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Availability and Potential of Local Biomass Resources as Fuel for Drying of Tropical Fruits in Northern Thailand

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Background

- The Thai economy is greatly dependent on agriculture
- Crop drying in Thailand operates mostly with fossil fuels
- Farmers are impaired by increasing costs of fuel prices
- Fruit drying requires particularly large amounts of energy
- Biomass is a relevant sustainable and renewable energy
- Crop wastes such as pruning wood, seeds and peels are current biomass resources that might be used as fuel
- Combustion of biomass materials on a broad scale first requires their availability and fuel properties be known

Objectives

- To investigate wood and processing residues of mango, litchi and longan and evaluate their potential as local energy sources for drying in Northern Thailand

Materials and Methods

- Pruning fields were evaluated and farmers were interviewed to determine availability of pruning wastes
- A survey of processing facilities was conducted using structured questionnaires to determine waste availability
- Samples of pruning wood and residual wastes such as peels and seeds were collected
- Samples were evaluated for physical characteristics and fuel properties (heating value, ash content and volatiles)

LPG-Fueled Dryer

Wood-Fueled Dryer

Longan Trees, Pruning Wood and Processing Wastes

Results

Pruning Wood

- Pruning wood production (6-60 kg/tree) depends most on farmer practices; current uses are limited
- All 3 crops produce wood with low ash content and high volatile matter/heating value, meaning good fuel potential
- Longan wood has the highest density and the largest amount of energy on a per volume basis

	H_2O Content (%wb)	Density (kg/m^3)	Heating Value (MJ/kg)	HV/ Vol (GJ/m^3)	Ash (%)	Volatiles (%)	Fixed Carbon (%)
Wood							
Mango	50.89	451.3	18.74	8.46	2.07	82.70	15.26
Litchi	45.86	591.0	18.40	10.87	2.02	77.84	20.13
Longan	41.19	621.0	17.74	11.02	3.68	77.94	18.39

Processing Wastes

- Large-scale facilities have large amounts of wastes, currently unutilized and posing disposal problems
- Some small operations use own wastes to make fertilizer

Fruit Processing Facility	Large Scale	Small Scale
Raw fruit input (tons/day)	30.2 ± 19.2	1.3 ± 0.6
Waste per input (%)	83.3 ± 48.9	31.0 ± 4.6
Processing time (days/year)	48.9 ± 8.0	55.0 ± 12.6
Estimated waste (tons/yr)	2,179	29

- Peels and seeds show good potential as fuels, but peel samples have high moisture contents (56-73%)

	H_2O Content (%wb)	Ash (%)	Volatiles (%)	Fixed Carbon (%)	Heating Value (MJ/kg)
Peel					
Mango	72.99	3.94	80.99	15.07	18.56
Litchi	62.32	3.99	77.46	18.56	19.75
Longan	56.60	4.21	77.7	18.10	17.29
Seed					
Mango	51.42	2.54	78.24	19.22	19.05
Litchi	59.86	2.08	75.44	22.49	18.14
Longan	35.13	1.93	80.91	17.16	17.74

Discussion and Conclusions

- Production and processing wastes of mango, litchi and longan have high potential as fuels in Northern Thailand
- High moisture content of fresh biomass materials may require drying before combustion
- In some cases, limitations on the use of wastes as fuel for drying may exist due to distant proximity of waste sources to drying facilities or seasonality of waste production

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