Technical Assistance to Strengthen R&D for Climate Change Resilience of Agriculture in the Philippines

Reference: CPH1064

Assessment of the existing R&D capacities for the development of biomass energy, of the associated technical, scientific and financial needs, and corresponding recommendations

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Interim report – final mission report

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April 23, 2024

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[1] Photo on cover, from left to right: Fernando Paras Jr. (UPLB, Philippines), Thierry Liabastre (AFD, France), Jean Gérard (CIRAD - BioWooEB, France), Patrick Langbour (CIRAD - BioWooEB, France)

Project summary

Project duration	**June 2023 to June 2024 – 1 year.**
Reporting period	March to April 2024
Global objective	Support to Philippines's agriculture and fisheries sector for Climate Change resilience.
Context	The Philippine government's R&D support for agriculture in general and R&D for climate-resilient have been minimal. In a context of a policy loan to the Government of Philippines for Climate Change, AFD is providing technical assistance to create a dialog for facilitating policy reforms which will enhance government's support for climate-resilient agriculture and fisheries sectors.
Specific objective	This Technical Assistance (TA) will provide technical support on R&D policy reforms and for climate-smart technologies and practices on high-value crops, fisheries, and livestock and poultry. CIRAD is engaged to provide R&D support to the Department of Agriculture (DA). The technical support will assist the Department of Agriculture of the Philippines in fulfilling its policy action and outcome commitments under Reform Area 2 (resilience to climate impacts enhanced) of the Subprogram 2 of the Philippine Climate Change Action Program (CCAP) co-financed by AFD and ADB.
Donor	Agence Française de Développement
Beneficiary	Government of the Philippines, Department of Agriculture
Geographic scope	Philippines
Two main components	Component 1: Comprehensive policy review and appraisal of the agriculture R&D landscape in the Philippines. Two main deliverables: a main report and a policy brief. Component 2: Capacity building for Philippine agricultural research on specific themes: • 2.1 Genetic expert CRISPR/Cas9 -Training in France • 2.2 Mango data acquisition, analysis - (Pixfruit & Soyield). • 2.3 Research project on aquaculture • 2.4 Research on lignocellulosic wastes and by products • 2.5 Sugarcane technologies transfer and R&D
Scope of this report	Component 2.4: Research on ready-to-transfer existing technology and the use of by-products

1. Background

This mission falls within the scope of amendment n°1 to the service contract *Technical Assistance to Strengthen R&D for Climate Change Resilience of Agriculture in the Philippines* (reference: CPH1064).

More specifically, it concerns Component 2: *Capacity building for Philippine agricultural research on specific themes*, phase 2.4. *Research on ready-to-transfer existing technology and the use of by-products*.

This mission validates and possibly adjust the elements of the review of technologies in operation in the Philippines to produce biomass energy and identification, and related R&D centres. These elements are already provided in report 2.4.1 Preliminary review.

The main objective of the mission is the assessment of the existing R&D capacities for the development of biomass energy, of the associated technical, scientific and financial needs, and corresponding recommendations.

This mission will lead to the definition of specifications for a feasibility study for the implementation of one (or more) biomass energy production unit(s) by thermochemical conversion of lignocellulosic biomass consisting of related products and by-products of the agricultural and forestry sectors, for the production of biofuels (forthcoming 2.4.3 report, May 2024, *Specifications for a technology transfer project for biomass industry*).

As indicated in the detailed attached mission program (appendix 1), three main types of activities were planned:

1. Visits to R&D centres and/or laboratories involved in biomass valorisation, meetings and exchanges with the managers and staff of these structures.

2. Visits to biomass processing units and facilities for multiple valorisation purposes, meetings and exchanges with the managers of these units.

3. Field visits to crops generating lignocellulosic wastes and related by-products.

2. Content and progress of the mission

The main participants in this mission were Dr. Jean Gérard and Dr. Patrick Langbour, both CIRAD experts from France, and Dr. Fernando Paras, Jr., the national expert.

The description of this mission follows the chronological order of the visits and meetings.

The contact details and references of the people we met at each of the facilities we visited are given in Appendix 2.

2.1. Courtesy visit to the Chancellor of the University of the Philippines Los Baños - UPLB (March 22, 2024 - Friday, day 1)

The mission began with a brief meeting with the Chancellor of UPLB, Dr. Jose Camacho, Jr.

Discussions were mainly about the involvement of UPLB and CIRAD, objectives and progress of the project.

Dr. Rico Ancog, Philippine Project Leader, and UPLB executives, Vice Chancellor Agham Cuevas, and Vice Chancellor Rossana Marie Amongo were also present during the meeting.

Chancellor Camacho and the UPLB Executives expressed their support to the project and are looking forward to more fruitful collaborations between CIRAD and UPLB for sustainable development.

2.2. Department of Science and Technology - Forest Products Research and Development Institute - DOST-FPRDI (March 22, 2024 - Friday, day 1)

The team visited DOST-FPRDI, which is tasked with generating, improving, and disseminating technologies and information to enhance the efficiency of forest-based product utilization to boost local industries' competitiveness in both domestic and global markets for the benefit of the public.

The Director of FPRDI, Dr. Rico J. Cabangon, and some executives of the institute welcomed the team. The institute's focus includes researching forest residues and wood waste, leading to the development of technologies for biomass valorization.

Dr. Anniver Ryan Lapuz presented various research endeavours aimed at processing wood waste into charcoal and briquettes.

Carbonizer

For carbonizing rice hull, sawdust, coffee bean hull and other fine agro-waste materials

PhP 30,000.00

1. CARBONIZER

Sawdust charcoal produced	2.1 kg/hr
Fabrication cost (as of 2017)	Php 30,000

Bamboo charcoaling kiln

The FPRDI's 90-kg capacity bamboo charcoaling kiln was designed to produce high quality charcoal and pyroligneous liquor (PL).

The kiln uses raw materials such as bamboo and bamboo processing wastes. It has a furnace, a double-walled stainless-steel cylindrical oven, a chimney and a condenser for the recovery of PL. Its furnace is equipped with grates and insulated by castable refractory cement.

3. Charcoal kiln

FPRDI was recognized as a facility with proficient technical personnel capable of prototyping for research, development, and engineering purposes related to valorizing woody plant waste.

Notably, FPRDI developed both batch and continuous carbonizers lacking heat recovery systems, a deficiency identified during the discussions, which was deemed a potential area for further study and improvement.

2.3. Courtesy visit to the Municipal Government of Los Baños (MGLB) Local Chief Executive (March 22, 2024 - Friday, day 1)

The team visited the Local Government Unit (LGU) of the Municipality of Los Baños. A courtesy visit to the LGU was necessary for the team to appreciate the crucial role that the LGU plays in the implementation of any development project as well as understand how the Municipal Agriculture Office interacts with the farmers in the municipality.

The team, along with Dr. Rico Ancog, were warmly welcomed by the Municipal Mayor, Hon. Anthony Genuino, Ms. Miraflor Tado, Dr. Roberto Rañola, Ms. Cheryll Gonzales, Ms. Lizette Cardenas, Ms. Amila Pasukin, and Ms. Sharon Paras.

After a brief discussion about LGU and CIRAD, Ms. Cheryll Gonzales, the Municipal Agriculturist, presented their program, “LB Veggie Move”. It was a multi awarded program that helped local farmers move their produce and help the community cope especially during the pandemic.

Ms. Lizette Cardenas, The Municipal Environment and Natural Resources (MENRO) Focal Person, facilitated a short tour of the Los Baños Eco-Waste Processing Centre and Materials Recovery Facility (MRF).

Composter

Grinder - mixer

The visit to the facility opened up possible avenues for collaboration pertaining to possible TA on rapid composting and digestion technologies. If a successful pilot plant can be installed in the LGU-LB, it can be a learning facility for other LGUs.

2.4. UPLB, National Institute of Molecular Biology and Biotechnology – BIOTECH (March 22, 2024 - Friday, day 1)

The team was received by BIOTECH's top scientists, led by Dr. Mannix Pedro and Dr. Francisco Elegado.

Prior to discussions regarding their research work, a video presentation about the facility and BIOTECH’s Biotechnology for Industry, Environment, and Energy Program (BIEEP) was shown.

The program’s R&D efforts encompass the production of bioethanol and biodiesel from renewable resources, utilization of microorganisms for the degradation of plastics and plastic-containing

compounds, microbial degradation of oily/lipid-containing agro-industrial wastes, production of biomass and biomolecules (biosurfactants, enzymes) from yeasts for industrial and environmental applications, and the development of microbial-based technologies for agro-industrial waste management.

The team perceives BIOTECH as a facility with a high degree of R&D capability, attributed to its proficient scientists and laboratories capable of conducting research at the molecular level.

2.5. International Rice Research Institute - IRRI (March 22, 2024 - Friday, day 1)

The team's visit to IRRI, the main international agency dedicated to studying the valorization of rice production waste, proved insightful. Welcomed by Ms. Melinda Limlengco and Engr. Carlito Balimbing, they were introduced to IRRI's lead scientist in rice biomass waste valorization, Dr. Nguyen Van Hung, who attended the meeting remotely from Vietnam.

Engr. Balimbing presented IRRI's dynamic involvement in R&D endeavors aimed at effectively utilizing rice biomass waste.

Their initiatives revolve around transforming rice straw and husks into bioenergy, reintegrating nutrients into agricultural systems, curbing climate change by discouraging straw burning, and innovating value-added products such as bioplastics and biochar.

Despite lacking a prescribed pathway for rice production waste valorization, IRRI's presentation highlighted numerous possibilities and underscored the institution's longstanding recognition of the value inherent in husk and straw waste.

Of particular interest was the potential for rice straw carbonization, as emphasized in a study by Hohenheim referenced during the presentation. IRRI's comprehensive approach to rice straw management serves as a potential model for valorizing other agricultural wastes, such as those derived from corn, wheat, and other lignocellulosic wastes.


RICE STRAW BRIQUETTES
RICE STRAW PELLETS
LOOSE RICE STRAW


CARBONIZED
RICE HUSK PELLETS
SIMOW


MEKONG INSTITUTE
CGIAR
IRRI
Asian Mega-Deltas
RiceEco
Rice straw-based circular economy
for improved biodiversity and sustainability
Logistics
Optimized with balers, transportation, storage, app
Processing and products
Mushroom, cattle feed, organic fertilizer, bioplastics, urban agriculture products
Contract farming
(Agrifood traders and farmers) SRP, organic farming, urban agriculture
Green Circular Economy
Sustainable and low carbon rice production
No rice straw burning to secure rice-based


MEKONG INSTITUTE
CGIAR
IRRI
RiceEco
giz
Mechanized rice straw composting
Animal manure
Mechanized rice straw composting
Rice straw based substrate
Rice straw compost pellets
Packaged product for testing market
Business Model
NÔNG TRẠI XANH

2.6. UPLB, Center for Agri-Fisheries and Biosystems Mechanization (BIOMECH) and Institute of Agricultural and Biosystems Engineering – IABE (March 22, 2024 - Friday, day 1)

During their visit to the UPLB campus, the team visited BIOMECH and IABE. Dr. Roger Luyun, Jr., the Director of IABE, extended a warm welcome to the team, while Dr. Omar Zubia, Division Chairman of AMPED, and Engr. Marife Santiago, RD&E specialist of BIOMECH, highlighted the various R&D projects they've spearheaded and extended to farmers over the years.

These units boast commendable technical and prototyping capabilities, rendering them as possible partners for implementing R&D initiatives within the South Luzon.

The presentation made detailed the various research endeavors focused on waste valorization. Notably, aside from PHilMech, BIOMECH also carries a government mandate for technology development across various agricultural commodities, aimed at fostering sustainable agriculture.

Dr. Omar Zubia mentioned that his unit developed a biomass atlas for the Philippines in the early 2000s which was funded by the National Renewable Energy Laboratory (NREL) of USA. Dr. Zubia suggested the potential benefits of updating this resource for informed policy and strategic planning.

2.7. UPLB, The Department of Chemical Engineering - DChE (March 22, 2024 - Friday, day 1)

The team was warmly welcomed by Dr. Rex Demafelis, the Dean of the College of Engineering and Agro-industrial Technology (CEAT) of UPLB, alongside Dr. Monet Detras, Chairperson of the DChE.

A brief tour of the Biomass and Energy Research Laboratory was provided by Dr. Detras and Dr. Demafelis, during which they elaborated on their diverse research endeavors concerning plant biomass waste valorization.

One of the laboratories of the Department of Chemical Engineering →

Within DChE, the Biomass and Energy Research Laboratory stands as a hub for interdisciplinary exploration into biomass utilization. Research within the laboratory spans various facets of biomass valorization, encompassing pre-treatment methodologies, enzymatic hydrolysis, and biorefinery processes.

2.8. Los Baños Folia Tropica (March 23, 2024 - Saturday, day 2)

The team visited Dr. Rey Lucero, a retired scientists and CEO of Los Baños Folia Tropica.

He discussed how his enterprise produce different products from plant biomass waste by optimizing conditions for natural aerobic processes, a short movie presentation was proposed.

He supplies a big local client with his different soil amendment products.

He has a good collection of nematodes, insects, fungi, etc that works 24/7 to make various compost products. His green production system is a testament to his ingenious approach and low carbon footprint production is very inspiring.

His advocacy for environment friendly processes and his social responsibility is very inspiring.

Compost sifter (low-tech device)

2.9. Straw Innovations Ltd (March 23, 2024 - Saturday, day 2)

The team visited Straw Innovations in Pila, Laguna, where Dr. Craig Jamieson and Engr. Gabriel Escultos discussed urgent environmental issues linked to our rice production methods, especially concerning straw management.

Dr. Jamieson showcased their company with a compelling video presentation and outlined their strategies for addressing the challenges of straw collection. They aim to stop farmers from burning rice straw after harvest by providing harvesting services and to remove the straw from fields at no cost.

Straw Innovations, alongside institutions like IRRI and PhilRice, offers promising prospects for joint research on rice straw utilization.

Collaborative efforts could lead to innovative solutions that reduce the environmental impact of current agricultural practices and promote sustainable alternatives.

Ongoing discussions with ALCOM indicate a proactive approach to building partnerships that can enhance the reach and effectiveness of their initiatives.

2.10. Los Baños Municipal Agricultural Fisheries Council (March 23, 2024 - Saturday, day 2)

After returning from Pila, Laguna, the team headed back to Los Baños to meet with leaders from various farmers' groups operating under the Office of the Municipal Agriculturist.

Ms. Cheryll Gonzales introduced the leaders representing different agricultural sectors, including rice, tropical fruits, cut flowers, vegetables, and pig farming.

It's remarkable to learn that even for small-scale operations, there's the potential for an integrated, circular production system. The farmers explained how they are utilizing their plant waste by either composting it to create soil amendments or using the biomass waste as fuel for drying and cooking.


The interview highlighted the crucial role of the Local Government Unit (LGU) in providing guidance and capacity-building support to small-scale farmers within the municipalities. It underscores the importance of municipal-level initiatives in empowering farmers and facilitating sustainable agricultural practices.

On Sunday 24, March, the team travelled from South Luzon to Central Luzon, specifically to Nueva Ecija, which is the "Rice Bowl of the Philippines". During the trip, it was evident why such a title was given to the province. On both sides of the road, we witnessed golden rice paddies ready for harvest. Occasionally, there are farmers using the road for drying their palay.

PHilMech, PhilRice, and Central Luzon State University are the institutions that the team planned to visit are located in the 'The Science City of Muñoz'.

Note: During the travel from Laguna to Nueva Ecija, there were occasional rice straw burning in the field. It was mentioned during the discussions with Straw innovation and IRRI that most farmers burn the straw because it is the easiest way to get rid of it so that they can start preparing the land for next cycle. Even though there is already a law prohibiting burning of rice straw in-field, enforcement is also a challenge.

2.11. Philippine Center for Postharvest Development and Mechanization (PHilMech) (March 25, 2024 - Monday, day 4)

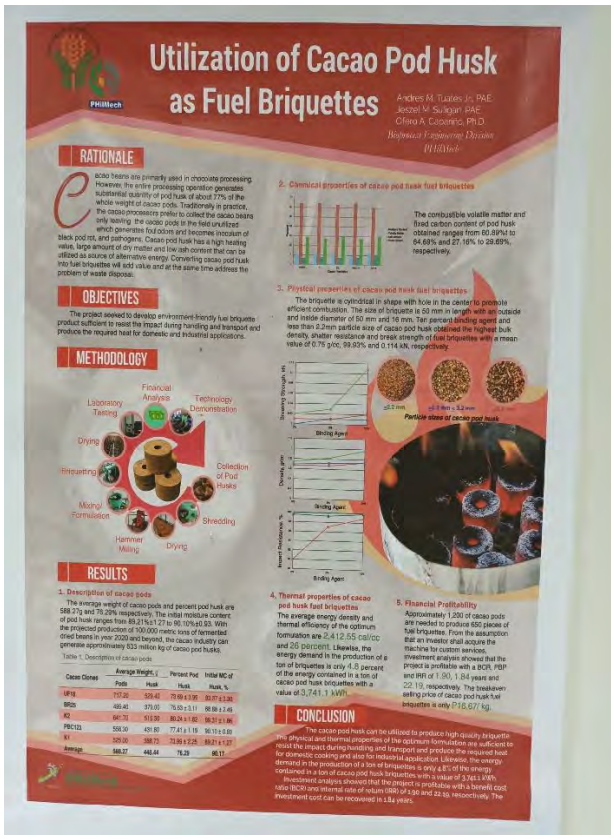
To start the working week, government agencies have flag raising ceremonies. The team participated in the flag raising and earthquake drill of PHilMech.

Dr. Joel Dator, PhilMech Director, and his executives warmly welcomed the team to the facility.

Prior to the presentation and dialogue, video presentations about PHilMech and CIRAD were viewed to provide some context for better interaction.

Dr. Andres Tuates and Dr. Ruel Peneyra then presented their study about hydrothermal carbonization process. It is a potential solution for valorizing plant biomass waste with high moisture content. Next step for them is to upscale and make a continuous fed system. This is seen as a possible point of collaboration. It would be explored if CIRAD can provide support and TA on how to accomplish this.

Secondly, a series of posters were presented on different ways of adding value to local agricultural produce, highlighting PhilMech's pro-activity in supporting local producers.



PhilMech hydrochar device prototype

2.12. ALCOM's NuevaChar (March 25, 2024 - Monday, day 4)

Alcom is currently operating a retrofitted gasifier in Palayan City, Nueva Ecija, and is utilizing rice husk to provide the local government with free heat for grain drying while making biochar in the process.

Atty. Rodeo Nuñez, ALCOM's Country Manager, along with esteemed technical consultants such as Dr. Ruben Lampayan and Dr. Alexis Belonio, warmly greeted the team and engaged in a thorough discussion concerning their biochar production process from rice hull and the many advantages documented in utilizing their biochar across various agricultural ventures.

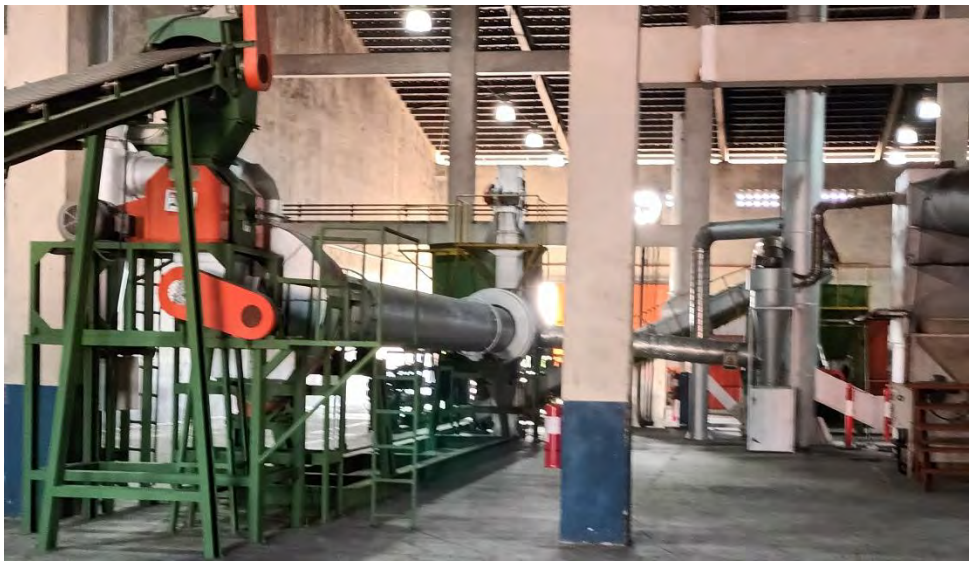
The discussion provided a comprehensive overview of their operational intricacies and the tangible benefits derived from their biochar product.

Subsequently, a guided tour of their facility was organized, showcasing the entire production cycle from the receiving and loading of rice hulls to their meticulous storage and packaging procedures.

The sheer scale of their operation left a lasting impression, underscoring their firm foothold in the carbon credit market in the Philippines through their rice hull biochar production.

It is evident that ALCOM is not merely content with their current status quo; rather, they are actively expanding their operations to different regions within the Philippines and are poised to establish similar production facilities overseas with added energy generation prospects in the mix.

This expansion underscores their commitment to sustainable agricultural practices and signifies their readiness to cater to a broader market. With a well-established presence and a forward-looking approach, ALCOM is poised to make significant strides in the realm of biochar production, both domestically and internationally, contributing to the global effort towards environmental sustainability and agricultural development.



ALCOM biochar factory

2.13. The Department of Agriculture - Philippine Rice Research Institute - DA-PhilRice (March 26, 2024 - Tuesday, day 5)

The team visited DA-PhilRice which is a government research institute dedicated to advancing rice science and technology in the Philippines. The institute has developed Biochar-based technologies for enhanced productivity, efficiency, resilience and adaptive capacity for smallholder rice-based farming communities in the Philippines

Dr. Ricardo Orge, one of the leading scientists of PhilRice, presented his Continuous type Rice Hull Carbonizer (CtRH) and their 'Palayamanan system', a systems approach to make the rice farmer more productive and resilient to the effects of climate change. Complete diversified use of biochar in the farm was discussed.

The CtRH is already an established technology for processing rice hull into biochar in the farm. However, this technology might even be more promising if it could be efficiently used to produce rice straw biochar in-field or near the farmer's house. Unlike rice hull which accumulates in the rice mill and are now used by many stakeholders, rice straw waste is left in the farmer's field. Hence, it might be a good idea for a decentralized system to address the issue of rice straw management.

Unique feature of CtRH is the heat recovery system or heat cogeneration for various applications. This feature was suggested to be incorporated in the FPRDI carbonizer design, which the designer acknowledged and agreed to look into.

It seems appropriate to incorporate heat recovery principles in any thermal systems that CIRAD would suggest (wood carbonization, Hydrochar, Biochar).


Continuous type Rice Hull Carbonizer

2.14. Central Luzon State University - CLSU (March 26, 2024 - Tuesday, day 5)

The final stop in the Science City of Muñoz in the CLSU. The university has significantly contributed to agricultural development in the Philippines through its research and development (R&D) initiatives.

CLSU's agricultural research programs focus on enhancing crop productivity, improving farming practices, and promoting sustainable agricultural systems, thereby addressing food security challenges and improving the livelihoods of farmers.

Additionally, CLSU has been actively involved in R&D work on renewable energy, particularly in the utilization of agricultural biomass for bioenergy production.

Through innovative projects and partnerships, CLSU has advanced technologies for converting agricultural residues into biofuels, biogas, and other forms of renewable energy, contributing to energy security, environmental sustainability, and rural development in the Philippines.

The Team was welcomed by Dr. Almar Villota and his faculty from the Department of Agricultural and Biosystems Engineering (DABE). A video was presented that highlights their facilities for instruction and research. Similarly, CIRAD video was also viewed to provide some context for discussion of the project.

Each of their faculty described their research endeavours, mostly in the field of aviation fuel production from agricultural waste and used cooking oil.

The presence of young scientists in the university and their proven research and development capability makes CLSU-DABE a good candidate for partnership and collaborative research.

From Nueva Ecija, the team travelled up the mountains to the city of Baguio and La Trinidad.

2.15. Benguet State University - BSU (March 27, 2024 - Wednesday, day 6)

Dr. Felipe Comilla, President of BSU warmly welcomed team and he immediately expressed his excitement and was thankful for the support of European institutions not only to his university but to the Philippines in general. He also expressed his support and is looking forward for future partnership between the different institutions in the meeting.

A short discussion of the objectives of the team's visit and was followed by a discussion of a major problem that BSU is currently facing. This is in the operation of the Benguet Agri-Pinoy Trading Center (BAPTC). The problem is associated with disposal of high moisture content, lignocellulosic waste from vegetables.

Maybe, CIRAD can provide some technical assistance on how to deal with this problem.

Definitely, whatever solution that could be proposed may also be applicable to all vegetable trading posts with similar problems.

2.16. Benguet Agri-Pinoy Trading Center – BAPTC (March 27, 2024 - Wednesday, day 6)

The problem described by Ms. Mildred Licangan and a BAPTC Operations Officer was the accumulation of high moisture content plant biomass waste from vegetables and trimmings.

When these accumulate and left to decompose naturally, it promotes an assortment of problems like foul odor, infestation of flies and other insects, and the pilings slowly limits the facility or the farm's

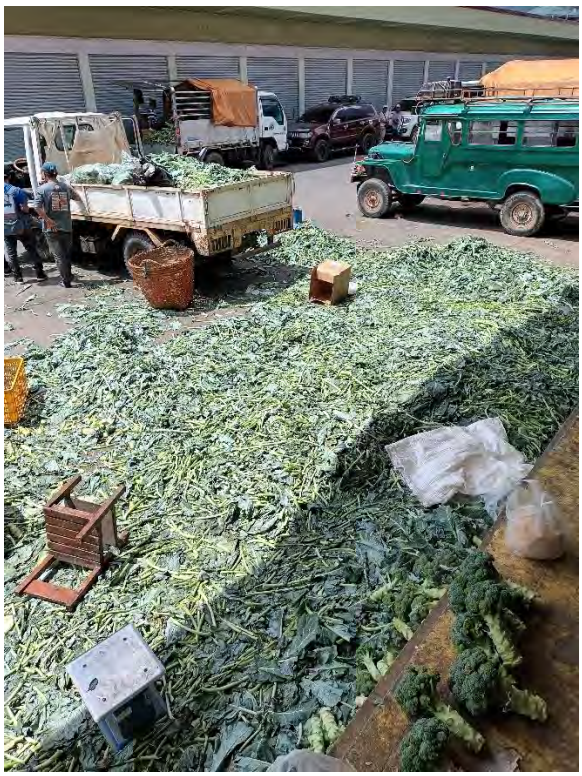
usable space.

These are not only present in the trading posts but are also found in the farms. Composting and digestion are some of the technologies that they have tried but according to them, it takes a lot of space and takes a long time for the processing of compost or biogas.

Furthermore, they have technical difficulties with digestion because of the drastic change in temperature in the region. Note that this might also be a good point for TA and collaboration for CIRAD.

Unloading docks

Arrival of market garden produce



Market garden by-products

2.17. Strawberry Farm (March 27, 2024 - Wednesday, day 6)

The strawberry farms are just a stone's throw away from BAPTC. The team ventured into the farms, picked some strawberries for snacks and interacted with the strawberry farmers.

2.18. Back to Manilla (March 27, 2024 - Thursday, day 7)

From Baguio city, the team travelled back to Novotel Suites Manila at Acqua.

The team had a recap of the whole trip, discussed some insights and possible scenarios and areas of interest. The meeting concluded the Philippine Mission CIRAD TA for the Philippines on Climate Change

Action Program (CCAP) - Part 2.4. Research for ready-to-transfer existing technology and the use of by-products.

Mr. Thierry Labastre of AFD joined the final meeting over dinner at the hotel.

3. Guiding ideas, prospects and development opportunities for phase 2.4.3 of the project *Specifications of a biomass energy production unit*

The aim of this phase 2.4.3 is to draw up the *Specifications for a feasibility study for the implementation of one (or more) biomass energy production unit(s) by thermochemical conversion of lignocellulosic biomass consisting of related products and by-products of the agricultural and forestry sectors, for the production of biofuels.*

The expected income is *R&D specifications for a technology transfer project for biomass industry*.

In the review report (inception report, 2.4.1), an assessment had been made on the main Philippine agricultural crops targeted by the study coconut, maize, rice and sugar cane - and the corresponding quantities of biomass produced.

Crop	**Production (P) in the Philippines (in tons) [1]**			**Type of biomass**	**Average corresponding quantity of biomass by-product (B) theoretically produced (in tons)**		
	2020	**2021**	**2022**		**2020**	**2021**	**2022**
Coconut	14 490 920	14 717 290	14 931 160	**shell and husks**	6 086 186	6 181 262	6 271 087
Maize	8 118 550	8 300 320	8 255 610	**stover and cobs**	11 211 331	11 462 347	11 400 604
Rice	19 294 860	19 960 170	19 756 390	**straw and husk**	24 557 095	25 403 853	25 144 496
Sugar cane	24 398 940	26 277 400	23 455 400	**bagasse**	7 319 682	7 883 220	7 036 620

* Rice by-products are logically the most abundant agricultural biomass resources in the Philippines, given the importance of rice production in the country (30% of Philippine land is devoted to rice cultivation, with an average per capita consumption of 123 kilos per year), and the fact that the country is not self-sufficient in this strategic commodity (in 2023, the Philippines imported over 3.5 million tonnes of rice, with a forecast of 4 million tonnes in 2024).

Visits and discussions during the mission highlighted the need to valorize rice by-products, straw and husks.

The use of rice husks appeared to be the least problematic due to the concentration of this biomass at production collection points, thus limiting logistical obstacles.

The rice husk biochar production unit (ALCOM) demonstrates this fact, and reveals the development prospects for this type of valorization.

This is one of the value-addition options to be proposed in phase 2.4.3 of the project.

* On the other hand, the valorization of rice straw has proved much more problematic, due to the dispersed nature of the resource and the complexity of collection and mobilization.

Traditionally, this biomass was burned on site, contributing to soil improvement.

Today, burning is theoretically prohibited.

Rice straw is left on site, contributing to soil fertilization, but with a fairly slow degradation, due in particular to decomposition partly under water in an anaerobic phase.

It is also used as a raw material, often braided, to make small objects such as those on display at IRRI (baskets, containers, household utensils). This type of recycling remains very marginal.

Because of its dispersed nature and the current lack of satisfactory valorization, the direct production (heat production) of decentralized energy using simple devices such as those developed by the FPRDI, carbonizer, drum kiln, charcoal kiln, or indirectly (production of briquettes or pellets) using simple devices such as Briquettor or Pellets device will be another proposed way of valorization (collaboration with UPLB and CLSU).

* The mission revealed that another category of by-products is currently under-utilized: wet to very wet waste. This includes vegetable production waste, such as that from the Benguet Agri-Pinoy Trading Center in Baguio.

At this collection centre, composting could be a suitable solution, but is not implemented due to lack of space and the nuisance associated with the degradation of organic matter (odor problems): on the Baguio plain, all available land is devoted to crops, so composting requires large areas.

For this type of wet waste, two types of technology can be considered:

1. Hydrochar production systems such as those developed by PhilMech appear to be suitable.
2. Methanisation in a digester in the absence of oxygen and in the presence of bacteria to produce biogas.

The next stage of the project will propose a double way of using wet waste to produce: (1) hydrochar, in particular from vegetable production waste, but also for corn by-products with a high moisture content; (2) biogas from these vegetable wastes using methanisation technique.

For maize cobs, other non-energy uses will be explored, such as techniques for producing pellets and flours with multiple applications (animal nutrition, plant protection, litter, etc.).

* Two other by-products of agricultural production were not discussed: sugarcane bagasse, coconut shells.

According to the information obtained during the mission, both of these by-products are currently fully valorized for all or part of the energy used in sugarcane and copra production and processing units respectively.

* Biomass Energy Resources Atlas of the Philippines update

This Atlas was produced by the Institute of Agricultural and Biosystems Engineering (IABE) in the 2000s with American funding (National Renewable Energy Laboratory - NREL; USAID).

During discussions with IABE representatives, it was unanimously agreed by all stakeholders that it would be highly opportune and profitable to update this Atlas, which is an essential prerequisite for the actions to be undertaken to develop the use of biomass of agricultural origin for energy production. **Updating this Atlas will be one of the actions proposed for phase 2.4.3 of the project.**

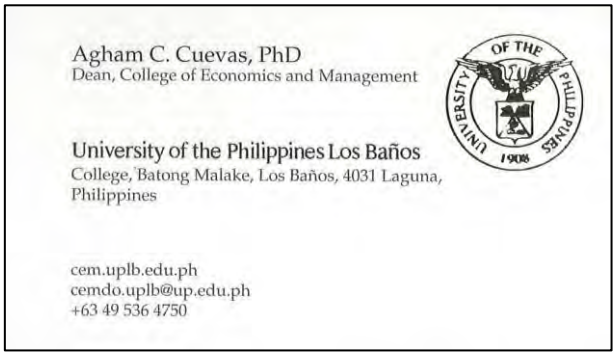
These various options and proposals will be confirmed after analysis of the information and data collected during the mission and in the literature.

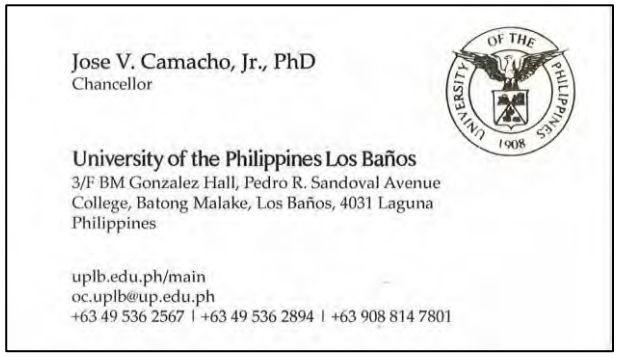
Appendice 1

Actual Itinerary for The Philippine Mission
March 22-28, 2024

Date	Day	Estimated Time of Arrival/Departure	Activity	Participants	Venue
March 21	Thursday	---- 10:00pm	Travel by plane to Manila, Philippines Hotel Check -In	JG, PL	Philippines Novotel Suites Manila at Acqua Hotel, Philippines
March 22	Friday DAY 1	7:00am	Pick up from Novotel Suites & land travel to UPLB, Laguna	JG, PL, FOPJ	Novotel Suites Manila at Acqua Hotel, Philippines
		8:30am	Courtesy visit to UPLB Chancellor	JG, PL, FPJ, CJCJ, RCA	UPLB, Laguna
		9:30am	Forest Products Research Institute (FPRDI)	JG, PL, FPJ, RCA	
		10:30am	Courtesy visit to the Local Chief Executive and Office of the Municipal Agriculturist	JG, PL, FPJ, RCA	LB, Laguna
			LUNCH		
		12:00pm	National Institute of Molecular Biology and Biotechnology (BIOTECH)	JG, PL, FPJ	UPLB, Laguna
		1:00pm	International Rice Research Institute (IRRI)		
		2:00pm	BIOMECH and IABE		
		3:30pm	Biomass Energy Lab		
		5:00pm	Check -In at Hotel 88 Spa (Freshen up)		LB, Laguna
		7:00pm	Meeting/Discussions/Wrap-up of Day 1/Briefing for day 2	JG, PL, FPJ, RCA, CJCJ	LB, Laguna
March 23	Saturday DAY 2	8:00am	Departure from Hotel 88 Spa; Travel to Los Baños Folia Tropica	JG, PL, FPJ	Laguna
		10:30am	Departure from Los Baños Folia Tropica; Travel to Pila Laguna, Straw Innovations/ LUNCH		Pila, Laguna
		1:00pm	Meeting at Straw Innovations		Pila, Laguna
		3:30pm	Departure from Straw Innovations; Travel back to Los Baños Municipal Building, Meeting with some LB Municipal Agricultural Fisheries Council		LB, Laguna
		5:00pm	Departure from LB Municipal Building; Travel back to Hotel 88 Spa		LB, Laguna
		7:00pm	Meeting/Discussions/Wrap-up of Day 2		LB, Laguna
March 24	(Palm) Sunday	11:00am	Check-out from Hotel 88 Spa; Travel to Central Luzon/LUNCH	JG, PL, FOPJ	Nueva Ecija, Central Luzon
		5:00pm	Check-in at at Check-in at Philippine Center for Postharvest Development and Mechanization (PHilMech) Guesthouse	JG, PL, FOPJ	
		7:00pm	Meeting/Discussions/Briefing for Day 3		
March 25	Monday DAY 3	7:30am	Attend PHilMech Flag Raising Ceremony/ Courtesy Visit to PHilMech Executive Director/Meeting	JG, PL, FOPJ	Muñoz, Nueva Ecija, Central Luzon
		11:00am	Departure from PHilMECH; Travel to ACM NuevaChar / LUNCH at Cabanatuan City (en route to Palayan City)		Palayan City, Nueva Ecija
		5:00pm	Departure from ACM Nueva Char; Travel back to PHilMECH Guesthouse		Muñoz, Nueva Ecija, Central Luzon
		7:00pm	7:00pm Meeting/Discussions/Wrap-up of Day 3/Briefing for Day 4		
March 26	Tuesday DAY 4	8:30am	Departure from PHilMECH Guesthouse; Travel to Philippine Rice Research Institute (PhilRice)	JG, PL, FOPJ	Muñoz, Nueva Ecija, Central Luzon
		11:00am	Departure from PhilRice; Travel to Central Luzon State University (CLSU/ LUNCH)		PhilRice, Muñoz, Nueva Ecija, Central Luzon
		2:00pm	Departure from CLSU; Check-out from PHilMech Guesthouse; Travel to Baguio City		In Transit
		4:00pm	Check-in at Newtown Plaza Hotel		
		7:30pm	Meeting/Discussions/Wrap-up of Day 4/Briefing for Day 5		Baguio City
March 27	Wednesday DAY 5	9:30am	Departure from the Newtown Plaza hotel; Travel to Benguet State University (BSU) / Courtesy Visit to the Head of BSU / Snacks	JG, PL, FOPJ	Baguio City
		11:00am	Meeting with BAPTC Management		
		1:00pm	Interaction with Strawberry Farmers		
		2:00pm	Back to BSU, Discussion with Faculty, Late Lunch		
		3:00pm	Good Shepherd/ Baguio Cathedral		
		5:00pm	Travel back to Newtown Plaza hotel		
		7:00pm	Meeting/Discussions/Wrap-up of Day 5		
March 28	(Maundy) Thursday	11:00am	Check-out from Baguio City hotel Travel to Manila / LUNCH on the road	JG, PL, FOPJ	Baguio City
		4:45pm	Check-in at Manila hotel	JG, PL, FOPJ	Novotel Suites Manila at Acqua Hotel, Philippines
		7:00pm	Meeting/Discussions/Conclusion of the Philippine Mission CIRAD TA for the Philippines on Climate Change Action Program (CCAP) - Part 2.4. *Research for ready-to-transfer existing technology and the use of by-products*	JG, PL, FPJ	
		9:00pm	Travel from Novotel Suites Manila at Acqua To Laguna	FOPJ	
March 29	(Good) Friday		Travel preparations	JG, PL	Flight to France

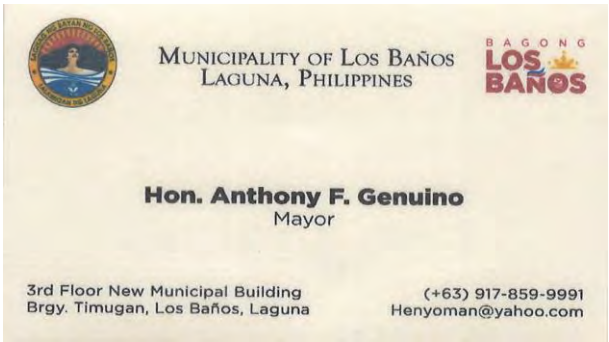
Contacts during the mission



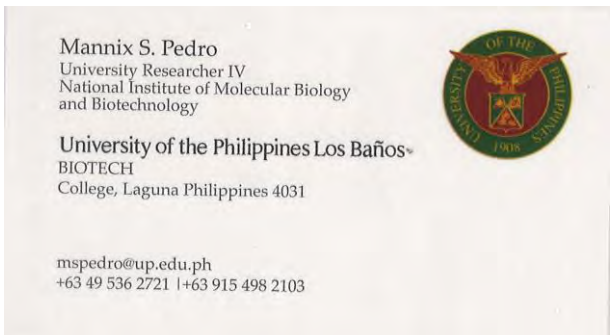


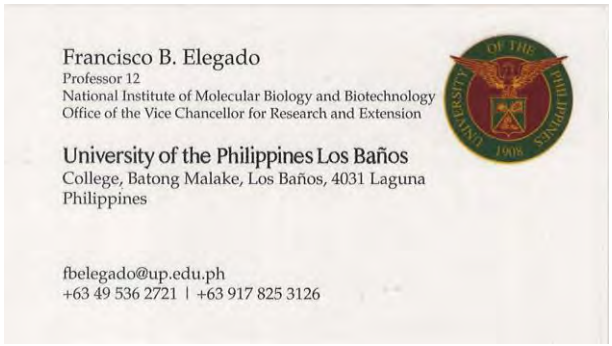
Visit to the Chancellor of the UPLB

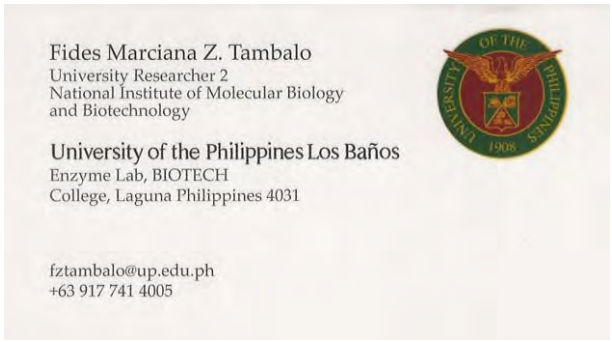
Forest Products Research and Development Institute



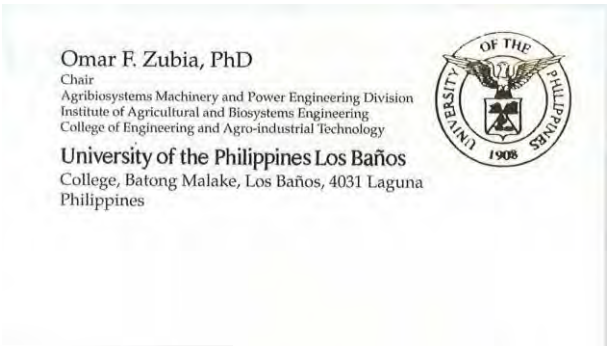
Municipal Government of Los Baños (MGLB) Local Chief Executive





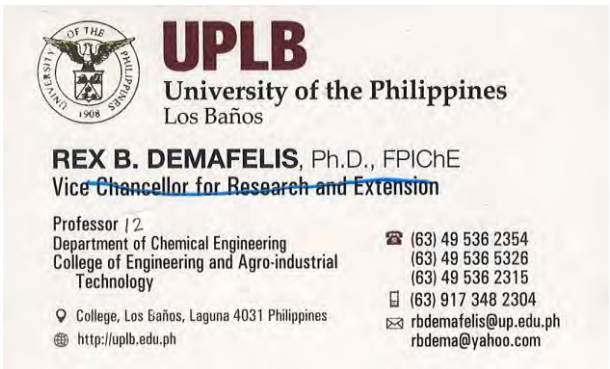


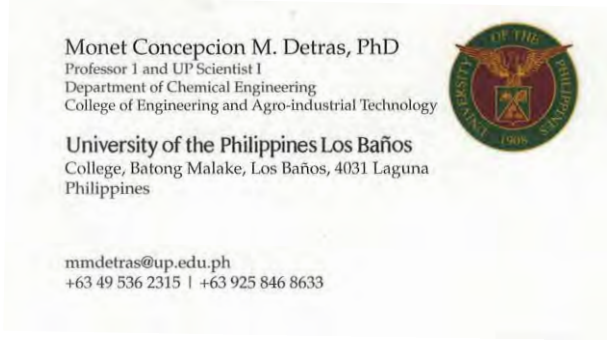
UPLB, National Institute of Molecular Biology and Biotechnology – BIOTECH



Institute of Agricultural and Biosystems Engineering – IABE

International Rice Research Institute - IRRI



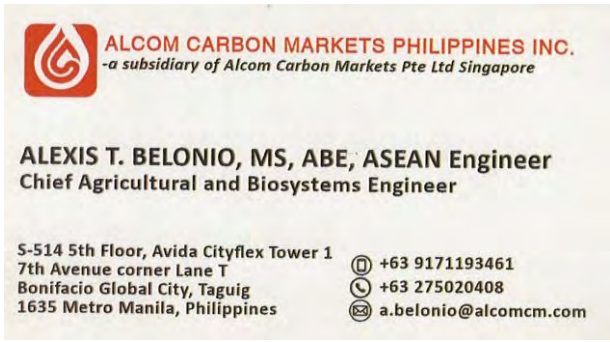


Department of Chemical Engineering - DChE

Folia Tropica

Straw Innovations Ltd

Philippine Center for Postharvest Development and Mechanization (PHilMech)



ALCOM's NuevaChar