DEPARTMENT OF GEOGRAPHICAL SCIENCES

Effects of Thailand's Energy Transition on Land, Water and Food: An Input-Output Analysis

Ipsita Kumar, Kuishuang Feng, Varaprasad Bandaru , Laixiang Sun
University of Maryland

BACKGROUND

- With population and economic growth, demand for all resources, including food increases.
- As agricultural production increases, cop residue generation also increases.
- Traditionally, residues are burned, leading to adverse impacts such as:
  - Increased pollution, in the atmosphere,
  - Poor visibility or haze,
  - Deterioration of human health, and
  - Local and global climate change.

CASE FOR THAILAND

- Ranked 6th in the world for rice production [1]
- Ranked 4th in the world for sugarcane production [1]
- Bangkok closed 400 schools due to smog [2, 3]
- Ranked 10th in the world for total biomass burned [4]
- Thailand seeks to achieve 30% energy from renewable sources, by 2036 [5]
- Majority of residue burned comes from rice and sugarcane (83%) [4]
- Currently, true usage of solid biomass is less than half the target usage [6]
- To achieve this, the area harvested for sugarcane is increasing and area for rice is falling [7]
- Shifts from rice to sugarcane has affects on land use, and water
- At the same time, the potential for biomass use for electricity is very high [8]

- A collection of data from the Department of Alternative Energy Development and Efficiency, Ministry of Energy [8], showed that a small fraction of paddy husk and sugarcane bagasse are been used for electricity generation relative to the potential usage of husk and bagasse

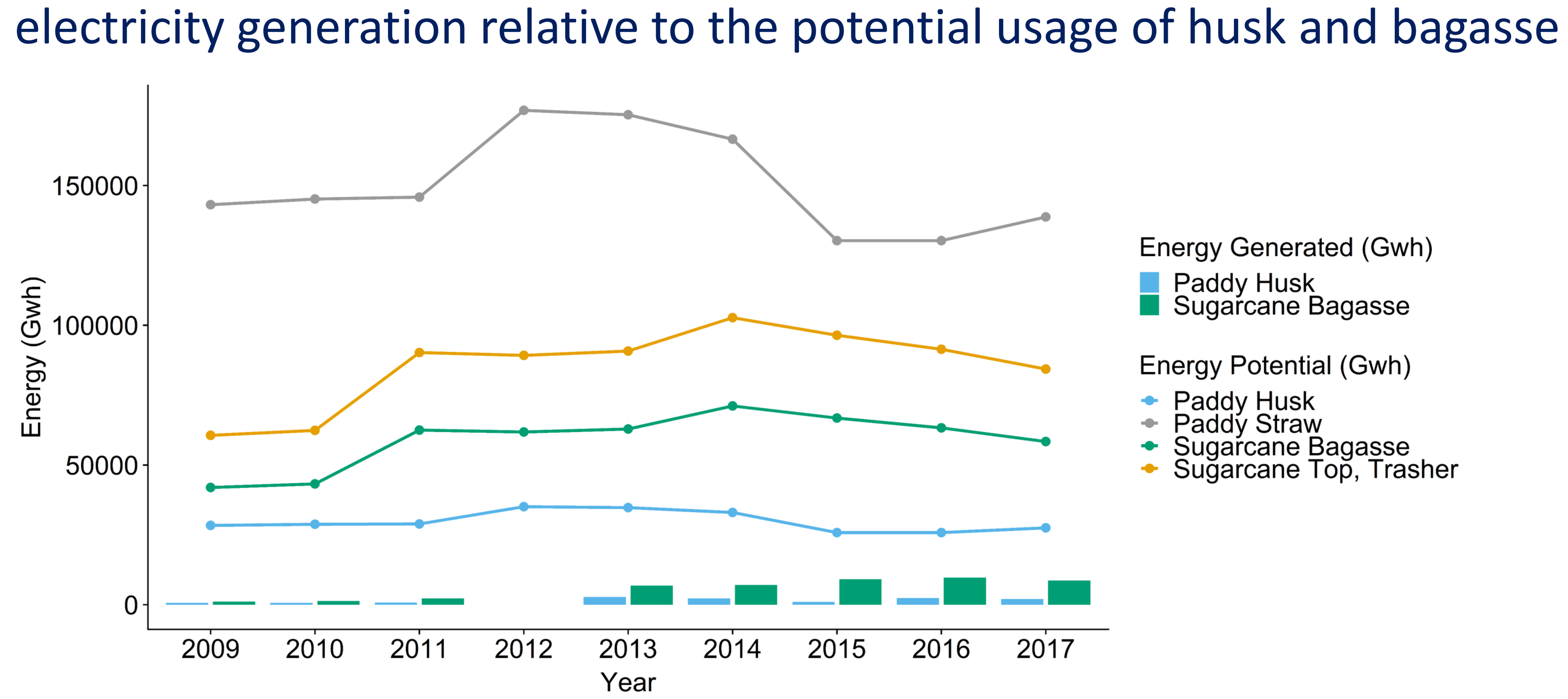

Figure 1: Energy Generated and Potential in Gwh from 2009-2017 in Thailand

OBJECTIVE

The objective of this study is to understand the economic consequences of changes in crop residue use for electricity generation in Thailand using an Input-Output (IO) model

THAILAND RENEWABLE ENERGY POLICIES

- **Zero Burning Policy for Sugarcane**
  - The policy targets the purchase of sugarcane by sugar mills, and to ensure they do not purchase burned cane from farmers by 2022 [9].
- **Alternative Energy Development Policy (AEDP)**
  - Alternative Energy Development Policy which seeks to have 20.11% electricity from renewable sources, of which, 5570 MW coming from biomass and a projection of 27789 ktoe of electricity demand in 2036 [5].

MODEL AND SCENARIO DEVELOPMENT

- We use the Input-Output (IO) Model understand economic impacts of changes to electricity production from rice, sugarcane, and other sources of electricity. The three future scenarios represent the above policies put forth by the government targeting crop residue burning, and use.
- The IO model explains:
  - The relationship between the consumption and production of all goods and services in the region, and
  - Helps understand the impacts on the economy if there are shifts in consumption or production of one or more sectors.
- The IO model will run
  - Two historical years, 2011 and 2014, and
  - 3 future scenarios, as seen below:

Scenario Name	Policy	Assumptions
No Burn (Best Case)	Zero Burning Policy for Sugarcane	• 40% use of industrial sugarcane bagasse potential for electricity generation, • Account for 12.16% electricity coming from sugarcane bagasse by 2022
AEDP	Alternative Energy Development Policy (AEDP)	• 73.06% biomass electricity coming from paddy and sugarcane • Share of biomass from sugarcane and paddy in total electricity is 4.16%
AEDP 1.5	Increase AEDP target by 50%	• Increase the total electricity from rice and sugarcane increases by 50%

RESULTS AND CONCLUSION

- Residue use can significantly reduce electricity from all other sources.
- The results from total output (figure 2) shows that in the No Burn scenario, total electricity from sugarcane significantly increases, which has led to a large reduction in electricity produced from all other sources of electricity.
- We see a significant increase in electricity from all other sources, which proves that the AEDP is not able to target the entire potential from sugarcane and rice residue.
- Even in the AEDP1.5 scenario, we do not see much of a shift in total electricity from all other sources.
- Water use is significantly high from all other sources as compared to the use by rice and sugarcane, as it is still very low use in the country as a percentage

RESULTS

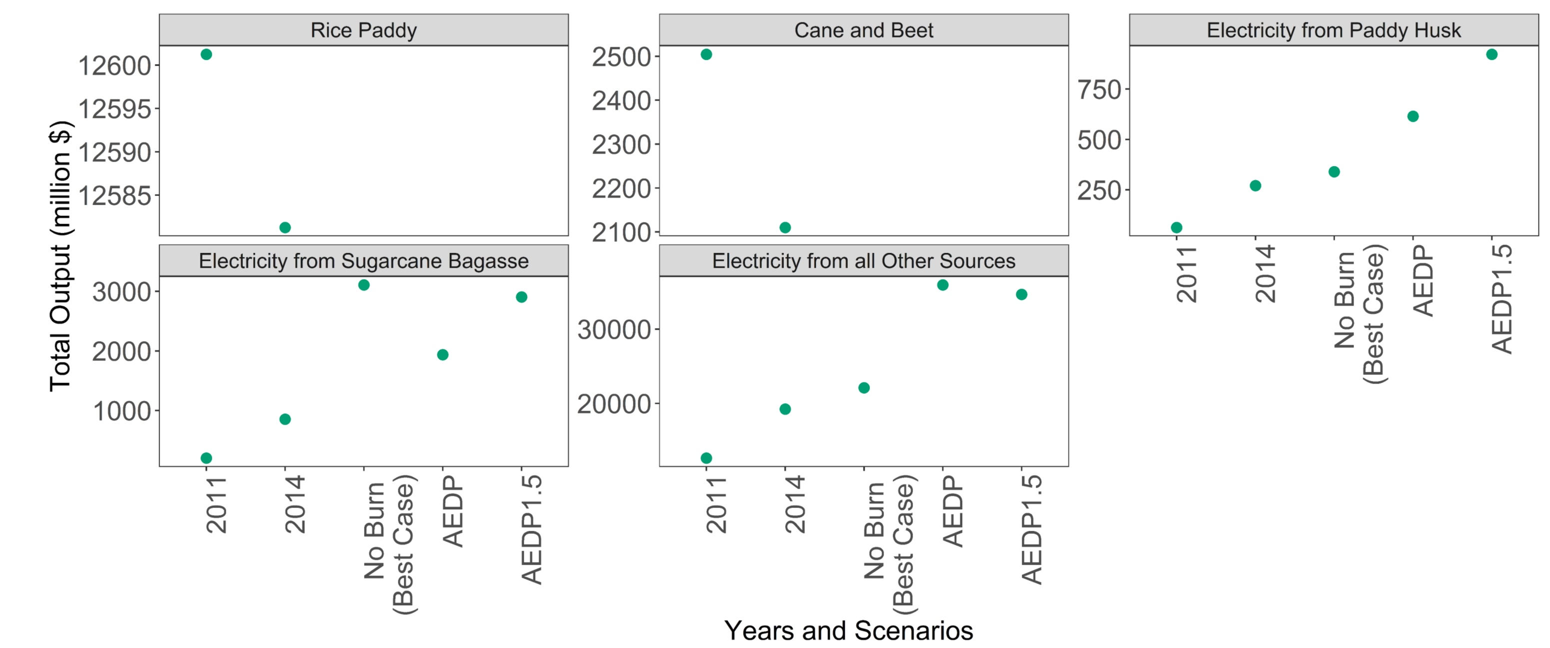

Figure 2: Total Output from key sectors

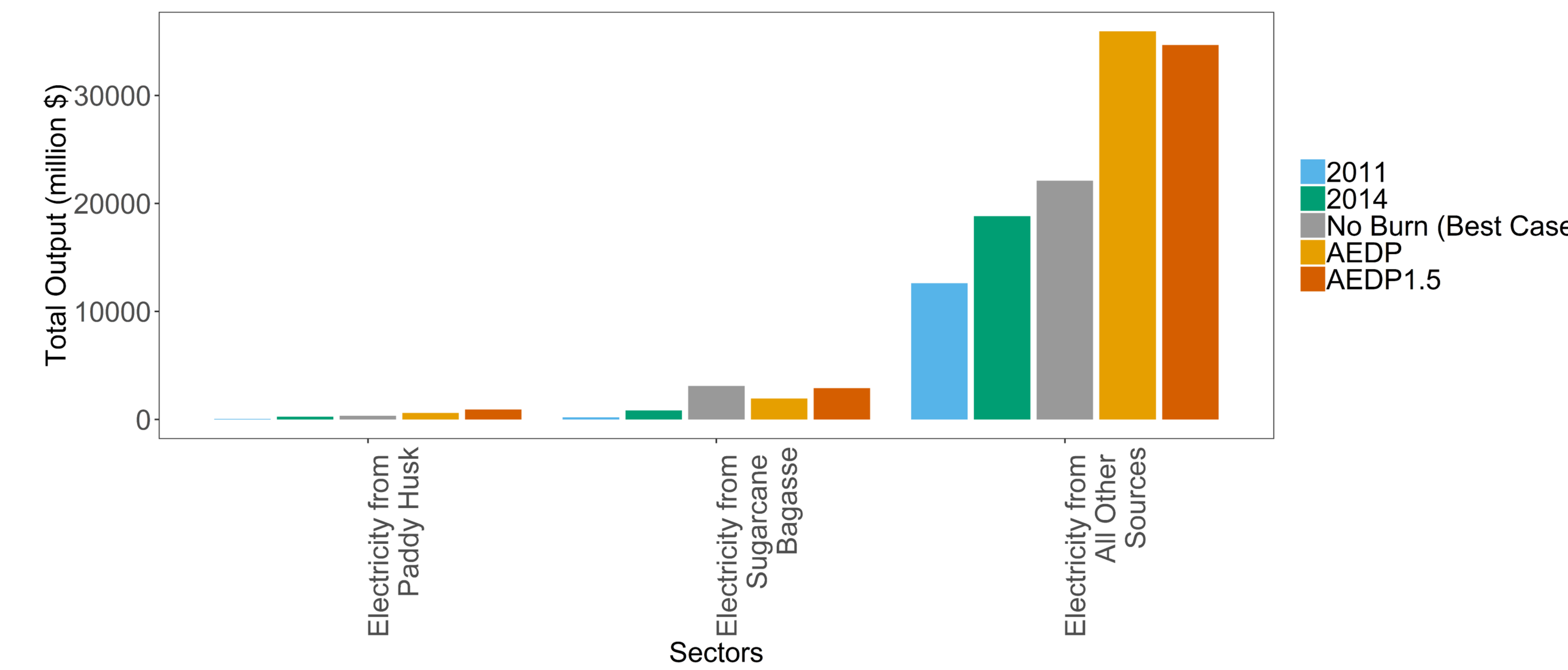

Figure 3: Total output for different scenarios for the energy sector

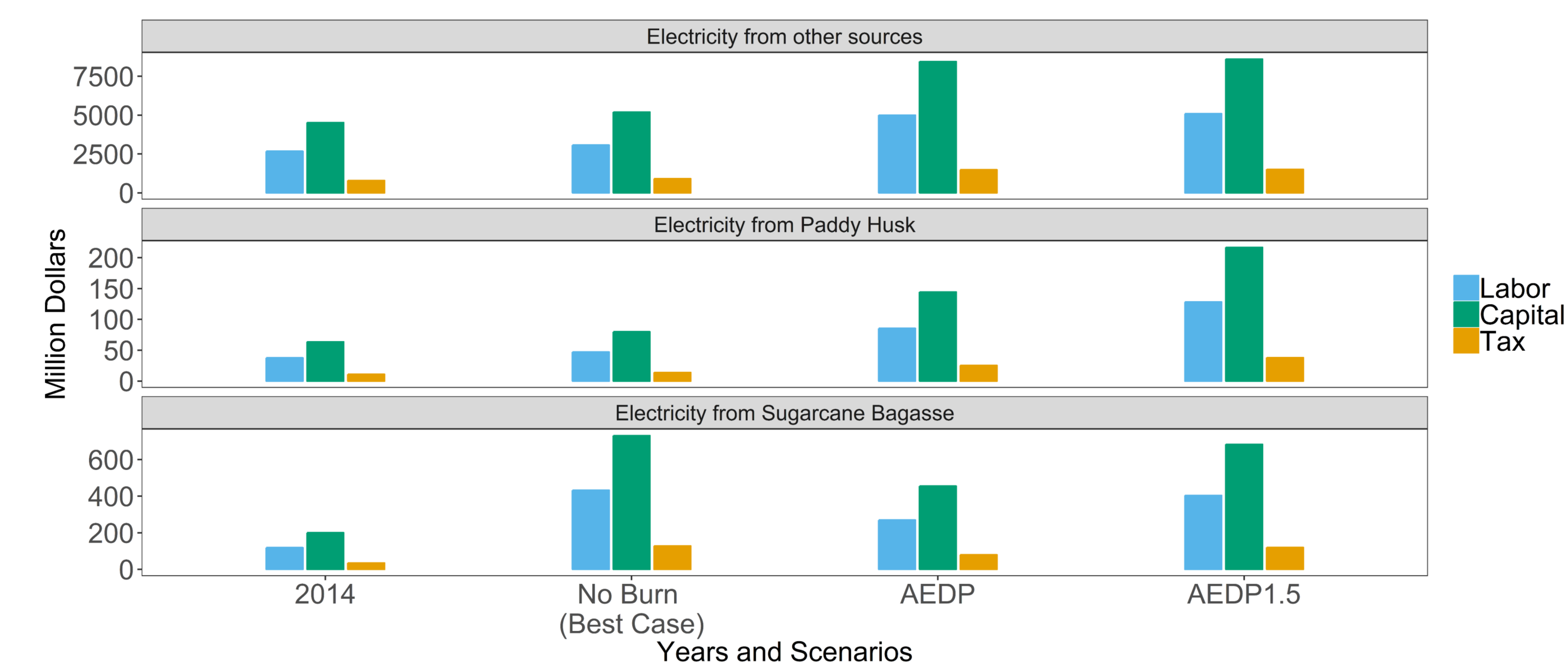

Figure 4: Value added from 2014 and 3 scenarios for different electricity sources.

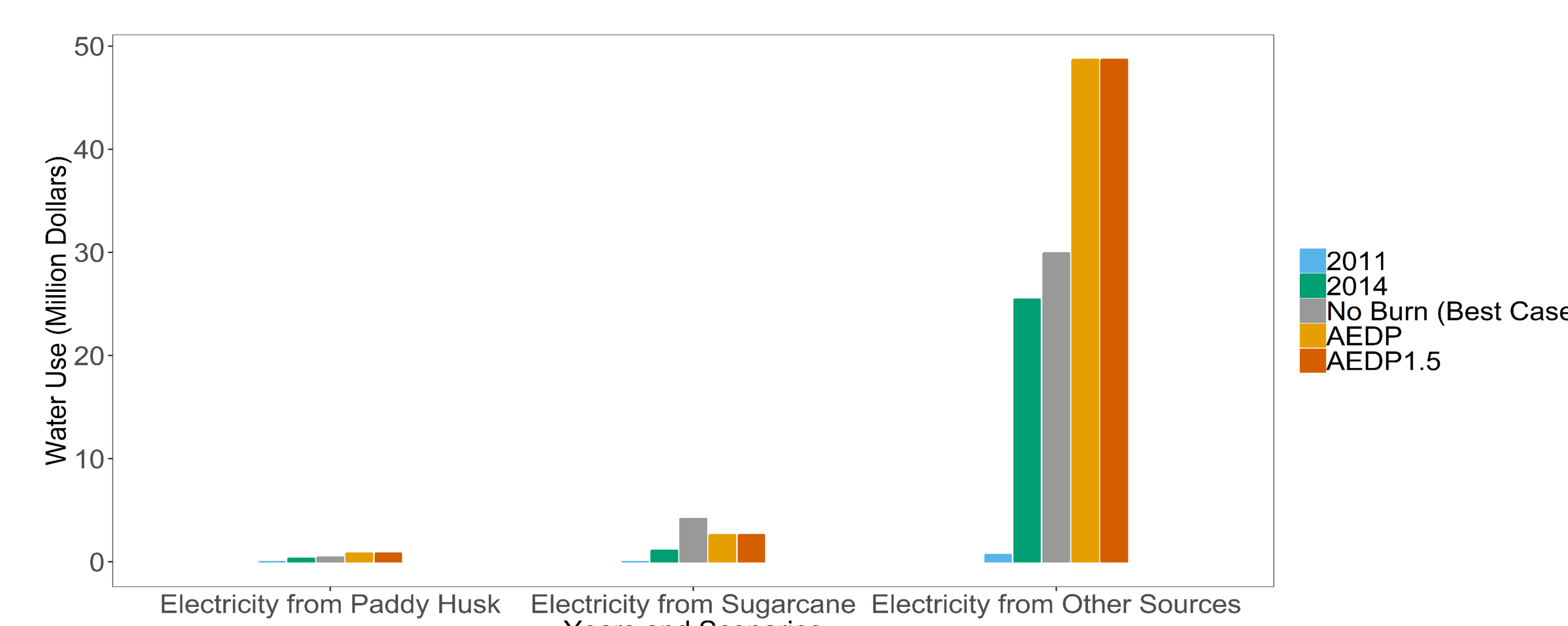

Figure 5: Water use (in million dollars) for the electricity sectors

REFERENCES

[1] FAO (2017) FAOSTAT statistics database – Crop Production (Thailand). Food and Agriculture Organization of the United Nations. [Rome]
[2] Beech, H. (2019). Bangkok Is Choking on Air Pollution. The Response? Water Cannons. - The New York Times. Retrieved from New York Times: https://www.nytimes.com/2019/01/30/world/asia/pollution-thailand-bangkok.html
[3] Rosane, O. (2019). Toxic Air Forces Thai Officials to Close 400+ Bangkok Schools. Retrieved from EcoWatch: https://www.ecowatch.com/bangkok-air-pollution-2627608098.html
[4] FAO (2016) FAOSTAT statistics database – Total Biomass Burned (Thailand). Food and Agriculture Organization of the United Nations. [Rome]
[5] DEDE. (2015). Alternative Energy Development Plan: AEDP2015. Department of Alternative Energy Development and Efficiency, Ministry of Energy, Bangkok.
[6] Cheewaphongphan, P., Junpen, A., Kamnoet, O., Garivait, S. (2018). Study on the Potential of Rice Straws as a Supplementary Fuel in Very Small Power Plants in Thailand. Energies, 11(2), 270.
[7] FAO (2016b) FAOSTAT statistics database – Area Harvested (Thailand). Food and Agriculture Organization of the United Nations. [Rome]
[8] DEDE. (2009-2017). Thailand Alternative Energy Situation Annual Report 2009-2017. Department of Alternative Energy Development and Efficiency, Ministry of Energy, Bangkok.
[9] The Thaiger. (2019). Ministry works towards ending sugarcane burning in three years | The Thaiger. From The Thaiger: https://thethaiger.com/hot-news/air-pollution/ministry-works-towards-ending-sugarcane-burning-in-three-years