

Sustainable Mechanization Solutions to Agricultural Waste Burning

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About CSAM

- Mandate: To promote knowledge exchange, research and development, technology transfer and agro-business development for sustainable agricultural mechanization
- Regional Hub for South-to-South and Triangular Cooperation directly serving 62 ESCAP member States and associate members
- Focus on Sustainable Development Goals (SDG) 2 (Zero Hunger), SDG 1 (No Poverty), SDG 13 (Climate Action), SDG 17 (Partnerships for the Goals).

CSAM's vision is to achieve production gains, improved rural livelihood and poverty alleviation through sustainable agricultural mechanization for a more resilient, inclusive and sustainable Asia and the Pacific



Why Do Farmers Burn Straw?

- **No perceived economic value** due to lack of **alternative uses**
- **High cost** of straw collection, transportation and storage, partially caused by the shortage of rural labour
- **Lack of time** for straw to decompose before next seeding cycle
- Lack of adequate **machinery and techniques** to treat straw residue
- **Low awareness** of the impacts of burning on the environment, food security and health



Picture courtesy: ICAERD (Indonesia)

Some Alternative Uses of Straw

- **Fertilizer** (directly or as cow manure)
- **Fodder**
- **New energy resource** (briquette fuels, biogas production, carbonization fuel, gasification fuel, degradation and ethanol)
- **Base stock** (mushroom growing)
- **Industry material** (papermaking, building material, crafts production, xylitol production)



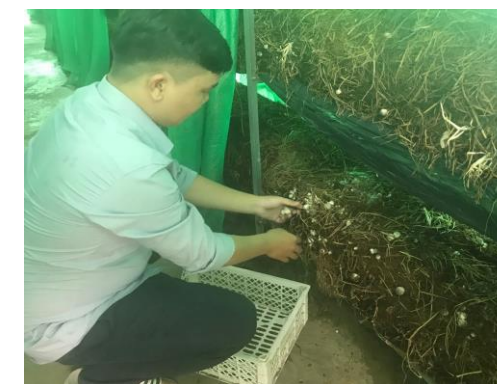
Fertilizer (mixing w/ soil)



Fodder



Bio-gas



Base stock (mushroom)

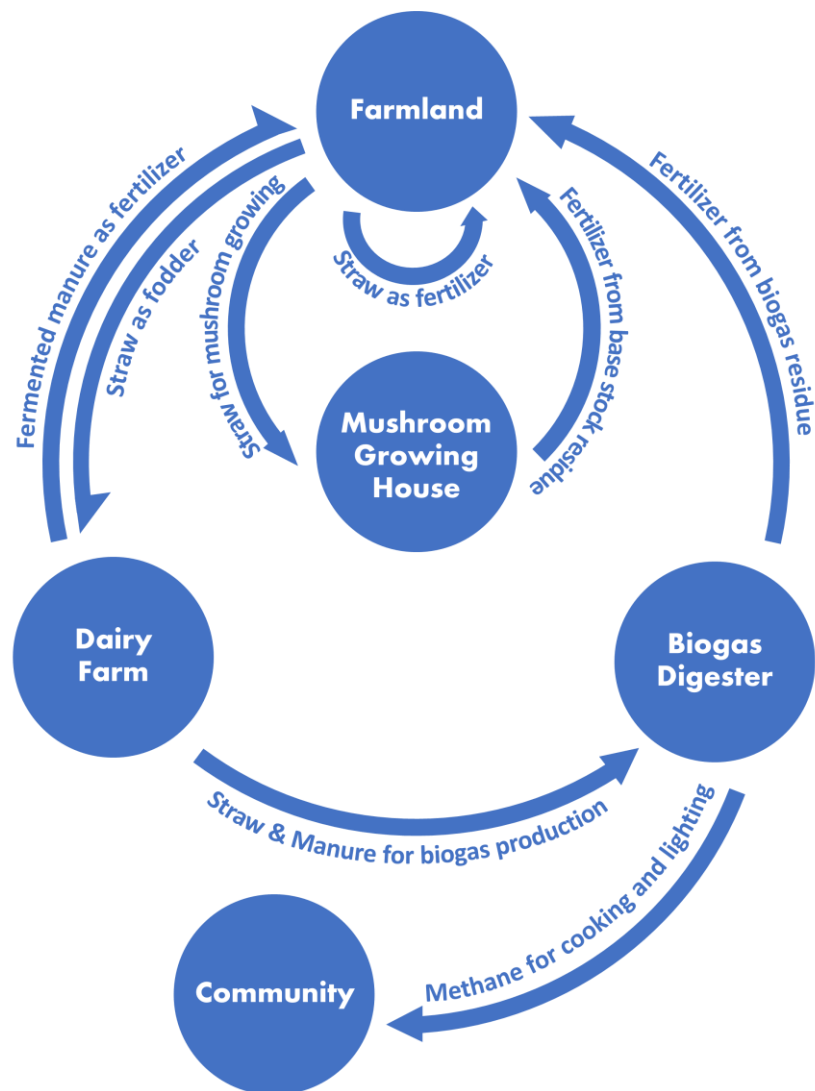
Pictures courtesy: China Agricultural University, SIAEP (Viet Nam)

CSAM's Regional Initiative on Integrated Management of Straw Residue: Circular Model of Straw Utilization

Promoting application of agricultural machinery and practices for sustainable, circular use of straw residue as **fertilizer, fodder, substrate for mushroom-growing, and biogas production**

Priorities for country pilots (on wheat-maize system and extended to rice):

- Sensitize stakeholders and **highlight economic benefits** of sustainable & integrated straw residue management to farmers
- **Incentivize adoption** of sustainable mechanization solutions and encourage **adaptation** to match local needs



Technical Mode: Straw Used as Fertilizer

1) Returning straw to the field



a) Wheat harvesting and straw chopping



b) Maize no-till planting



c) Maize harvesting



g) Seedling emergence



f) Sprinkling irrigation



e) Wheat planting



d) Straw chopping and mixing with soil

Pictures courtesy: China Agricultural University



Technical Mode: Straw Used as Fertilizer

2) Returning cow manure to the field



a) Feeding cows

→



b) Cow manure composting in fertilizer processing factory (using cow manure rotator)

↓



c) Sewage disposal through cow manure drain trap

←



d) Dry-wet cow manure separation

←



e) Returning cow manure to the field

Pictures courtesy: China Agricultural University



Technical Mode: Straw Used as Fodder (Ensilage Maize)



a) Maize harvested by maize ensilage harvester

→



b) Compacting straw ↓



c) Straw fermentation

←



d) Processing fodder

←



e) Feeding cows

Pictures courtesy: China Agricultural University



Technical Mode: Returning Biogas Slurry/Residue to the Field



a) Bio-gas production

→



b) Separation of biogas slurry/residue

↓



c) Returning biogas residue to the field
(Before winter wheat planting)

←



d) Returning biogas slurry (with water) to the field
(After winter wheat germination)

Pictures courtesy: China Agricultural University

Technical Mode: Straw as Base Stock for Mushroom Growing



a) Base material preparation



b) Bagging



c) Sterilization



d) Mushroom inoculation



e) Mushroom cultivation



f) Harvesting

Pictures courtesy: China Agricultural University



Pilot Project on Integrated Straw Management in China (wheat-maize system)

- With China Agricultural University and local farmers cooperative
- Positive outcomes (July 2019 to Aug 2022):
 - 1,000 tons of wheat and maize straw sustainably utilized from 23 ha pilot demonstration site in 2022 amounting to an **equivalent emissions reduction of 1,579 tons of CO₂** per year
 - **Soil Organic Matter increased** under different approaches (returning straw to the field, returning cow manure to the field and returning biogas slurry & residue to the field) by **up to 11.4%**
 - New formula for cattle fodder + kneading machine during ensilage process **improved milk production** by 3 ltr/day/cow, increasing value of milk produced by **160 USD/day** for 100 cows
 - **Increased net income** under different approaches by **up to 539 USD/ha**



Pictures courtesy: China Agricultural University

Pilot Project on Integrated Straw Management in Viet Nam

- With Sub-Institute of Agricultural Engineering and Post-Harvest Technology
- Positive outcomes (2018 to 2019):
 - Promoted ‘**In-door mushroom growing technology**’ applying a steam sterilizer and water supplying system
 - Indoor mushroom growing technology demonstrated as superior to traditional/ outdoor method:
 - **Higher mushroom yield** - rice straw using efficiency of approximately 26% compared to 13-15% in traditional method
 - **Lower production cost**
 - **Higher mushroom quality**
 - Substrate after mushroom growing used as a natural fertilizer - considerably **reduced application of chemical fertilizers** and lowered production cost
 - **Improved porosity and fertility of soil** & reduced negative impact on environment from straw burning



Pictures courtesy: SIAEP (Viet Nam)

Regional Initiative Extended to New Pilots in Cambodia, Indonesia and Nepal (2021-2023)

○ Approach implemented:

- Establishment of pilot sites
- Field trials of machinery
- Modification and adaptation of the machinery
- Capacity building and community awareness sessions
- Regional study tours for knowledge exchange

○ Pilot Model:

- In-situ and ex-situ utilization of straw (eg. as fodder and fertilizer) based on local needs
- Machinery used: Minimum-tillage seeder, baler, direct seed drill, handy straw cutter...

○ Results:

- Increased farmers' awareness
- Identification of smallholder-friendly solutions
- Strengthened local capacities



Pictures courtesy: Dept. of Agri Engg (Cambodia), Gadjah Mada University (Indonesia), Tribhuvan University (Nepal)

Pilot Project on Integrated Straw Management in Cambodia

(with Swisscontact and Dept of Agricultural Engineering)



Balers

Can compress loose straw into compact round or rectangular 'bales' that are easier to store and transport



Direct Seed Drill

Can shorten time needed for crop to mature & allow more time for residue to decompose naturally

Pictures courtesy: Dept. of Agri Engg (Cambodia)

Pilot Project on Integrated Straw Management in Indonesia

(with Gadjah Mada University)



Handy Straw Cutter



Thresher



Customized Straw Pressing Machine for compact storage



Trailer for Straw Transportation

Low-cost, Smallholder-friendly Equipment & Solutions

Pictures courtesy: Gadjah Mada University (Indonesia)



Pilot Project on Integrated Straw Management in Nepal

(with Institute of Engineering, Tribhuvan University)



Super Seeder / Minimum-Seed Drill
 Can incorporate paddy straw & stubble into soil and simultaneously sow seeds



Field Trial
 Left side control plot (traditional) & right side (Super Seeder)



Drum Seeder
 Low-cost solution, can shorten time for crop to mature



Straw Block-making Machine
 for straw use as fodder

Pictures courtesy: Tribhuvan University (Nepal)

Regional Knowledge Exchange



Integrated Straw Management Regional Study Tour, 7-10 November 2019, Ludhiana, India



Virtual Workshops and Demonstrations, 28 October 2020 & 25 October 2022, Laixi, China



Regional Study Tour on Mechanization Solutions for Straw Management, 21-27 November 2022, Thailand

Sustainable Agricultural Mechanization for Integrated and Climate-Smart Straw Residue Management

Promoting mechanization-based solutions for integrated and climate-smart management of straw residue

CHALLENGE
The burning of straw residue after harvesting is a common practice, including in many least developed countries (LDCs) in East-Central and South-East Asia. This practice causes air pollution, soil degradation, and other negative impacts. Addressing this challenge requires a combination of technical, financial, and institutional support. In order to address these issues, various approaches are being applied to sustainably utilize straw in East-Central and South-East Asia. In Cambodia, an initial activity was promoting conservation agriculture in which minimizing or eliminating tillage is an important aspect. However, the lack of suitable agricultural machinery is one of the main constraints. There is a need to test integrated straw utilization models through an east-south-south cooperation in Cambodia, Laos, and Vietnam, and sharing the innovative approaches identified in South-South and triangular cooperation.

TOWARDS A SOLUTION
The 7-year Sustainable Food and Nutrition Transformation (SFNT) in Cambodia

IMPACTS
The SFNT project has identified and tested a model to utilize straw as fertilizer, mulch, bio-fuel, etc., for soil health, pest and disease control, and as a source of income for farmers. This model is being tested in Cambodia, Laos, and Vietnam. The project is also testing the model in Cambodia, Laos, and Vietnam. The project is also testing the model in Cambodia, Laos, and Vietnam. The project is also testing the model in Cambodia, Laos, and Vietnam.

GOOD PRACTICES

in South-South and Triangular Cooperation in Least Developed Countries:

From the Istanbul Programme of Action to Achieving Sustainable and Resilient Development



16 March 2022

Good Practices in South-South & Triangular Cooperation in LDCs





Won ESCAP Innovation Award & 'best business pitch' - Nov. 2022

Key Implementation Needs

Alternative uses of straw – supported by agricultural machinery - can provide sustainable solutions for burning but we need:

- Identification of context-specific options
- Local adaptation
- Community engagement and local champions
- Training and capacity building
- Multi-stakeholder approach
- Field-level regional / international exchanges and cooperation

Thank you for your attention!

For more information, please visit www.un-csam.org

or email escap-csam@un.org