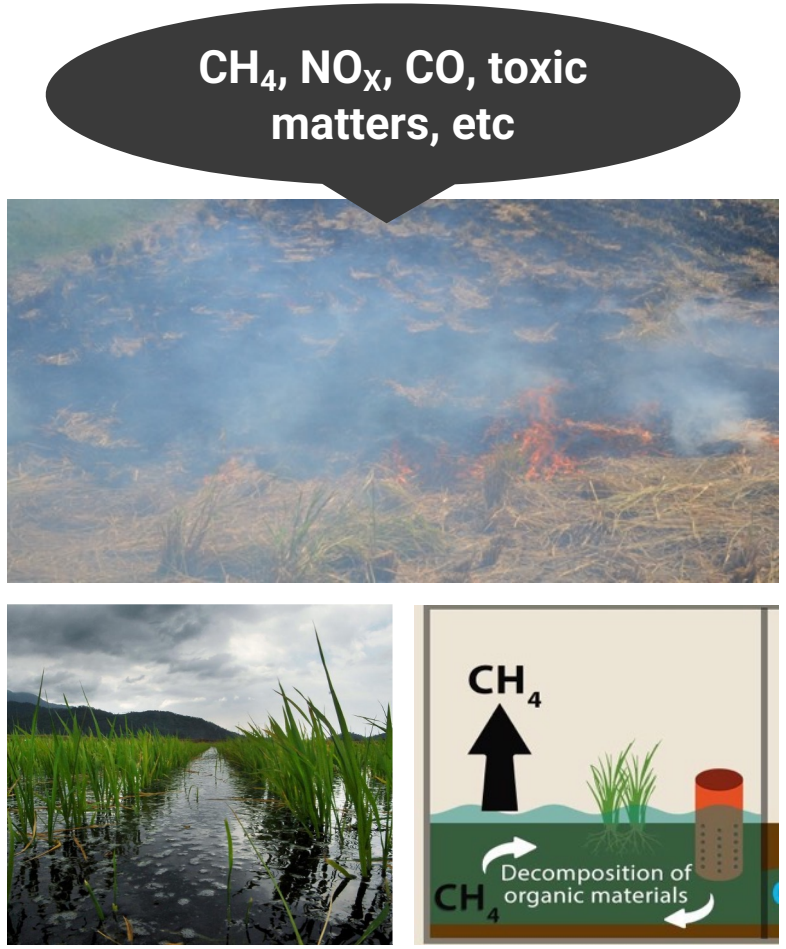
Problems

1) **Burning** > 50%

- Nutrient lost
- GHGE and pollutions
- Biodiversity loss (soil-dwelling organisms such as fungi, bacteria and rotiferal)

2) **Incorporation of rice straw in the flooded field** > 30%

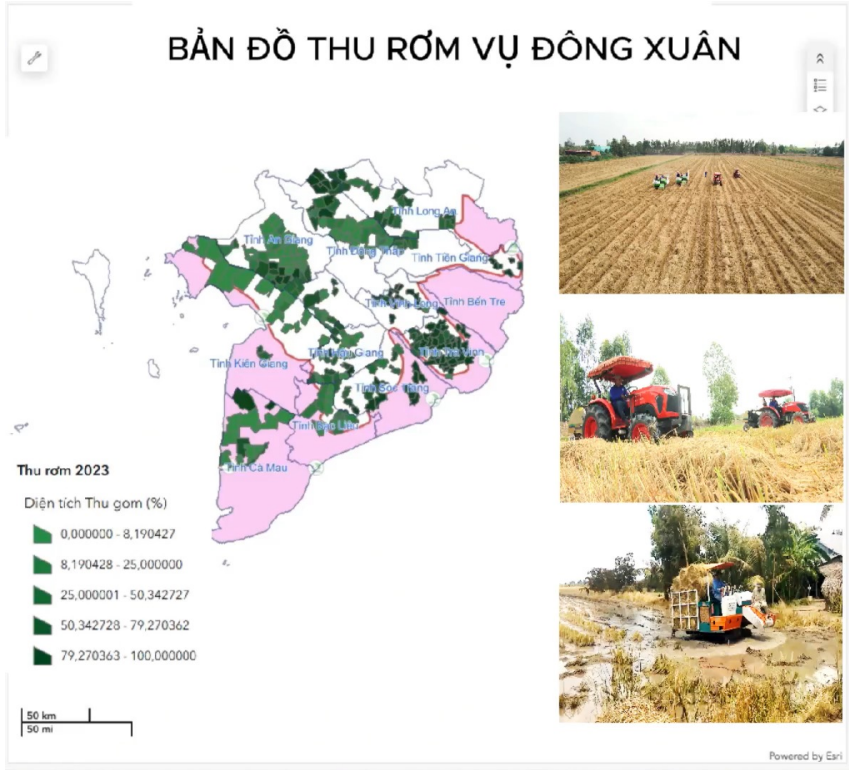
- CH_4 (1 CH_4 = 28 CO_2-eq)
- Methane toxicity, black root diseases



From science (data-driven innovations) **to practices** (large scale adoption)

Mapping to develop a strategy for rice straw management in MRD

(IRRI, 2025; 10k-farmer survey)

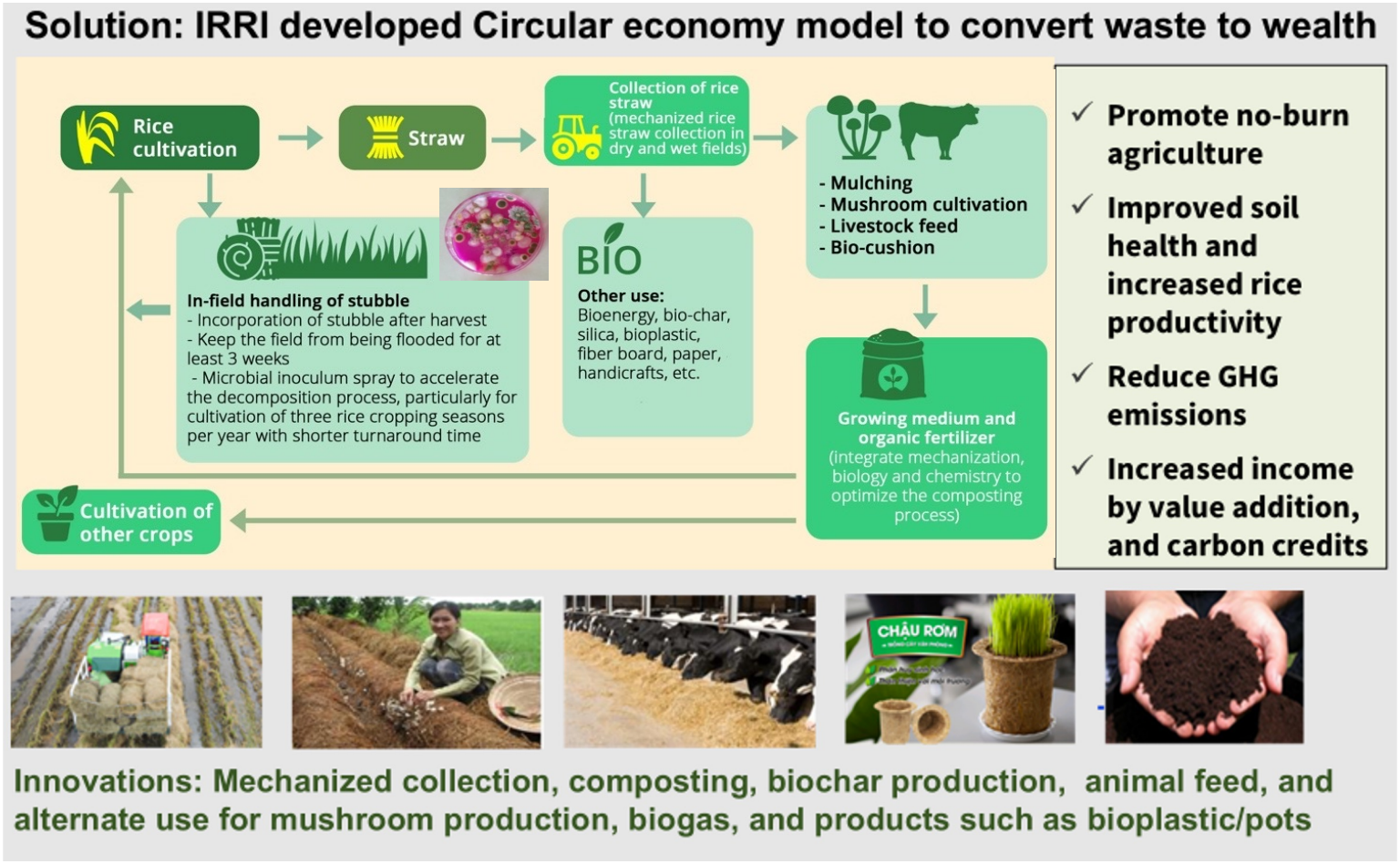




Tên tỉnh	%S Thu gom WS2223	%S Đốt rơm WS2223	%S Vùi rơm WS2223	%S Thu gom SA23	%S Đốt rơm SA23	%S Vùi rơm SA23	%S Thu gom AV
An Giang	23.85	71.4	4.8	20.3	62.4	17.3	
Bạc Liêu	7.73	78.3	14	3.8	44.4	51.7	
Cà Mau	16.99	35.3	45.7	0.2	1.1	98.8	
Cần Thơ	34.42	61.3	4.3	35.5	43.1	21.4	
Đồng Tháp	35.44	58.6	5.9	25.8	57.2	17	
Hậu Giang	33.88	62.8	3.4	21.9	17.1	61.1	
Kiên Giang	4.95	90.1	4.9	3	40	57.1	

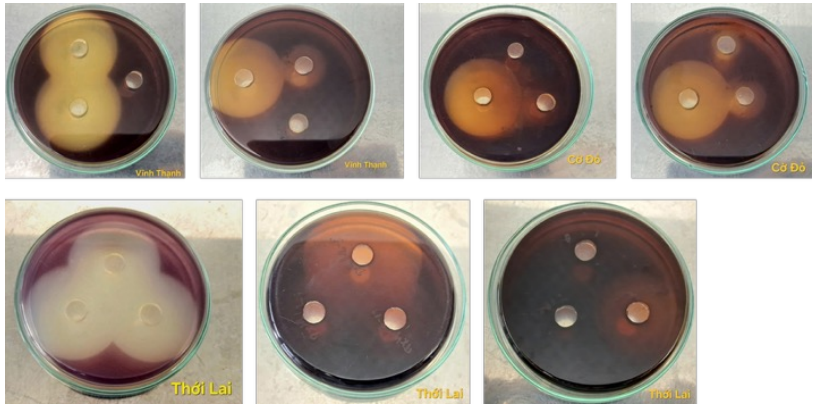


Rice & rice straw–based circular economy



Mechanization combined with microbial technology for rapid rice straw decomposition

- Bacteria decomposing rice straw (Ongoing IRRI's projects in the Philippines and Vietnam)
- Mechanized rice straw incorporation + microorganisms can speed up the decomposition of rice straw and increase soil health
- Rice straw decomposed before new crop establishment → reducing CH_4

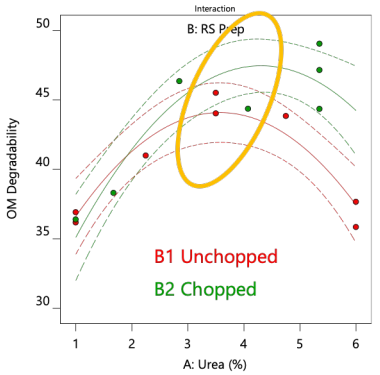




Improved straw-based ruminant feed







Optimization of rice straw pretreatments for ruminant feed

(IRRI Rice-StrawPH project, 2020)



Collection and compacting



Processing (increase digestibility and nutrient efficiency)



Feeding (highest value in grass scarcity season)

BMZ- rice straw project (2016-2019):

Case in Vietnam: At a dairy farm with about 15,000 milk cows: using urea-treated rice straw → reduce cost by about 50% (US$ 150/ton) compared with the imported biomass-feed.

Mechanized rice straw composting

Combines physical and bio-chemical processes for optimizing rice straw decomposition efficiency and organic fertilizer quality.





After-mushroom, low quality, or wet straw



Animal manure





Organic fertilizer



Compost pellets



Packaged products

05

business models successfully developed and operated in Vietnam

Bioplastic plant pot and urban agriculture







Two products are being registered IP (patents):

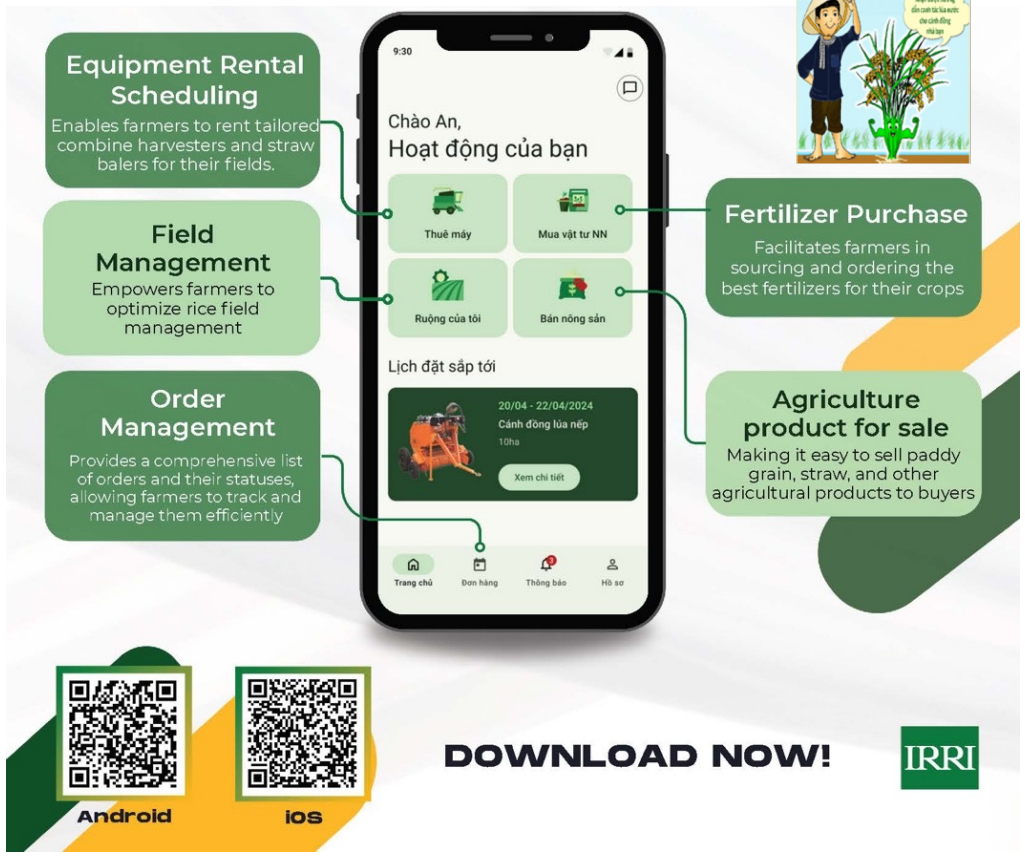
- Rice straw-based bioplastic plant pots
- All-in-one organic growth box (bio-pot, straw compost, and seeds) for urban agriculture



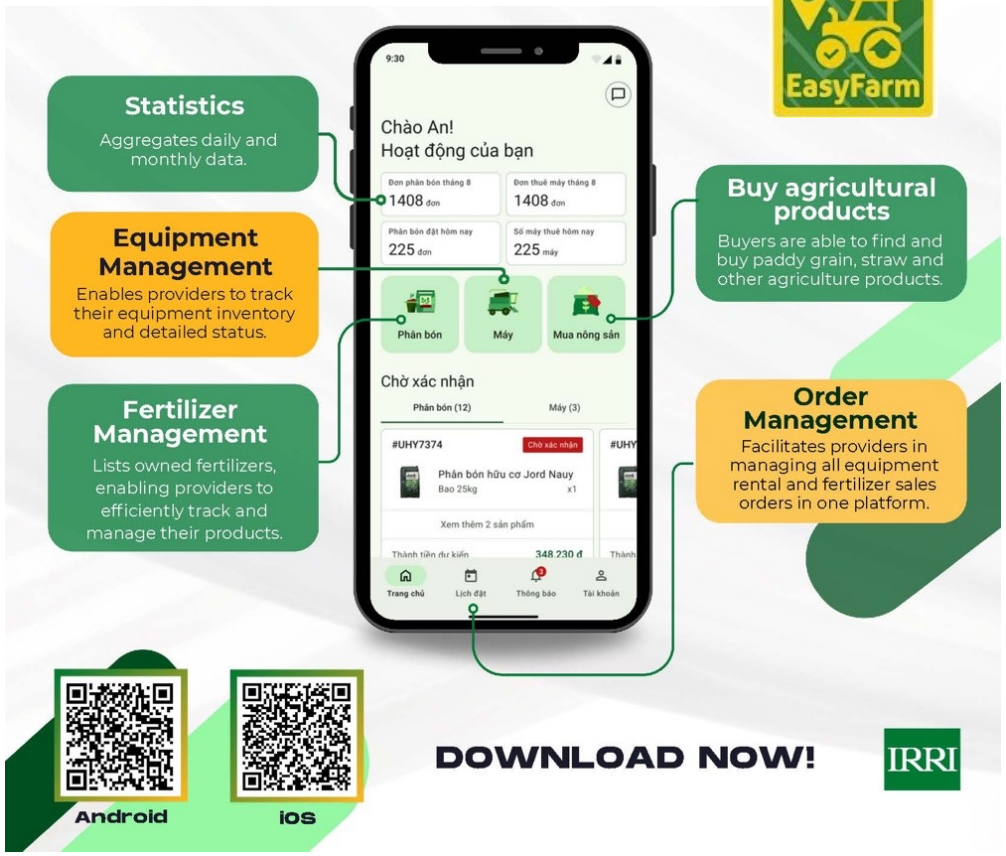


EasyFarm – match-making between farmers and other stakeholders along rice value chain

App for Farmers



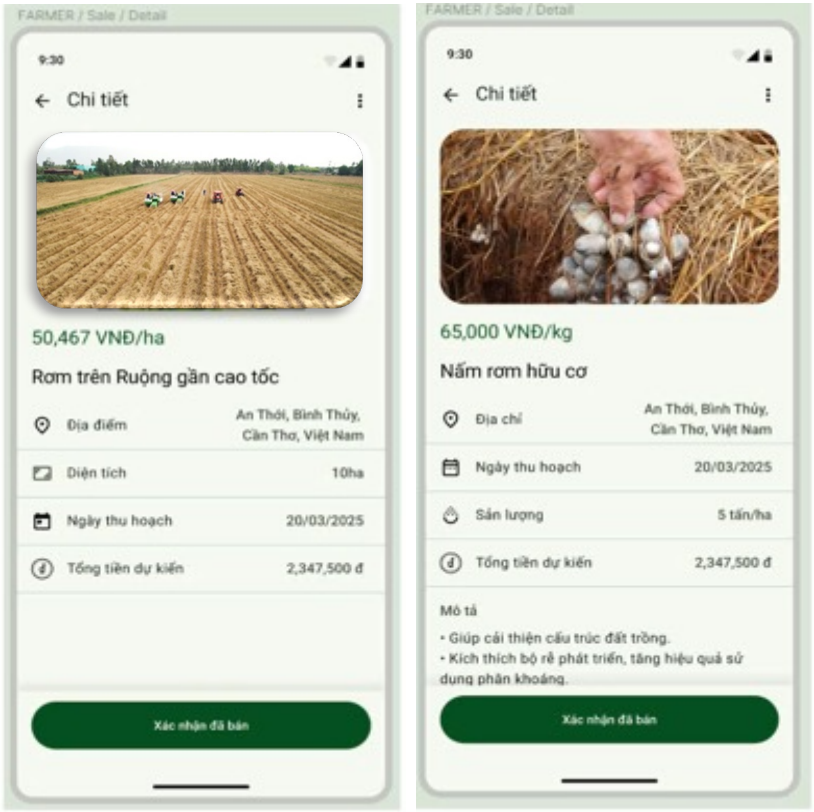
App for services



EasyFarm – match-making between farmers and other stakeholders along rice value chain



Book rice straw balers



Farmers can sell paddy grains, rice straw and other products on the App



App service providers/ dealers/ buyers

Recommendations and collaboration opportunities

- Scalable and sustainable solutions for rice straw decomposition, handling and processing
- Deploy new technologies, e.g. biochar, biofertilizer, bioplastics, etc.
- Improved rice straw logistics and value chains (comprehensive study, site-specific assessment, mapping, etc.)
- Capacity building for rice straw management and business models
- Digital tools/ Apps for improving value chain – e.g. EasyFarm: match-making between farmers, service providers, buyers, etc.



THANK YOU

Contact for further information:

Dr. Nguyen Van Hung
Senior Scientist; Lead – Mechanization and Postharvest Team, IRRI
Email: hung.nguyen@cgiar.org
Website: www.irri.org

CSAM
Centre for Sustainable Agricultural Mechanization

Related publications

- Hung et al., 2019. An assessment of irrigated rice production energy efficiency and environmental footprint with in-field and off-field rice straw management practices. Scientific Reports (2019) 9:16887. https://doi.org/10.1038/s41598-019-53072-x.
- Hung et al., 2016. Energy Efficiency, Greenhouse Gas Emissions, and Cost of Rice Straw Collection in the Mekong River Delta of Vietnam. Field crops research, 198:16-22. https://doi.org/10.1016/j.fcr.2016.08.024
- Hung et al., 2020. Life Cycle Assessment Applied in Rice Production and Residue Management. In Gummert M., Hung N., Pauline C., Douwaith B. (editors), 2019. Sustainable rice straw management, Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Hung et al., 2022. An assessment of irrigated rice cultivation with different crop establishment practices in Vietnam. Scientific Reports. https://doi.org/10.1038/s41598-021-04362-w.
- Wassmann et al., 2022. Carbon footprint calculator customized for rice products: concept and characterization of rice value chains in Southeast Asia. Sustainability. https://doi.org/10.3390/su14010315.
- McDonald, et al., 2020. Indian agriculture, air pollution, and public health in the age of COVID. World Development 135 (2020) 105064. https://doi.org/10.1016/j.worlddev.2020.10506
- Organo, et al., 2022. Assessing the potential of a Trichoderma-based compost activator to hasten the decomposition of incorporated rice straw. Scientific Reports. https://doi.org/10.1038/s41598-021-03828-1.
- Upcraft, et al., 2021. Protein from renewable resources: mycoprotein production from agricultural residues. Green Chemistry. DOI: 10.1039/d1gc01021b
- Hung et al., 2016. Generating a positive energy balance from using rice straw for anaerobic digestion. Energy Reports, 2016(2):117-122. https://doi.org/10.1016/j.egyr.2016.05.005
- Migo-Sumagang et al., 2020. Rice-straw-based heat generation system compared to open-field burning and soil incorporation of rice straw: an assessment of energy, GHG emissions, and economic impacts. Sustainability 2020, 12, 5327; doi:10.3390/su12135327.
- Connor et al., 2020. When climate change is not psychologically distant – Factors influencing the acceptance of sustainable farming practices in the Mekong river Delta of Vietnam. World Development Perspectives. https://doi.org/10.1016/j.wdp.2020.100204.
- Romasanta, et al., 2017. How does rice straw burning compare with other straw management practices in terms of on-field CH4 and N2O emissions? A comparative field experiment. Agriculture, Ecosystems and Environment, 239: 143–153.
- Truc et al., 2018. Quantification of direct and indirect greenhouse gas emissions from rice field cultivation with different rice straw management practices – A study in the Autumn-Winter season in An Giang Province, Vietnam. J. Viet. Environ. 10(1). https://oa.slub-dresden.de/ejournals/jve/article/view/2925.

Related publications (cont.)

- Hung et al., 2017. Processing rice straw and rice husk as co-products. Burleigh Dodds Science Publishing. Series No. AS04, pp. 121-148.
- Hung et al., 2019. Rice Straw Overview: Availability, Properties, and Management Practices. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Gummert et al., 2019. Sustainable rice straw management, Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Chivenge, et al., 2019. Rice Straw Incorporation Influences Nutrient Cycling and Soil Organic Matter, Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Allen, et al., 2019. Rice straw management effects on greenhouse gas emissions and mitigation options, Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Hung et al., 2020. Development and Performance Investigation of an Inflatable Solar Drying Technology for Oyster Mushroom. Energies 2020, 13, 4122; doi:10.3390/en13164122.
- Migo-Sumagang, et al., 2019. Optimization of a downdraft furnace for rice straw-based heat generation. Renewable Energy. https://doi.org/10.1016/j.renene.2019.11.001
- Balingbing, et al., 2020. An assessment on technical and economic feasibility of mechanized rice straw collection in the Philippines. https://www.mdpi.com/2071-1050/12/17/7150
- Balingbing, et al., 2019. Mechanized Collection and Densification of Rice Straw, Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Nghi et al., 2019. Rice Straw-Based Composting, Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Maguyon-Detras, et al., 2019. Thermochemical Conversion of Rice Straw. Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Ngan et al., 2019. Co-digestion of Rice Straw for Biogas Production. Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Le-Vinh-Thuc, et al., 2019. Rice-Straw Mushroom Production. Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Aquino, et al., 2019. Rice straw-based fodder for ruminants. Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.
- Demont, et al., 2019. Rice straw value chain and a case study for rice straw mushroom value chain in Vietnam. Springer Nature. https://link.springer.com/content/pdf/10.1007%2F978-3-030-32373-8.pdf.