Sustainability Challenges of Biomass for Energy: Focus in the Philippines*

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Flow of Discussion

1. Current situation of biomass for energy in the Philippine
   > Biomass (crop residues) for energy
   > Potential power from algae
2. Assessing the Sustainability of some Biomass for Energy in the Philippine Context
   > General interrelated issues regarding Biomass –to- Energy
   > AGRONOMY of biomass sustainability

1. Current situation of Biomass for Energy in the Philippines

Philippines can be 100% dependent on renewable *(geothermal, wind, solar, hydro, biomass).

41 % of the primary energy mix was contributed by renewable energy sources in 2011.

50%>>>>>>>>>2020

TOTAL 2,799.70 installed RE by April 2015(DOE)

Republic Act 9513: "*The Renewable Energy Act of 2008*"

Potential Power from Available Biomass (Philippines, in MW)

(Amarra,2015)

Crop	Biomass Resources	Luzon	Visayas	Mindanao	Total
Palay	Rice Hull	126.00	8.60	20.58	155.18
	Rice Straw	207.60	79.30	142.72	429.62
Corn	Corn Cobs	116.29	3.60	14.63	134.52
	Corn Stalks	1,187.89	23.30	295.03	1,506.22
	Corn Leaves		11.30		11.3
Coconut	Coconut Shell	154.30	2.10	22.13	178.53
	Coconut Husk	345.10	2.10	63.62	410.82
	Coconut Frond	77.60		550.61	628.21
Sugarcane	Bagasse	0.10	842.30		842.4
	Cane Leaves / Cane Trash	0.30	87.80	58.44	146.5
	Waste Water		26.80		26.8
	Filter Cake		16.60		16.6
Oil Palm	Empty Fruit Bunch			3.88	3.8
	Shell			1.37	1.37
	Husk			2.56	2.56
	Frond			38.74	38.74
	Hogs/Swine Manure		19.60	1.56	21.16
	Chicken Manure		14.40	3.19	17.59
	MSW			27.12	27.12
Sawmill	Sawmill Slabs			63.52	63.52
	Sawmill Dust			6.73	6.73
	Total	**2,215.18**	**1,137.80**	**1,316.43**	**4,669.41**

4,670MW

1,032.34 MW for Sugarcane

Awarded biomass project as April 2015= 192 MW

Note: For Visayas, we used CEST and UASB Technologies
CEST (Condensing Extracting Steam Turbine)
UASB (Upflow Anaerobic Sludge Blanket Digestion)

Aqua based Biomass→Energy

Algae

In the Philippines, interests are high on sea-derived biomass or algae for energy.

The Philippines has 220 million hectares of coastal and marine areas which can be tapped for sea weed (crop) farming ; 1 million ha freshwater-water lilies, fast growing grasses.

In the US, ..algae-derived biofuel could displace 70 billion litres per year of fossil fuels in road transport and aviation fuels by 2030

(http://www.carbontrust.co.uk/emergingtechnologies/current-focus-areas/algae-biofuels-challenge/pages/

University –based research on the use of algae as feedstock for biodiesel.

Professor Milagrosa M. Goss of UPLB > promising species of freshwater microalgae ……

Chlorella vulgaris, Scenedesmus obliques and *Nitzschia palae* → biodiesel feedstock.

A larger R& D - UPLB in cooperation with the Ateneo de Manila University and the University of Santo Tomas.

University of Santo Tomas' Faculty of Engineering, Dr. Maria Natalia Dimaano in cooperation with the state-run Philippine National Oil Co.-Alternative Fuels Corp. (PNOC-AFC) are doing R&D on Algae as feedstock of biodiesel . "The algae are grown with sunlight, water and carbon-carrying emissions from power plants".

Sen.Angara, Chair of the Congressional Commission on Science, Technology and Engineering (COMSTE). “

>>proposed the establishment of the Philippine Institute for Algae Research and Commercialization (PINARC),

(http://biofuels.carboncapturereport.org/cgi-bin//

profiler?key=Philippine_Institute_For_Algae_Research&pt=3#sthash.aUdC8EHA.dpuf

Private sector initiative :SECURA’s network of Biotechnology Systems are evaluating the productivity of local microalgae strains.

at Bgy. Tagpako, Gingoog City, Misamis Oriental, Mindanao , Philippines (Manayaga,2015).

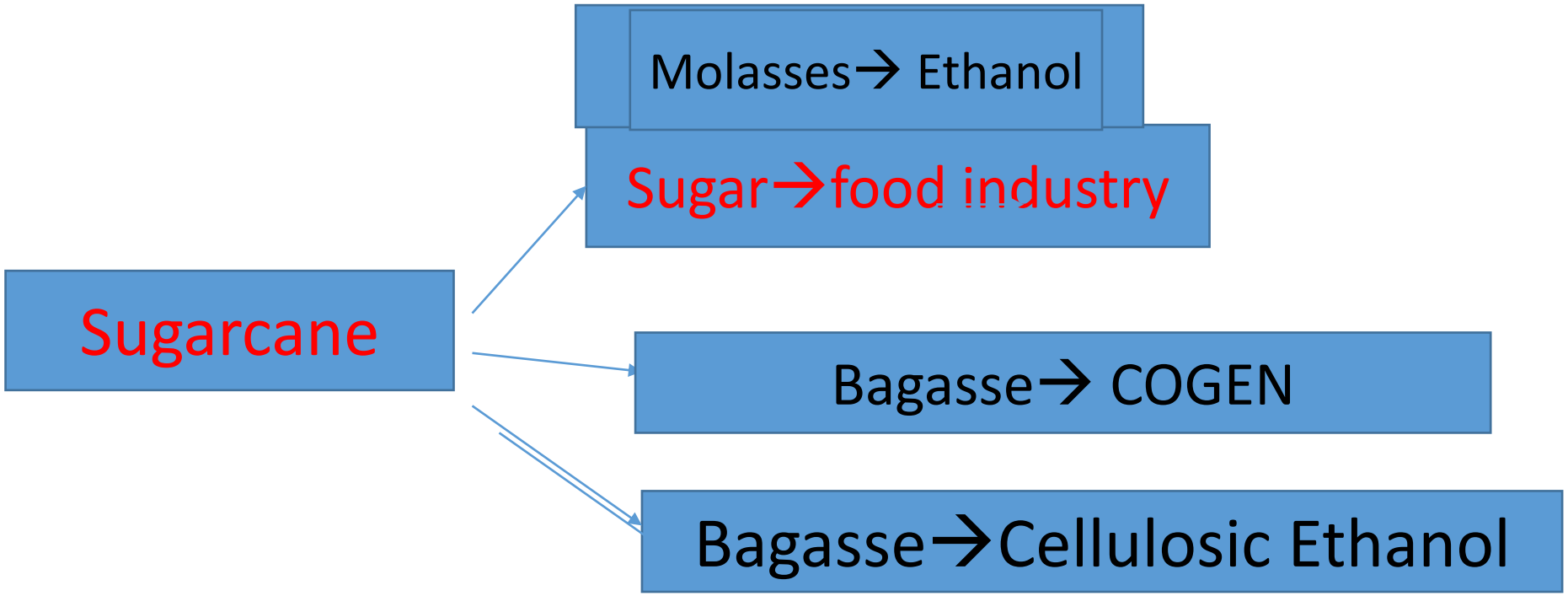
Sugarcane Industry

Philippine Sugar Industry Directions (Amarra,2015)

→ Ethanol production

→Commercial cogeneration

Sugarcane industry directions



300-400 li/ton

a president of one sugar mill said "Cogen is evolving as the 2nd industry within the sugar industry".

……feed-in-tarriff for biomass COGEN at P6.33/kWhr*

***Republic Act 9513: "The Renewable Energy Act of 2008"**

On Ethanol ……

Molasses

Republic Act 9367: *"The Biofuels Act of 2006"*

Provides fiscal incentives and mandates on the use of biofuel-blended gasoline.

2009
- 5% bioethanol by total volume mandate

2011
- 10% blend
- Estimated **383 million** liters per

2020
- 20% blend
- 860 million liters per year

Current Production Capacity =222.12 Million Liters

161 M li

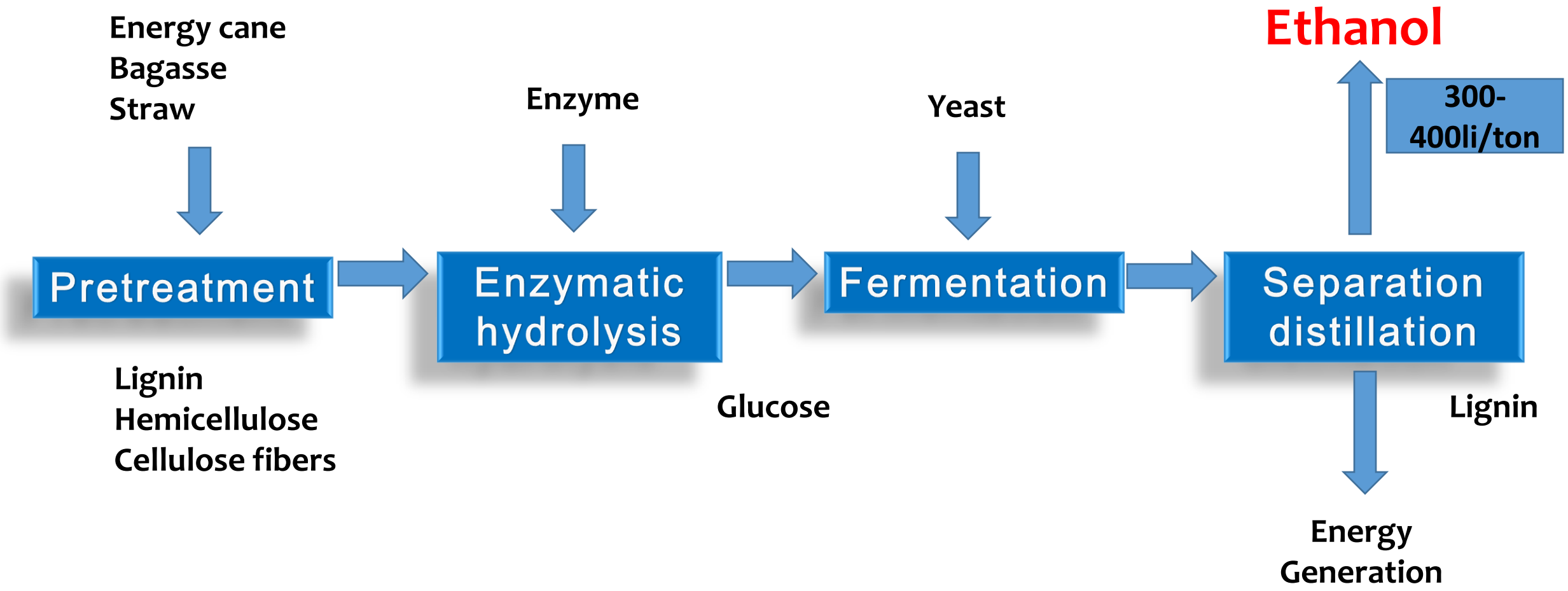
648 Mli

2nd-Generation Ethanol Process

1975, Patrick Foody Sr. initiated work on a “steam explosion” process to improve cellulose digestibility for use as animal feed

>>> 38 years after…..

2013 – Raízen begins construction of their $US100 million “biomass-to-ethanol” facility in Costa Pinto sugar cane mill in Piracicaba, São Paulo, Brazil.



Rice

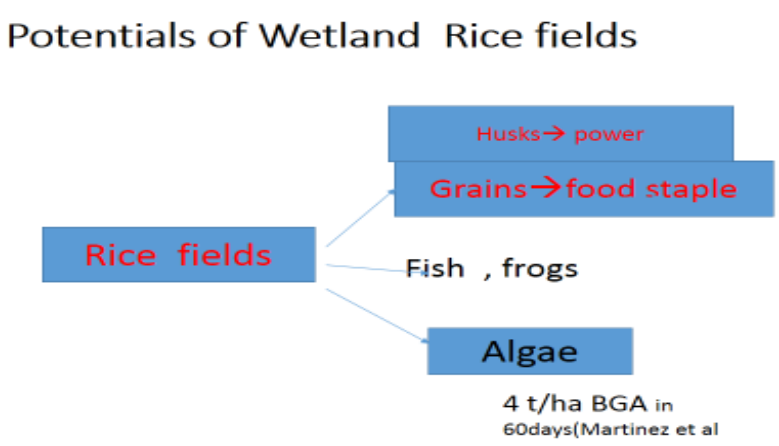
… “Biomass to Energy is a sunrise Industry” (Tadeo, 2015).

4 rice husk fired-power plants in the Philippines .

Three (3) of them are located in Nueva Ecija and one in Isabela province producing a total power of 49 MW or 44.1 MW net power after deducting parasitic load.

All the power ature (485 °C).

The average ir MW GHG emission reduction.



Interests are high in using rice husk →power plants ….

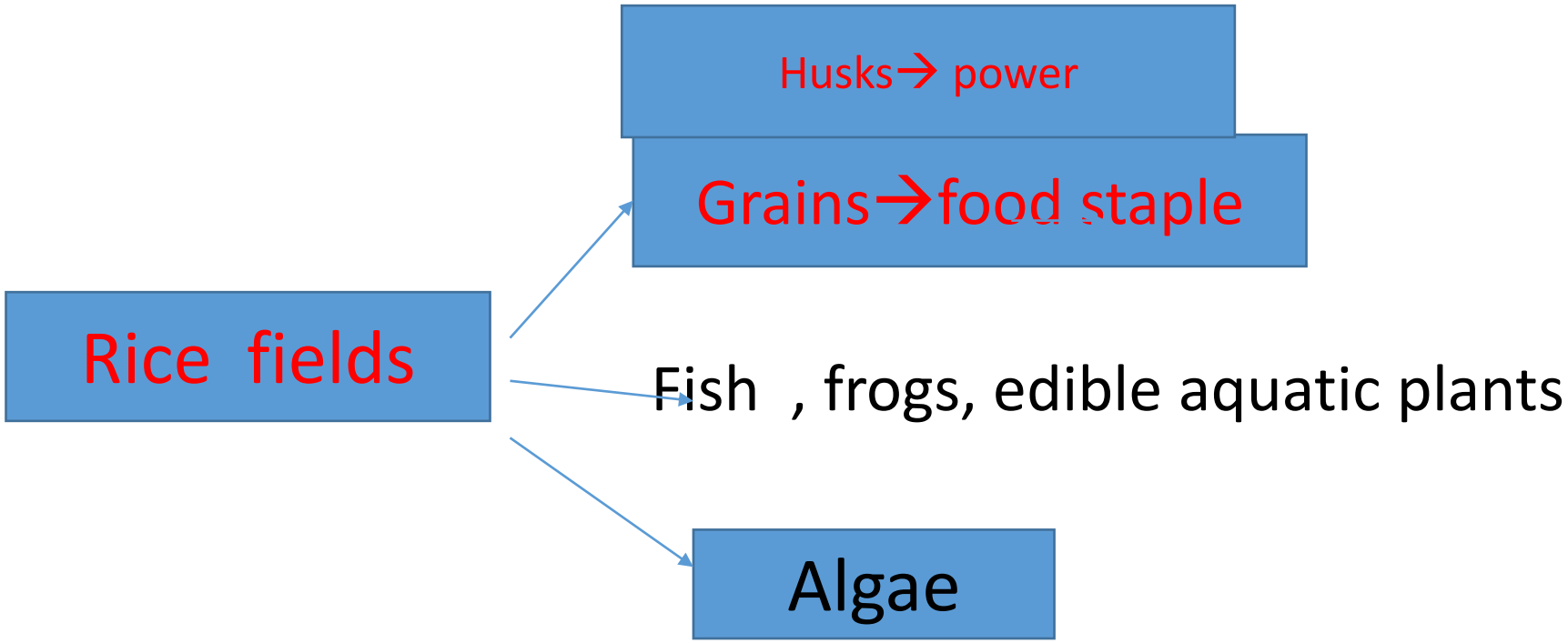
1) Feed-in-tariff (FIT) incentives to participants or investors/owner

→ PhP6.63/kwhr

2) Rice husks are available. Disposal is expensive. Where to find disposal site is difficult or far from where it is produced.

3) The dominant view is that rice husks are just burnt for easy and quick disposal ; health and environmental hazards (Gadde et al.2009)

Potentials of Wetland Rice fields



2.**Assessing the Sustainability of some Biomass for Energy in the Philippine Context**

Indicators…..

→Environmental, Health and Safety Compliance

→Social and economic benefits

→Energy balance---EnRoI= Energy return over energy input

→ Supply of biomass feedstock materials for power generation

→ Pricing of biomass feedstock

→ Agronomy of biomass/feedstock sources for power

Summarized benefits of biomass→ power (Energy)

Farm multifunctionality-economy,ecology,energy (IASSTD,2008)

Environmental, health

- Less pollution-soil,, air water
- Less GHG emission
- Compliance to..

→ Clean air , Clean water

→Solid waste

Conformance to national , global standards

Social , economic

generates employment, additional income

→Crop establishment-land prep.

planting , care &mgt.of crops

→Jobs during plant construction, operation, maintenance, repair

→Harvesting,hauling , processing of feedstock

Fig.2. Post- harvest burning of sugarcane trash .To quickly burn, a farm worker lig
other end of the field. Photo taken at Negros Occidental Philippines, Feb.20,201

Less GHG emission*

Gasoline →Sugarcane ethanol…56%

Diesel→ Biodiesel……68%

Gasoline→ Cellulosic ethanol.. 91%

***Boume et al.2007**

Energy balance---EnRoI= Energy return over energy input

Sugarcane juice→Ethanol = 7- 8.0 (Brazil)
Sugarcane bagasse→ COGEN=_____??
Cellulosic Ethanol → =36 (Max)
Rice husks → Power =_____???
Dedicated Biomass→ Power=_____???
(Napier, MPTs)
Algae → Biodiesel =_____?????
Palm biodiesel = 6-8

Resource assessment

Supply of biomass –

→ there are many competing uses for rice husks (*for balut making, fuel for bakeries, noodle manufacture, potting media for ornamentals, mulching materials, carbonized to mixed in making organic fertilizer etc.).*

→Same is true for sugarcane trash, coconut husks/fronds, corn stalks/cobs

Pricing of biomass for power

"Biomass production starts from the field."

→Equitable or "just price" for the farmers/producers and the users/factory owners.

….not an issue for those factory owners who also own the farm

→COGEN in the sugar industry- a new source of income

- Sharing system under the law (R.A. 809), only the main product (sugar) and co-product (molasses) are shared.

- The mill is earning through COGEN mainly due to their bagasse. Planters should have share on the COGEN income.

  > Coop – owned mills- not an issue

  > Privately– owned mills- will be an issue

For SUGARCANE bagasse used in COGEN, after the computed/actual payback period

- ….Phil. R.A. 809 that stipulates sharing between the planters and millers on sugarcane products … should include co-products→COGEN

- Under the law that govern sugar product sharing (R.A. 809), there are at least 3 tiers: 60:40, 65:35, 70:30 for planters and millers, respectively.
- For CPS- same principle , maybe used

Suggested purchase price of sugarcane bagasse, cane trash, napier, fuelwood *

Biomass	Moisture Content(%)	Fuel Value/ton based on the bunker oil energy equiv.(PhP)	Suggested Price per delivered tonne(PhP) 1	Suggested Price per delivered tonne(PhP) 2
Sugarcane Bagasse	48-52	1658	1050	1693
Sugarcane trash	26	2489	1650	2660
Napier	26	2489	1650	2660
Fuelwood	35	3100	3000	4836

1.The suggested purchase price for biofuels at 2/3 of the energy cost of oil or $20 USD per barrel

2.The adjusted purchase price for bi0mass at 2/3 of the energy cost of oil or $48.26 USD per barrel

http://www.bunkerworld.com/prices/..331.50/tonne. Jul 3,2015

*Mendoza et al.(2001)**

Rice husks, treated as voluminous “wastes” in rice milling

In Bay,Laguna, rice husk is priced at P10/15kg bag or at PhP 0.67/kg.

1PhP=44USD

At this price, it should be asked whether the feedstock price is still profitable to run the husked-fired power plant?

AGRONOMY of biomass sustainability

→cuts across technical, economic, social and political

On technical……

→sustaining soil fertility means nutrients absorbed must be balanced by nutrients applied (or N*in* = N*out*).

Taking out biomass for power is taking out also the nutrients absorbed by the plant. Where will nutrients come from?

From Haber-Bosch manufactured N-fertilizer which used 1.8 li diesel oil per kg (Pfeiffer,2003; Mclaughlin et al. 2000).

Sugarcane Farmers are into Trash Farming

Dedicated crops for power

(Napier grass or any tree grown for power plants)

Energy over foods….energy crops shall be grown in marginal soils or areas which are not grown to food crops.

From the agronomic point of view, “marginal soil” is relative.

→Philippines land area (30M ha) is so dense in relation to the population (100 million).

→It is difficult to locate … e planted to biofuel crops that will not compete with food cro…

Rice husks →power (RHA)*

Rice husks → recycling in the farm.

→ adequate uptake of silicon (Si) can substantially increase the tolerance of rice (*Oryza sativa* L.), sugarcane (*Saccharum officinarum* L.) and other crops to both abiotic and biotic stresses (Dantoff et. al., 2001; Ma and Takahashi, 2002).

→ CRH (Biochar) mixed with animal manure makes good quality organic fertilizer.

At present , many farmers know already how to carbonize rice husk (CRH) producing what is popularized as “biochar” --- good soil conditioner

**RHA must be recycled back in the farm(Si and many other micronutrients)*

Cellulosic biomass → 2nd biofuel.. Not competing with human food? ***DEDICATED BIOMASS- NAPIER GRASS, MULTIPURPOSE TREES***

The basic equation of photosynthesis is …

$$CO_2 + H_2O \rightarrow CHOn + O_2$$

CO_2 is non-limiting but water* is.

Growing crops (biomass) for power shall require tremendous amount of water.

*1.9 kg of biomass /1000kg water ..

→the world's total human usage of renewable supply of water by 2025 may reach 70%.

Postel, S.L., G.C. Daily and P.R. Ehrlich. 1996. Human appropriation of renewable fresh water. Science 271:785

Conversion of biodiverse forestlands to –single monocrops has effects on water/hydrologic cycle, biodiversity habitat, soil erosion . **FORESTs ARE CO2 sinks.**

Brazil plans to expand sugarcane areas from the current 9.5million ha to 17 million ha for bioethanol.

Between 2000 and 2010, three million hectares were converted to sugarcane.

More than 70% of this land consisted of pastures, and 25% had been used for growing grains (http://phys.org/news/2014-07- payback-soil-carbon-pasture-conversion.html#jCp).

The AGRONOMIC/technical issue of crop production for biomass for power… extends → economic, social and political

- It becomes very political when there are brownouts due to power shortage.
- It becomes very political when there is no water for household use and the media portray communities on long-files waiting for their turn to fetch water.
- It becomes very politically explosive when food staple is scarce or there is perceived shortage.

“Biomass to energy is a sunrise industry!” Yes!

….. the sun rises in the morning if only to set again in the evening! Can we avoid the sun rotating in its own axis?

How can the biomass to energy evade the universal rule “What comes up will come down?”

We put our trust and confidence to the collective wisdom of all!.

Thank you….

Copkun cub!!!

Maraming salamat po!!

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