Inception report

Bio-waste minimization and valorisation for low carbon production in the rice sector - Vietnam

Eric Buysman

01 August 2016

Table of Contents

1. General Introduction

The Climate and Technology Centre and Network (CTCN) approved a Technical Assistance (TA) for bio-waste minimization and valorisation and low carbon production in the rice sector. The TA was initiated at request of the Vietnamese Nationally Designated Entity (NDE) to the UNFCCC, the Department of Meteorology, Hydrology and Climate Change (DMHCC) of the Ministry of Natural Resources and Environment (MonNRE).

A consortium of consultants led by SNV Viet Nam was mobilized on the 4th of July 2016 following the approval of the team leader, Eric Buysman. The project starting date is therefore the 4th of July. The assignment lasts around 12 months and with that the end date of the project is July 2017.

The full team mobilisation occurred on the 25th of July 2016 with a 2-day internal team meeting. The team consists of 6 experts: Mr. Eric Buysman, team leader and energy expert, Mrs. Nguyen Thi Thu Ha, deputy team leader and densification/climate finance expert, Mr. Nguyen Thanh Phat, access to finance and bankable business model expert, Mr. Nguyen Thanh Thi, rice expert, Mr. Nguyen Danh Anh Thi, Medium/large scale solution expert and Mr. Nguyen Duc Minh, Thermal Conversion Expert. The team is assisted with admin and finance assistants in both the Hanoi and Ho Chi Minh City SNV offices.

In the same period the team has organized meetings with the Energy Institute of the Ministry of Industry and Trade (MoIT), the Viet Nam Centre of Clean Production(VNCPC) and a kick-off meeting with MoNRE. The list of persons met is attached in Annex I. The team also visited the field on Friday the 29th in Nigh Binh and Thai Binh provinces in order to understand the situation better in preparation of this inception report.

The TA has completed the Inception Phase; its purpose was to review assumptions in the ToR and to present a revised work plan for the remainder of the project.

2. Project description

The TA requested was based on the observation that rice husk is under- and unsystematically used or often dumbed and burned in Viet Nam. Utilization of the excess husk could be used as an energy source or marketed as fuel and comprise therefore an enormous opportunity for the sector. In other countries, such as in Cambodia and Thailand, the systematic economic valorisation of rice husk has become key to boost productivity and tackle environmental issues. The aim the TA therefore is to explore various routes of rice husk valorisation that can minimize bio-waste and improve overall economic performance of Vietnamese rice mills while at the same time reducing greenhouse gas (GHG) emissions.

In Viet Nam the production of rice continues to increase, both due to expansion of cultivation area and increasing yields. According to the latest figures of FAO, around 45 million ton of rice was produced in 2015. Given that 20% of paddy consist of husk, around 9 million ton of rice husk was available representing around 32,400 GWh[1] at rice mills. Valorisation of this resource could help millers to reduce their energy costs and environmental footprint.

There are indications that rice husk is becoming a valuable product for rice mills. The price of rice husk is increasing which is negatively impacting certain industries that rely on them, such as traditional brick factories and briquette producers. Some are forced to operate only during the milling season when husk

[1] *1 kg rice husk = 3.4 to 3.6 kWh/kg, Vietnam Institute of Energy (2013)*

is available in abundance and at relatively low price. In the off-season, prices are in general higher as most mills are milling at low capacity or do not operate.

These indications contrast the premise that the resource is underutilized and sometimes dumped. However, there may still be scope to upgrade the husk to higher quality fuels or improve energy recovery. Furthermore, the price of husk varies significantly between locations which is primarily caused by the fact that husk has a very low bulk density (120 kg/m^3) and is therefore expensive to transport. Isolated mills, or mills connected by poor infrastructure, will therefore receive a low price for their husk. In those cases, there are opportunities to increase the bulk density of husk (densification) or to utilize the husk for (captive) power generation. The valorisation optimization tool will address these options in detail (see chapter 3).

2.1 Scope

The Mekong Delta is the largest rice production area in Viet Nam. An estimated 50% of all paddy produced comes from this region including almost all the exported rice. The prime focus of the study will therefore be on the Mekong river delta.

This delta consists of 13 provinces in which double cropped rice is the standard and in some provinces such as An Giang, rice is even cropped three times in certain districts (figure 1). In those districts, the milling season is relatively long which is an important determinant in creating favourable conditions for various valorisation options.

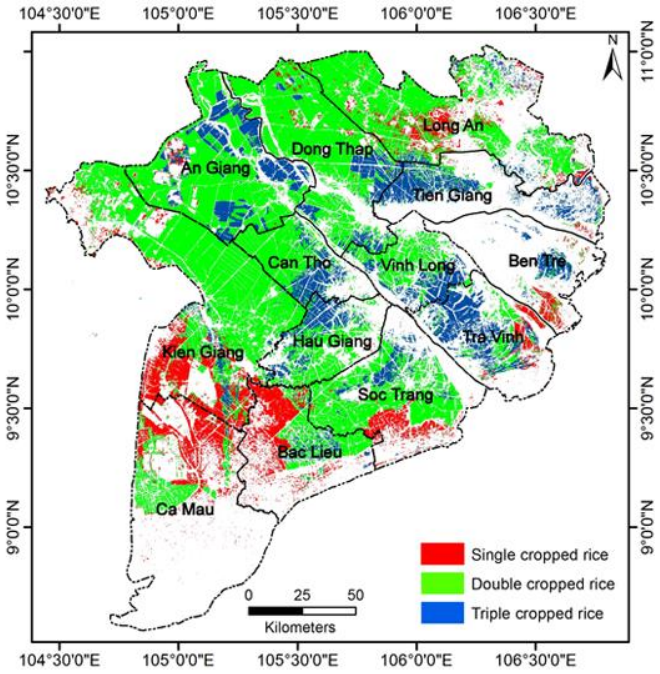


Figure 1: Rice cultivation area in the Mekong Delta Region and number of annual crops

3. Implementation schedule

The main activities identified in the ToR and SNV's technical proposal are:

1. A decision making tool/ for the selection of the optimal valorisation route of rice husks;
2. Validation of developed tool and detailed assessment of technologies and valorisation options. This includes overview of a selected number of potential business models (description and analysis);
3. Detailed case study of a bankable project, in partnership with a nominated firm;
4. Overview of access to financing options for different business models (different size and ownership);
5. Reporting, field visit and workshops.

The revised and detailed work plan can be found in Annex II. The implementation schedule supporting this work plan is presented here below and is based on the technical proposal.

Activity 1 – Valorisation Tool – development of decision support tool

This valorisation tool will be developed in the period August to November 2016. The aim of this tool is two-fold:

1. **Informative** – serve as a tool for rice millers to create awareness on the various valorisation opportunities there are for rice husk

2. **Decision making** – the tool helps rice miller to identify the most feasible opportunity to valorise rice husk based on technical, economic and sustainability indicators.

Potential routes of valorisation that are applicable to Viet Nam and that will be included are:

Table 1: Applicable valorisation routes

Route	Current situation at mills	Justification
Pellets	15-20 in Mekong Delta region	Large mills in the Mekong delta are already producing pellets with capacities of 1 to 5 ton per hour. There is an existing market and the product is higher valued than briquettes. The technology however is also more expensive. The valorisation tool can assess in which cases pellets are more viable compared to briquettes and the other way around.
Briquettes	>100	Briquettes can be produced at any mill regardless the size but may be more interesting to smaller mills as the capital investment is much smaller compared to pelleting machines. The market for briquettes includes breweries, garment and beverage factories[2].
Combined heat and power (CHP)	0	Technology is relatively common in other industries; in total 43 are in operation of which 7 at sugar mills. In

[2] *Hong Nam Nguyen, Minh Ha-Duong, Laurent Van de Steene. A critical look at rice husk Gasification in Cambodia: Technology and sustainability. Vietnam Academy of Science and Technology Journal of Science and Technology, 2015, pp.247-252.*

		Cambodia there are also large mils with CHP[3]. CHP is in particular interesting when steam can be sold to a nearby industry or used on-site. For example, steam could also be used via a heat exchanger for paddy drying and/or parboiling rice. Surplus electricity can be sold to the grid for $5.8/MWh[4].
Steam generation only	1[5]	Dinh Hai Cogen Joint Stock Company 9 MW plant used to supply steam to 8 factories in the Can Tho industrial zone until 2012 when the factories switched to using their own boilers. There may be scope for rice mills to sell steam to nearby industries or other mills for paddy drying or to sell rice husk to industries with steam boilers.
Power generation only	0[6]	In March 2016 Decision 942/QD-BCT increased the feed in tariff to around $7.4/MWh from $5.8 for biomass power projects (excluding CHP) depending on the region where the project is located in. This could create opportunities for husk to power plants.
Rice husk powered Paddy drier	Most	Paddy drying is an integral part of a milling system. Around 10 to 20% of the husk is required to dry the paddy depending on the moisture content. Paddy should be dried to around 14% in order to minimize the percentage of broken rice from milling. Not all mills however have a high quality paddy drier that dries uniform and controlled and some even rely on sun drying. Therefore, there are opportunities to install an improved paddy dryer that uses husk as fuel source for the drying process in those mills.

Rice husk gasification (RHG) is likely not viable in Viet Nam, and parallels can be drawn to the Cambodia RHG experience. RHG with the aim to produce power has been applied extensively in Cambodia. Over 160 gasifiers have been installed in the period 2005-2015. An evaluation survey showed that since 2012 more gasifiers stopped working than new capacity was installed and in 2015 a third of the installed RHGs were not in operation[7]. The main reasons were issues related to operation and maintenance and waste management issues of hazardous waste (tar and wastewater). Most of these millers switched to grid electricity. Furthermore, the economics of the RHG changed dramatically in that period; firstly, in 2012 husk was available for free, this increased to $13-25 per ton in 2015 at the mill gate, or an increase of around $0.03-$0.05/kWh, secondly diesel prices halved in that period and the national grid has enabled many millers to connect to the grid instead.

The grid tariff in Cambodia is with $0.17/kWh much higher than Viet Nam where it varies between $0.04, $0.06 to $0.11/kWh for low, normal and peak hours (22 KV)[8]. Hong et al. (2015)[9], concluded therefore that RHG is not economically viable in Viet Nam and on top of that noted that Viet Nam has stricter environmental laws and regulations imposing polluters to pay a high environmental tax. RHG that operate with dry filters produce less hazardous waste but are also more expensive which limits the viability even more. In conclusion, given the experience in Cambodia and the even less favourable

[3] i.e applied with success in Cambodia at Angkor Kasekam Roongroeng Co. LtD (AKR) mill which has installed a 2 MW CHP plant in 2011 and processes 250,000 ton of fragrant rice annually
[4] Decision 24/2014/QD-TTg, March 2014
[5] Interview with Mr Nguyen Duc Cuong, director of the Energy Institute of MoIT
[6] Le Quyen Luua, Anthony Halogb (2016) Rice husk based bioelectricity vs. Coal-fired electricity: Life cycle sustainability assessment case study in Vietnam - 13th Global Conference on Sustainable Manufacturing
[7] SNV (2015) Waste to Energy survey report
[8] Decision No. 2256/QD-BCT dated March 12, 2015
[9] Hong Nam Nguyen, Minh Ha-Duong, Laurent Van de Steene. A critical look at rice husk Gasification in Cambodia: Technology and sustainability. Vietnam Academy of Science and Technology Journal of Science and Technology, 2015, pp.247-252.

conditions for the technology in Viet Nam, the feasibility is rather low. The expert team will nevertheless study the option in some more detail before concluding that this option is not viable.

Other gasification technologies however, such as domestic gasifier stoves, are feasible end-use options for rice husk or rice husk pellets. Market linkages between mills and fuel shops could be created to promote the use of this fuel (to be studied in activity 2 or 3 depending on the chosen business model).

Other valorisation options such as torrefaction or oil production are either in experimental stage or at pilot stage. In general, there is a lack of information on these options including market information. The valorisation optimization tool can only access routes that are applicable to the miller and will therefore not include routes that are not market ready. On a case by case basis some routes may be applicable. For example, torrefaction of husk would result in bio-char which may be valuable to bio-fertilizer factories as raw material for their fertilizers production or to farmers. But it is not possible with a generic tool to assess those niche opportunities.

Activity 1.1: **Development of the list of quantitative and qualitative indicators** (August - October)

The implementation involves the gathering of quantitative and qualitative criteria and indicators. The list with be developed with input from the Vietnam National Cleaner Production Centre (VNCPC), other relevant stakeholders and communication with national and international experts. The exact role of VNCPC however need clarification (see chapter 6).

An example of this list (early draft) is shown in Annex 3, one sheet with a technical description of the technology, market and the technology suppliers and one sheet with technology feasibility criteria (i.e. a size criteria), technical, economic and sustainability criteria and qualitative criteria related to the impact on vulnerable groups, labour conditions etc.

Furthermore, the expert team will visit various rice millers, rice experts, technology providers, stakeholders, the selected rice milling company, to obtain an in-depth and updated understanding on a) the benefits and challenges of rice husk as an energy source; and b) the potential processing routes. These field visits are planned in the period August to September 2016 and will focus on the Mekong Delta region.

Activity 1.2: Tool development (September-November)

The tool will contain a number of components, including a sheet on baseline information in which the practical availability of rice husk, baseline energy consumption, rice mill throughput, seasonality in rice milling and cost estimates. Other components include technology selection, market selection, investment plan, operational costs and climate change and social inclusion. The output will be an excel file with an attractive interface programmed using Visual Basic for Applications (VBA) that is easy to use by millers and made available in Vietnamese next to an English version. The tool will be applicable to small, medium and large millers and can be used as a basis to develop business plans.

Activity 2 – Identification and development of Business Models

SNV team will identify and develop business models for rice husk valorisation based on the analysis of existing case studies and potential new ones. A desk study will be done based upon prior work done by the SNV team, the CTCN Network, the VNCPC and other local stakeholders such as the Institute of Energy. Where necessary relevant Vietnamese case studies can be visited for additional information. In total 2-3 potential routes of rice husk valorisation and strategies will be studied.

It is proposed that the expert team recommends 2-3 valorisation routes to the NDE. In case NDE agrees with the recommendations, the expert team will study these in detail.

The implementation of this activity is planned in the period December to February 2017.

Activity 3 – Develop a bankable project

One of the state-owned companies, e.g. Song Hau Food, was preselected to apply the tools developed in activity 1 and 2. In the period mid-December to May 2017 an optimal valorisation route will be identified for the selected company including an economic and financial analysis. The overall outcome would be the development of a bankable business plan.

The outcome of this activity will be (1) business plan and (2) a presentation pitching the project in May 2017.

Activity 4 – Overview of access to financing options

Access to finances for the private sector continues to be a struggle in Vietnam. At the same time the financial institutions present in Vietnam indicate that accessing strong, high quality (commercial) projects in Vietnam is challenging. Furthermore, access to finance for state owned companies such as the Song Hau food company is different from private companies.

It is proposed to study one route for the selected company and 2 routes for the selected business models identified in activity 2 targeting the private sector. The outcome is a report on financing opportunities and will be completed by June 2017.

Activity 5 – Addition reporting and activities

Next to the activities 1 to 4, progress reports will be developed on a regular interval (see chapter 4), a stakeholder feedback report, draft final report (1 June 2017) and final activity report (mid July 2017). It is also proposed to organize a kick off workshop (see chapter 4) and a final workshop (July 2017).

SNV suggested to organize a study tour to visit one of the case studies in South Vietnam or even to Cambodia to visit a rice mill with the 2 MW combined heat and power plant. The purpose of this tour would be for decision-maker, both the government and the private sector to see successful cases of bankable rice husk to energy projects. This tour could tentatively take place in March 2017.

4. Suggested changes

Kick off workshop: The technical proposal of SNV proposed to organize a kick-off workshop within 1 month after signing of the contract. It may not be possible within the current timeframe to identify the right participants for this workshop and secondly, the team feels that a better strategy is to obtain a thorough understanding of the field prior to organizing a workshop. This in particular because there are indications that the key premise on which the TA is based, the underutilization of rice husk, may have changed.

Therefore, it is proposed to postpone the workshop until a moment that the team has studied the local situation in detail. A good moment for this would be when the valorisation tool is finalized. During the workshop attending rice millers could for example be invited to fill in the tool with assistance of the expert team. A kick-off meeting however, as specified in the ToR, has been held with MoNRE on the 1st of August.

Communication procedures. The ToR mentions a monthly communication interval on updating the main stakeholder on progress with a progress report. The team feels that this is too frequent and more commonly done on a quarterly interval. It is therefore suggested to reduce the reporting interval to once per quarter.

5. Proposed roles

The official counterpart in this assignment is MoNRE. Based on the outcome of the kick-off meeting that was held with the NDE of MoNRE, the expert team envisions the following role for MoNRE:

Activity	Detail	Role on MoNRE/NDE
1.1	Draft list of quantitative and qualitative indicators	Review and commenting
	Final list of indicators	Approval
1.2	Valorisation tool	Review and approval
	Workshop and presentation of the tool	Co-organiser of the workshop
2	Selection of business models	The expert team will propose a few potential models and will seek consensus with MoNRE on the models for further study
3	Proposed business model for the state owned company	The expert team will seek consensus with MoNRE and the state company before going ahead
4	Bankable business model	MoNRE is the focal point of various climate investment funds. The expert team will seek assistance from MoNRE on which funds could potentially support investments in the rice husk sector.
5	Quarterly updates, draft final and final report	Review, commenting and approval
	Final workshop	Co-organiser of the workshop
	Study tour TBD	In case a study tour is organized, MoNRE should participate and assist in selecting participants.

In addition to this, MoNRE could facilitate in setting up meetings with other relevant ministries such as MoIT (Ministry of Industry and Trade) and MARD (Ministry of Agriculture and Rural Development).

6. Key issues to be addressed

The following issues have been identified that need clarification

	Issue	By Whom
A:	VNCPC is mentioned as technical assistance and in-country working partner but the role has not been formalized and needs clarification.	MoNRE, VNCPC and UNIDO
B:	The expert team is expected to support one of the state owned enterprises, e.g. Song Hau. A decision is needed on which mill shall be supported or on which basis the mill shall be selected.	MoNRE, VNCPC
C:	Stakeholder Feedback report. ToR page 21: A stakeholder feedback report has to be developed by the selected mill in cooperation with the response implementer. It is not clear what the objective of this report is and what information this should contain.	MoNRE, VNCPC and UNIDO

Annex I: List of Persons and Organizations met

Name	Position	Organization
Mr. Tran van Nhan	Director	VNCPC
Mr. Nguyen Duc Cuong	Director	Energy institute of MoIT
Mr. Nguyen Van Huy	Director	International cooperation department of DHMCC
Mr. Pham Van Tan	Deputy Director	DNE focal point of DHMCC MoNRE
Ms. Chu Thi Thanh Huong	Deputy Director and manager CBICS project	DHMCC of MoNRE

Annex II: Detailed revised work plan

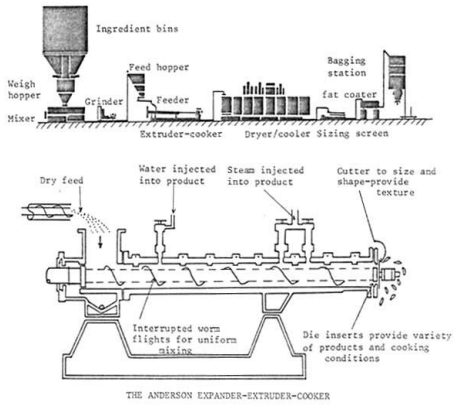
	ACTIVITIES	July					August					September				October					November				December				January				February				Mar	Apr	May	June	Jul
		2	9	16	17	24	31	07	14	21	28	04	11	18	25	02	09	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	05	12	19	26					
1	**Valorisation tool development**																																									
1.0	Survey of firms/mills and technology providers																																									
1.1	List of Quantitative and qualitative indicators																																									
1.2	Draft valorisation tool and guideline																																									
1.3	Expert review of draft tool																																									
1.4	**Final draft version of tool**																																									
2	**In-depth develop business models**																																									
2.1	Technical assessment of existing outlets and markets																																									
2.2	Business model description and analysis																																									
2.3	**Report 1:** Business model description and analysis																																									
3	**Detailed analysis of a bankable project**																																									
3.1	Business model developed of one of the state owned milling companies																																									
3.2	LCA (as part of the report)																																									
3.3	Pipeline of potential scale up opportunities																																									
3.4	Create market linkages																																									
3.5	Explore opportunities and develop an approach to get energy carriers certified (if applicable)																																									
3.6	Presentation and pitch of the project																																									
3.7	**Report 2:** Business plan of bankable project																																									
4	**Milestone 4: Report on financing opportunities**																																									
4.1	Detailed overview of access to financing options																																									
4.2	List of potential sources of funding																																									
4.3	**List:** High level list of concrete actions required to develop the project to final investment decision																																									
5	**Additional reporting / activities**																																									
1	Inception report preparation, meetings and submission																																									
2	Quarterly progress reports																																									
3	Stakeholder feedback report (by selected miller with SNV)																																									
4	Draft final activity report, presentation and discussion																																									
5	Submission Final Activity Report																																									
6	Workshop, Tool presentation and closing																																									
7	Study tour (TBC)																																									

Official public holiday (Tet, Vietnamese new year)

Annex III: Example of a technology description sheet and the list of quantitative and qualitative criteria

1 Technology description

2 Technology sketch



THE ANDERSON EXPANDER-EXTRUDER-COOKER

3 Technology suppliers in VN

	Company name	Province	Address	website	telephone	Email	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

4 Main markets

#	Market
1	
2	
3	
4	

4 Relevant standards/policies

#	Standard/policy
1	
2	
3	
4	

5 Anything else worth mentioning

Feasibility criteria for the technology (to be used for the decision tree)			
#	**Variable**	**Criteria**	**Justification**
A	Mill size		
B	Usage scenario		
C	Market		
D	etc		
F	Operation		
G			
H			

Quantiative indicators						
1	**Technological**	**Indicator**	**Unit**	**Value**	**Comments/criteria**	**Source**
	1	i.e. overal conversion efficiency to electricity	%			
	2	CAPEX (capital expenditure)	$/kw			
	3	Capacity factor	%	85		
	4	Parasitic load	%			
	5	Lifetime	years			
	6	Ash production	% of rice husk			
2	**Economic**	**Indicator**	**Unit**	**Value**	**Comments/criteria**	**Source**
	1	LCOE	$/kWh			
	2	OPEX (operation and maintaince expenditure				
		Fixed O&M	% CAPEX			
		Variable O&M	$/MWh			
	3	Feedstock cost	VND/ton			
	4	Transporation cost of feedstock	VND/ton/km by boat			
			VND/ton/km by truck			
	5	Income from ash selling	VND/ton			
	6	Discount rate or WACC (weighted average cost of capital)				
3	**Sustainability**	**Indicator**	**Unit**	**Value**	**Comments/criteria**	**Source**
	1	GHG emission reductions	tCO_2e/kg	xxtCO2/MWh		
	2	Gender inclusiveness	% female owned jobs	TBD		
	3	Number of female jobs created	person-years	TBD		
	4	Income generated by females	VND/year	TBD		
	5	Income earned by female labourers	VND/year	TBD		

Qualitative criteria				
	Indicator	**Indicator**	**Risk**	**Mitigation measures**
1	**Impact on women in the whole chain**			
2	**Labour conditions**			
3	**Potential environmental impact**			
		Air pollution		
		Water pollution		
		Soil pollution		
4	Other?			
	Technological maturity	Experimental/pilot/commerically marketed		

SNV Vietnam Office

Address: 6th floor, Building B, La Thanh hotel, 218 Doi Can street, Ba Dinh, Ha Noi, Vietnam

Tel. 84 - 4 -8463 791, Fax. 84 - 4 -8463 794

Email: vietnam@snvworld.org

Website: www.snvworld.org