2019 SOUTH EAST ASIA SUGARCANE SUMMIT

JULY 7-10, 2019 | KHAO YAI, THAILAND

75 years AUSTOFT

CASE IH AGRICULTURE

Facts & Figures in Sugar Crops – Thailand Focus

Jaime Finguerut jaime.fing@gmail.com

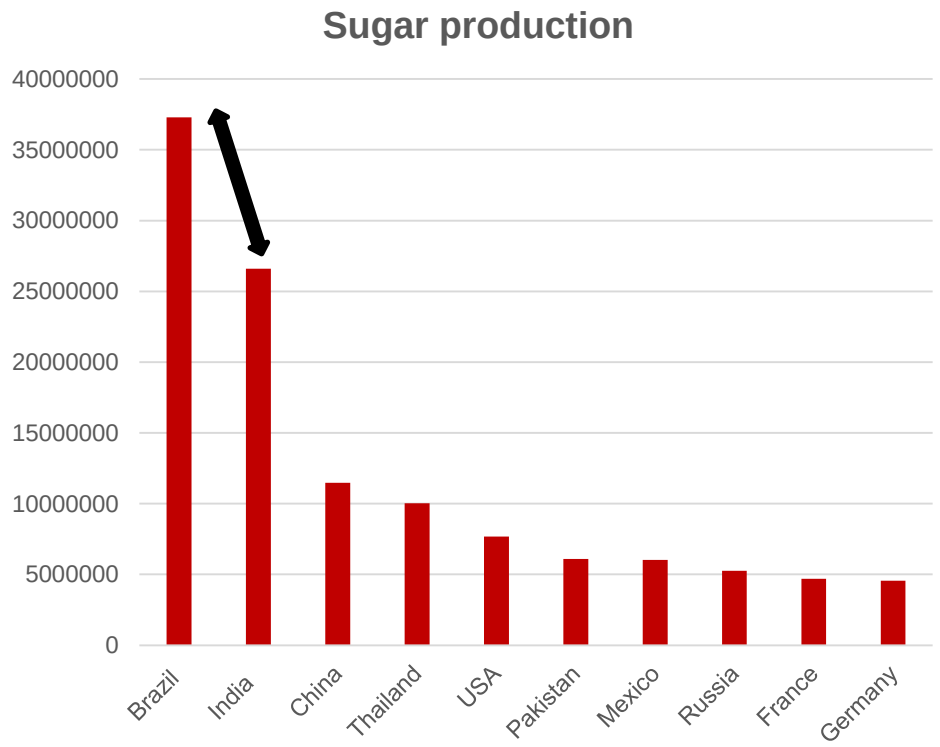
75 years AUSTOFT

CASE IH AGRICULTURE

Top Ten Sugar Countries

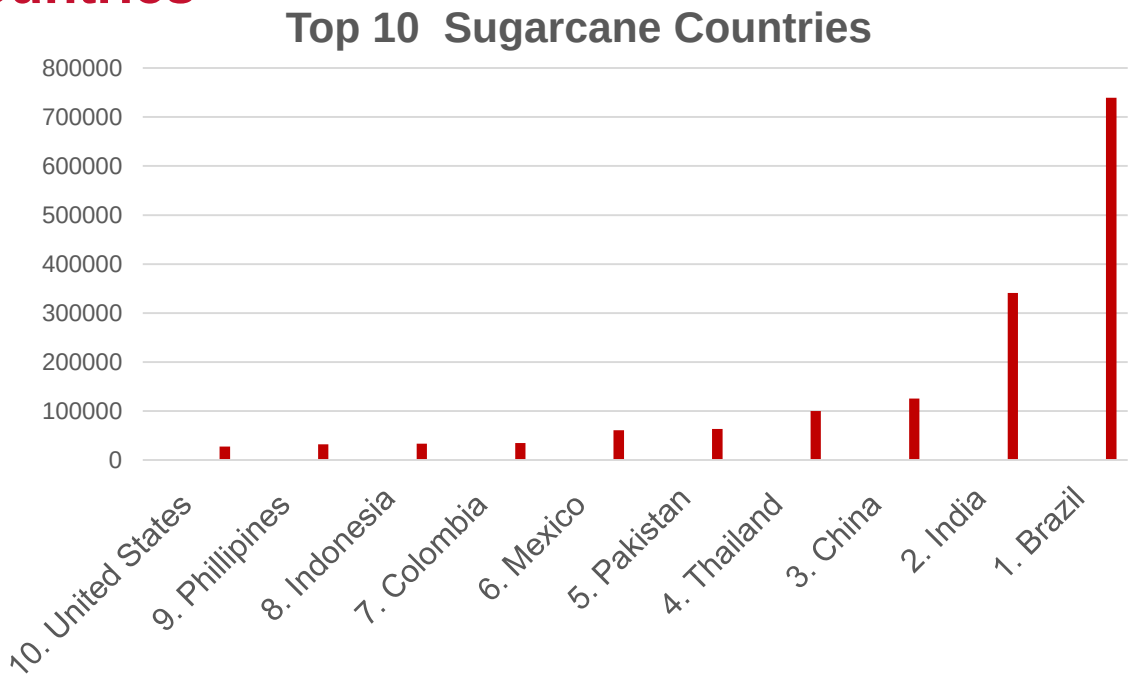
Top Ten Sugar Countries (by tonne)

- Brazil : 37,300,000
- India : 26,605,000
- China: 11,474,000
- Thailand: 10,024,000
- USA: 7,666,000
- Pakistan: 6,103,000
- Mexico: 6,021,292
- Russia: 5,249,339
- France: 4,692,000
- Germany: 4,563,800



Top Ten Sugarcane Countries

10. United States (27,900 TMT)
9. Phillipines (31,900 TMT)
8. Indonesia (33,700 TMT)
7. Colombia (34,900 TMT)
6. Mexico (61,200 TMT)
5. Pakistan (63,800 TMT)
4. Thailand (100,100 TMT)
3. China (125,500 TMT)
2. India (341,200 TMT)
1. Brazil (739,300 TMT)



Sugarcane Crop in the World

Linnenluecke et al. (2017)

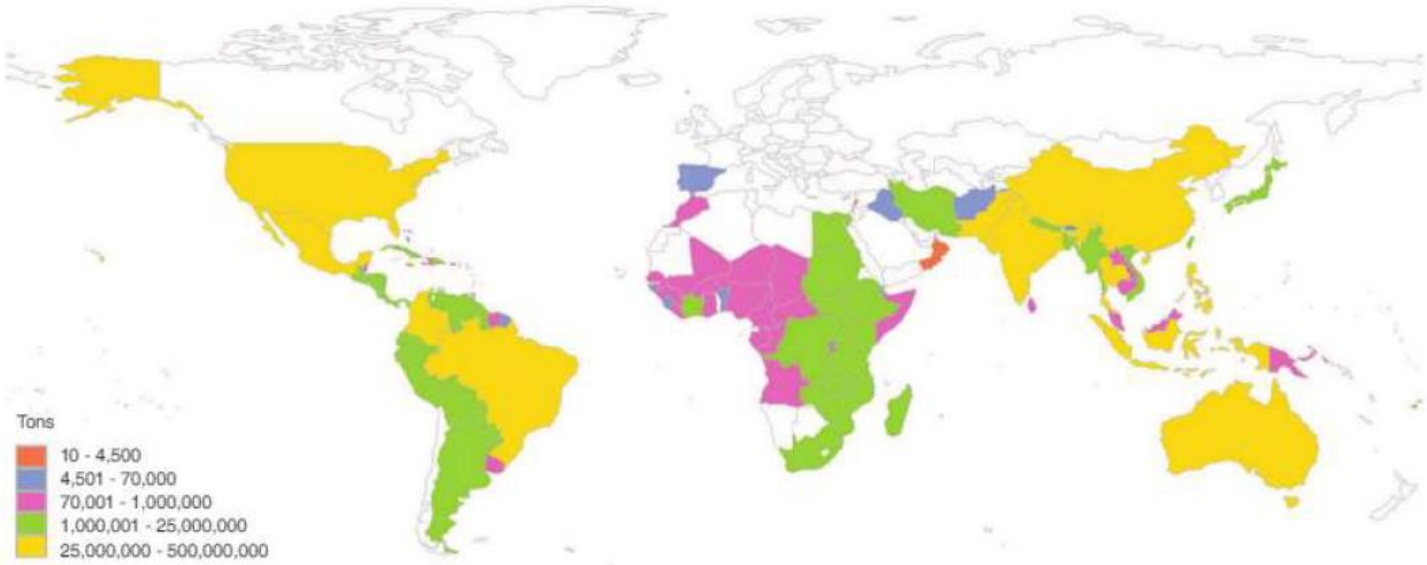


FIGURE 1 | Production quantities of sugarcane by country (average tons 1994–2014). Created with R package rworldmap based on data from FAOSTAT (http://www.fao.org/faostat).

Top Ten Sugarcane Countries: Expansion

Table 1. Countries with biggest expansion in sugarcane area harvested, 2005–2013.

Rank by absolute increase	Countries	Area in 2005 (hectares)	Area in 2013 (hectares)	Absolute increase (hectares)	Percentage increase (%)
1	Brazil	5,805,518	9,835,169	4,029,651	69
2	India	3,661,500	5,060,000	1,398,500	38
3	China	1,365,777	1,827,300	461,523	34
4	Thailand	1,035,227	1,321,600	286,373	28
5	Pakistan	966,400	1,128,800	162,400	17
20	Cambodia	5992	28,500	22,508	376
23	Zambia	22,000	39,000	17,000	77
28	Tanzania	20,000	30,000	10,000	50
34	Swaziland	50,932	56,000	5068	10
99	South Africa	328,000	325,000	−3000	−1

Source: Authors' own calculation from FAOSTAT database (FAO 2014).

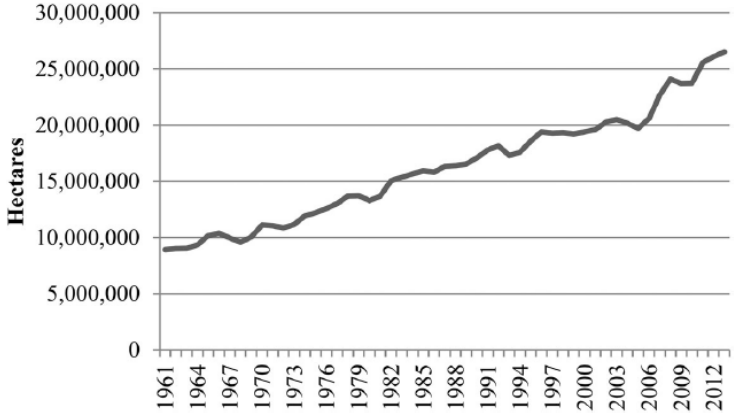


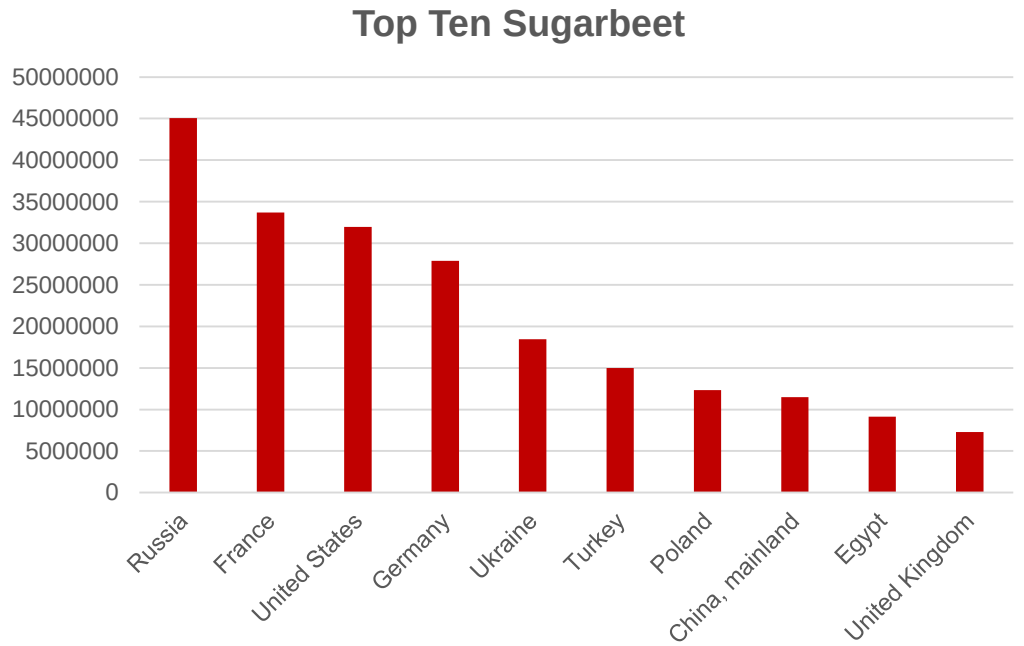
Figure 1. Worldwide sugarcane area harvested, 1961–2013.
Source: Authors' own calculations, from (FAO 2014).

Top Sugarcane Countries: Productivity

1. Colombia	120 ton/ha	13.3 ton sugar/ha
2. Eswatini (Swaziland)	106 ton/ha	13.5 ton sugar/ha
3. Guatemala	103 ton/ha	10.9 ton sugar/ha
4. Malawi	92 ton/ha	12.6 ton sugar/ha
Australia	82 ton/ha	11.2 ton sugar/ha
Brazil	74 ton/ha	10.1 ton sugar/ha
India	74 ton/ha	7.8 ton sugar/ha
South Africa	55 ton/ha	6.2 ton sugar/ha

Top Ten Sugarbeet Countries

Russia	45,057,000
France	33,688,393
United States	31,954,713
Germany	27,891,000
Ukraine	18,438,900
Turkey	15,000,000
Poland	12,349,546
China	11,469,050
Egypt	9,126,058
U.K.	7,291,000



Top Ten Sugarbeet Countries: Productivity

Rank	Country	Productivity (t)	Production per Capita (Kg)	Harvested Area (Ha)	Yield (Kg/Ha)
1	Spain	3,240,073	69.4	33,16	97.688
2	Chile	1,646,680	93.7	17,112	96.23
3	France	33,794,906	502	402,675	83.926
4	Austria	3,534,415	400	43,497	81.257
5	Nethl.	5,502,200	319	70,722	77.8
6	Germy	25,497,200	308	334,5	76.225
7	Croatia	1,169,622	279	15,493	75.494
8	USA	33,457,880	102	455,76	73.411
9	Belgium	4,021,110	352	55,504	72.447
10	Slovakia	1,506,939	277	21,481	70.152

Top Ten Biofuel Countries:

Rank	Country	Ktonne oil equivalent	World Share %
1	USA	38,088	40
2	Brazil	21,375	22.4
3	Indonesia	4,849	5.1
4	Germany	3,445	3.6
5	China	3,099	3.2
6	France	2,727	2.9
7	Argentina	2,726	2.9
8	Thailand	2,119	2.2
9	Nethl.	2,099	2.2
10	Spain	1,840	1.9

Thailand overview

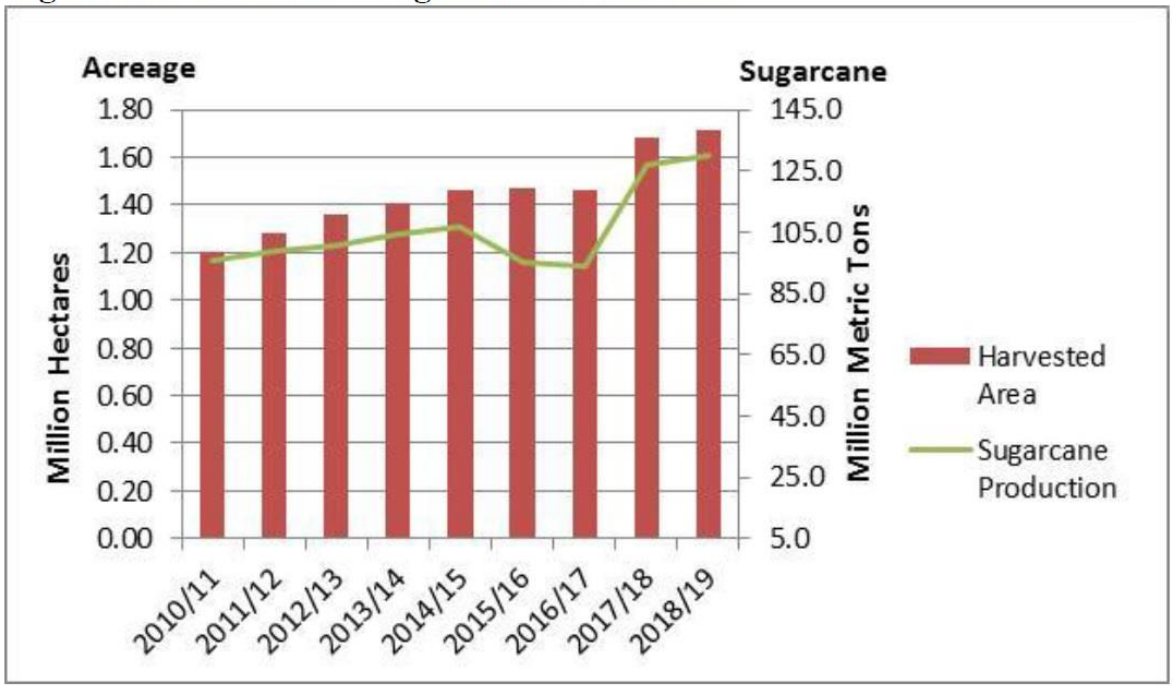
1. Production

1.1 Sugarcane

MY2018/19 sugarcane production is forecast to increase to 130 million metric tons, up 2 percent from MY2017/18, due to expanded acreage (Figure 1.1). Farmers are likely to continue to expand sugarcane acreage as two new sugar mills are expected to begin operating in MY2018/19. Combined, the two new sugar mills will have a production capacity of around 40,000 tons of cane per day. These two new facilities are both located in the northeastern region which accounts for around 45 percent of total sugarcane production. This would increase the total number of sugar mill facilities to 56 mills, up from 54 operating mills in MY2016/17. The new sugar mills are likely to actively encourage farmers to expand sugarcane acreage in order to secure cane supplies. Additionally, the Hydro and Agro Informatics Institute expects that precipitation in 2018 will be 10 percent above normal, which will help maintain an average yield of 11-12 metric tons per rai (68-75 metric tons/hectare) for MY2018/19 sugarcane production. However, the lower world sugar prices will likely causes farmers to delay replacing older sugarcane with newer seeds which limits further average yield improvements.

Thailand overview

Figure 1.1: Thailand's Sugarcane Production



Thailand overview

Table 1: Thailand's Sugarcane Production

Sugar Cane for Centrifugal	2016/2017		2017/2018		2018/2019	
Market Begin Year	Dec 2017		Dec 2018		Dec 2019	
Thailand	USDA Official	New Post	USDA Official	New Post	USDA Official	New Post
Area Planted	1520	1520	1560	1700	0	1730
Area Harvested	1425	1425	1540	1680	0	1710
Production	93680	93878	105000	127000	0	130000
Total Supply	93680	93878	105000	127000	0	130000
Utilization for Sugar	92950	92950	104000	126000	0	129000
Utilization for Alcohol	730	928	1000	1000	0	1000
Total Utilization	93680	93878	105000	127000	0	130000
(1000 HA) ,(1000 MT)						

Thailand overview: Ethanol

Table 4.3: Thailand's Production, Supply and Demand for Ethanol Used as Fuel and Other Industrial Chemicals

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018f
Beginning Stocks	63	44	48	63	22	42	40	37	30	54
Fuel Begin Stocks	62	24	22	58	20	21	26	21	17	40
Production	467	521	613	790	1,048	1,070	1,190	1,290	1,480	1,500
Fuel Production	419	451	486	471	950	1,058	1,174	1,276	1,461	1,480
Imports	6	7	6	6	5	11	11	13	12	13
Fuel Imports	0	0	0	0	0	0	0	0	0	0
Exports	16	48	139	304	64	5	0	0	0	0
Fuel Exports	0	0	0	0	0	0	0	0	0	0
Consumption	476	476	465	533	969	1,078	1,204	1,310	1,468	1,520
Fuel Consumption	457	453	450	509	949	1,053	1,179	1,280	1,438	1,500
Ending Stocks	44	48	63	22	42	40	37	30	54	47
Fuel Ending Stocks	24	22	58	20	21	26	21	17	40	20
Total BalanceCheck	0	0	0	0	0	0	0	0	0	0
Fuel BalanceCheck	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Refineries	11	19	19	19	21	21	21	21	26	26
Nameplate Capacity	581	977	977	977	1,307	1,472	1,472	1,472	1,875	1,875
Capacity Use (%)	80	53	63	81	80	73	81	88	79	80
Co-product Production (1,000 MT)										
Bagasse	44	132	134	180	209	243	252	216	261	290
Feedstock Use for Fuel (1,000 MT)										
Sugarcane	160	480	486	654	760	882	915	787	949	1,056
Molasses	1,287	1,100	1,415	1,418	2,615	2,895	3,165	3,067	3,617	3,991
Cassava	557	925	650	468	1,670	1,864	2,166	3,014	3,272	2,778
Feedstock D										

Market Penetration (Million Liters)										
Fuel Ethanol	457	453	450	509	949	1,053	1,179	1,280	1,438	1,500
Gasoline	7,524	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,030	11,300
Blend Rate (%)	6	6	6	7	12	12	12	12	13	13

Note: - Beverage ethanol is not included in this table.
- Cassava-based ethanol production mainly uses fresh cassav root as feedstock. The convesion rate is 1 MT:160 liters.
- The conversion rate of molasses-based ethanol is 1 MT:240 liters.
- The conversion rate of sugarcane-based ethanol is 1 MT:75 liters.
- Co-product of sugarcane-based ethanol production is bagasse (275 kg/1 MT of sugarcane).
- 2018 figures are FAS estimates.

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy (Fuel Ethanol Production Data)
Department of Energy of Business, Ministry of Energy (Fuel Ethanol Consumption Data).
Liquor Distillery Organization, Excise Department, Ministry of Finance (Industrial Ethanol Production and Consumption Data)

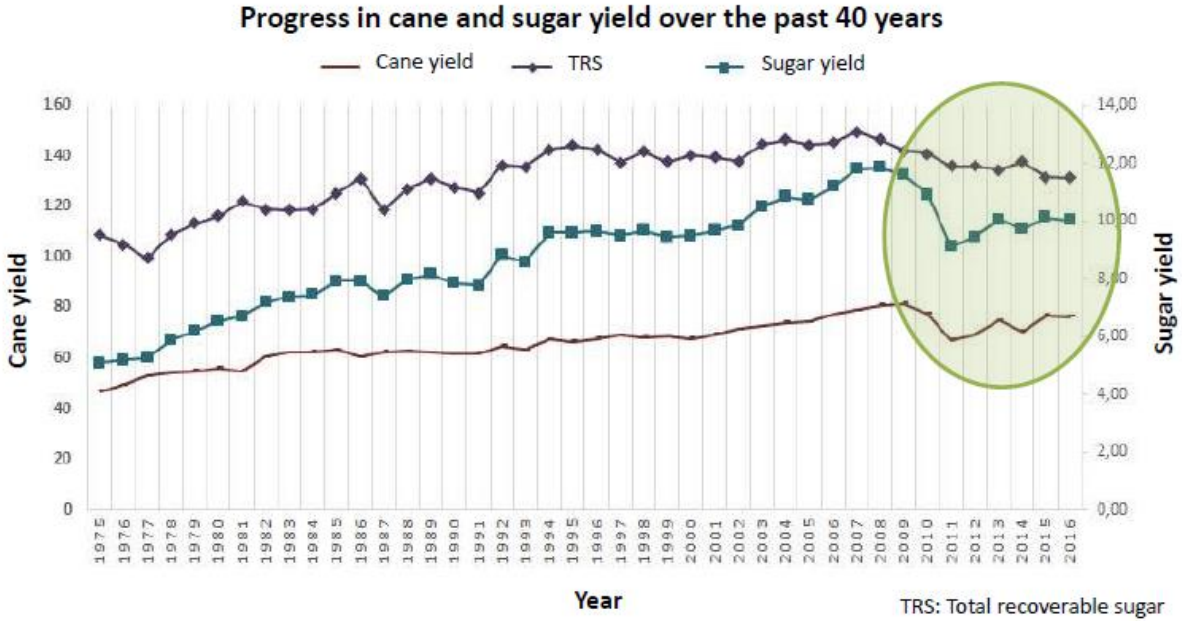
Analysis: Comparison of Beet vs Sugarcane

- Production of sugar/ha bigger than sugarcane
- Increasing productivity (biotechnology)
- Has no fiber, what means that needs a fuel for processing
- Planting with seeds, what is a cost advantage
- Beet juice much easier to extract (cooking makes the root very soft)
- Sucrose content in beet juice bigger than sugarcane
- Sucrose in beet juice much easier to crystallize
- Short period of growth, harvesting depends on climate, storage is a problem. Has no ripening stage, what is an advantage
- Temperate climate (tropical sugarbeets?)

Analysis: Comparison t/cane/ha and t/sugar/ha

- High yields depend on irrigation (70% water and 30% all other factors)
- Too much water decreases sugar content in juice. Control maturation
- Final product's costs depend on sugarcane cost and productivity (ton/ha.year) is the main cost, together with sugar content and purity
- If no irrigation is possible, sugarcane has to adapt to the production environment (weather, soil, management- cultural traits)
- Sugarcane varieties developed and recommended using soil and climate maps. Use several varieties : a team of the best varieties, early, middle and late
- Better management equals to more profit-integrated pest control, fertilizers,etc.
- Mechanization brings huge challenges. New planting methods are critical. Use sugarcane straw and all other by-products

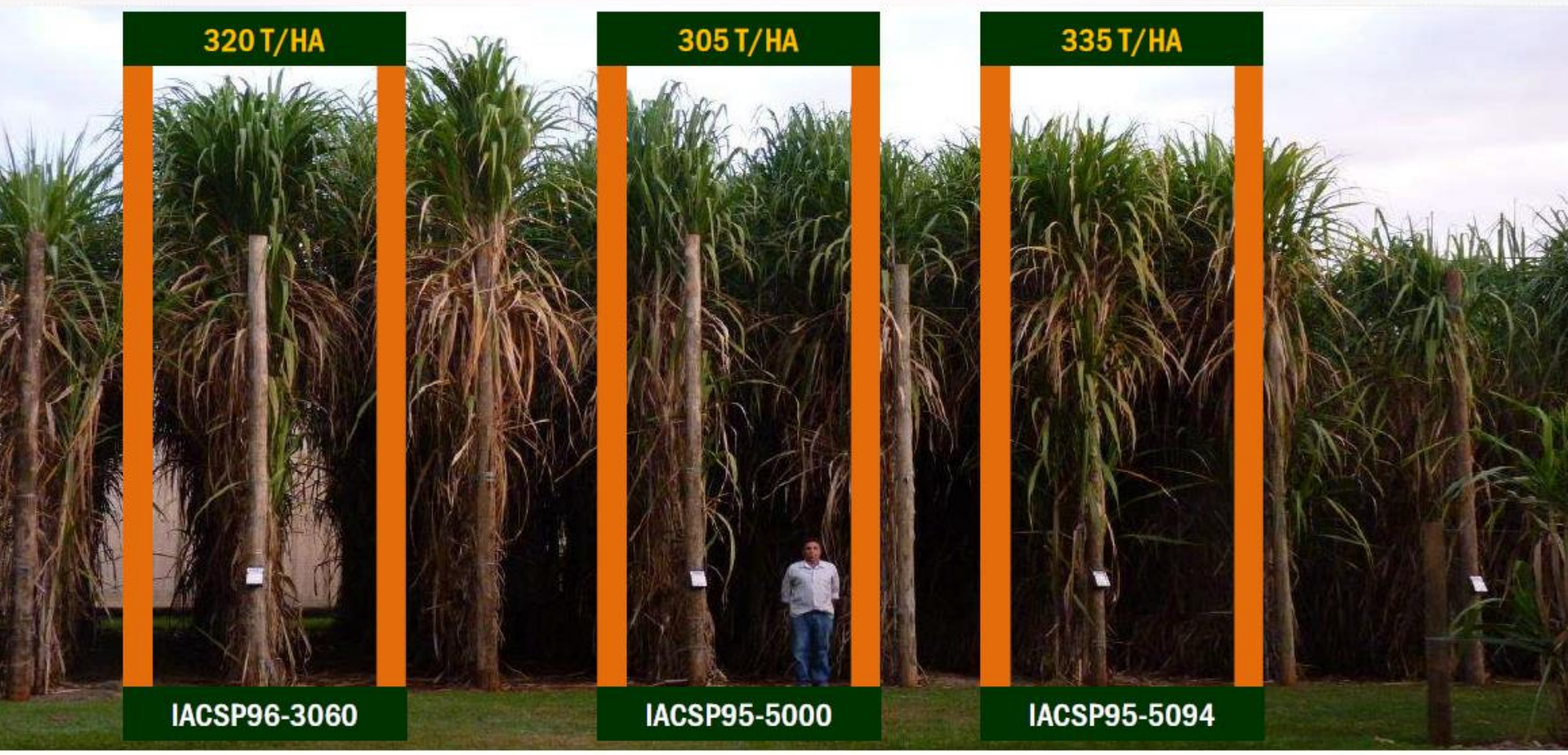
SUGARCANE PROGRESS OVER THE YEARS
BRAZIL – LIMITED PROGRESS



TRS: Total recoverable sugar

BIOLOGICAL POTENTIAL

Programa CanA IAC



Analysis: Flexible Ethanol Production in Brazil

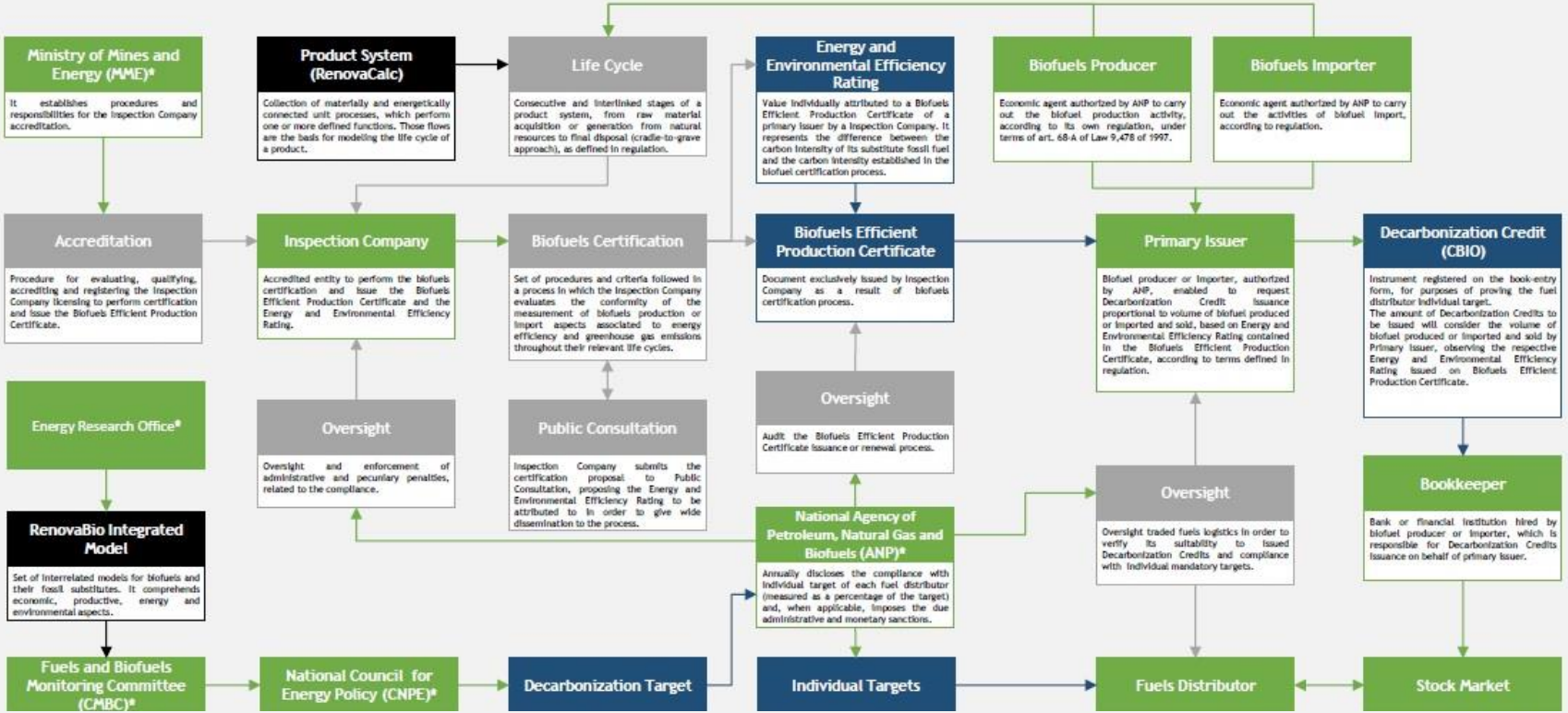
- Brazil was very successful in replacing gasoline for ethanol, first blending anhydrous to gasoline then developing dedicated ethanol engines for hydrated ethanol and finally the very successful flexible fuel cars (gasoline or ethanol in any mixture)
- Almost all Brazilian sugar mills are flexible, can make 40 to 60% of the mix in sugar and or in ethanol with no further costs and still exporting electricity to the grid. Use of any type of sugarcane juice and richer and more fermentable molasses with no losses
- Flexing the production maximizes value and decreases risks, attracts investors.Better uses of price peaks. Mills are big, crushing more than 2.5 millions tons / year to decrease costs Modern ones crushes 25,000 ton /day
- Ethanol and bioelectricity are not dependent on sucrose purity in sugarcane, and extends the useful crop period
- All byproducts are used, residues are fertilizers and go back to the sugarcane fields around the mill. Water is recycled, heat and mass balances are optimized

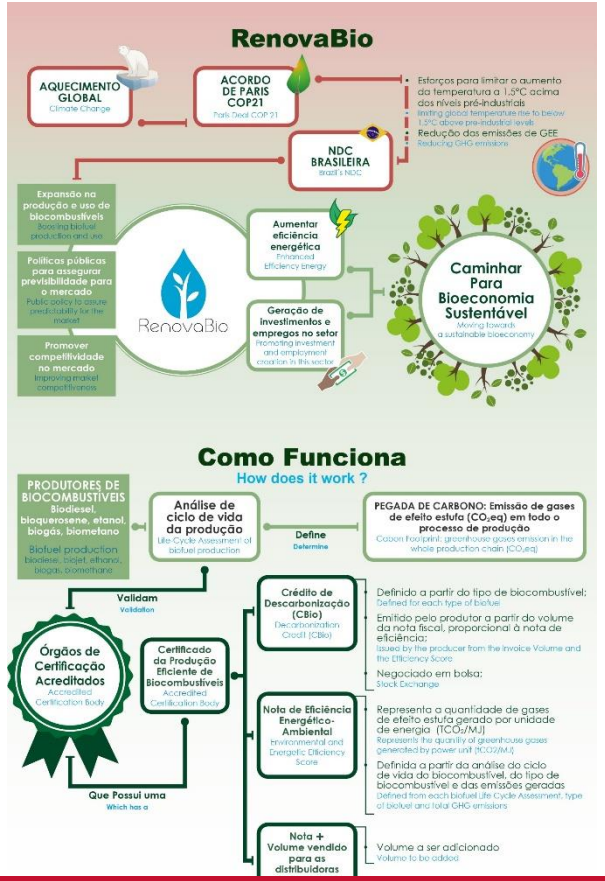
Analysis: New Mobility Decarbonization Policy - RenovaBio

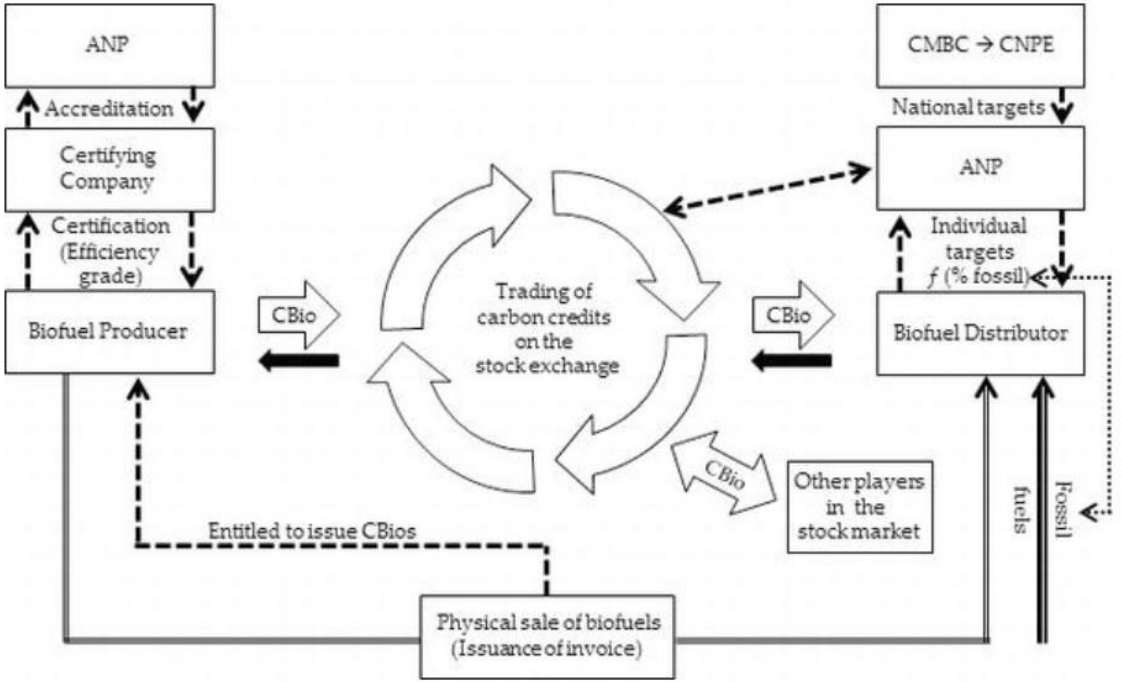
- Brazil was very successful in replacing gasoline for ethanol, first because of strong government policy around energy, petroleum, sugar, ethanol and sugarcane
- First Program called Proalcool was very successful in the historical petroleum shocks
- Between 1990 and 1995 there was total sugar business deregulation, no more subsidies and incentives for this sector, but petroleum was still government regulated
- RenovaBio is our first long term policy including biofuels in Brazilian mobility energy matrix, with goals for decarbonizing it, giving long term predictability for the biofuels business. Similar to California policies.
- The policy is very simple. The petroleum fuel sellers have annual goals to decrease their emissions, buying decarbonization credits generated by the biofuel's producers.
- Each biofuel producer use a simple life cycle emissions calculator and are certified for approved third parties and so they are able to receive the "carbon certificates". The best producers receive more certificates for the same production, so will have more revenue
- The Carbon Certificates (CBIO) trading is still being defined by the financial and government regulatory boards but will be a significative revenue for the producers and more importantly will generate the drivers for the biofuels production increase
- More mobility, more petroleum fuels needed what will make more biofuels production needed for emissions abatement, in a virtuous cycle

RENOVABIO FUNCTIONAL FLOW CHART

Empresa de Pesquisa Energética




RenovaBio
AQUECIMENTO GLOBAL
Climate Change
ACORDO DE PARIS COP21
Paris Deal COP 21
NDC BRASILEIRA
Brazil's NDC
Esforços para limitar o aumento da temperatura a 1,5°C acima dos níveis pré-industriais
Limiting global temperature rise to below 1,5°C above pre-industrial levels
Redução das emissões de GEE
Reducing GHG emissions
Expansão na produção e uso de biocombustíveis
Biofuels supply, production and use
Políticas públicas para assegurar previsibilidade para o mercado
Public policy to assure predictability for the market
Promover competitividade no mercado
Improving market competitiveness
RenovaBio
Aumentar eficiência energética
Enhanced Efficiency energy
Geração de investimentos e empregos no setor
Promoting investment and employment creation in this sector
Caminhar Para Bioeconomia Sustentável
Moving towards a sustainable bioeconomy
Como Funciona
How does it work ?
PRODUTORES DE BIOCOMBUSTÍVEIS
Biodiesel, bioquerosene, etanol, biogás, biometano
Biofuel production
biodiesel, biojet, ethanol, biogas, biomethane
Análise de ciclo de vida da produção
Life Cycle Assessment of biofuel production
Define
Determine
PEGADA DE CARBONO: Emissão de gases de efeito estufa (CO_2eq) em todo o processo de produção
Carbon Footprint: greenhouse gases emission in the whole production chain (CO_2eq)
Validam
Validation
Órgãos de Certificação Acreditados
Accredited Certification Body
Certificado da Produção Eficiente de Biocombustíveis
Accredited Certification Body
Que Possui uma
Which has a
Crédito de Descarbonização (CBio)
Decarbonization Credit (CBio)
Definido a partir do tipo de biocombustível:
Defined for each type of biofuel
Emitido pelo produtor a partir do volume da nota fiscal, proporcional à nota de eficiência:
Issued by the producer from the invoice Volume and the Efficiency Score
Negociado em bolsa:
Stock Exchange
Nota de Eficiência Energético-Ambiental
Environmental and Energetic Efficiency Score
Representa a quantidade de gases de efeito estufa gerado por unidade de energia ($tCO_2/M.J$)
Represents the quantity of greenhouse gases generated by power unit ($tCO2/M.J$)
Definida a partir da análise do ciclo de vida do biocombustível, do tipo de biocombustível e das emissões geradas
Defined from each biofuel Life Cycle Assessment, type of biofuel and total GHG emissions
Nota + Volume vendido para as distribuidoras
Volume a ser adicionado
Volume to be added


ANP
Accreditation
Certifying Company
Certification (Efficiency grade)
Biofuel Producer
CBio
Trading of carbon credits on the stock exchange
CBio
CBio
CMBC → CNPE
National targets
ANP
Individual targets
f (% fossil)
Biofuel Distributor
Other players in the stock market
Entitled to issue CBios
Physical sale of biofuels (Issuance of invoice)
fuels
Fossil

Analysis: Biorefinery Further Integration in Sugarcane

- Borras et al: ‘flex crops and commodities’ have multiple uses (food, feed, fuel, fibre, industrial material, etc.) that can be flexibly interchanged while some consequent supply gaps can be filled by other flex crops
- In Brazil there is clear trend to co-produce other crops, such as soybeans (and peanuts) in rotation, planting areas and more importantly, integrating (cheap) corn produced in rotation with soybeans (for export) in some geographies, to make cheaper ethanol all the year around.
- The fuel for both, corn ethanol and sugarcane ethanol, is sugarcane bagasse and straw (and biogas)
- New markets can be attended using corn ethanol co-products for meat production (chicken, pigs and cows)
- All this can be made in the same area, using sugarcane reform and adjacent areas to make corn and feed the animals in intensified cattle feedlot ranches, recycling manure as a compost together with all sugarcane residues, increasing soil fertility and so increasing sugarcane productivity and longevity
- Sugarcane residues such as vinasse, filter cake and some straw can pass first through biodigesters, producing biogas and then biomethane replacing diesel for the agri-machinery
- Planted forests can use the “worst” (hilly) places around the mills, to eventually use the wood as fuel and for timber and pulp and paper, also increasing soil carbon (carbon farming)