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HOCHIMINH CITY UNIVERSITY OF NATURAL RESOURCES AND ENVIRONMENT

Green (Biobased/circular) economy for cities and territoried resilience – Lessons learnt from the Case study of An Giang, Vietnam and Pitea, Sweden sustainable community

07-09 Nov., 2019

Co-funded by the Erasmus+ Programme of the European Union

ERASMUS+ INTENSE

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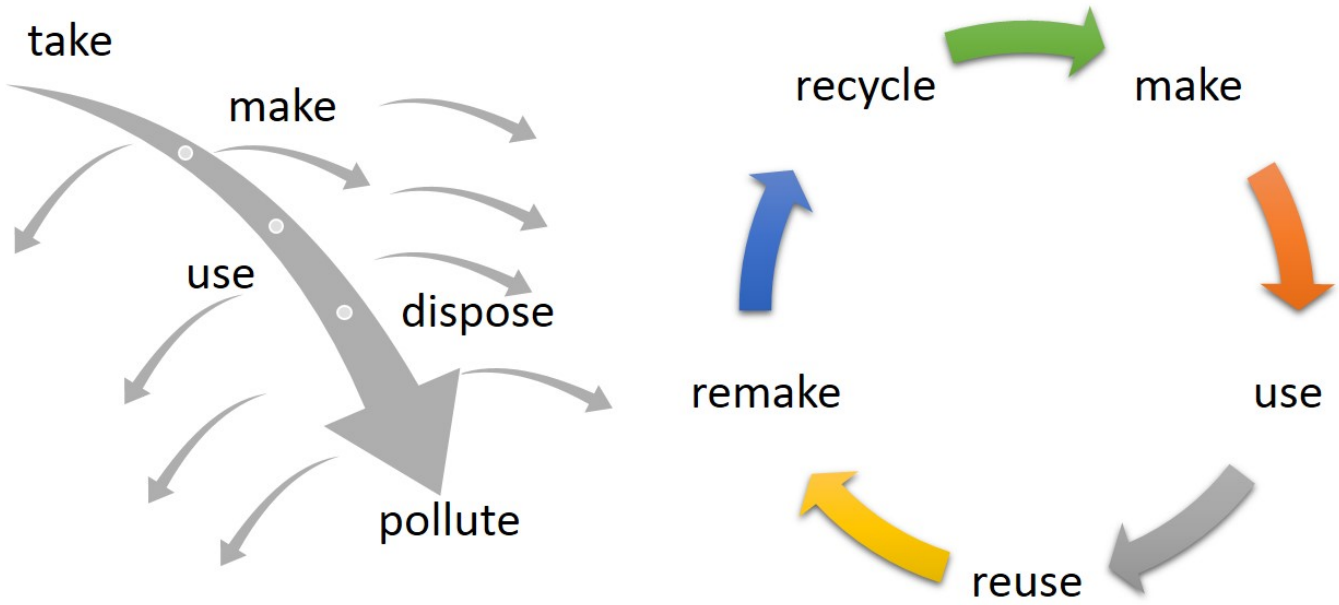
1. Green economic concepts

2. Some circular economic models in Vietnam

3. Lessons learnt from the case study on An Giang –Pitea sustainability communities on green economic transition

Circular economy concepts



CC 3.0 Catherine Weetman 2016

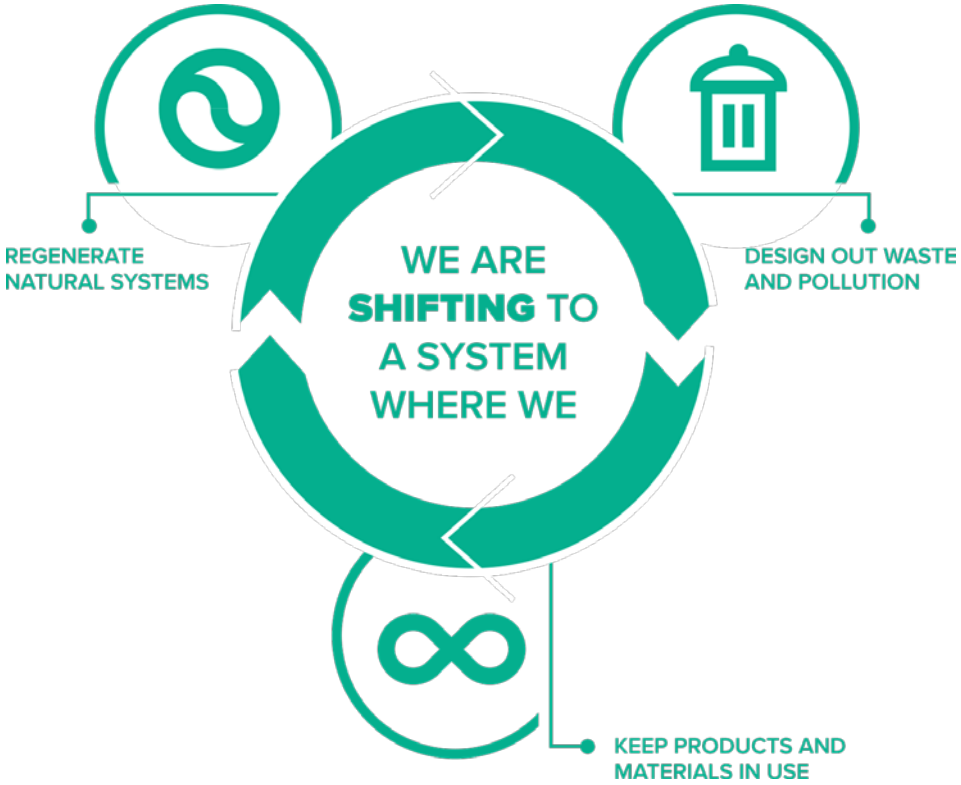
A circular economy is an economic system aimed at eliminating waste and the continual use of resources.

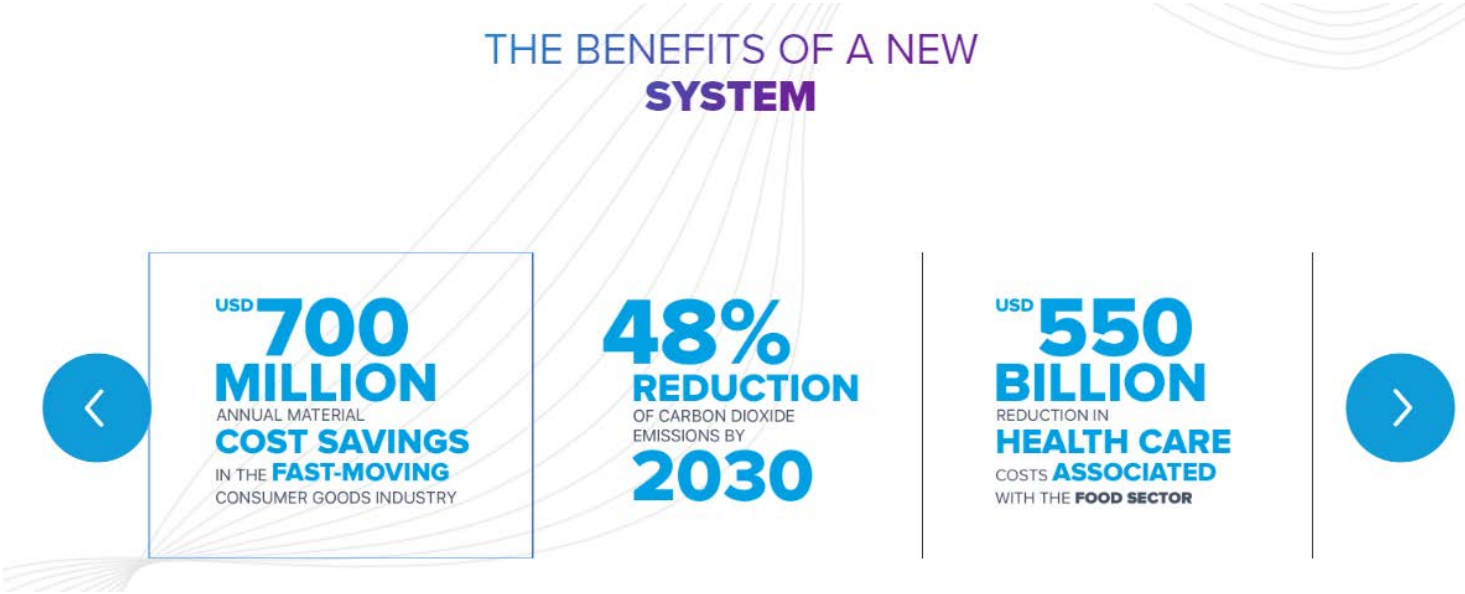
Beyond the current take-make-waste extractive industrial model, a circular economy is based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

www.ellenmacarthurfoundation.org/circular-economy/concept

Transition to a restorative, circular mode





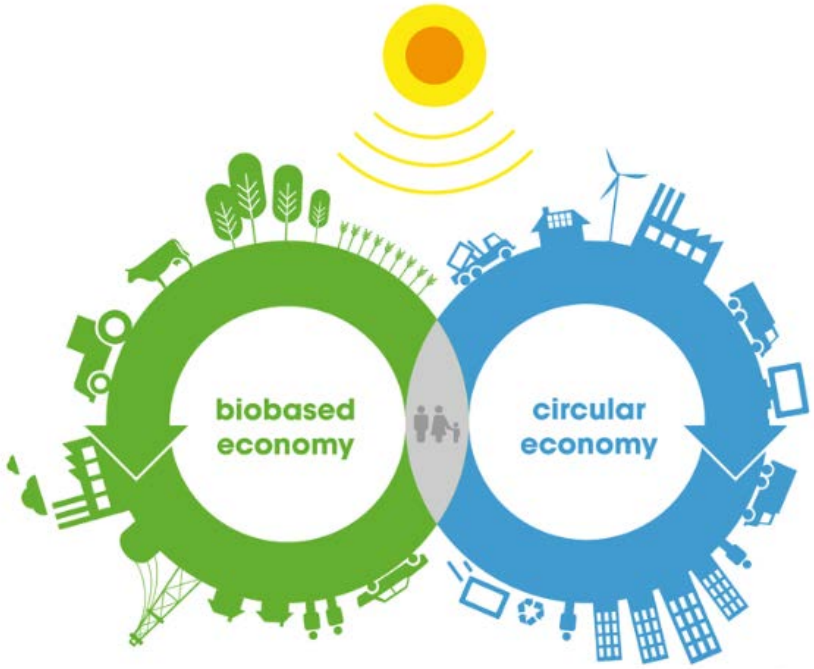
https://www.ellenmacarthurfoundation.org/

Towards the Circular Economy: Economic and business rationale for an accelerated transition, report in 2012 of Ellen MacArthur Foundation and McKinsey & Company,

"The Circular Economy – A new sustainability paradigm?". *Journal of Cleaner Production*. **143**: 757–768. doi:10.1016/j.jclepro.2016.12.048.

Biobased economy concept

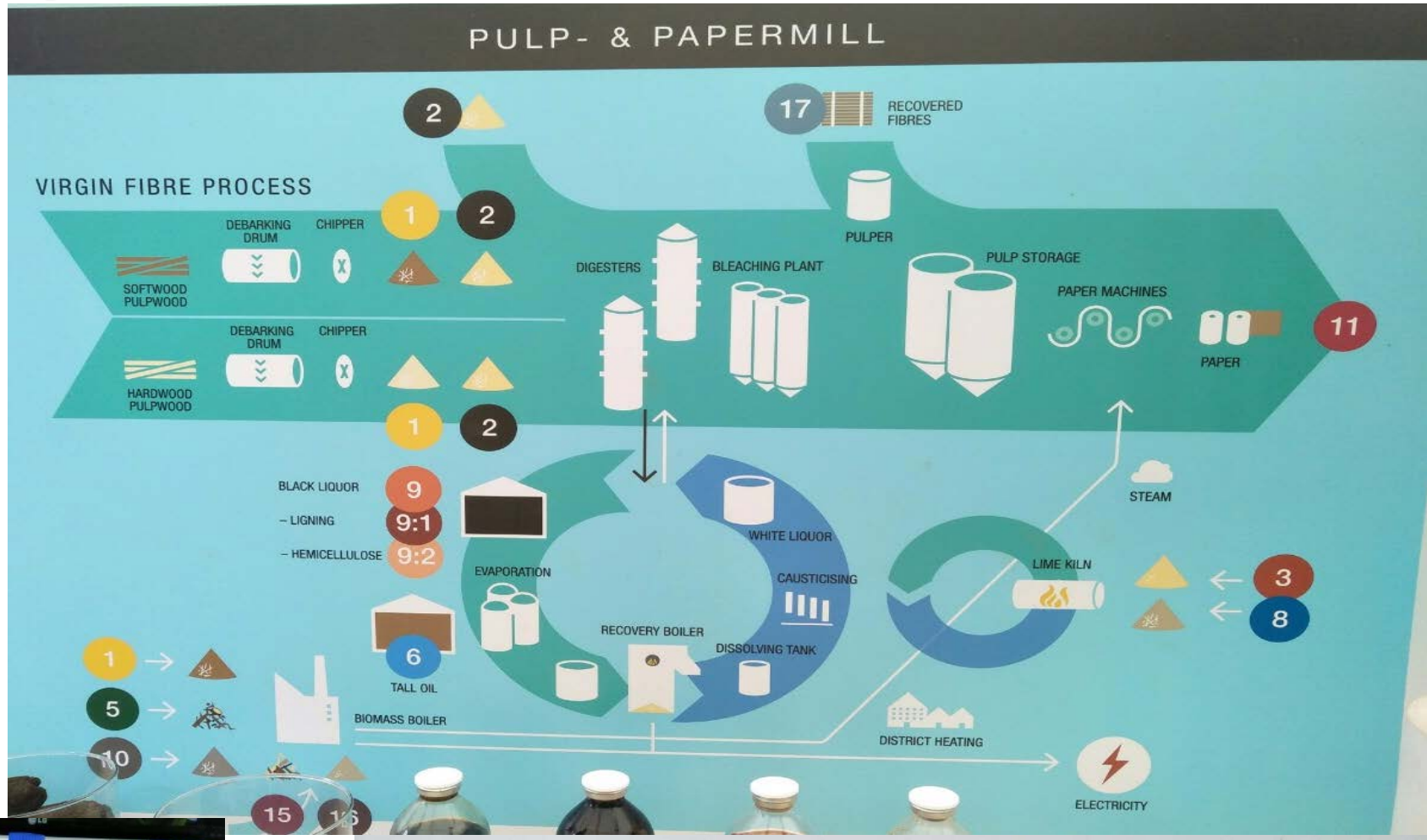
- **Biobased economy or bio-economy** refers to economic activity involving the use of biotechnology in the production of (bio-based) goods, services, or energy from biological material (or biomass) as the primary resource base.



Focused industries:

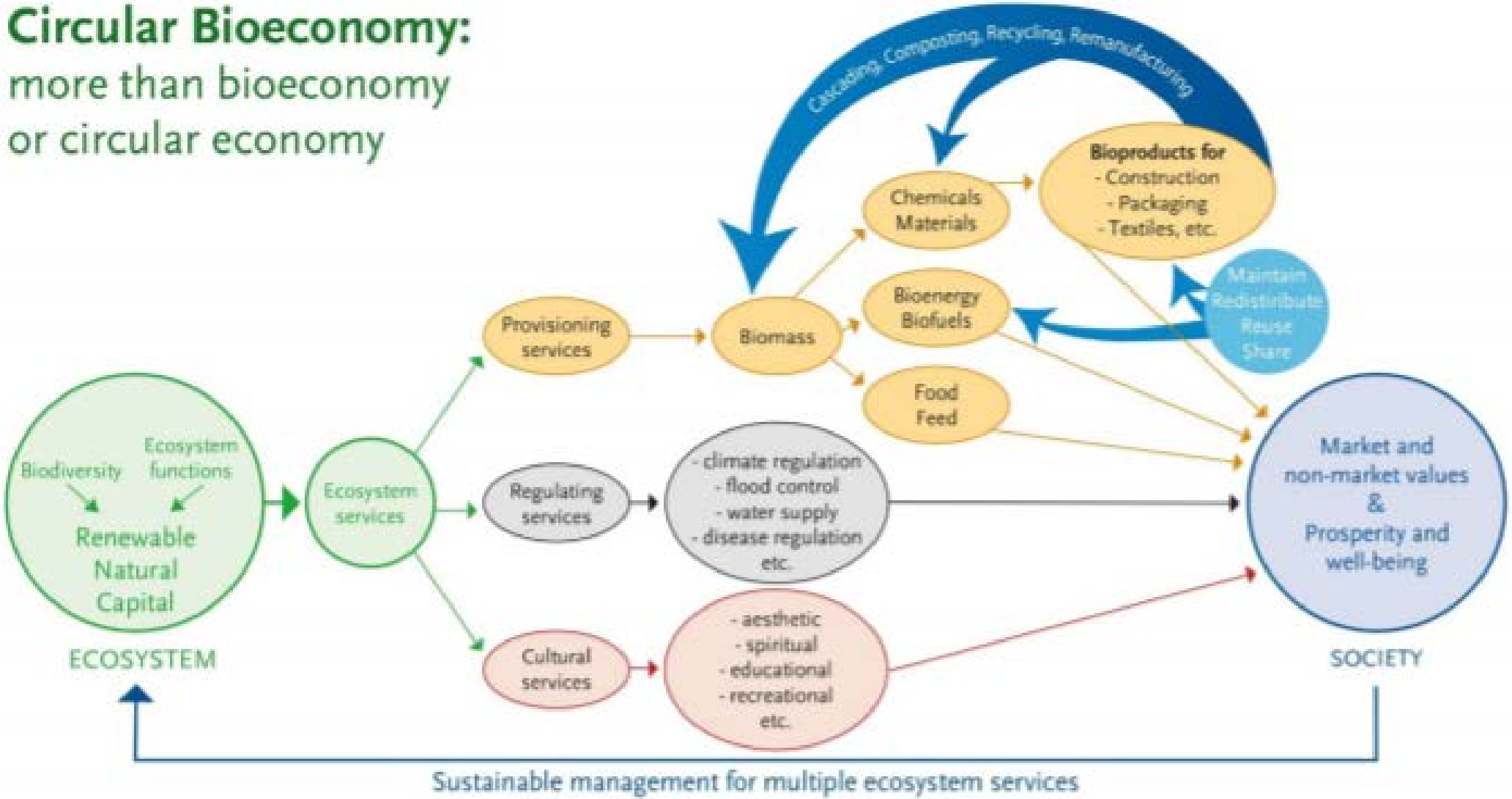
- fine chemicals/medicines
- food
- chemicals/bioplastics
- transport fuels
- electricity and heat

Bioeconomy for paper industries in Pitea, Sweden



1 BARK
2 RAW CHIPS
3 SAWDUST
4 DRY CHIPS
5 FOREST RESIDUES
6 TALL OIL
WOOD PRODUCTS
8 PELLETS
9 BLACK LIQOUR
9:1 LIGNIN
9:2 HEMICELLULOSE
10 FIBRE SLUDGE
11 PAPER
12 CRUDE TALL DIESEL
13 ROSIN
14 TALL OIL PITCH
15 RECOVERED WOOD
16 PEAT
17 RECOVERED FIBRES

Circular Bioeconomy:
more than bioeconomy
or circular economy



Source: Hetemäki, L., Hanewinkel, M., Muys, B., Ollikainen, M., Palahí, M. and Trasobares, A. 2017. Leading the way to a European circular bioeconomy strategy. From Science to Policy 5. European Forest Institute.

http://www.piteasciencepark.se/wp-content/uploads/2017/12/11-the-hole-day-part-one.pdf

15X/17


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER X
3 GOOD HEALTH AND WELL-BEING X
4 QUALITY EDUCATION
5 GENDER EQUALITY X
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY X
8 DECENT WORK AND ECONOMIC GROWTH X
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE X
10 REDUCED INEQUALITIES X
11 SUSTAINABLE CITIES AND COMMUNITIES X
12 RESPONSIBLE CONSUMPTION AND PRODUCTION X
13 CLIMATE ACTION X
14 LIFE BELOW WATER X
15 LIFE ON LAND X
16 PEACE, JUSTICE AND STRONG INSTITUTIONS X
17 PARTNERSHIPS FOR THE GOALS X
SUSTAINABLE DEVELOPMENT GOALS

In 2009 –2010

【ベトナムからの報告】

Integrated Policies for Fish-based Eco-industrial Cluster Development in Vietnam

水産業を中心とした環境調和型産業クラスターの開発へ向けた統合的政策

Nguyen Thi Van Ha and Nguyen Phuoc Dan
ニュイン・ディ・バンハ　　ニュイン・プーク・ダン

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Faculty of Environmental Manageme
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環境調和型産業クラスターがもたらすアジアの持続可能な地域開発

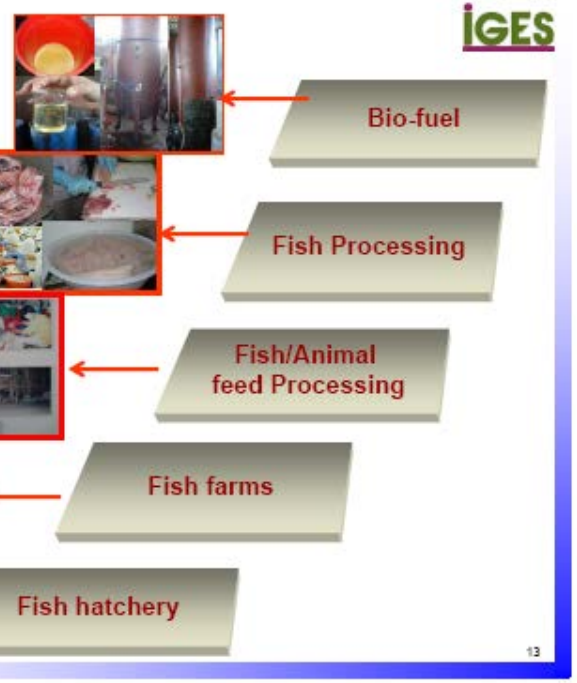
Eco-Industrial Clusters Leading to Sustainable Local Development of Asia

地球変動研究ネットワーク（APN）、（財）国際エメックスセンター、
県大気環境保全連絡協議会、地球環境関西フォーラム、関西広域連携協議会、（社）関西経済連合会、
環境創造協会、兵庫県環境保全管理者協会、（財）新産業創造研究機構、大阪商工会議所

環境調和型産業クラスターとは？

連携・協力関係にある企業が集積することにより、エネルギー・資材・水・情報等の資源を効率的に共有し、環境と経済の両面においてプラスの効果を生み出すこと（またはそのような地域）。

Case Study Clusters



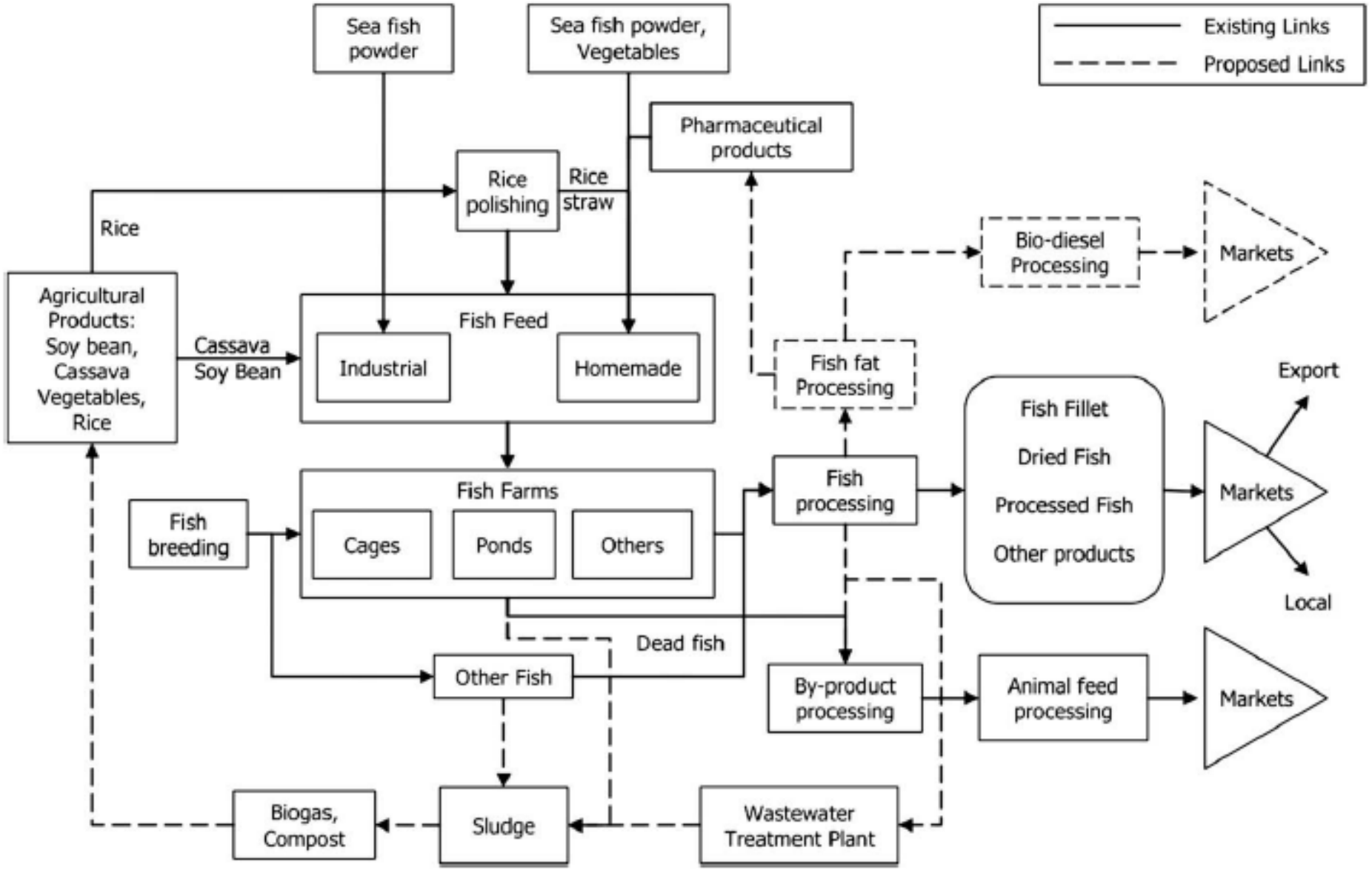


Fig. 8. Proposed fishery sector based eco-industrial network in An Giang Province.

In 2010 –2012

ORIENTATION OF EFFICIENCY USTILIZATION OF BIOMASS IN CU CHI DISTRICT, HOCHIMINH CITY

Phan Minh Tan, DOST

Nguyen Thi Van Ha, HCMUT

Nguyen Tuan Thanh, DOST

Nguyen Phuoc Trung, DARD

Vo Dao Chi, HCMUT

Cu Chi Peoples' Committee

© TemplatesWise.com

EXISTING BIOMASS USAGE IN CU CHI DISTRICT

Goat Farm (An Phu) : 1.200 heads



Dairy cow farm at An Phu: 3,000 heads/ 63,000 heads in Cu Chi



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EXISTING BIOMASS USAGE IN CU CHI DISTRICT

Earthworm Compost Manufacturer (9 ha)

Vermi compost

Liquid fertilizer from earthworm

Cow manure mixture

13

EXISTING BIOMASS USAGE IN CU CHI DISTRICT

Pig Farm: 3,000 heads (300 swine)/ 130,900 heads in Cu Chi




Orchid Farm/ Flower (40/256 ha)

Mushroom Farm

Crocodile Farm (30,830 heads)

14

TYPES OF BIOGAS DIGESTERS IN CU CHI DISTRICT

1. HPDE type

2.Thailand-Germany

3.Composite type

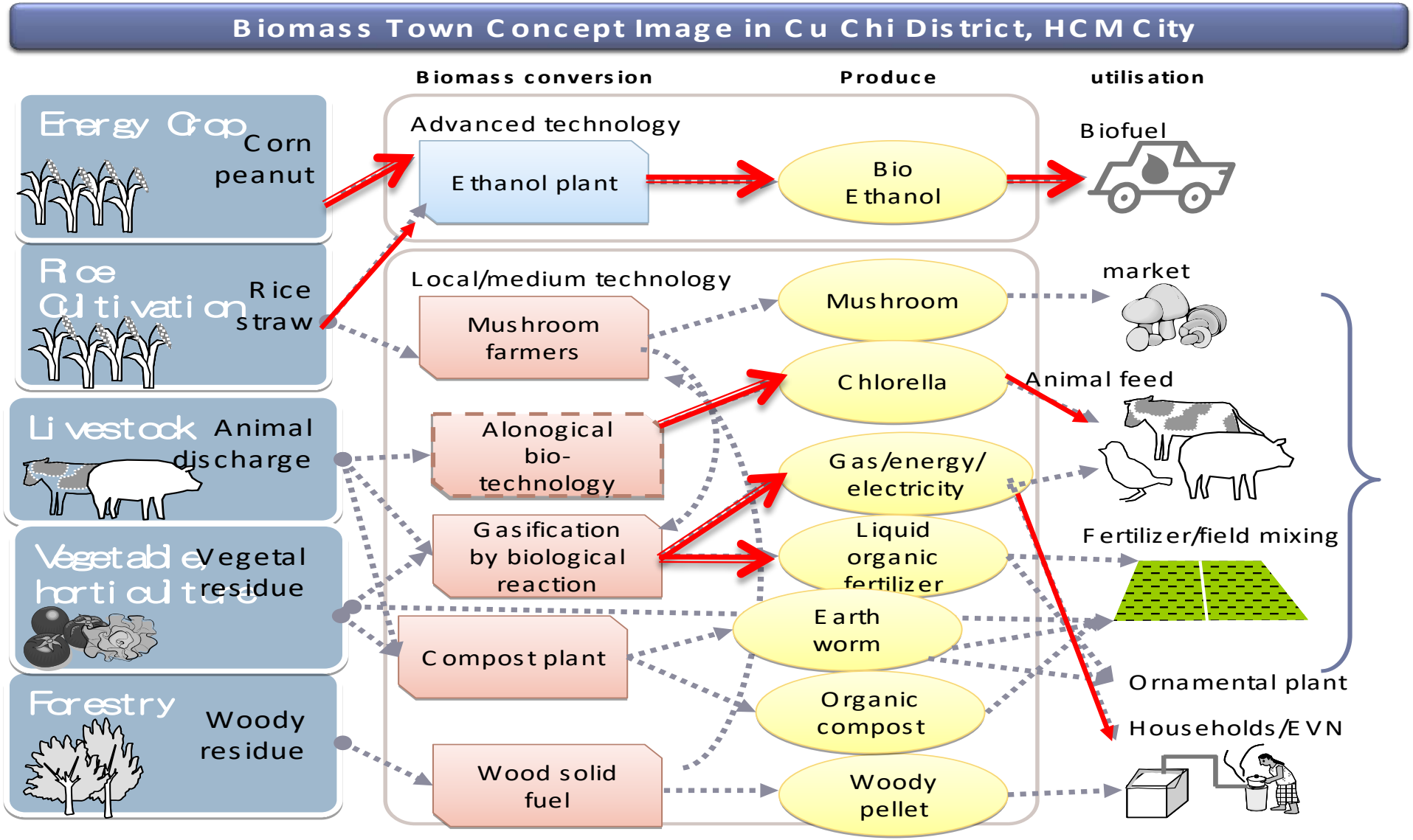
4.KT2

Source: Tuấn, 2009

5.KT3

6.Floating cover

PROPOSED CONCEPT OF BIOMASS TOWN



Link needed to be established or strengthened

16

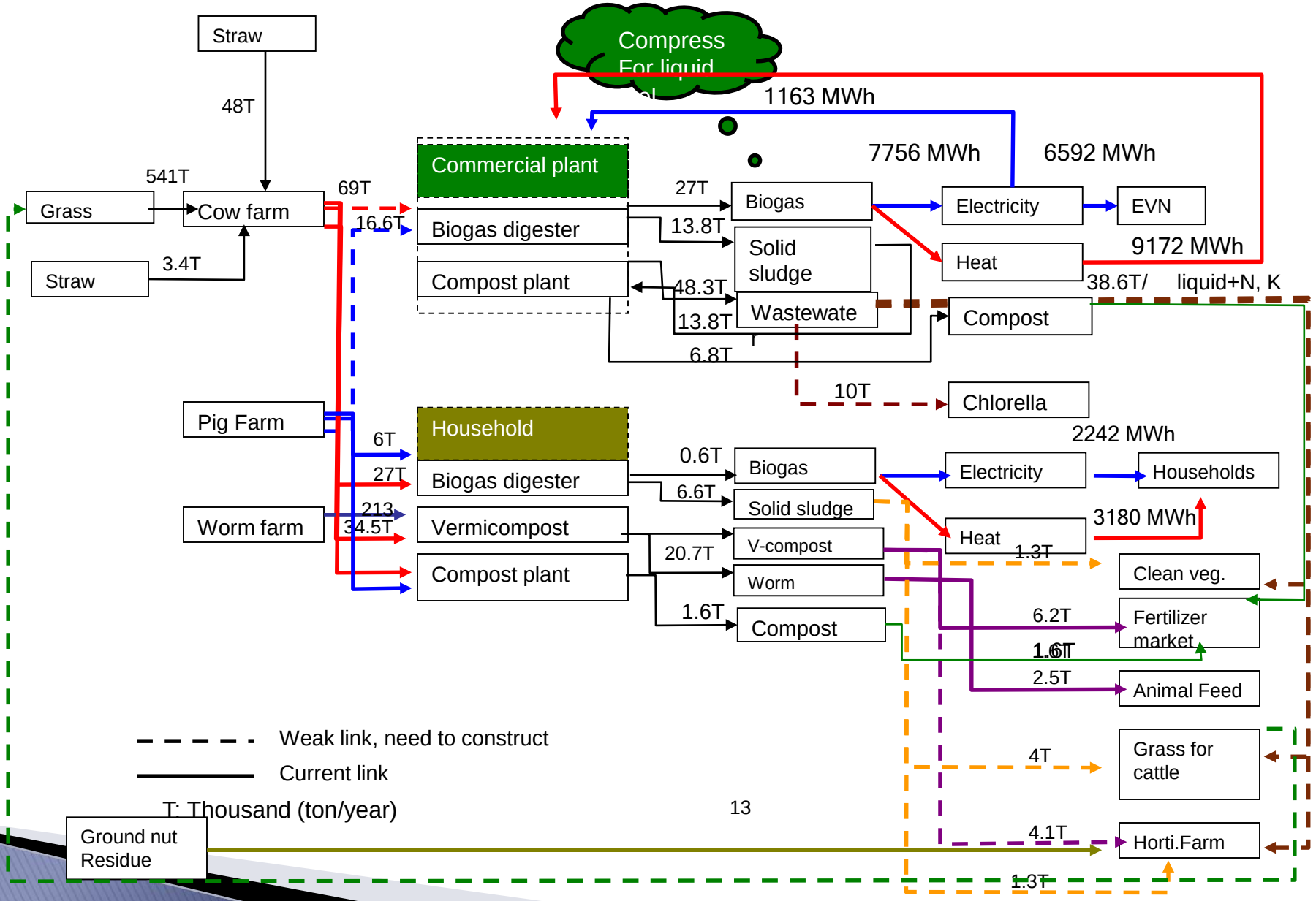
BIOMASS TOWN MODEL FOR STUDY AREA A

- Phuoc Long pig farm, 10,000 heads
- Electricity capacity: 0.6 MWh/year

Clean soil
Condense gas
electricity
Fertili zer
Compost, earthworm
Clean methane gas
Garden, Fields
livestock farms
was te
Biogas digester
Sludge
Wastewater for irrigating weed field
wastewater
Filter
Treated wastewater
Chlorella production
filter
chlorella
Animal feeding
Dry or ferment

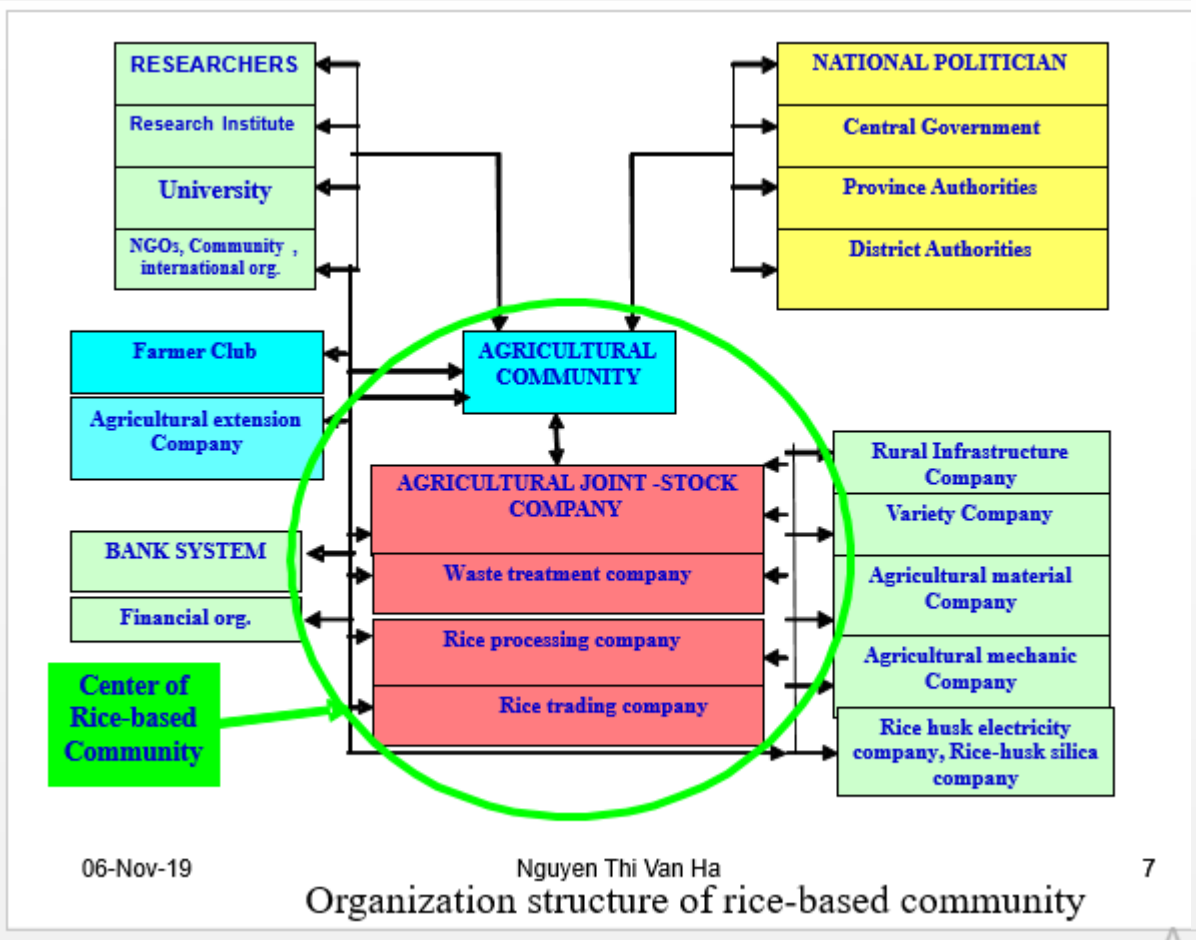
17
17

MASS FLOW AND BALANCE FOR THE PILOT MODEL

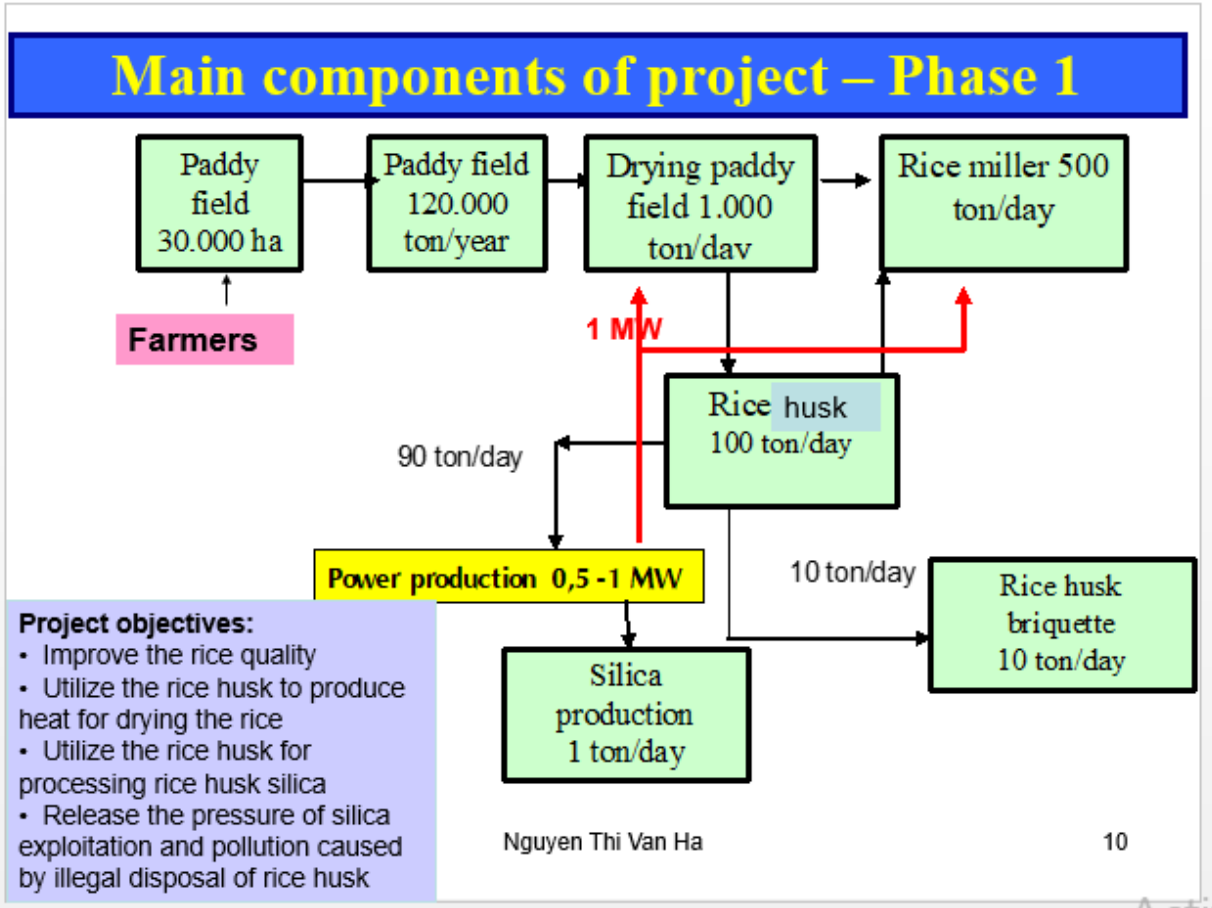


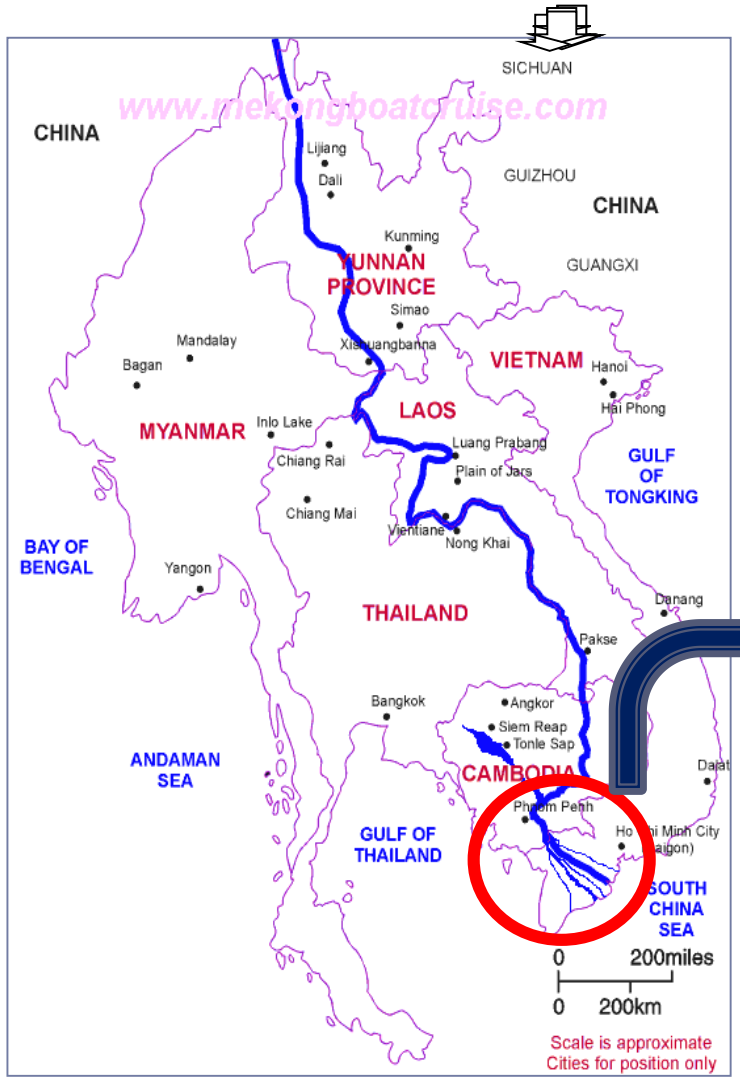
In 2012 -2020

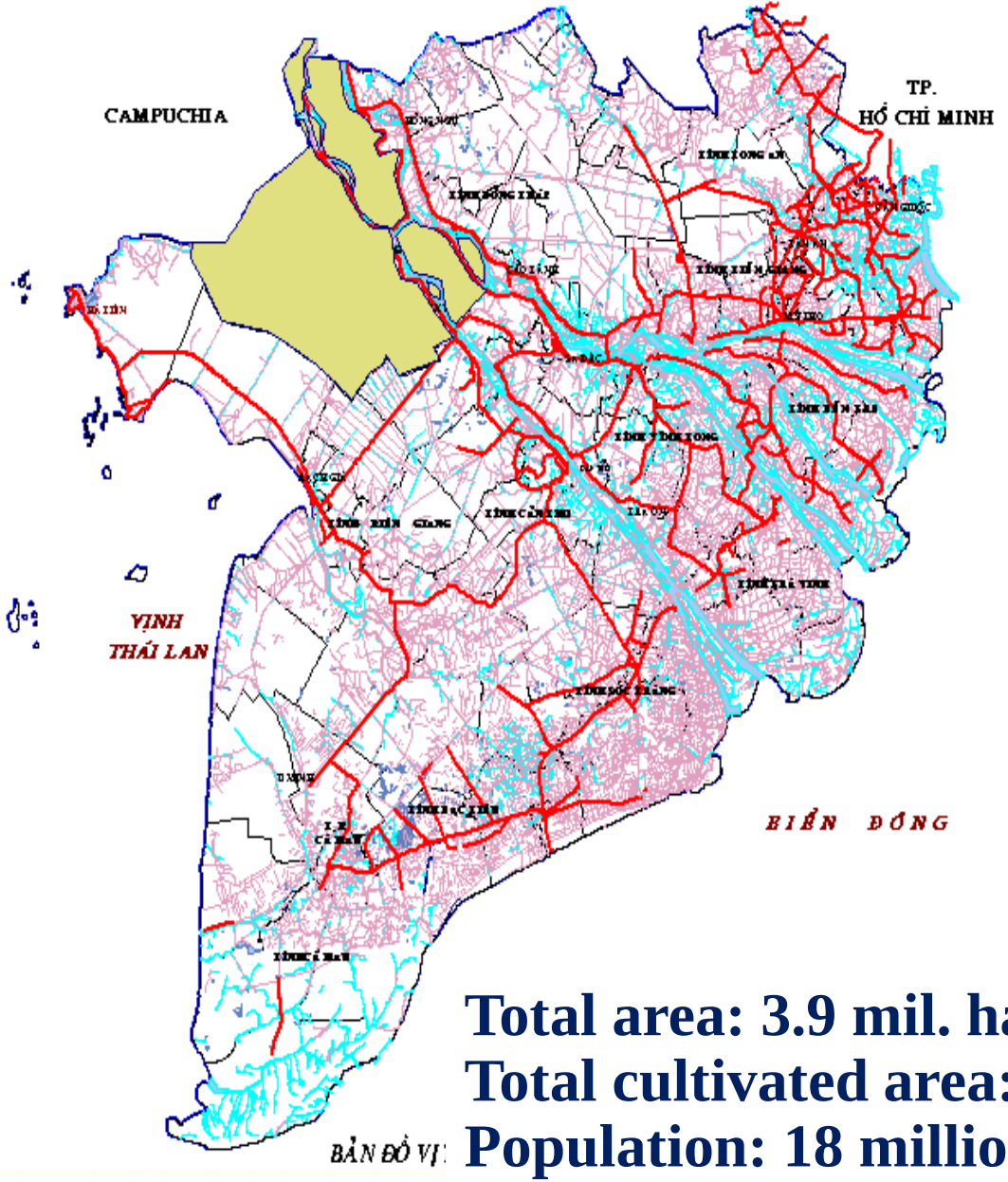
RICE-BASED COMMUNITY MODEL IN THE MEKONG DELTA



Organization structure of rice-based community

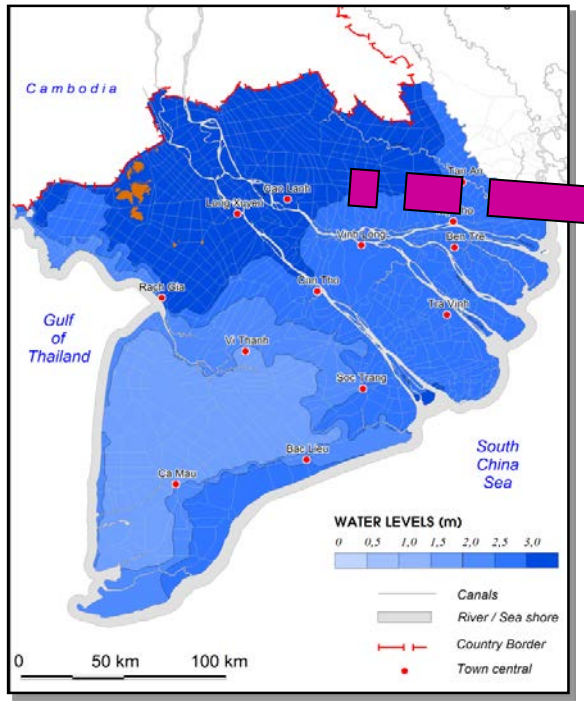


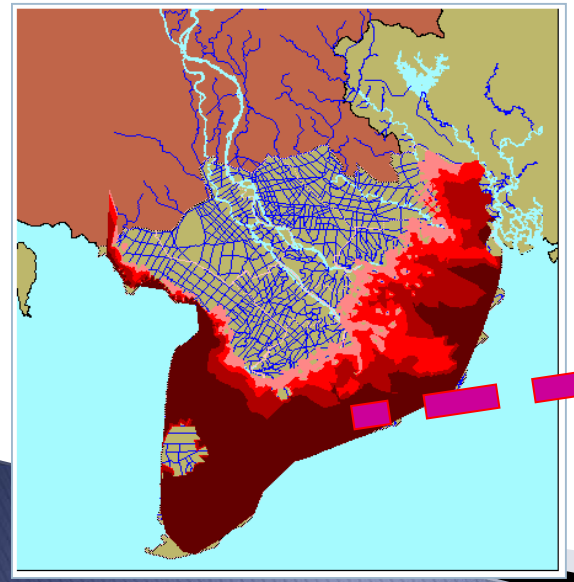


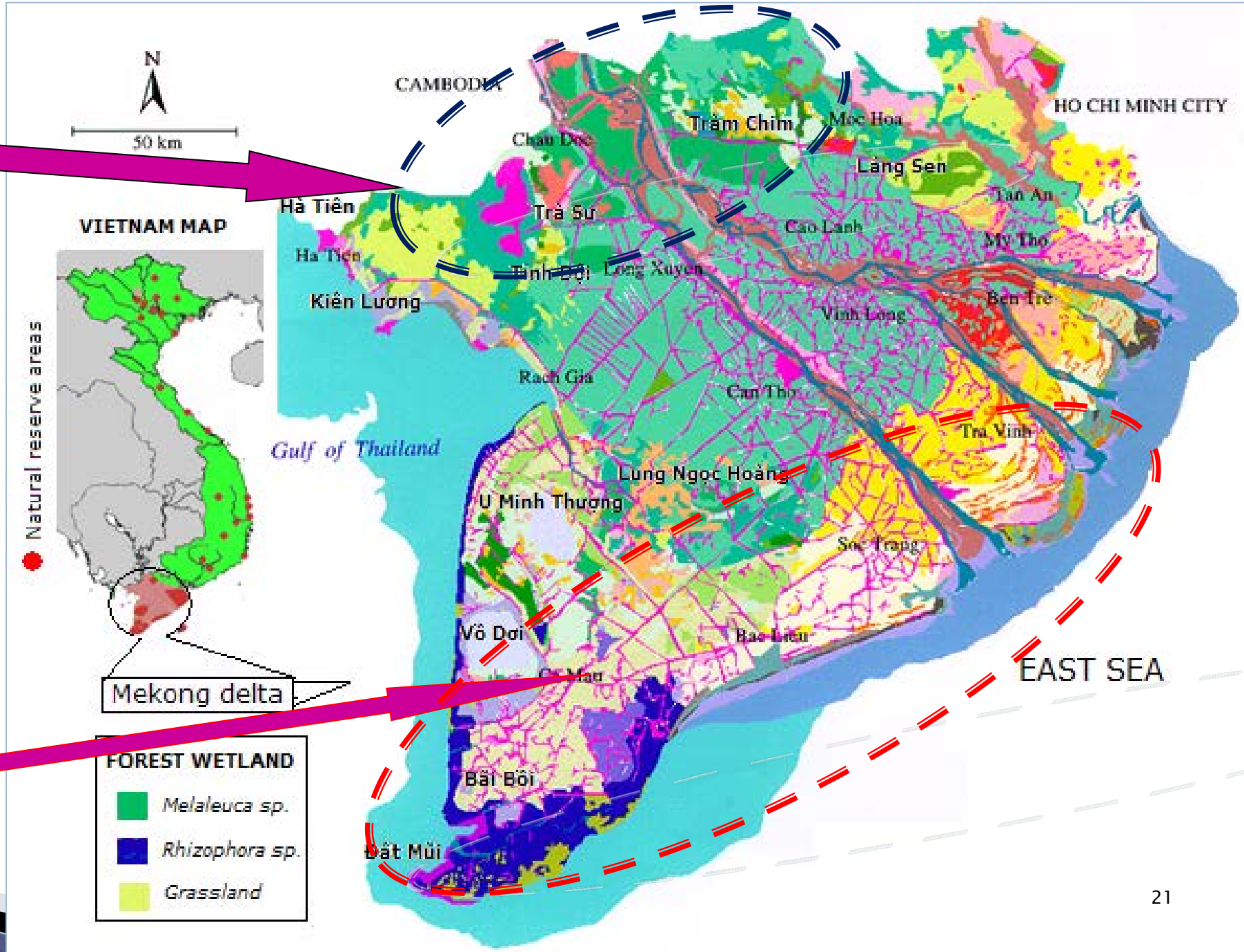


Total area: 3.9 mil. ha
Total cultivated area: 2.4 mil ha
Population: 18 million peoples
- **80% are rural**

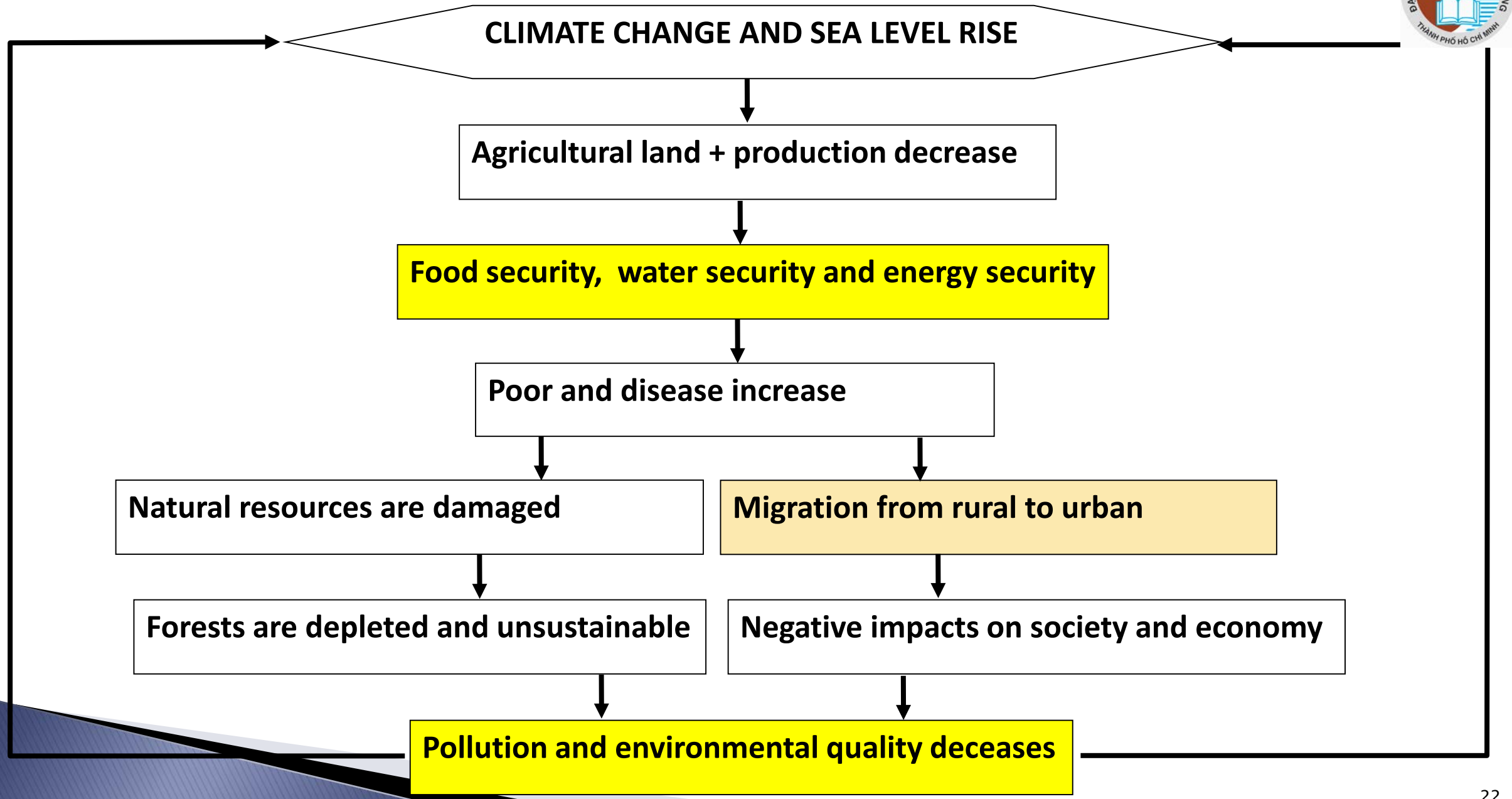
Total of Rice: 24 million tons/year


Cambodia
Gulf of Thailand
South China Sea
WATER LEVELS (m)
0 0,5 1,0 1,5 2,0 2,5 3,0
Canals
River / Sea shore
Country Border
Town central
0 50 km 100 km




N
50 km
VIETNAM MAP
Natural reserve areas
Mekong delta
CAMBODIA
HO CHI MINH CITY
EAST SEA
Gulf of Thailand
Hà Tiên
Ha Tien
Kiên Lương
Châu Đốc
Trà Sư
Tịnh Biên
Long Xuyên
Trăm Chim
Mộc Hoa
Làng Sen
Tân An
Cao Lãnh
Mỹ Tho
Bến Tre
Vĩnh Long
Rạch Giá
Cần Thơ
Trà Vinh
Lung Ngọc Hoàng
U Minh Thượng
Sóc Trăng
Vô Dơi
Bạc Liêu
Cà Mau
Bãi Bồi
Đất Mũi
FOREST WETLAND
Melaleuca sp.
Rhizophora sp.
Grassland

Environmental and climate change problems in Mekong delta



Resources of rice straw and rice husk in An Giang

Existing emission of rice straw and rice husk

Locations	Paddy field (ha/year)	Paddy yield (ton/year)	Rice husk (ton/year)	Rice straw (ton/year)
Vietnam	6 million	44 million	8.1 million	44 million
Mekong Delta	4 million	22 million	4 million	22 million
An Giang	563,940	3.6 million	0.69 million	3.6 million

Vietnam should develop rice husk power plants of 160-189 megawatt capacity near rice mills (129 rice mills with capacity of 50 -100 ton/day)

In 2011

http://www.lookatvietnam.com/2009/12/rice-husk-powers-into-energy-consciousness-2.html






Specification of rice husk

- RH is composed of ••••

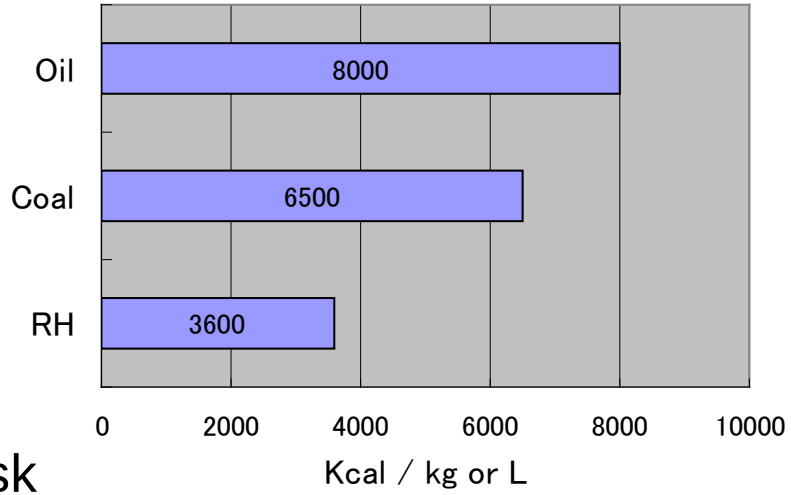
(wt%)

Organic	～60
Carbon	～20
Ash(SiO_2)	～20

} → Bio-ethanol **Burn as Fuel**

SiO_2 remains as exhaust

- Energy of •••



RH has about 60% of energy comparing with coal

- Element, SiO_2 and H_2O in rice husk

RH of about 20wt% is amorphous silica (SiO2).

C	H	O	N	S	SiO_2	H_2O	Total
37.1	4.1	31.6	0.4	<0.1	**17.8**	9.0	100

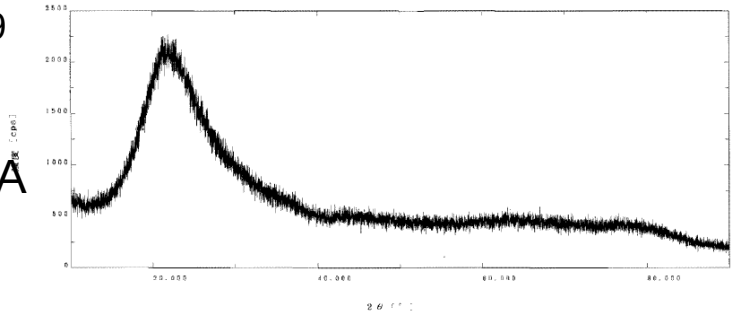
Composition and energy of Rice husk

Specification of rice husk ash

Component	No treatment	Washed by water	Washed by acid solution
SiO_2	**95.77**	**98.72**	**99.76**
Na_2O	0.18	-	-
K_2O	**2.11**	**-**	**-**
MgO	0.38	0.06	-
CaO	0.53	0.75	0.06
Al_2O_3	-	-	0.07
Fe_2O_3	0.05	0.03	0.02
ZnO	0.01	0.03	-
MnO	0.05	0.03	-
P_2O_5	0.41	0.06	-
SO_3	0.33	0.23	-
Cl	0.12	0.03	-

Source: Wada, 2009

XRD of RHA



	RHA wtppm
B	17
Na	200
Mg	510
Al	40
P	480
S	420
K	3500
Ca	690
Ti	3.9
V	<0.1
Cr	<0.1
Mn	250
Fe	51
Co	0.11
Ni	0.12
Cu	2.4
Zn	23
Sr	3.6
Zr	<0.1
Mo	<0.1
Ba	0.33
Pb	0.15

Source: Ha, 2010

Chemical compositions of RHA

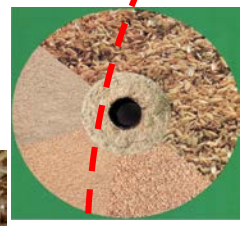
Rice-based industries cluster

Farmers

Paddy field → Paddy → Drying paddy → Rice mill

CHP generation

Rice husk



Rice straw

Char coal

Electricity and Heat

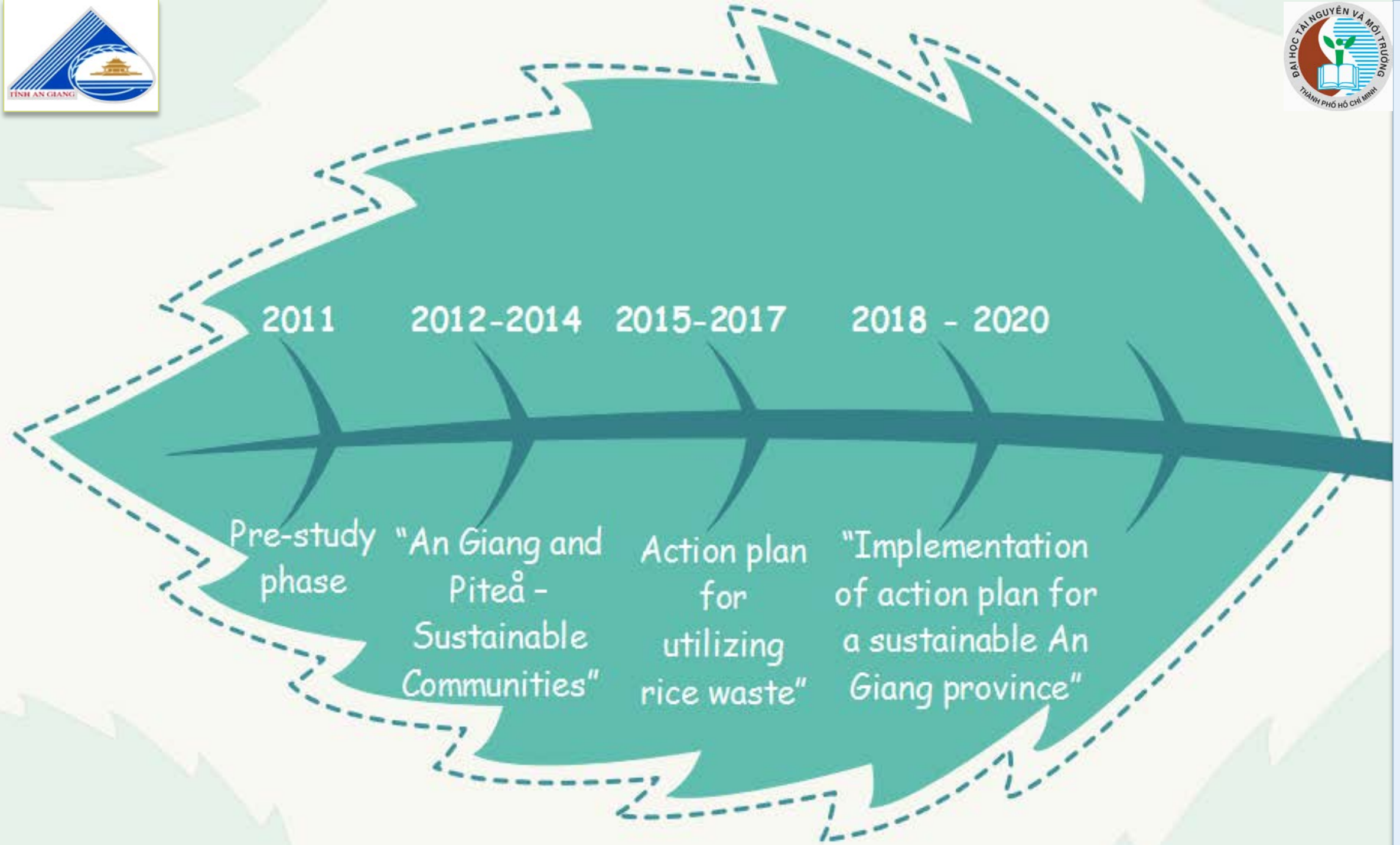
Rice husk Briquette/pellet

Rice husk ash

Silica and carbon production

Project objectives:

- Improve the rice quality
- Utilize the rice husk to produce heat for drying the rice
- Utilize the rice husk for processing rice husk silica
- Release the pressure of silica exploitation and pollution caused by illegal disposal of rice husk



An Giang – Piteå

Municipal Partnership program 2012 - 2020

Writing outline

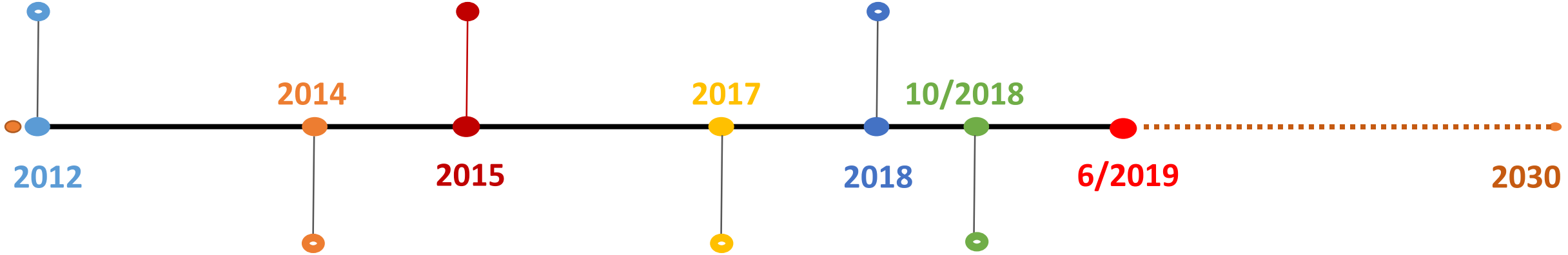
Project group meetings
Workshop
Interview
Stakeholder's meetings

Writing

Project group meetings
Workshop
Stakeholder's meetings

Implementing activity plans

Detail plans
Budget



Approval decision

Strategy plan of effective management and utilization of rice biomass for energy production in climate change context for An Giang province to 2030

Approval decision

Action plan of effective management and utilization of rice biomass for energy production in climate change context for An Giang province period 2018 - 2030

Adjusting The Action plan's objectives

Ratio of rice husk to be collected for rice husk power production or other energy products
The ratio of straw collected for energy production

Strategy plan of effective management and utilization of rice biomass for energy production in climate change context for An Giang province to 2030

Specific Objectives

- Increase value chain of rice-byproducts and biomass renewable energy products
- Increase the participation and interest of the whole society on biomass utilization
- Contribute to the economic growth in a sustainable way for An Giang province as well as Chau Thanh on rice production and processing

Vision of An Giang to 2030 reduced 8% of total GHG

Targets of Strategy plan of effective management and utilization of rice biomass for energy production

Objectives of the Strategy	2015 - 2020		2021 - 2030	
	Châu Thành	An Giang	Châu Thành	An Giang
Area of straw collected (% of total rice area)	40%	20%	60%	40%
Advanced technique of rice cultivation (ha)	5,090	80,257	5,090	101,440
Percentage of rice husk utilization for power and heat energy	50%	30%	75%	50%
Percentage of rice straw utilization for energy production	0%	0%	30%	15%
CO2 reduction (ton/year)	21,848	105,305	33,601	300,888

Implementing progress of period 1: from 2015 to 2020

Objectives of the Strategy	Targets in 2020		Results 2018	
	Châu Thành	An Giang	Châu Thành	An Giang
Area of straw collected (% of total rice area)	40%	20%	21%	24%
Advanced technique of rice cultivation (ha)	5,090 (20%)	80,257 (15%)	15,751 (65%)	99,167 (17%)
Percentage of rice husk utilization for power and heat energy	50%	30%	ND	69% (*)
Percentage of rice straw utilization for energy production	0%	0%	0%	0%
CO2eq emission reduction (ton/year)	21,848	105,305	21,225	ND

Project impacts since 2012

1 Awarewness

Changing views on the value chain of by-products of people and managers **at different levels → by-products rice is considered a precious resource**

2 Economic profits

2018	An Giang	Income of farmers (VND)
Area of straw collected	150,000 ha	**75 billion**
rice husk Collected	799,418.60 tons	**959 million**

3 Capacity building

Trainings for farmers, enterprises, officials
Knowledge and experience exchanges
Study tours
workshop

4 Sustainable development

Approval of Stratergy and action plan to 2030
Supporting for projects in fileds of climate change
Learning and sharing knowledge from successful models and experts
Participation of communities
Pursue the goal of improving rice value chain and sustainable rice communities

Outputs from the cooperation

- Strategy plan of effective management and utilization (in 2014)
- Action Plan of effective management and utilization (in 2017)
- Center of excellence on renewable energy and energy efficiency (CoEREF)
- 10 Business plans of Combine heat and energy plants & BIOMASS
- An Giang BioTechCenter following ETC and Piteå's experience
- Technical training for farmers on production of forage, mushroom, rice straw collection
- A steering committee (32 members)
- A rice- based industries cluster
- A Biomass management association

Target groups	Jan 2012 – May 2019 (person) in projects
Farmers	1.128
Enterprises	41
Officials (all levels)	409

Outcomes from cooperation

- Trained technician and politician
- Changes of mindset and awareness in rice community
- Long term impacts on environment, economic, social welfare and nature to achieve the sustainability goals
- Technical solutions on biomass energy from rice husk
- Involvement of women

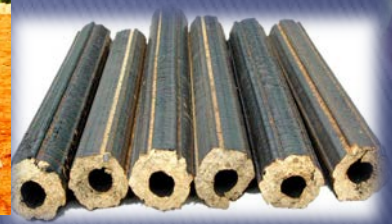
Before

Now

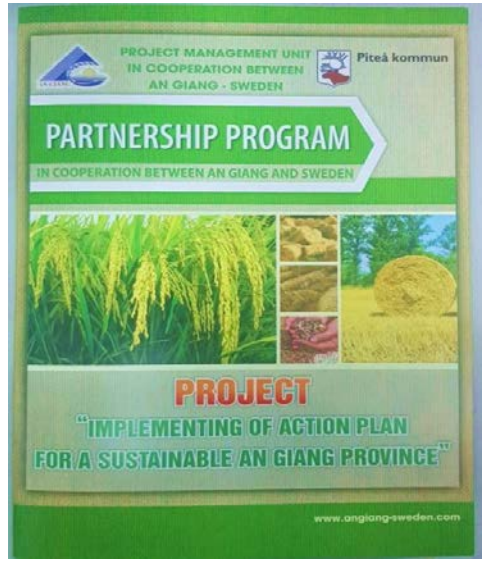
Before

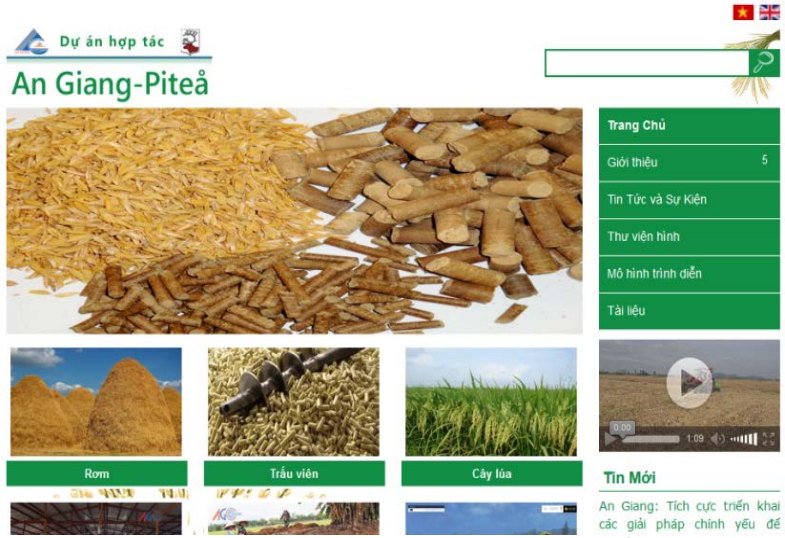
Now

Thermal insulation materials (products of JIC in An Giang)



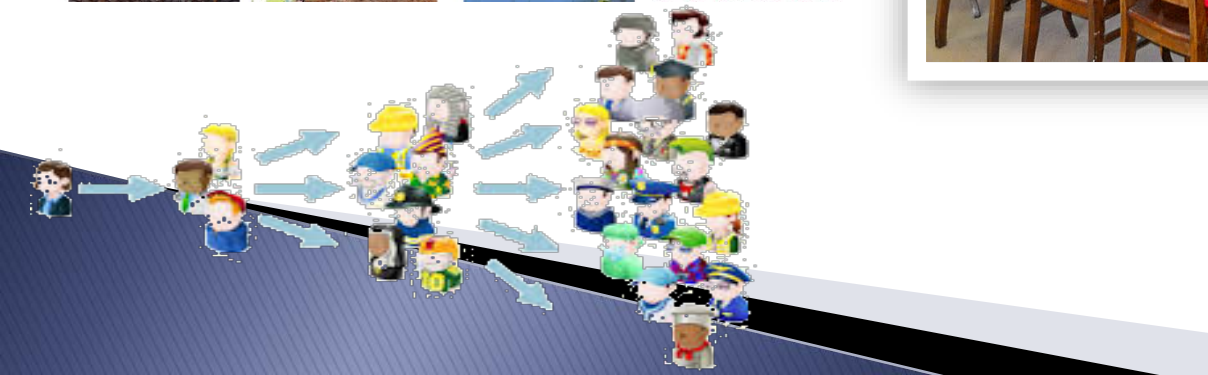
4. WebGIS Database and website www.angiang-pitea.com and http://angiang-sweden.com





ATV

TuTube



Inspired researches from the cooperation between Universities and Enterprises

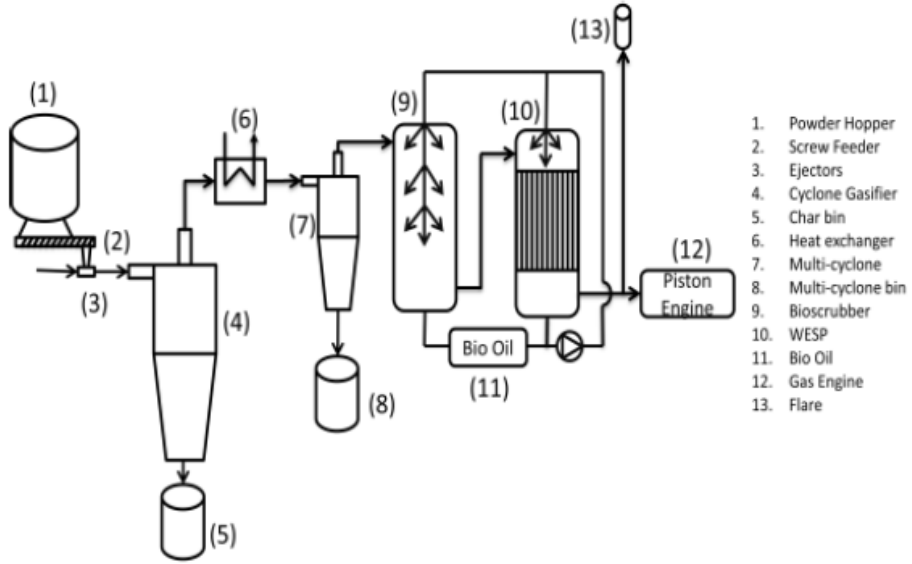


Figure 1. Schematic of the cyclone gasifier and the gas cleaning equipment

Table 1. Ultimate analysis of the different fuels

Ultimate analysis (wt% dry ash free)	C	H	O	N	S
Torrefied	54.9	6.0	38.7	0.1	N.D.
Peat	56.9	6.0	34.1	2.6	0.3
Rice husk	49.2	6.1	43.9	0.4	0.0
Bark	53.1	6.0	40.5	0.4	0.0

Sources: M. Risberg, 2012

Table 2. Proximate analysis and lower heating value the different fuels

Proximate analysis (wt% dry)	Volatiles	FixC	Ash	LHV (MJ/kg)
Torrefied	77.9	21.8	0.3	20.7
Peat	67.9	26.1	6.0	19.6
Rice husk	66.0	14.7	19.3	14.9
Bark	70.7	26.3	3.0	18.7

Table 3. Gas composition for the different fuels and heating value of the gas after the gas cleaning equipment.

	CO2 %mole	CO %mole	H2 %mole	CH4 %mole	LHV (MJ/Nm^3)
Torrefied	10.8 ± 0.27	20.1 ± 0.83	9.2 ± 0.20	3.3 ± 0.25	5.75
Peat	12.0 ± 0.04	15.9 ± 0.17	10.8 ± 0.24	1.4 ± 0.06	4.07
Rice husk	14.2 ± 0.14	15.0 ± 0.22	6.8 ± 0.10	2.7 ± 0.04	4.51
Bark	13.0 ± 0.09	16.9 ± 0.22	6.7 ± 0.09	2.7 ± 0.05	4.84

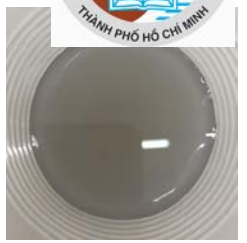
RH burning test at ETC with MEVA

Inspired the cooperation between HCMUNRE and Enterprises

25 μm

10–15 μm

5 μm



HOANG HA®

Owning technology of green-silica production from rice husk, applying and marketing green-silica products for paint production

Without silica

With silica chemical

With silica powder from RH

With silica gel from RH

Silica products from RHA

Lessons learnt from Piteå –An Giang cooperation for developing circular economic

- Triple Helix model plays important role
- ETC operation/RISE for innovation researches
- Innovations on bio and circular economy
- Piteå Science Park or AnGiang BioTechnique Center for incubation and entrepreneurship

Lessons learnt from Piteå –An Giang cooperation for developing circular economic

- Gasification technique
- Bio-waste management and experience
- Incentive policies
- Commitments of Government, Investors, Industries
- Transparency and democracy process (strategy development, action plan, implementation and monitoring)

Thank you for your listening!

Changes in rice communities

No.	Activities	Before 2012	After 10 years
1	**The situation of using rice husk**	• Dumped into rivers, canals	• Energy production: Heat/electricity • Production of high value products: Briquettes, pellet, thermal insulated materials, silica, handicraft products
2	**The situation of using rice straw**	• Burned out in the fields • Used for growing mushrooms and mulching for planting vegetable	• Rolled by machine • Growing mushrooms • Making food for buffaloes / cows • Fertilizer, mulching for planting vegetable • High value products
3	**Number of straw rolling machine**	• **0**	• ≈ 250 (in An Giang)
4	**Paddy rice cultivation area**	• 625.186 ha	• 632.000 ha
5	**Collected straw's area**	• 120.000 ha (**≈19 %**)	▪ 200.000 ha **≈32 %/40% of the action plan** (increased 66% compared to 2012)
6	**Awareness**	• Rice husk, straw and ash were wastes	• Changing views on the value of by-products of people and managers: Developing and approving the Strategy and Action Plan on effective management and use of rice biomass by 2030 (by-products rice is considered a precious resource)

Changes in rice communities

No	Activities	Before 2012	After 10 years
1	❖ Additional income from rice by-products:		
	➢ For farmers	▪ cost money for treatment/disposal	▪ Straw's price in the fields: 500.000 đ/ha ▪ Straw roll's price: ≈ 20.000 -25.000/roll ▪ Husk's price: 600 đ – 1.500 đ/kg ▪ Ash's price: 120.000 đ – 200.000 đ/ton
	➢ Entrepreneur: rolling straw, producing Briquettes, pellet, ash	▪ There is no straw bales business	▪ Profit from new business (trading straw/Briquettes, transport)
	➢ Rice mill owners (Using rice husk to dry paddy rice and selliing rice husk)	▪ High Energy cost (electricity - heat)	▪ Save energy costs and gain high profits from rice husk and rice husk ash
	➢ Creating jobs for rural labors	▪ None	▪ Create jobs in rural areas (Drive straw rolling machine, porterage - transport)
2	❖ Rice husk ash	▪ Planting vegetables / flowers	▪ Towards producing silica and other high value products

Participation

Target groups	person
Farmers	1.228
Enterprises	50
Steering Committee, provincial decision-makers, civil servants and staff from departments, sectors in the localities.	50
Students (Universities, schools)	200

- Reduced 4 % GHG emission due to the effective management and utilization of rice biomass for energy production in climate change context for An Giang province to 2030

Changes in rice communities (2012 – 2018)

	Activities	2012	2018
1	**The situation of using rice husk**	• Dumped into rivers, canals	• Energy production: Heat/electricity • Production of high value products: Briquettes, pellet, thermal insulated materials (JIC) • Producing silica • Making handicraft products
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Future cooperation between An Giang and Piteå
New proposals focus on young generation

- **Objectives:** Improving young people's engagement in society and developing the communication with citizens
- **Project life:** 1 year broadening and developing
- **Activities:**

- Improving presentation skill/ entrepreneurial skills *(Start-up projects/plans)*
- Building capacity on arranging and developing their own projects/plans
- Dialogue for sharing knowledge, experience and culture between young generation in An Giang and Piteå
- Preparing for new application for a three-year project **2021 – 2023**