French Research Institutes Workshop

Centre de Coopération Internationale en Recherche Agronomique pour le Développement

CIRAD, Kasetsart University, Bangkok

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Mae Fah Luang University

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The French-Upper Mekong Sub-region Academic Cooperation Centre

Lectures:

- **Hevea Research Platform in Partnership (HRPP): a Franco-Thai network to strengthen research and higher education on natural rubber production in Thailand and SEA" by Dr. Frederic Gay (CIRAD), Coordinator**
- **Why to look at Bio-carbon economy by Dr. Philippe GIRARD, Director of CIRAD, Bangkok**

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In a nutshell

CIRAD is a French research centre working with developing countries to tackle international agricultural and development issues.

Status:

CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) is a public industrial and commercial enterprise (EPIC) under the joint authority of the Ministry of Higher Education and Research and the Ministry of Foreign and European Affairs.

Mandate:

CIRAD works with the whole range of developing countries to generate and pass on new knowledge, support agricultural development and fuel the debate on the main global issues concerning agriculture.
CIRAD is a targeted research organization, and bases its operations on development needs, from field to laboratory and from a local to a global scale.

Activities:
CIRAD's activities involve the life sciences, social sciences and engineering sciences, applied to agriculture, food and rural territories.
CIRAD works hand-in-hand with local people and the local environment, on complex, ever-changing issues: food security, ecological intensification, emerging diseases, the future of agriculture in developing countries, etc.

Scientific Strategy:
CIRAD's operations centre on six priority lines of research.
It primarily works through joint research platforms (14 worldwide and seven in the French overseas regions).

Partnerships:

CIRAD has a global network of partners and of twelve regional offices, from which it conducts joint operations with more than 90 countries. Its bilateral partnerships fit in with multilateral operations of regional interest.
In metropolitan France, it provides the national and global scientific communities with extensive research and training facilities, primarily in Montpellier.
CIRAD is a founding member of **Agreenium**, the national consortium for agriculture, food, animal health and the environment, and a member of the **Alliance nationale de coordination de la recherche pour l'énergie.**

CIRAD in figures:

- A staff of 1800, including 800 researchers.
- Joint operations with more than 90 countries.
- Three scientific departments: Biological Systems (BIOS), Performance of Tropical Production and Processing Systems (PERSYST), and Environment and Societies (ES).
- 37 research units.
- Twelve regional offices in metropolitan France, the French overseas regions and other countries.
- Around thirty collective research tools accessible to partners from developing countries.
- About 5 million Euros spent on PhD courses; 800 researchers and technicians from all over the world received and trained each year.
- A budget of 214 million Euros in 2010.

Update date: 09/08/2012

(http://www.cirad.fr/en/who-are-we/in-a-nutshell)

Regarding environment, there is no way to continue to produce as people did before. Population is growing, the surface available for agriculture will reduce, and this is particularly true around large cities that are growing very fast. Land originally used for agriculture is just disappearing.

Another way to meet the challenge is to try to change habits regarding waste, reducing waste contents, and changing diets habits. Another important point is prices; deal with prices to allow everybody to have access to food. Some credits recently showed that this is not so obvious.

Sustainable agriculture is a major issue for CIRAD. It means improving the productivity and the competitiveness of agriculture and life stocks while meeting the global challenges, so we aim for a better agriculture, a less impacting agriculture, improving the quality and the safety of the products. It is also very important because the market is now wider and many products are transferring from one country to another. Contamination and transfer of diseases must be avoided.

It is also a better use of natural resources, reduction of disparities between rural and urban areas.

CIRAD is tailor made for this goal. It is working worldwide, 1800 staff, close to 900 researchers. It is a 219 million Euros of turnover in 2011. There are 37 research units organized in 3 departments. One is dealing with biological systems, the second one with agriculture and processes, processing of sustainment and agriculture product transformation and the last one with environment and society, a more socio-economic approach departments.

CIRAD has 12 offices worldwide, 700 people working abroad. Even if the head office is based in Paris, most of the researchers in France are based in the Southern part of France.

CIRAD researchers are working in 14 countries in Africa, Latin America and Asia, and we have collaborative projects with 90 countries worldwide. So CIRAD is much spread all over the world, but mainly in tropical countries.

It is a public organization, a French government funded organization, with the scope of trying to contribute to the development of tropical countries in the field of agriculture. All the research projects CIRAD is working on concern agriculture, on a wider and global approach. Over 50 years of experience, mainly from Africa, the countries that used to be French colonies. Actually, CIRAD was created after the independence of the colonies to continue to develop agriculture and tropical crops in these African countries.

CIRAD values have brought us to work with people and collaboration. The approach is quite unique, CIRAD is not a funding project, not a funding agency but the contribution of CIRAD is in term of people. Now, there are 10 researchers based in Kasetsart University in Bangkok, and this is quite a large contribution in time.

It is a research organization and of course the scope is to try to publish international journals, the quality being important. Because CIRAD is working for development, sharing information, training people are very important as far as we are dealing with development.

CIRAD has a great specific expertise. It comes from a long collaboration in Africa on tropical crops, and of course in rural areas, rural communities, on all kinds of tropical crops including animal productions, fishery, as well as tropical forests.

CIRAD has lead decades of research in the South which makes CIRAD quite unique regarding the knowledge on tropical crops. CIRAD database is unique and worldwide. CIRAD has also some specific experience on eco-system and farming.

CIRAD is working in a wide range of situations and actors / players try to understand the change for a better system, the system being in constant evolution. In order to be able to analyse the impacts of the change and the risks, the economy being global, there is a big change regarding the market, but also regarding the climate change, that may affect agriculture a lot. We are dealing with a world where commodities will become rarer. The prices will increase so there will be a competition and we need to try to reduce as much as possible the use of these commodities, and use them better. CIRAD scope is to foster innovation and also to work with bodies assisting ministries, international organizations.

Something very specific is that CIRAD is working and doing research in partnership. CIRAD is working together with local research organizations in their laboratories.

Concerning the three departments of research fields:

- Biological systems: the scope is to better understand the biological system from molecules to eco-system.

- Tropical products and processing system: trying to analyze farming practices, farming systems performances, as well as the transformation process into final products and their quality.

- Environment and society: from a local to a global scale, it concerns health and socio-economic aspects.

From vision to action: CIRAD defines six priorities:

- Ecological intensification: develop ecologically intensive agriculture, a more productive agriculture but less impacting as possible. The scope is to inventing farming systems to optimize yields and preserve bio-diversity. How nature functions to avoid lack of resources, developing new varieties. Designing sustainable producing systems, the scope being to produce more but better.

- Biomass energy and societies in the South: Ensure that the emergence and development of bio-energies benefit people in developing countries. Energy is a key point and a key factor for developments. The idea is to study the efficiency and the stability of Biomass production, as well as Biomass resources.

- Accessible, quality food: Innovating to make food accessible, varied and safe. Study the production system and the processing technology to avoid the contamination of the products. Time is largely dedicated to training people, the importation of tropical products in Northern countries.

- Animal health and emerging diseases: Especially true in South-East Asia with emerging diseases starting in this region. Foreseeing and managing the infectious disease risks linked to wild and domestic animals, and rafting appropriate sanitary policies.

- Public policy, poverty and inequality: Supporting public policies aimed at reducing structural inequality and poverty. Promoting public policies designed to reduce inequalities, working with stakeholders, farmers, etc. Even is rules exist, the implementation is not always applied, and rural areas are depending on agriculture.

- Agriculture, environment, nature and societies: Understanding the relations between agriculture and the environment and between human communities and nature better so as to manage tropical rural areas sustainably. Allow a better management and better use of natural resources is the best way to protect an area.

The idea is to try to analyze the interface between agricultural areas, eco-systems with resources to be managed and protected. How to use a part of the natural resources, and what need to be preserved, and CIRAD tries to develop this approach with people. Study the impact of climate change on agriculture and the environment. Trying to

forecast what may happen, how to mitigate these risks. It is true with a lot of natural resources, and water, for instance, will become soon a problem. Studying the relationships between human communities and nature: it is important to understand how people behave and believe in order to be able to propose appropriate solutions.

CIRAD is working in partnerships trying to establish platforms that could be a technical platform, like a laboratory for research, like a network, a network of people dealing both with research and education. It is innovative to do research in partnership.

The condition for a research platform is networking, in order to increase international research committees, CIRAD often helping to merge research units together. It tries to contribute to the collective global effort in research and trainings to meet today's and future's challenges. Combining efforts together is more attractive to international agencies. Now, CIRAD has 14 platforms in partnership worldwide, three of them being in South-East Asia: Thailand, Laos and Vietnam, many platforms are in Africa, because of historical reasons and because they are French language speaking countries; and finally in Latin America.

In Thailand: There are 15 researchers based in Thailand, and all together, 30 persons in total (for missions, technical assistance, PhDs). 10 of them are based in Kasetsart University, which makes of Kasetsart University the largest partner of CIRAD in the world, in term of researchers based in the same institution. In term of collaboration, Thailand is just after Brazil and Madagascar Island. In Kasetsart University, people are working on rubber tree: energy, emerging diseases and conservational agriculture, etc. Four researches are based in Asian Institute of Technology, working on fishery and water resources and management. One researcher is based in Land Development Department, working on soil conservation.

HRPP, a Franco-Thai network to strengthen research and higher education on natural rubber production in Thailand and SEA

Dr. Frederic GAY

Abstract

The "Hevea Research Platform in Partnership" (HRPP) was initiated by the researchers of the Rubber Research Project under the Thai-French Research Framework sponsored by Commission on Higher Education, and the Government of the French Republic through the French Embassy to Thailand, and Thailand International Cooperation Agency. This platform aims at strengthening the excellence in the rubber commodity chain as well as academic networks and regional cooperation through the sharing of body of knowledge and technology transfer in this particular area. On May 26th, 2008, the "Memorandum of Understanding Creating the Hevea Research Platform in Partnership (HRPP) in Thailand" was officially signed by the four core partners (Kasetsart University (KU), Prince of Songkhla University (PSU), Department of Agriculture of Ministry of Agriculture and Cooperatives (DOA) and CIRAD). Owing to the needs for further development in this field of research to achieve acceleration of regional and international development, many universities and research institutions (5 from Thailand and 6 from France) became our Associate Members such as Mahidol University, Khon Khaen University, Ubon Rachathani University, Mae Jo University and BIOTEC for Thai side, and Montpellier SupAgro, INRA, IRD, University of Montpellier II, University Blaise Pascal of Clermont-Ferrand and University du Maine of Le Mans for French side.

HRPP is an information exchange platform where the members can share their vision, co-build new joint-research projects and co-produce high level scientific knowledge. Annual seminars and workshops support this dynamic. At present, activities under this platform have been implemented by the HRPP members under supervision of a Steering Committee and a Scientific Committee.

Why to look at Bio-carbon economy

Dr. Philippe GIRARD

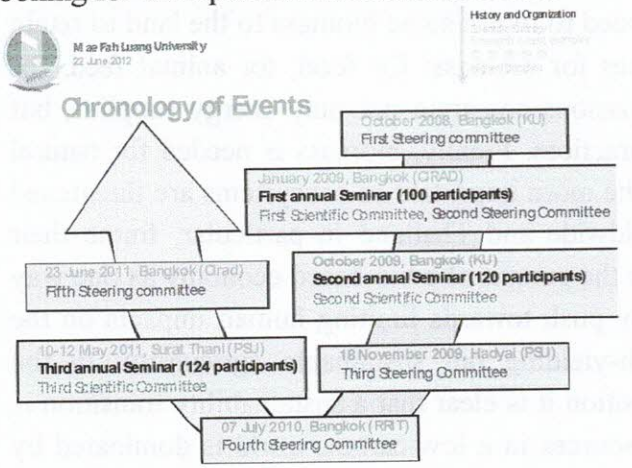
Abstract

Building a low-carbon economy and reducing greenhouse gas emissions to keep climate change within relatively safe bounds will require increasing use of biomass – plant and animal materials. Biomass is a promising source of renewable low carbon energy, but it's not an unlimited resource: it is constrained by land and water availability, by soils' ability to produce biomass, and by the need to return some biomass to the land to retain nutrients. There are also competing uses for biomass: for food, for animal feed, for materials – and the need to reduce emissions constrain not only energy supplies, but also land conversion and agricultural practices. Finally, biomass is needed for natural habitat and ecosystem functioning, all the more important as ecosystems are threatened by a changing climate. Countries worldwide and Thailand in particular, frame their future in terms of sustainability, and see the pursuit of a bio-based economy as one way to achieve this. There is a strong policy push towards limiting human impacts on the climate while also developing a high-yielding but sustainable agriculture. In the relatively short time toward such a transition it is clear that a sustainability transition is possible. The discussion of biomass resources in a low-carbon world is dominated by existing energy uses; for combustion, and as feedstock for bio fuels. Both of those uses are likely to continue for the near future, but in the long run, the increasing demand will necessitate to improve the use of the raw material in two ways, by requiring more efficient conversion technologies and by increasing the range of bio based products that can be produce (on a bio refinery based concept). This paper will rapidly present the drivers to the Bio-carbon bases economy and the biomass specificity and constraints. It will then focus on pyrolysis technologies and bio fuels options which are developing and finally, present challenges. Thus, to understand the future of the bio-based economy, it is important to look beyond our immediate need to use biomass to help reduce carbon emissions.

Hevea Research Platform in Partnership(HRPP): a Franco-Thai network to strengthen research and higher education on natural rubber production in Thailand and SEA"

By Dr. Frederic Gay (CIRAD), Coordinator

HRPP is a Franco-Thai network partnership platform dedicated to research and education on natural rubber production and technology, first in Thailand, but CIRAD is looking for its expansion to South East Asia.



HRPP was created in May 26th, 2008 but actually, it was an output of Thailand and France collaboration for over 10 years, especially between CIRAD and Kasetsart University on research on rubber tree and natural rubber products.

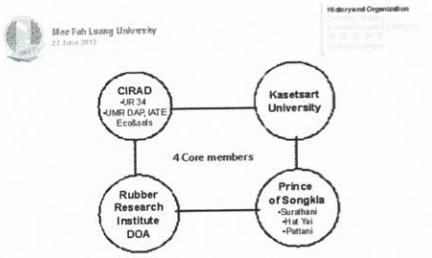
There were 2 mains projects:

- Doras project - Rubber Institute project Center of Excellency of Kasetsart University.

- Franco-Thai project, "improving the rubber tree productivity", signed with the Thai Cooperation Agency.

These projects enhance collaboration from the rubber seed to the rubber block.

The four core members signing the Memorandum of Understanding on May 26th, 2008 were: CIRAD on the French side, Kasetsart University, Prince of Songkhla University and the Department of Agriculture (especially the Rubber Research Institute) on the Thai side.

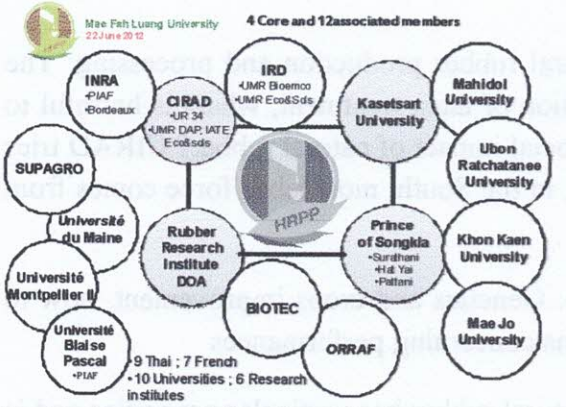


Then, in July and August 2008, the first steering committee validated the official list of the associate members. In 2008, nine associate members joined the platform:

- On the Thai side, Mahidol University, Mae Jo University, Ubon Rachathani University and Khon Kaen University.

- On the French side, 2 research institutions through their research units:
IRD (Institute for Research and Development)
INRA (National Research Institute in Agricultural Science)
and 3 universities in France: SupAgro (Consortium of Universities on Higher Education in Montpellier), the University of Montpellier and the University of Blaise Pascal, in Clermont Ferrand. Clermont Ferrand being the siege of Michelin Company in France.

Since 2008, 3 more associate members joined the HRPP platform:
University du Maine on the French side, who has good specialists on natural rubber, and the polymer; and 2 Thai partners: BIOTEC (consortium specialized in biotechnology) and ORRAF (office for rubber replanting in Thailand).



Today, there are 16 partners. 9 Thai partners, 7 French partners, 10 universities and 6 research institutes. The platform has a steering committee which has one representative member of each core member. There is one founding common Scientific project divided in 4 main disciplinary fields: Agronomy and physiology; Genetic and Biotechnology; Technology and Quality; Socio-economics. Finally, a scientific committee, which has one representative of each core member (4) and associate member. (16)

Scientific Strategy:

The steering committee agreed to gather on one common scientific project. The originality of this platform is its integrated multidisciplinary approach which addresses various issues from the *Hevea* seed to the rubber block.

Currently, experts in genetics, agronomy, plant physiology, eco-physiology, environmental science, biochemistry, rubber technology and socio economics conduct more than 20 joint research operations carried out by Thai and French scientists together.

CIRAD tries first to identify the main challenges of natural rubber production of today in Thailand, worldwide and also in the Sub-region. Then, to identify the developmental issues linked to these challenges and consequently list the questions addressed to the research people. Finally, these questions will be translated into research operations conducted by HRPP partners.

The 5 main issues identified last year are:

1. Productivity of rubber plantations in Thailand: what makes the rubber productivity in Thailand? What are the determinants in terms of socio-economic and biological determinants.

2. Global and local changes impact on rubber production and sustainability in Thailand: land use changes and climate changes. In the South, there is competition with oil palm and other activities like tourism. In the North-East, it is mainly a replacement of other crops, as it is a recent plantation. What is the impact of rubber in the sustainability of the ecosystem? In the North of Thailand, the rubber plantation is even a more recent plantation and there a challenges due the suitability of this crop with the local agronomic and economic condition.

3. Environmental and social impact of natural rubber production and processing: The impact with the bad odor with the fermentation of latex treatment, which is harmful to the neighboring communities. What is the social impact of natural rubber? CIRAD tries to tackle the social impact of natural rubber, in the South; most labor force comes from Myanmar and Cambodia.

4. Performances of rubber planting material: Genetics and crops improvement, how to improve the clone and thus solve the problems concerning performances

5. Non consistency of raw natural rubber: natural rubber has particular properties and is inconsistent and cannot be replaced by natural rubber. For instance, there are some questions regarding the control of rubber consistency.

Questions to research that come from these issues:

1. Continuous decrease of the size of Thai rubber smallholdings is linked with the general adoption of very intensive tapping systems by Thai rubber farmers.

Improving the tapping productivity of smallholder plantations is a priority.

Nowadays, knowledge is still insufficient to determine what the optimal conditions for rubber cultivation in Thailand are.

Nevertheless, the possibility to increase productivity relies on the farmer's constraints and goals. Thus, it is important to understand the conditions for alternative tapping systems (Double Cut Alternative, Low Intensity Tapping Systems, Controlled Upward Tapping .....) to be adopted by the smallholders.

2. South-East Asia, particularly Thailand, is the scene of substantial changes in connection with global changes. The rubber sector is affected by these changes.

Need to understand the impacts of local climate changes and land use changes, in particular the extension of rubber cultivation towards the northeast and the north of the

country where sub-optimal conditions prevail. The rainfalls are not enough in the North and thus, rubber plantation will not be optimal.

It is also necessary to understand how farmers perceive and react to the impacts of climate change on their plantations, as well as how they respond to the socio-economic change, and to help them to develop strategies to cope with these changes.

3. Tree crop plantations are a forest-like ecosystem which may contribute to the regulation of climate and the provision of supporting services as well. For example, rubber tree plantations contribute to carbon sequestration and help avoiding deforestation through the use of renewable rubber wood.

On the other hand, downstream, natural resources primary industry faces different environmental issues (bad smell; consumption of natural resources, carbon footprint for standardization; non-desirable chemical additives)

Besides individual assessment of each of these environmental impacts, a main challenge is to develop an integrated assessment of the environmental footprint of the natural resources commodity chain based on the Life Cycle Assessment (LCA) methodology. This method should also include the assessment of social impacts of natural rubber production.

4. Since more than 40 years, the varietal types used in a rubber plantation are made of clones budded onto unselected seedlings that are used as rootstocks, with a predominant use of the clone RRIM600 in Thailand.

Clone diversification should prepare the move to more performing clones, promote a better capacity of adaptation, and reduce risks such as the possible onset of *Corynespora* disease.

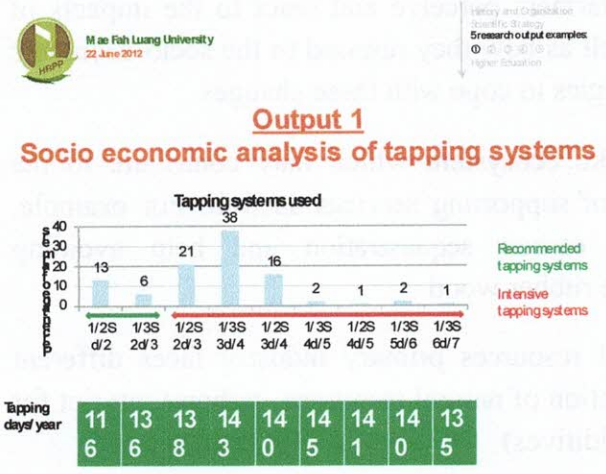
5. As for every natural product, it is difficult to produce raw NR with a constant quality all around the year.

This is one of the major issues faced by NR factories in Thailand as their customers ask for more consistency in terms of properties. So far, the international or national standards defining the ranges of acceptable properties are useful but not sufficient to predict the manufacturing behavior.

It is therefore important to investigate more on the factors which drives this "natural" lack of consistency.

5 EXAMPLES OF RESEARCH OUTPUTS

1. Socio economic analysis of tapping systems:

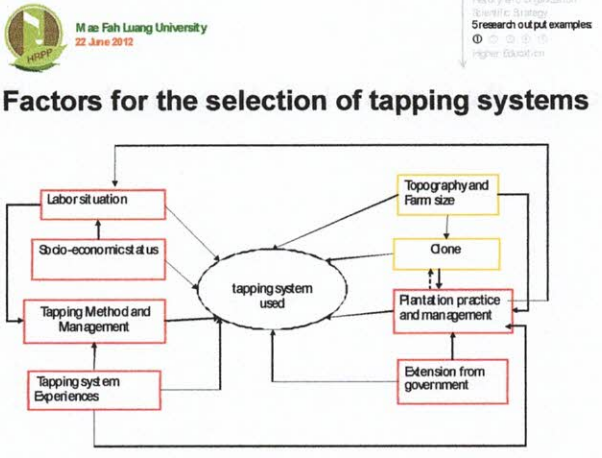


The aim was to give a descriptive study of the tapping used by farmers in Songkhla Province and try to understand why they chose the system they use.

The survey was conducted in 2008 with 118 farmers, and the main results showed that the farmers use very intensive tapping system, at least 2 consecutive days and then have one day rest. The most intensive system showed by this survey is "6d/7", which means 6 days of tapping and 1 day of rest.
It is very intensive compared to Africa, which is one day of tapping and four days of rest. So in Thailand, this is very intensive, and actually, this is not what is recommended.
On the graph, the green arrow shows the good tapping system. It can be either 1 day of tapping, 1 day of rest, or 2 days of tapping and 3 days of rest.
The red arrow represents the tapping systems which are not recommended and that are used by the farmers.
In the survey, the farmers were asked "How many days in the year are they tapping?".
The results showed that the farmers who are doing one day of tapping and one day of rest lost about 60 tapping days, so the next question is why the farmers are not tapping as much as their tapping system should require it.

What are the criteria for deciding which tapping system to use by the farmers?

There are plenty of factors: There are bio-chemical factors conditions of the plantation or the clone, the topography of the land, the farm size. There are also factors linked to the plantation management (Ex. Use of fertilizers on one day, instead of tapping).



All these factors are inter-related.

To which extent land and labor constraints and their evolution affect farmers' tapping practices?

The tappers are from Burma, and with the opening of Burma, many workers go back to their country and there is less labor to tap. In some parts, there is a lack of tappers. So, it affects their tapping system.

What is the role of risk management in the farmers' decision?

Are the Thai farmers taking high risks when choosing their tapping systems or are they very conservative? Depending on their strategy, they will choose a more conservative tapping system or a more innovative one.

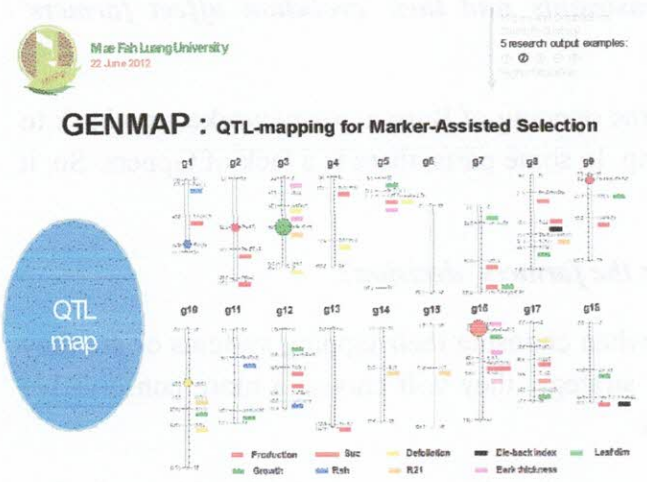
How do the farmers adjust their tapping practices in response to high rubber price?

During the last 3 / 4 years, the prices has raised after a big drop. Now the price is about 4 dollars for one kilo. We can see an impact about the price practiced in some regions of Thailand. If someone hires one tapper, he will have to share the benefit. With the increasing prices, the farmers often fire their tappers as they do not want to share the benefits. And thus it will have an impact on the tapping practices.

2. GENMAP : QTL-mapping for Marker-Assisted Selection

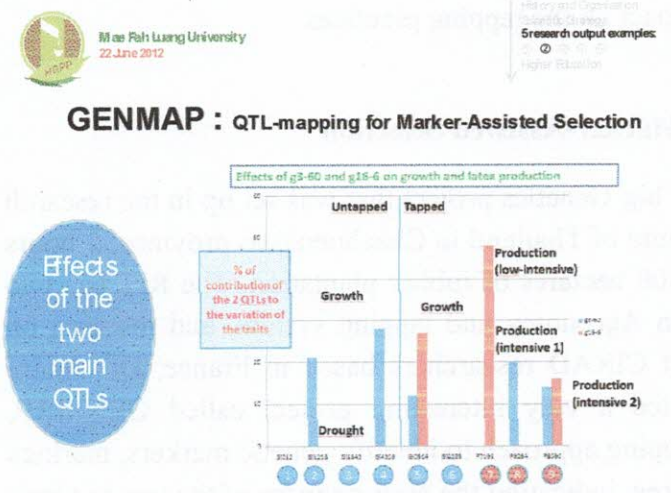
It concerns work on Genetics. It is a big Genetics project that was set up in the research Center of the Rubber Research Institute of Thailand in Chachoengsao province, 2 hours East of Bangkok. There are about 300 hectares of rubber plantation. The RIT has two kinds of researches: one research on Agronomy and tapping system, and research on Genetic. About 9 years ago, one of CIRAD researchers based in France, Dr. André Clément-Demanche, has implemented a very interesting project called GENMAP, which aims at applying the QTL mapping approach to identify genetic markers, markers linked to the genetic markers of the tree, indicating the performances of the tree in terms of growth or latex production. For this project, the researchers involved in this project worked on the family of clones coming from the crossing of two clones: the RRIM 600, the most common clone in Thailand (80% of the plantations), and a clone coming from Malaysia. The two clones are very different in terms of growth and latex production. From this, they got 400 genetic individuals and they used them to build a genetic map by the mean of genetic analysis.

From this, 400 individuals, they selected 200 genotypes that they planted in a field in Chachoengsao province, and they measured many aspects of the rubber tree on these clones for seven years: the growth, the height, the physiology of the leaves, etc. At the end, they had a list of observations of measurements, called agronomic characters, and they tried to correlate them with the genetic markers.



They use 16 markers. These markers just locate the genome, but we cannot know with those genetic markers what the genes are. What is known is that those genetic markers are specific to the rubber tree. They found out two main genetic markers for rubber trees, on located on chromosome 3, called G3-60, and one on the chromosome 16, called G16-6.

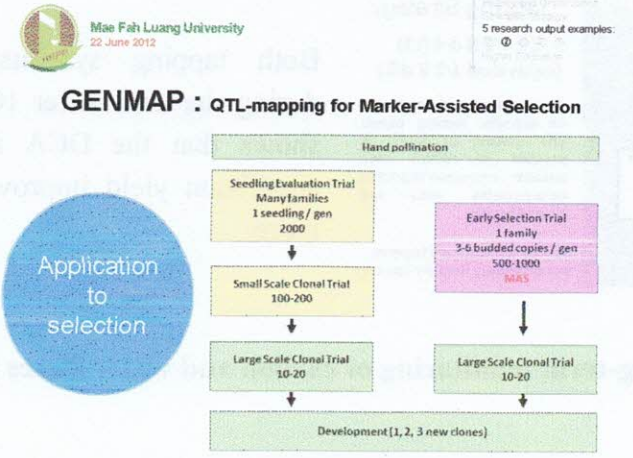
After looking at the correlation of these two genetic markers with the agronomic characters they measured in the field.



The geneticians found correlation in a range from 5 to 16%, which is a normal range. But for rubber, in that study, they found that the QTL G3-60 and G16-6 yielded very high correlation with some of the characters, like for instance, production (up to 50%), so it means that these two specific QTL explain 50% of the variability of this character. They play a major role on this character. So if you are able to locate those two genetic markers in the new clone, you may say that these clones will have good performances in terms of latex yield and in terms of growth.

So the next step of this project is to develop a "Marker-Assisted Selection" approach, a selection of new clones based on the knowledge we have now on these genetic markers. You cross two clones, you will get hundreds of descendants, of different genotypes and you perform genetic analysis for each genotype to look if they have a genetic marker that have been highlighted by the Genmap project.

This is also a way to speed up the selection process because for rubber, the selection process usually takes 20 to 25 years. With the "Marker-Assisted Selection" marking approach, the aim is to reduce the time by half.



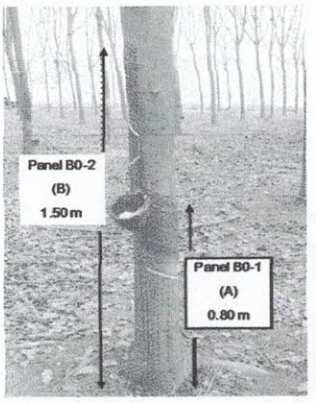
3. "Double Cut Alternative" (DCA) tapping system

CIRAD has developed a tapping system with different partners in Thailand, called "Double Cut Alternative". The idea of this tapping comes from the specific context of the low tapping productivity for Thai rubber plants. As mentioned before, the tapping systems used by Thai farmers are very intensive. If you compare it with the yield, the productivity of the tapping systems is quite low. So the question was how productivity could be improved for the same tapping system. For the same tapping time, could productivity be improved?

A new tapping system was created and was first implemented in 2000 at the Chachoengsao Rubber Research Center first and then on other sites. The aim of this project was to optimize high tapping frequency by setting the tapping on two different places. The second experiment was in Chantaburi province in 2004; then, in 2007 in Songkhla province, the traditional area for rubber plantations.

Usually when tapping a tree, people will open half of the back of the tree. You open a panel half of the circumference of the tree and people will tap this panel until the bottom of the tree. When one panel if finished, people will tap the other side of the tree.

The idea of the DCA is to alternatively tap both sides of the tree. One day on one side, and the next day, on the other side. The following day will be for rest and then, the tapping will start again on the first side, etc. This tapping was designed in that way because CIRAD and Kasetsart University did some research on the physiology of the latex production at the trunk level. From the results, it was found out that it would be better to tap alternatively on two panels instead of tapping one panel all the time. The first cut on the panel opened at 80 cm. and the second cut on the second panel opened at 1.5 m.



DCA
Tapping Strategy

2 x 1/2 S d/4 (t,t)
(equivalent 1/2 S d/2)

The 2 cuts should be located on opposite tapping panels and vertically as distant as possible to reduce their possible competition regarding carbohydrates, water and mineral supply

Both panels are used together and alternately from the opening

Both tapping systems were compared during the trial. After 10 years of study, it shows that the DCA system provides a significant yield improvement, about 10% more.

4. Rubberflux: long-term monitoring of carbon and water fluxes in a rubber plantation

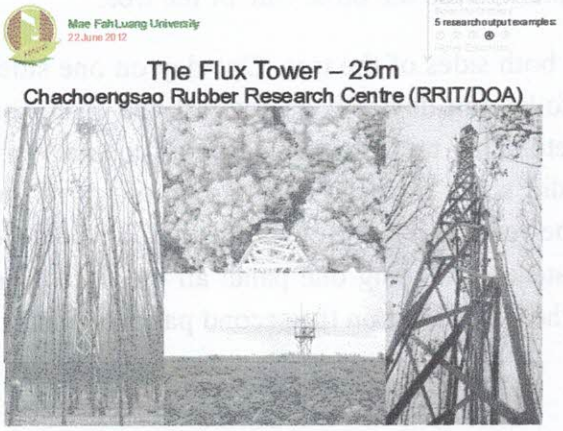
It was established about 5 years ago. The objectives of this experimental site is

- to investigate the relationships between the carbon/water functioning of the trees and latex production. Carbon and water are essential to any living metabolism, but here, we try to understand more particularly what is the interaction and the impact on latex production.

- Assess the carbon and water footprints of rubber plantations. Nowadays, it is a project extended to human activities. For agricultural activities, it is very important because agricultural activities consume water and produce carbon.

- Study the impacts of climate change on the performances of rubber plantations. In this study we try to link the performances of the rubber tree with the climate. If we are able to do that, somehow, we are able to predict what will be the future of the rubber tree and the climate change.

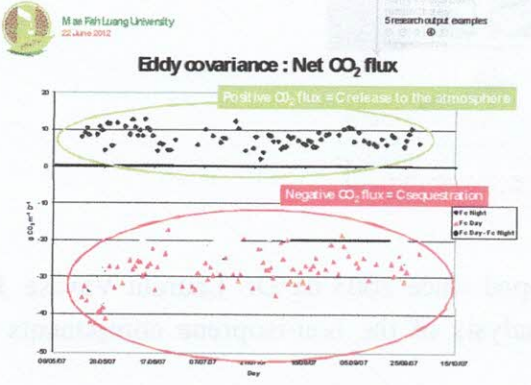
This research study is an experimental site located in Rubber Research Institute in Chachoengsao province, under the DOA. This is a very sophisticated experimental site, huge with expensive instruments. The main system is a tower, the flux tower, 25 meters high, 5 to 6 meters above canopy plantation.

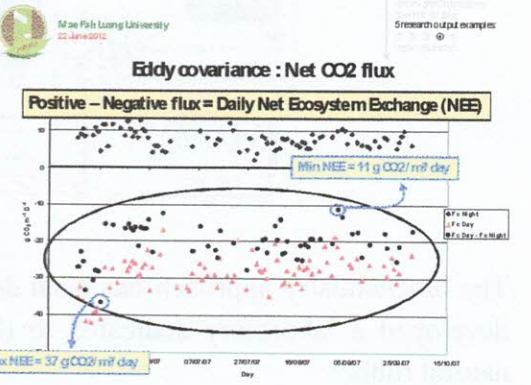


On that tower, there are different instruments to measure solar radiation, rainfalls, physiology of the tree, etc. There are also two specific sensors to measure the flux of water and carbon between the canopy and the atmosphere. The measurement is very precise: one measure collects data every 5 milliseconds. It works continuously.

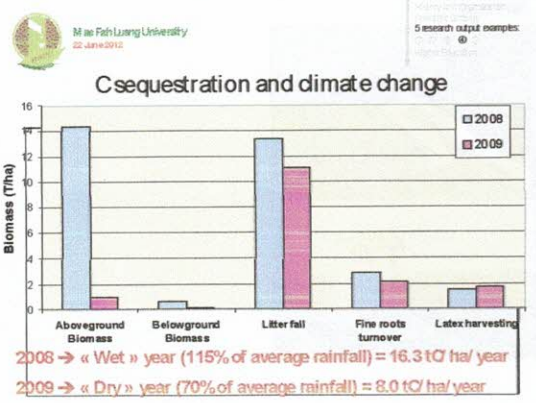
What we try to develop on this experimental site is a comprehensive approach of the water and carbon flux in what we call the soil plant atmosphere system.

There are instruments above the canopy but also in the soil to understand how to carbon and the water are inter-related. They measure the carbon biomass, the photosynthesis, the leaf area, the transpiration of the tree, etc. Results are combines to understand the water and carbon cycle at the level of this plantation.



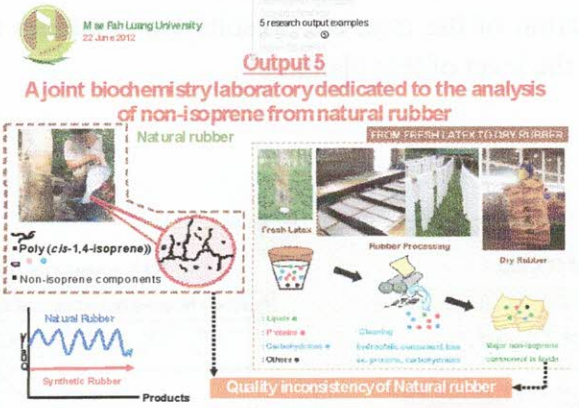


Here are some results of the net carbon flux measurement between the canopy of the plantation and the atmosphere. The green symbols represent the positive carbon flux (carbon released by the vegetation to the atmosphere), during the night by the respiration of the tree. But during the day, there is a negative carbon flux (the vegetation is taking carbon from the atmosphere to the tree via photosynthesis). This is what is called "carbon sequestration". The difference between the positive and the negative flux, the net flux between the rubber plantation and the atmosphere is negative. It means that in terms of carbon budget, the rubber plantation is sequestering carbon from the atmosphere. In that aspect, it has a positive impact on climate change, carbon-dioxide being the cause of global warming.



This slide shows some figures about the carbon sequestration in the trees and in the soil of the rubber plantation. It was obtained by measuring the biomass of the trees and by studying the turnover of the wood to the soil. We check the amount of change of carbon over one year, and calculate the turnover of carbon over a year. Two years were on the study, 2008, considered as a "wet" year and 2009, as a "dry" year.

5. A joint biochemistry laboratory dedicated to the analysis of non-isoprene from natural rubber



The biochemistry approach has been developed since 2003 by Dr. Laurent Vaysse. He developed a laboratory dedicated to the analysis of the non-isoprene components of natural rubber.

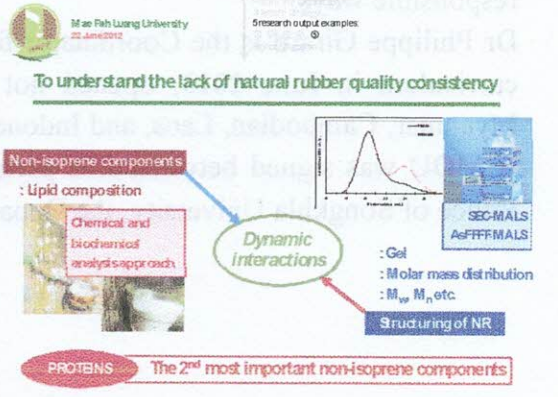
What are non-isoprene components? The latex that flows out of the rubber tree is mainly composed of a polymer, called "Poly Cis-1,4-isoprene", a big chain of carbon, 80% of carbon and this is this big chain of carbon that makes the particularity of the latex. This polymer accounts for 80-85% of the dry mass of the latex. But there are also non-isoprene components, like lipids, proteins, minerals that represent only 15% of the dry mass. We assume that they have a big impact on the particular physical and chemical property of natural rubber. This is the main difference with synthetic rubber. Synthetic rubber is made from petrol, so carbon only. These non-isoprene components have a huge impact on the quality of the latex.

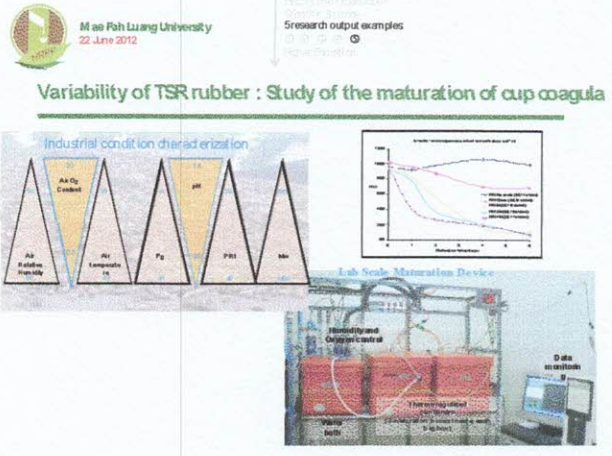
From the fresh latex to the dry rubber block, how do these non-isoprene components change with the processing (drying, washing, etc.). And finally, what is left in the rubber block and how it impacts the physical and chemical properties of rubber.

Actually, there is a bio-chemistry laboratory in the Agro-Industry Department, Kasetsart University. The team also developed a method to first, produce rubber sheet from latex on small scale, a mini factory to produce end products, and second, methods applicable at the large scale.

For the last 10 years, Dr. Laurent Vaysse, look at the lipids change in the latex during the different processes: what are the factors affecting the quality? Since recently, this team focused their work on the protein, what are the roles of protein in the properties of the latex.

Another work done in this topic of natural rubber quality was to study the impact of maturation cup coagulum.





In Thailand, after tapping the trees, the natural rubber can be harvested in two ways:

- either as fresh latex, the farmers collect latex and sell it to the factory to make rubber sheets or blocks or to

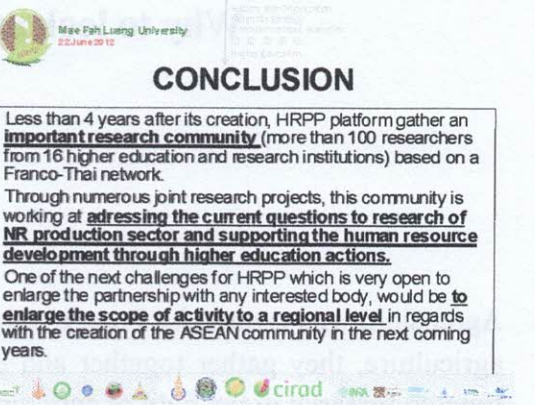
be used as fresh latex to make condoms for instance.
- either as coagulated in the cups. The coagulum is coagulated rubber, which is white, but outdoor conditions will darken the cup.

They will make some huge piles of these coagulum and inside these piles, there will be some chemical processes that will have an impact on the composition and the quality of the rubber, as well as the bad odor.
The team of Dr. Laurent Vaysse developed a fermentation box to imitate the coagulum pile and tries to understand which processes take place inside the piles.
HRPP has a particular project in higher education and capacity building, which is one of the main objectives of the platform, not just only developing and carrying out research operations. The idea is also to contribute to improve the capacity of people in Thailand but also in the Sub-region, like Vietnam, also a rubber producing neighbor country, to improve the human capacity; in the end, to improve the production, the productivity, and the quality of natural rubber production.
In the HRPP, there are two parallel strategies to reach the goal of capacity building.
- Train students or young researchers through Bachelors, Masters and PhDs
- The set up of a Master curriculum shared by Prince of Songkhla University, Kasetsart University and CIRAD: "Natural Rubber Production, technology and Management".

This Masters covers all the aspects of rubber production from the Hevea seed to the rubber block, including the management aspects.
It is to provide advanced level human resources in respond to a demand from the rubber supply chain in Thailand and South-East Asia. The idea is to support development and modernization of the natural rubber production sector in sustainable and social-responsible ways.
Dr Philippe Girard is the Coordinator for this curriculum. CIRAD plans to launch this curriculum in June 2013, opened not only to Thai students, but also Vietnamese, Myanmar, Cambodian, Laos, and Indonesian students.
A MOU was signed between five partners for this curriculum: Kasetsart University, Prince of Songkhla University, the Department Of Agriculture, SupAgro, and CIRAD.

Master in Natural Rubber Production, Technology and Management
SMOU

In order to officialize the development of the Rubber Master Curriculum, and facilitate the approval and accreditation at the university level, a Specific Memorandum of Understanding has been signed on February, 9th 2011 by the 5 partners (KU, PSU, DOA, SupAgro , Cirad).



The PhDs are made under a "sandwich" program between a French university, Montpellier SupAgro, and a Thai university.

Conclusion:

The HRPP platform gathers an important research community, today; there are more than 100 researchers from 16 higher education and research institutions in France and in Thailand.

Through numerous joint research projects, this community is working at addressing the current questions to research of natural rubber production sector and supporting the human resource development through higher education actions.

One of the next challenges for HRPP would be to enlarge the scope of its activities to a regional level, mainly through the Masters curriculum. CIRAD hopes that through higher education, it will be able to build the link with Academic universities and researchers in other countries, to develop research activities with them. It is the same with Thai institutions or universities who are not yet members. Any institution can apply to be a member, providing that this institution has already has an activity on rubber and has some connections with France. A letter needs to be sent to the HRPP President, stipulating that the institution would like to be an associate member.
For CIRAD, the best way to start collaboration is with education and students with Masters and PhDs. CIRAD can be co-advisors.

Why to look at Bio-carbon economy

By Dr. Philippe GIRARD

Agreenium was created by French universities and French research centers working on agriculture, they gather together and created Agreenium to increase visibility and the training research in the field of agriculture and CIRAD is a member of Agreenium.

Introduction to the global economy, some key features:

There are 70 000 companies, which have created 700 000 sisters companies. These companies are sharing 2/3 of the world trade, so it makes it global. Among the world's largest revenues, 51 are countries, in term of GDPs and 59 are companies, so companies have more income than most of the countries worldwide.

These companies are working as a network on global production chain. In fact, they are creating the global economy.

This growth is creating some negative externalities. One very well-known is the Green House Gases effect, affecting climate change. Up to now, people are talking about global warming, but it is clear that there is a risk of heretic climate. Another one the rapid development of industrial area, they are creating some free markets zones, with limited constraints. In fact, these changes have a strong impact on long term economy for host countries.

Because the market is global and because some customers are changing a little bit their thinking of the companies, the companies are right now thinking "Carbon". Some of them just have to do it and have to respect some national regulations, and also we are training to follow rules that set up by fund agencies International Funding Agencies or Banks, fixing strict rules regarding the environment. Because of the lobbies from the clients, from evaluation agencies, having a social impact on people, also pushed by unions, public opinions stockholders, to force these companies to be more "clean".

Why company is « thinking » carbon

- **Because it has to do it:**
  - To respect national regulations
  - To follow specific rules from funding agencies
- **Because of lobbies:**
  - From its customers/clients, evaluation agencies
  - Unions, public opinion or stakeholders pressure
- **Because it is risky to do nothing:**
  - Green branding strategies
  - To be ahead / its main competitors
- **Because it's not costly; it may be valuable** (incentives)
- **Because the top management is convinced**

How do we measure the success of local climate action?
Conflict between economic and environmental objectives

cirad

Some companies do it, because they have to do it, otherwise, it would be risky not to do it. They also think that they could be ahead compared to their competitors. There is no direct economic impact on the process, but they increase the shares on the market as they can claim they are "clean". It not costly and it might be valuable and there are some incentives.

Companies are moving to these trends. Sometimes, in rare cases, the top management is convinced that it is important to do it and pushes the company towards this direction.
What is important and often missing is how we measure success of local climate action. Most of the time, there is a limit on changing the trends because there is a conflict between economic and environmental objectives. How to evaluate the costs and the benefits?
Another important point is that the foreign direct investment increases a lot, especially in a country like Thailand.

Foreign direct investment increasing

- Foreign direct investment in alternative/renewable power generation, recycling and manufacturing of environmental product reach 90 B$ in 2009
- 40% of low carbon project in developing countries (2000-2009)
- by 2030 additional investment to maintain GHG emissions at current levels are estimated at 1 trillion/y (18 000 wind mill of 3MW).

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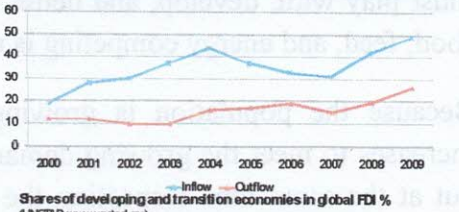
The foreign investment in alternative/renewable energy and especially in power generation by recycling and manufacturing environmental products reached 90 B$ in 2009. 40% of this direct investment was concerning low carbon projects in developing countries.

By 2030, additional investment to maintain GHG emissions at the current level is estimated at 1 trillion a year (or 18 000 wind mill of 3 M W). It is a huge amount of money that will be available for low carbon economy in terms of direct investment, so there is a huge potential for a country like Thailand.

All these direct investments are shares between developing and transition economy investment. In fact, another interesting point is that transition economies are also investing a lot in these kinds of activities. Thailand with its climate, its population and its level of development is quite attractive. So, there is a

Foreign direct investment increasing



Shares of developing and transition economies in global FDI % (UNCTAD, www.unctad.org).

➢ Room for larger Foreign direct investment in Thailand, if attractive

cirad

room for Thailand to play and to attract a quite substantial amount of this investment.

What makes Thailand attractive? First, it is the general policy framework. Thailand has already set up some policies in favor of renewable energy and particularly Biomass energy. Thailand also signed agreements concerning the environment. Secondly, it is the market drivers. There is a market for low carbon products, especially in energy technology, Biomass, wind, water. Another point too is that, in Thailand, natural resources are valuable; especially talking about Biomass, there is still some land available. Land changes, as well as the competition regarding land. Land is available for bio-energy and these kinds of activities.

What also is important to attract investment in countries is the availability, or the incapability, and the room for the transfer of technology. Access to technology and ability to attract and develop innovations is quite high in Thailand. It offers some potential for collaboration and investment in time because people are ready for that.

Thailand is also an interesting country because of the business facilities available, measures regarding feedback, investment. Regulations which are incentive and that make the investment easy compared to other countries.

How global could the industry become?

Even if the industry and economy are already global. There is a rising population with higher demands, increasing pressing on natural resources, land, oceans and this is a big challenge to deal with. What is important not to forget is that bio-resources provide vital ecosystem services which are quite hard to evaluate. What are the costs or the prices of these services? What is required? What is the minimum we should keep on in order to make sure we can continue to grow and respect the environment? The answer is not clear. What amount of land and resources for ecosystem services compared to food, feed, energy, materials? So what would be the balance? No country can answer this question. CIRAD is working on it. We often talk about competition but it is a theoretical competition. For example, in certain countries where energy is not available, producing bio-crops for bio-fuel and increasing the yields in the fields and using only a small part of these crops to produce energy in order to double or triple the yields per hectare makes sense. Competition exists of course, but there is also synergy that we must play with, develop, and better understand. Just trying to put it in opposition with food, feed, and energy competing is not totally true.

Because the population is growing and because the land is limited, productivity increases to meet the growing demand. How to achieve that in order to be competitive but at the same time respecting the environment? There are still many questions and room for research in that area. We are talking about GMOs, there are many talks about them. People like them or don't, but it is something we cannot avoid. Where can we go?

How to do it? Those are real questions, like the use of fertilizers, irrigation when water is becoming scarier. There is a huge competition on the fine usage of water, so there is a big challenge around this.

What kind of feed stocks can be grown in a future climate? The climate is changing a lot. How will it affect the growth of agriculture and what kind of crops can be grown? We are talking about salty land. It is already a challenge. So we should adapt agriculture to the climate change; but to which extent? This is the question.

Who will have the ability to commercialize and invest in new industrial development? Who will be the key players? The countries and their governments have a very important role to play in order to control and manage instead of letting people do what they want.

And of course, what will happen to energy supply and demand in the future? Especially regarding petrol with its increasing prices, what kind of innovations are we looking for? Is nuclear an option? Of course, it is one of the option, but to which extent?

These are questions that CIRAD is trying to answer regarding these aspects of carbon economy.

Why Bio-carbon? In fact, when we are talking about bio-carbon, we are talking about Biomass. Amongst the variety of mitigation and sequestration options available in the carbon markets, the "bio-carbon" sector offers significant opportunities. These are not the only ones, but there is a lot of room there for investment. Of course, in the forestry sector, on agronomy and agro-forestry and bio-energy such as anaerobic digestion, cogeneration, gasification and pyrolysis for second generation bio-fuel, substitution: cement production. These are technical options which are more or less available to be able to substitute conventional fuels to renewal and Biomass. In all these domains, Thailand is or may rapidly lead especially in ASEAN region.

That's also why CIRAD has its collaboration in Thailand. This is a good way of trying to spread the technology and be able to have a major impact, not only in one country but also in the region. It is also the room for South-South collaboration. In Africa, the technology is not available but might be available in Thailand and transfer to Africa without trying to modify too much. For the transfer of technology from Europe to Africa, sometimes, the gap is too high and there is room for what CIRAD is doing right now in Brazil. A lot technologies used that have been developed in Brazil have been transferred directly to Africa; it is a triangular collaboration between Brazil, Africa and France (or Europe). In this way, results can be maximized.

Biomass is quite interesting, but it has some drawbacks and it's not easy to work with Biomass.

One of the major drawbacks is its low density. If you are talking about fuels, you will have to use the fuels where energy is needed. Yet, Biomass might not be available where energy is needed, thus you will have to transport this Biomass where it will be used.

Because of its low density, Biomass transportation is quite expensive and makes it not feasible. Consequently, density is the real problem when dealing with Biomass on the large scale, even medium scale.

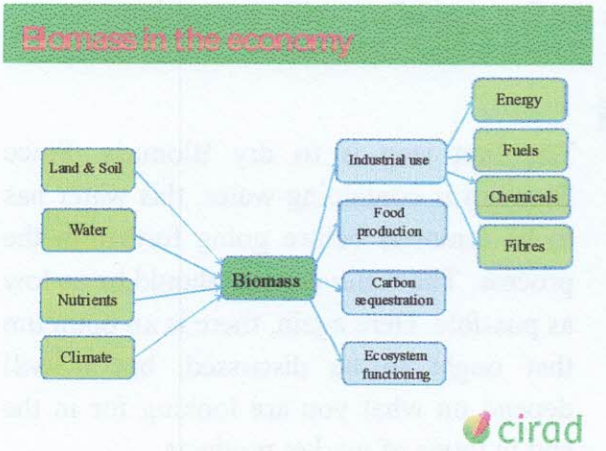
Another drawback is low calorific value compared to other fuels like petrol. When it is called, the density is 1/5 of the energy sources. And in fact, we will have to deal with a large amount of products on the same energy output, which increases the price of the process and of the commercial technology.

Biomass has a wide variation of properties depending on which Biomass you are dealing with. Physical properties might vary. It varies between species but it may also vary within one single species from time to time. For instance, rice straw from Chiang Rai may be different from rice straw form the Southern part of Thailand because the soil is different and species might be slightly different. So the biomass straw and may create some problems in technologies.

Due to all this, handling is very difficult. And finally, when we are dealing with Biomass, we have to deal with seasons, and it is particularly true with agro-industry residues, like straw for instance. It might be also true with plantations. For example, during the rainy season, it is not possible to go into the field and to harvest wood because it is not possible to go there.

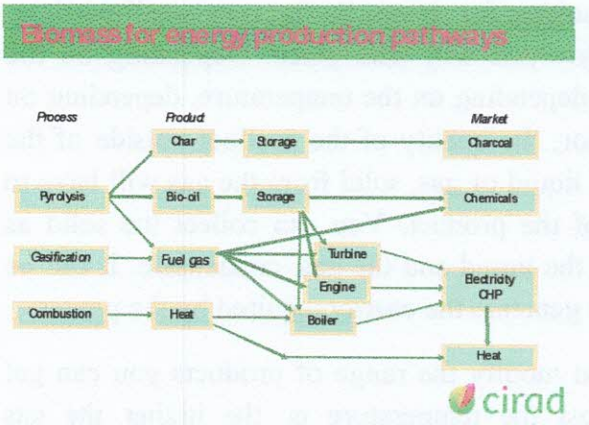
The seasons lead to some problems, as you will have to stock a large quantity of Biomass in order to use it all year round and this storage is costly. You will need space, you will have to pay for this space and it creates some problems as Biomass may decay.

When dealing with biomass, you will have to deal with the land and the soil quality. Depending on the land and soil quality, it is possible to produce more or less Biomass and the quality will be affected. Of course, you cannot grow Biomass without water and this is one of the main problems of Jatropha. A lot of people are talking about Jatropha. Jatropha is a plant that can produce seeds very rich in oil. It is possible to produce oil out of Jatropha. People claim that Jatropha can be grown in dry areas, but it is not true. Jatropha can survive in dry areas, but cannot produce. And if you want Jatropha to produce seeds, you will have to supply water. Without food and water, a plant cannot grow. For Biomass, nutrients are important as you will have to deal with nutrients and thus will have to choose to use fertilizers or not. And consequently, you may impact on the environment and we will go back to same problems concerning stability, the climate and the climate changes may also affect the Biomass production.



Biomass has different uses and all these uses might be in competition: energy, fuels, chemicals, fibers. But one of the major uses of Biomass is food and feed production and we should not forget this point. Competition exists, but not as people is talking about it. We should not avoid this question. It's a real question.

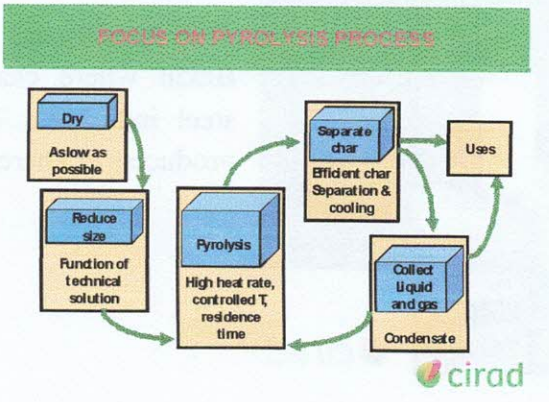
Another option is carbon sequestration. It is another way to try to balance the problems we are facing with energy use; and the last one is Biomass as pyro-planning ecosystem functioning, on the soil and in the atmosphere itself. All these aspects are very important to consider when you are dealing with Biomass for whether food or energy.



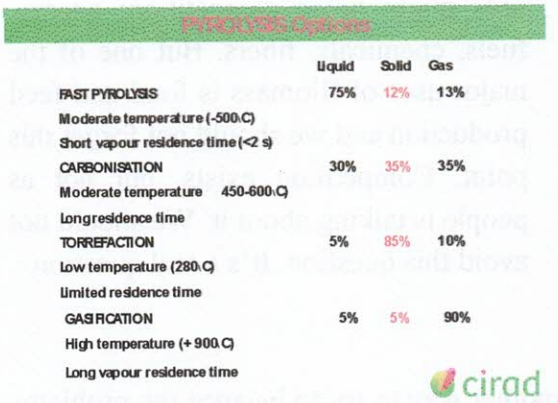
Concerning thermo-chemical conversion. Thermo energy: by heating the Biomass, you can concert the biomass into final products which are usable. There are three main pathways.

The first one is Pyrolysis, when you transform Biomass to solids gases or liquids. The second one is Gasification, when you transform Biomass into a gas. The third one being Combustion, when you transform straight Biomass into gas and actually you will use the heat to "heat".

It is possible to produce different products on the market, like charcoal, chemicals, electricity or heat. All these can be produces through thermo conversion. These pathways are quite difficult. Depending on how deep you will go in the process, you will produce only heat or heat and gas or liquids, and so on.



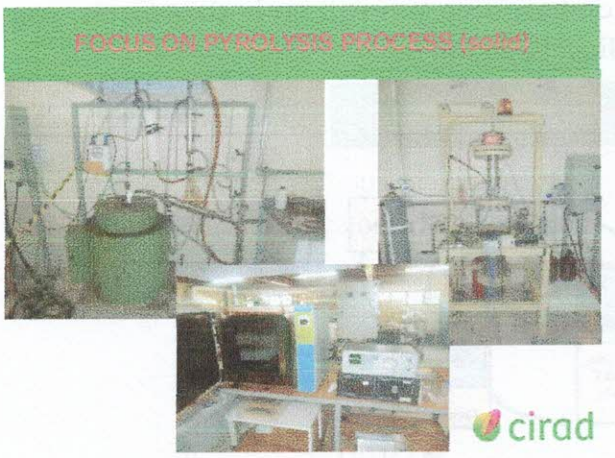
We will focus on pyrolysis process as it is the first step of any other conversions.



The first step is to dry Biomass. Since Biomass is containing water, this water has to be removed before going further in the process. The water content should be as low as possible. Here again, there is an optimum that ought to be discussed, but it will depend on what you are looking for in the end in terms of market products.

In many cases, if you want to convert this Biomass into processes, the size should be reduced as large amounts cannot be used the reactors. The size will vary depending on what kind of technical solution you are looking for. It can be for very small particles like flowers or large loads. Then, the pyrolysis will take place. Depending on the heating rate, how fast you heat a particle, depending on the temperature, depending on how the particles will remain in the reactor; the quality of the product outside of the reactor will vary a lot. For any case, solid, liquid or gas, solid from the gas will have to be separated in order to recover a part of the product. You can collect the solid as charcoal for instance, and you can collect the liquid and the gas, condensate. It can be used for other purposes or it can be used to generate the energy required by the process.

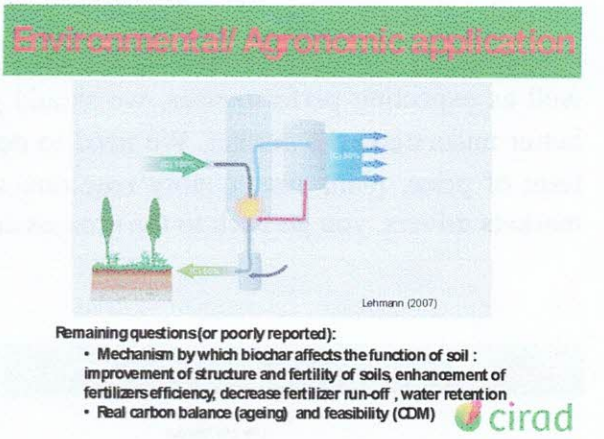
Depending on the process parameters, you modify the range of products you can get from liquids, solids and gas. The highest the temperature is, the higher the gas production will be.
If you increase the residence time, you will normally increase the solids production. Low temperature and short vapor residence time will increase the liquids production.
So depending on your market, it is quite easy to control the process and to produce more gas, more liquids or more solids. Some equipments have been developed in some laboratories of CIRAD.



This model has been developed in Brazil where charcoal is needed for steel industries. They are the largest producers of charcoal.

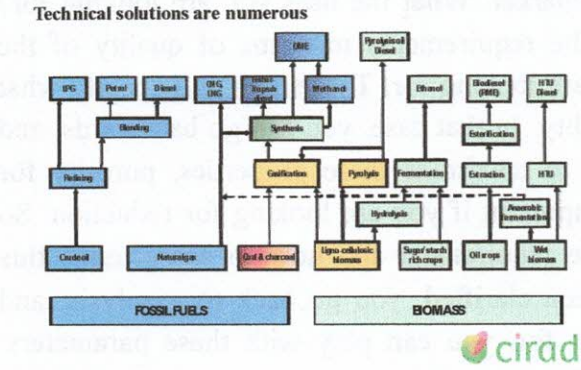
What is very important, and very often in chemical engineering, people are working on the process, but what is important is the market. What the uses you are looking for? Depending on the uses, it will specify the requirements in terms of quality of the product, as well as the performances you are looking for. These uses will specify what kind of products you need in terms of quality. In that case, you can go backwards, and based on requested properties, you have to maximize these properties, porosity for carbon, or mechanical strengths can be important if you are looking for reduction. So which property is important regarding the requirement and how to characterize this property? When all these aspects have been clarified, you go back to pyrolysis, and then, depending on what you are looking for, you can play with these parameters: temperature or time pressure. You will get appropriate properties. Yet, all the parameters will differ according to the products you are looking for. And of course, Biomass will affect all this depending on what kind of Biomass you will use. Biomass will affect the pyrolysis processes, as well as the char quality or even liquids. You may have some minerals matters which, depending on the temperature, can goes to the gas, and which affect the processing. Also, depending on the Biomass and the product you are looking for, you will select the Biomass you can use. You cannot use any kind of Biomass for any kind of end product.

In Thailand, some people are discussing and are trying to develop agronomic application of charcoal. Some "Guru", like Lehmann, claims that "bio-char in soil presents a significant opportunity for capture and long-term storage of CO2".



Potentially, it looks interesting but producing charcoal out of Biomass, just to store it into the soil, on the theoretical point of view it's interesting, but on the economic point of view, it's not feasible. This kind of option might be interesting if charcoal had some positive effects on the soil. Just storing charcoal in the soil is not economic right now; unless you are able to prove and play with all the properties of the charcoal which may increase the quality of the soil. For sue, there are some improvements in the soil, but which kind of charcoal, what kind of Biomass should be used? In France, a country which used to produce a lot of charcoal, many people were questioning how to improve the porosity properties of the charcoal regarding fertilizers and some nutrients. So there are many possibilities regarding the use of bio-char in the soil. Yet, many questions to be answer, like for instance, how this carbon will evaluate while aging?

1st step of BTL 2nd generation bio fuels

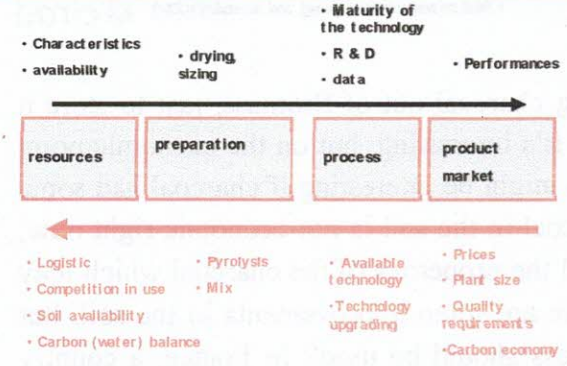


Pyrolysis and Biomass are the first steps from Biomass to liquids, second generation bio-fuel production.

Here again, there are huge amounts of different pathways to produce second generation bio-fuels: thermo-chemical conversion, pyrolysis gasification. Research is already involved and there is a huge potential. In that case, instead of using a small part of Biomass, like oil or sugar, to produce alcohol or bio-diesel, you could use oil Biomass to produce those fuels; which may be more economic on the long term as right now, the technology is not available.

Instead of starting on the resources and working on the characteristics and the availabilities, and trying to size or dry the Biomass in order to use it in the process, as well as expecting performances, we should go on the opposite way. First, we need to better understand the market. We need to define what the drivers of the market are, in term of price, plant size, quality requirements, and carbon economy. Based on these markets drivers, you go back to the process and look at the available technology.

Emerging conditions the Bio energy chain



Emerging conditions

- Mass, energy and carbon balance assessment and optimization for different applications: chemicals, bioproducts, agronomy and energy.
- Better understanding of the demand (quality, socio-economic approach)
- Carbon : availability of metrology et methodology for measurement and certification of carbon certificates (storage, mitigation, ...)

cirad

The carbon credit price is decreasing, because of the financial crisis but mainly because of the climate change negotiations.

Measurement, monitoring and verification represent between 20 to 40% of total cost particularly true for small projects (the largest potential)

Up to now, the cost reduction by development of standardized methodology (for small project limited in size)

There is an incertitude or precision of the measure conduct to the adoption of conservative approach that under estimate saving. So there are needs for the development of:

- remote sensing based on new metrology,
- and more accurate methodology, a new area with a very large potential.

There is room for international cooperation.

1. Within ASEAN through Thailand network and with Thailand as a platform (hub)
2. International CIRAD Biomass and bio energy research unit established joint research lab :
    - in Brazil (IBAMA) oriented to pyrolysis and torrefaction
    - In Burkina Faso (2iE) oriented on first generation bio fuel (strait vegetable oil and etherification for rural applications, jatropha), activated carbon

The transfer of technology and South to South collaboration.

Pictures