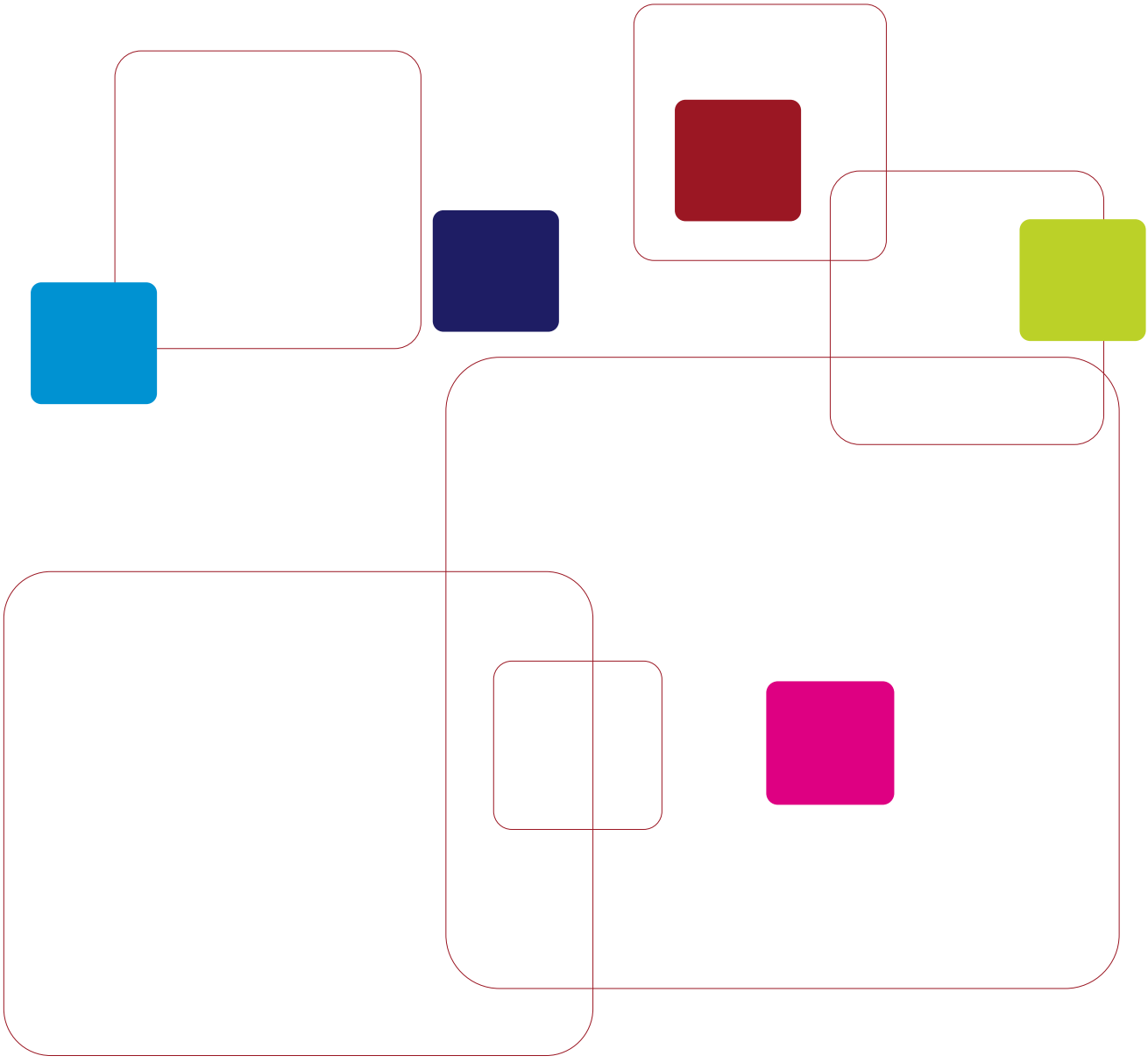
Final activity report



Name of author(s): Eric Buysman

06-09-2017

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1 Introduction

1.1 Background and conceptual framework

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 CTCN of the Department of Meteorology, Hydrology and Climate Change (DMHCC) of the Ministry of Natural Resources and Environment (MonNRE). The aim of the TA 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.

SNV has executed this assignment in the period July 2016 to August 2017. This report is the completion report.

1.2 Contact person

Main contact persons are:

Bastiaan Teune	*Sector Leader Renewable energy*	*bteune@SNV.org*
Nguyen Hong Hanh	*Deputy team leader*	*nhonghanh@snv.org*

1.3 Team composition

All work completed was a team effort. The following persons contributed to the work:

Member	Position	Comment
Bastiaan Teune	Project manager	
Eric Buysman	Team leader/energy expert	
Nguyen Hong Hanh	Deputy team leader	Replaced Ms. Ha during maternity leave
Nguyen Thi Thu, Ha		
Nguyen Duc, Minh	Thermal Conversion expert	
Le Thi Kim, Phung	Valorisation expert	Replaced Mr. Thi after his migration to Canada
Nguyen Danh Anh, Thi	Medium/large scale solution expert	
Pham Thi Thanh, Huong	Access to Finance and Bankable Business model expert	Replaced Mr. Phat after his resignation
Nguyen Thanh, Phat		
Nguyen Thanh, Nghi	Rice Expert	
Nguyen Hai, Van	Project assistant	
Hoang Thanh, Ha	VBA expert	

1.4 Overall conclusion

The overall aim of this assignment is to improve mill economics and reduce GHG emissions. For that purpose, all applicable rice husk valorization routes were studied including paddy drying with rice husk furnaces, briquetting, pelleting, raw husk sales, gasification, power, combined heat and power and biochar and amorphous silica ash (ASA).

The most viable route depends on many variables, such as amount of husk produced, distance to off-takers, efficiency of the rice husk furnace, human resource cost and technology specific indicators such as OPEX, CAPEX and economy of scale effects.

For that reason, the Valorization Optimization tool was developed, to assess which route yields the highest rate of return in the context of a specific rice mill. The Tool only focusses on existing technologies of which sufficient data is available, which is paddy drying, briquetting and pelleting technologies and raw husk sales. Gasification, power generation, combined heat and power routes were found not to be viable due to high husk prices, low electricity feed-in tariff and low electricity prices and were therefore not included.

In general, however, the first use of rice husk is fuelling the rice husk furnace of a paddy dryer. Paddy drying is a priority at rice mills, as insufficient drying leads to low head rice recovery and thus more broken rice resulting in lower income.

However, only 20% of the husk is required for paddy drying and 80% remains available for other routes. The route that yields the highest returns on investment is either briquetting or raw husk sales at the moment. The market for both products is well established. When the distance between the mill and the off-taker are large, briquetting will likely yield higher returns on investment as it is less expensive to transport owing to a much higher bulk density. An alternative densification method, pelleting, cannot compete with briquetting as the production costs are higher. In the past pelleting was very attractive as there were export opportunities. However, the export market collapsed and as a result pellets have to compete with briquettes on the domestic market.

Rice husk ash contains a high percentage of crystalline silica ash which is a pulmonary carcinogenic and can cause silicosis. Next to being a health hazard, it is not systematically used, sometimes dumped or miler even pay for the disposal. For that reason, in Activity 2 a feasibility study was conducted on creating valuable rest-products after combusting rice husk; biochar and amorphous silica ash (ASA). More study is required to understand if these routes can create more value to the rice miller compared to briquetting or raw husk sales. Details on these routes are provided in chapter 1.5.

In conclusion, the first use of rice husk is fuel for the paddy drying furnaces, and the most attractive valorization route that gives the highest returns on investment for the remaining husks is either briquetting or raw husk sales at the moment.

1.5 Potential business models that require more study

The biochar and ASA route were studied in detail for Activity 2. The key results of are shown in the table below

Route	*ASA*	*Biochar*
Estimated market size	$370 million/year (as pozzolan)	N/A
Current price of product	Silica fume is priced $300-$600, Rice husk ash with high ASA content has similar or better properties than silica fume as pozzolan	4,200-6,000 VND/kg, but trading volumes are small, local and project based
Technologies studied	ASA rice husk furnace ASA power plant, 1,2,5,10 MW	Biochar rice husk furnace
Technology origin	UK, company Torftech	Domestic, company Viet Hien
Product price required to reach 10% IRR	• Rice husk furnace: $400/ton ASA • 1 MW: $450/ton • 2 MW: $320/ton • 5 MW: $250/ton • 10 MW: $180/ton Prices are within the range of the silica fume prices. However, ASA may need post-processing and the initial price may well be lower to attract the interest of companies. There is also a risk that husk prices increase which would directly affect the viability.	4,000 VND/kg This is lower than the prices offered by other projects. However, biochar is not available commercially and there is no demand for the product yet. The venture is therefore high risk unless long term demand is created.
Key constraints	• Unfamiliarity with the product and usage as pozzolan • High upfront costs of the power plant and high risks as the value of ASA is not set • Reliance on a limited resource: rice husk with volatile pricing • Feed-in tariff for biomass power is low, lower than wind and solar, making investments challenging and high risk.	• Unfamiliarity with the product and the benefits are not directly observed • Lack of existing market • Technology has not been piloted yet in a rice milling setting • Regulatory environment not established for biochar – need for a quality standard.
Opportunity	• Large potential offtake market • Import substitution by in-country resource for silica fume • Potential to produce high performance concrete • Fits well with the renewable energy sub-target of 750 MW biomass power by 2020	• Strong climate change impact by sequestering carbon • Climate change adaptation by improving soil health • Can reclaim sulphates affected soils and bring them back to full productivity • Elimination of carcinogenic rice husk ash
Support required to come to concrete implementation plans	Market studies, business model development, market linkage creation, testing of concrete mixes and standardization	Pilot testing of the technology in a rice milling setting, biochar field tests, biochar quality standards
Financing options for the support needed	CTC/N, EEP Mekong, PFAN	CTC/N, EEP Mekong, MOST National Technology Innovation Fund

1.6 VNCPC and SOFIS

The work builds upon the excellent work executed by VNCPC and SOFIS in the rice milling sector and several synergies were created. In particular the critical input and comments from VNCPC on the reports and the guidance offered were instrumental to successful completion of this assignment.

2 Achievements

2.1 Reports completed

Soft-copies of all the reports can be accessed by clicking on the screenshots of the Report cover pages in the sections below or click **here** for the folder with all the reports. The link will remain active until 31/12/2017.

2.1.1 Inception report

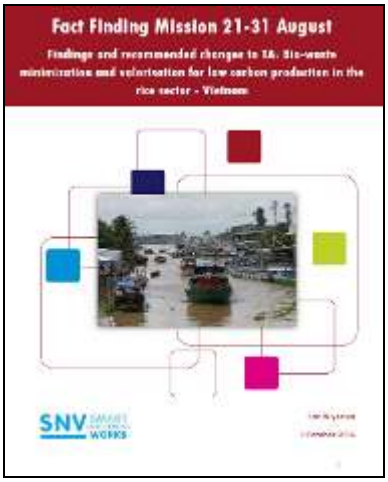
One week after team mobilization an inception report was prepared. This draft report was submitted on the 1st of August 2016 and the final report on the 5th of September 2016.

The report provided an overview of the project, a detailed implementation schedule, suggested changes, proposed roles and key issues to be addressed.

The report noted that the basic premise in the ToR, rice husk is something dumped or under- and unsystematically used may no longer be correct.

2.1.2 Fact-finding report

A 10-day fact-finding mission was organized between 21 and the 31st of August in the Mekong Delta and Cambodia. This included meetings with experts in the field, rice millers and other businesses. A visit to Cambodia was included as some rice husk technologies employed there which are not available in Viet Nam, i.e. rice husk gasifiers and rice husk power plants



The main finding was that rice husk is well valorized and that it is difficult to create more value. It was therefore suggested to focus on rice husk ash (amorphous silica ash) and to enlarge to scope to solar PV in lieu of upcoming the feed-in tariff for solar PV plants. A separate report on this, the fact-finding report, was shared on the 7th of October to the stakeholders.

After the submission of the fact-finding report various meetings were held with the NDE, VNCPC and CTCN. It was eventually decided to forgo the solar PV route as this was not related to rice husk valorization. VNCPC, the request proponent, proposed to focus on biochar production from rice husk and this was subsequently studied in more detail.

2.1.3 Activity 1.1: List of qualitative and Quantitative indicators

The list of qualitative and quantitative indicators, Activity 1.1, was shared on the 15th of February and finalized on the 15th of March 2017.

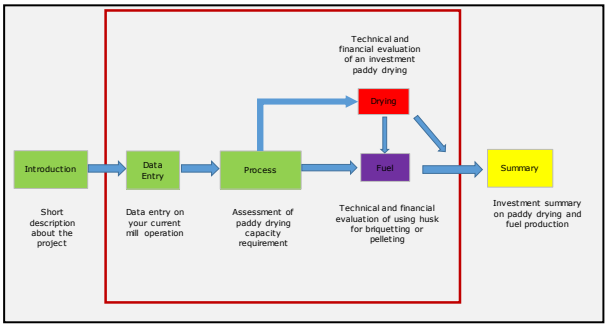
The deliverable consists of a reader and an excel file with the indicators. The following rice husk valorization routes were included, briquetting, pelleting, paddy drying, gasification, power and combined heat and power.

The list of indicators included feasibility criteria, quantitative criteria on technology, economic and sustainability and qualitative criteria such as gender considerations, labor conditions and potential environmental impact.

2.1.4 Activity 1.2: Valorization Optimization tool

The valorization optimization tool, Activity 1.2, was finalized on the 12th of June after an extensive period of review. The review process is document in a separate report '*Report on Rice Husk Valorization Tool Development and review process'.* The review process consisted of gathering feedback from millers that have used to the tool, feedback from VNCPC, feedback from the kick-off workshop in which the tool was presented and on top of that 2 external consultants were recruited to review the tool.

The tool is developed for rice millers that plan to switch from relying on brown rice purchases to sourcing their own paddy. This is in response to Government Decision No 606/QD-BCT which stipulates that rice exporting companies have to source at least 50% of their own paddy Therefore, many millers plan to invest in a paddy drying technology and de-husking capacity. As a consequence, more husk is produced. The tool helps the miller to identify the most attractive means of rice husk valorization including technology selection.



The tool is developed in Microsoft Excel using Visual Basic Application (VBA). The system requirements are: Windows operating system and Microsoft Excel 2010 or higher.

2.1.5 Activity 2.1: Technical assessment on rice husk business models

Activity 2.1 is on the identification of innovative business models that can help rice miller to improve their economics and reduce their GHG footprint.

The report concluded that rice husk is well valorized and that it is difficult to create more value from rice husk. Rice husk ash on the other hand, is not valorized, sometimes dumped or even millers pay for the disposal. Moreover, rice husk ash contains a high concentration of crystalline silica ash which is a known pulmonary carcinogenic and can cause silicosis.

Therefore, the report recommended to focus on the rice husk furnaces in order to produce different residues than rice husk ash. The two routes recommended where biochar and amorphous silica ash production from rice husk; two useful products with a potential high value.

2.1.6 Kick-off workshop

On the 5th of May 2017, the kick off workshop was organized. The overall aim of the workshop is to gather feedback from participants on the work executed and on the rice husk business models recommended for further development. During the workshop two main topics were discussed, (1) the valorisation tool that can help rice millers to evaluate the most viable valorisation route for their rice husk resource and (2) business models for innovative rice husk valorisation routes.

The outcome of the workshop was that the participants strongly endorsed the recommended routes; biochar and ASA. It was also agreed that given that these routes are still in demonstration phase of technological maturity that the output would be a feasibility study and not a business model report.

In total 26 people attended the workshop. On the 10th of May 2017, a proceedings report was developed and shared.

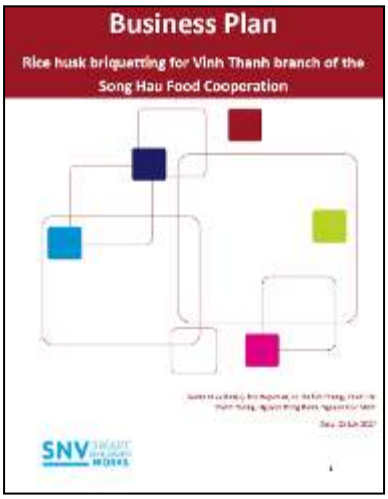
2.1.7 Concept note for CTCN meeting in Copenhagen

On the 12th of May a concept note was developed for the NDE in preparation of its meeting at the CTCN in Copenhagen. That note discussed the progress of this Request and the limitations. For example, biochar and ASA are new routes to Vietnam and require, to fully assess its potential, more analysis such as a market study, technical analysis, assessment of policy and potential regulatory reform creating market linkages with off-takers and development of business models. A one-year extension of the Request was proposed which was deemed necessary to move to concrete implementation plans.

An updated version of the concept note is included in Chapter 5: Post Assistance Plans

2.1.8 Activity 3: Bankable Business plan

A bankable business plan was developed in close consultation with the selected rice mill; the Song Hau Food Company. The draft was shared on the 11th of July and the final version on the 25th of July. The most viable valorization route for their branch is briquetting. This was both established using the Valorization Tool and by discussions with Song Hau.



The business plan focuses on a new branch that they plan to open which is strategically located in a paddy cultivation area. The new branch, Vinh Thanh, would de-husk paddy and then transport it over water-way to the main branch in Can Tho for further processing. Produced husk will be densified into briquettes and sold to traders. The company will become a large briquette producer producing 26,161-ton briquettes in year 5.

Song Hau Food Company appreciated the business plan and are happy with it. The investment however is pending on the overall investment in the new branch.

2.1.9 Activity 2: Feasibility study on innovative business models

A feasibility study was conducted on 2 valorization routes, biochar and amorphous silica ash (ASA) production from rice husk. The study looked at the feasibility of biochar and ASA rice husk furnaces and of an ASA power plant.

The study determined under which conditions both products could yield a return on investment. Within the price ranges observed of biochar in other projects and analogues of ASA, silica fume, it may be possible to develop viable business models. More study however is required to understand the market fundamentals of these products, especially in terms of quality and quantity.

The report was shared on the 12th of August, and is at time of writing of this report under review by the VNCPC.

2.1.10 Activity 4: Reporting on Financing Options

A report on the financing options was shared on the 12th of August and is under review by the VNCPC.

The report looks at financing options to prepare a project and at options to finance project implementation. In the case of biochar and ASA financing is necessary to prepare the project, i.e. market studies are required, support to standard development and demonstration of the technology.

Project financing is not yet applicable as the innovative business models studied are not market mature. Briquetting on the other hand may not attract financing as it is business as usual in the Mekong Delta and a relatively small investment.

2.1.1 Final workshop and field visit

On the 31st of August, the closing workshop will take place in Can Tho, the agenda is attached in Annex I. Around 60 persons are invited, including rice millers, technology providers, government organizations, UNIDO, VNCPC and the NDE.

On the 30th a field visit will be organized for JIC and Song Hau Food Company. JIC is a Japanese company that is producing high heat resistant insulation material from rice husk ash and calcium in An Giang. The visit to Song Hau Food Company will focus on their milling operation and on the measures implemented to improve energy efficiency under the UNIDO Resource Efficient and Cleaner Production (RECP) project.

The proceedings will be attached in the final version of this report in Annex I, II and III.

2.2 Workshops attended

Several workshops were attended as part of this assignment:

- October 2016: Workshop on rice husk silica in HCMC – organized by BSB
- 28th of April 2017: Workshop on rice husk silica in Hanoi – organized by BSB
- 03 March 2017: Resource Efficient and Cleaner Production Program (RECP) in HCMC – organized by VNCPC and SOFIS. In this workshop, initial findings of the Request were shared.

3 Barriers

The main barriers are listed here below

Husk is well utilized and traded as commodity

- Husk price has dramatically increased. In the period of 2012-2016 the price has double or quadrupled according to other studies to around 600-700 VND/kg (~$30/ton) currently.
- Husk is well utilized; the first use is for paddy drying furnaces, then densified as fuel followed by direct trade of raw husk. The main market of the later are brick factories that are strategically located along the waterways.

Given that millers receive good value for their husks, it is very difficult to increase that value. It was therefore not possible to come up with rice husk valorization routes under activity 2.2. It was for that reason that the focus shifted to valorization of rice husk ash as biochar or amorphous silica ash.

Barriers specific to power generation

- The electricity tariff and the feed-in tariff are relatively low. That in combination with the high husk price makes power or combined heat and power not viable (see the Activity 2.1 report for more details)

Barriers specific to the feasibility study on ASA and Biochar

- The benefits of biochar are not directly obvious in contrast to fertilizers. It takes time before the soil improves and the yield. Farmers will therefore hesitate to invest. This barrier will impede rapid market development of biochar products.
- There is no standard on the quality of biochar and it is difficult to visually distinguish between biochar and carbonized husks from regular rice husk furnaces. There is a need for a quality standard to distinguish between those products

Amorphous Silica Ash (ASA)

- ASA from rice husk is new to Viet Nam and has not been used for (high performance) concrete at commercial scale. This unfamiliarity is a barrier and needs to be addressed by applied research on using ASA as admixture for various concrete grades. The standard on pozzolans may need to be updated/refined as well based on the findings.

4 Lessons learnt

The key lessons learnt are:

- Rice husk is well valorized. Dumping and unsystematic use of the resource as described in the ToR could not be confirmed.

- The upper price limit of rice husk is set by the price of coal. Companies and ESCO's often run multi-fuel boilers and use the cheapest fuel that they can obtain. If the price of husk increases, they may switch back to coal or other fuels.

- There is well established market for rice husk briquettes in Viet Nam. There are many technology suppliers, rice millers or companies that produce briquettes and there are many off takers that use the briquettes for their boilers to produce steam.

- Rice husk ash however is not valorized, unsystematically used and sometimes dumped.

- Rice husk ash is a pulmonary carcinogenic that can cause silicosis. Awareness of this is very low in the rice husk sector and deserves more attention.

- Power generation is only viable when the rice husk ash, as ASA, is valued at a price compared to silica fume.

- Biochar offers many benefits, such as carbon sequestration and improves soil properties. It can also help to reclaim sulphates-rich soils and bring them back to full productivity.

- The potential market for ASA and biochar can be enormous, and deserves more exploration.
    - ASA can help Vietnam to substitute imports of silica fume with a domestic source of amorphous material (ASA)
    - Biochar has a good fit in the rice husk sector. By brining biochar back to the field, yields can improve which subsequently helps farmers to earn more income and millers to process more paddy.

5 Post Assistance Plans

SNV prepared for the NDE a concept note on post assistance plans for their meeting with CTCN in May 2017 in Copenhagen. An updated version of that note is copied here below:

Concept note – Request for 1-year extension

1. Introduction

The CTCN request 2015-040/VIE-01 is implemented by SNV with technical support from the in-country working partner VNCPC. The assignment started in July 2016 and will finalize in July/August 2017. The aim of the TA is to explore various routes of rice husk valorisation that can minimize bio-waste and improve overall economic performance of rice mills while at the same time reducing greenhouse gas (GHG) emissions.

The support request 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 to tackle environmental issues.

The Vietnamese rice milling sector has developed substantially since the date of this request; 1 July 2015. Currently, rice husk is used systematically and rice millers receive a relative high value for their resource. In a kick-off workshop that was organized on the 5th of May 2017, in which the NDE and VNCPC also participated, this finding was confirmed by the participants.

Examples of rice husk usage are fuel for rice husk furnaces that supply heat to paddy dryers, densification into briquettes or pellets which are subsequently sold to industries that require steam (garment factories, fish processing factories) or sold raw and used in brick kilns or in fluidized bed boilers. The rice husk value has increased dramatically from around $5 to $10 in 2013 to $25 to $45 in 2017 per ton depending on the season and the locality.

The implementation of the request has nevertheless resulted in useful outputs:

(1) **A valorisation optimization tool** – this tool is very useful for rice millers. Many of the millers in Vietnam purchase brown rice instead of paddy. This mode of operation is being discouraged by the government and by 2020 millers that export rice must at least process 50% paddy of their total output. This is leading to significant investment in the sector in paddy drying and dehusking capacity. The tool helps the millers to identify the most optimal paddy drying technology and the densification technology for their remaining husks based on several indicators.

(2) **Business plan for a selected company –** The Song Hau Food company is selected for this purpose. This company also needs to invest in more drying and husking capacity for their export licence. A business plan is being developed on optimal valorisation their husk resource.

Another activity focusses on business model development for rice husks. A study executed during this assignment into potential business models revealed that power generation was not deemed viable with current electricity tariffs, feed-in-tariff and husk prices. Briquetting and pelleting on the other hand are technologies that are well established in Vietnam which do not require support. The report concluded that most rice husk valorisation routes are well developed or not viable. Rice husk ash however, which is produced at significant amounts at rice husk furnaces of paddy dryers (20% of husk is ash), is not systematically used and sometimes dumped or is even a cost to the millers.

Two potential rice husk ash valorisation routes have been identified, biochar and amorphous silica ash (ASA) production. Biochar can help to improve soil health and subsequently improve rice yields while ASA has a wide range of potential applications such as a pozzolan in concrete displacing imported silica fume and improving concrete qualities, additive to high quality paints, ingredient in high heat resistant insulation, PV panels etc. At small scale biochar is being sold in Vietnam for 6,000 VND/kg ($300/ton) and silica fume which can be replaced by ASA is in the order of $300 to $600/ton.

In Vietnam, around 9 million ton of husk is produced annually of which around 20% is used for drying (1.8 million ton). Thus around 360,000 ton of ash is produced at mills annually and another 1.44 million ton is produced at industries that use husk as fuel.

The Activity 2.2 report will focus on the feasibility of rice husk ash valorisation at rice mills. Participants of the kick-off workshop strongly endorsed this. However, since this is a new field, the scope would first be limited to on-mill production of ASA or bio-char and secondly only a preliminary analysis is possible within the request.

2. Proposal – one year extension

CTCN request 2015-040/VIE-01 identified potential routes of bio-char and ASA production. However, the output will be limited to a preliminary analysis. In order to fully assess the potential of these 2 routes, more analysis is required such as a market study, technical analysis, assessment of policy and potential regulatory reform creating market linkages with off-takers and development of business models,

A one-year extension of CTCN request 2015-040/VIE-01 can focus on this activities and lead to concrete implementation plans. Rice husk ash valorisation conforms CTCN's mandate on supporting climate technologies: (1) Biochar has a long residence time in the soil and is a form of carbon sequestration (2) ASA applied as pozzolan improves compressive strength on concrete and reduces the amount of cement required to attain the same strength. Cement production is associated with high CO_2 emissions.

Annex I: Agenda closing working

Workshop content: The workshop will provide an overview of all the work executed under this assignment. Starting with the valorisation tool that can help miller to examine the most economical use of their husks, then 2 innovative potential business models will be discussed, bio-char and amorphous silica ash, followed by a practical example of a business plan for rice husk briquetting, a session on financing options and recommendation for follow up study.

Venue: ANH DAO MEKONG 2 HOTEL & RESTAURANT Can Tho

Time and Date:

- **Workshop**: 9:00 – 13:00 including lunch
- **Date:** 31 August.

Language: Vietnamese and English simultaneous translation

Tentative agenda

Time	Activity	Person in charge
8:30 - 8:45	Welcome remarks	NDE VNCPC
Chair: NDE		
8:45 – 9:00	Workshop objectives, overview of the assignment	Bastiaan Teune
9:00 - 9:30	Valorization tool	Nguyen Duc Minh
9:30 - 10:00	Business plan rice husk briquetting	Song Hau Food Company
10:00 - 10-15	Coffee break	
10:15 - 10:45	Bio-char business model feasibility study	Eric Buysman
10:45 - 11:15	ASA business model feasibility study	Eric Buysman
11:15 -11:30	Financing options	Nguyen Hong Hanh
11:30 - 11:45	Post-assistance plans and discussion	Eric Buysman
11:45 – 11:55	Closing remarks by request proponent of the assignment	VNCPC
11:55 - 12:10	Closing remarks	NDE

Annex II: Closing workshop proceedings

MEETING MINUTES

UNIDO's closing workshop on 30th – 31st Aug 2017

Welcome remarks:

9:00 A.M – 9:10 A.M: Mr. Pham Van Tan, Deputy Director General of the Department of Meteorology, Hydrology and Climate Change of MONRE, NDE focal point, gave the welcome remarks and introduced the purpose of the project. The objective is development and promoting advanced technology which can help the rice sector to reduce CO2 emission and adaptation to climate change. He mentioned that through utilization of rice husk coal can be replaced as well as improving of rice husk value which is the purpose of the CTCN support. The outcome of the assignment are technology solutions to use husk effectively in rice mills.

9:10 A.M – 9:15 A.M: Mrs. Hoang Mai Van Anh, Program Officer of UNIDO Vietnam, shared to the audience an overview of CTCN, the projects and how it has been promoting new climate friendly technologies. This CTCN assignment is a technical assistance for rice mills in the Mekong river delta implemented by the SNV Netherlands Development Organization.

9:10 A.M – 9:20 A.M: Mr. Bastiaan Teune, Energy Sector Leader of SNV Netherlands Development Organization, gave welcome remarks on behalf of SNV. He stressed the key aim of the workshop are discussions on rice husk valorisation technology and next steps after the project.

9:20 A.M – 10:10 A.M: the audience introduced themselves and their objectives to attend the workshop.

1. Song Hau food company: Mr. Do Hoang Thanh, Vice director; Nguyen Thuy Linh, Chief Account; Nguyen Van Tai, Business & Technical Department. Mr Thanh on behalf of Song Hau company will present a business plan rice husk briquetting.
2. Loc Troi company: Mr. Nguyen Bao Loi, project engineer of Engineering department
3. Researcher, retired lecturer of the Nong Lam university: Mr. Phan Hieu Hien
4. ECOFARM: Mr. Nguyen Hai My, CEO, shared with participants about Ecofarm. Ecofarm was supported by SNV's BCF fund on producing of biochar from agriculture waste, especially rice husk.
5. Vinafood 2 – Thot Not branch: Mr. Tran Van Ven, Chief of Business Department cum Deputy Director, expected to learn more about briquetting technology.
6. An Giang food company: Mr. Huynh Quang Truong, Director; Mr. Nguyen Anh Minh, Factory manager. Mr Minh said that their company is milling in An Giang and rice husk is used in dryers and sold to traders. The company want to know more about briquetting.
7. Can Tho Department of Agricultural and Rural development: Nguyen Thi Kim Ngan, she is looking for new technologies for valorization of husk and other information related to rice sector.
8. An Giang Environment Protection Fund (AEPF): Mrs. Pham Ngoc Xuan, Deputy Director, she has been monitoring SNV's project on valorization of agriculture waste. She also shared with the audience one of the project is implementing by AEPF, namely Vietnam – Sweden project. In addition, she will organize a closing workshop in October 2017 which will be attended by MoNRE representatives. Furthermore, she is looking for a discussion on biochar technology.
9. An Viet company: Pham Van Ngoc, Director
10. Viet Hien company: Le Viet Hien, Deputy Director, producer of the Swiss FLOX-pyrolysis biochar technology in Daklak.
11. JIC Vietnam: Mr. Moritomo, Director; Ms. Mie Norimoto, Representative Office Manager; Nguyen Van Truc, sale manager. Mr. Truc introduced JIC Vietnam and the insulation product that they are producing from rice husk in An Giang. The company hopes to learn more about the rice husk market and market for their products.
12. GERES Cambodia: Mr. Armand Blondeau, project manager, is implementing a project in utilizing of agricultural waste in Cambodia. He wants to learn more about briquetting and boiler technology.
13. Researcher, lecture of Hanoi University of science and technology: Mr. Nguyen Duc Quyen. He is a researcher on energy saving and efficiency. He and his colleague are researching power systems which can retrieve silica from rice husk ash.
14. Researcher, lecturer of the Economy Department - Can Tho University. She is interested in solutions on using rice husk in Mekong delta.

15. VNCPC: Mr. Le Xuan Thinh, Deputy Director; Nguyen Thanh Trung, Project officer. He introduced VNCPC's projects.
16. Researcher, lecturer of Ho Chi Minh City University of Technology: Mr. Pham Trung Kien is a coordinator with Ecohel project. He studies combustion processes and retrieved silica after burning of husk.

Presentation 1: Valorization tool

Mr. Nguyen Duc Minh introduced the valorization tool to the audience. The presentation provided an overview on the objective and structure of the tool. This tool includes a start page, the page on the assessment on paddy drying capacity, paddy drying investment and an assessment of the most applicable densification technology for the remaining husks and a summary overview.

Presentation 2: Business plan rice husk briquetting

10:10 A.M to 11:00 A.M: Mr. Thanh on behalf of Song Hau Food Company presented a business plan on rice husk briquetting that was prepared by SNV. This business is necessary as large quantities of husk will be produced at the new location which is relatively isolated.

Question:

Mr. Nguyen Duc Quyen-Researcher: Are the transportation costs include in product price?

Mr. Pham Trung Kien-Researcher: he asked Song Hau if they use the ash after combustion.

Mr. Eric-SNV: Answered that transportation cost are included and that ash is not valorised. He said that in his next presentation he will focus on innovative routes to valorise ash.

Presentation 3: Biochar and ASA business model feasibility study

11:00 A.M to 12:15 A.M: After the coffee break Mr. Eric presented the technical feasibility study on biochar and ASA business models in Vietnam. The research was focused on biochar technology produced by Viet Hien company and Tortech technology in producing power and silica.

Question:

Mr. Pham Huu Hien-Researcher: He claimed that biochar is not reducing emission.

Mr. Eric-SNV: Explained that carbon sequestered in biochar belongs to the long carbon cycle and that it reduces emission on a human time scale.

Mr. Le Viet Hien-Viet Hien company: He provided an example on affecting of biochar into soil improvement.

Mrs. Pham Ngoc Xuan-AEPF: She used to study biochar and ASA. She suggested that more study is necessary and a biochar standard is necessary.

Mr. Nguyen Duc Quyen-Researcher: He proposed to use biochar as fuel

Mr. Eric-SNV: He explained that the calorific value of rice husk biochar is low and it does not burn well.

Mr. Pham Trung Kien-Researcher: He is interested in biochar and ASA market in Vietnam

Mr. Eric-SNV: Not enough time was available to conduct a full-fledged study.

Presentation 4: Financing options

12:15 A.M to 12:30 A.M: Mr. Nguyen Hong Hanh presented on various sources of finance that can be accessed for rice husk valorisation projects

Presentation 5: Post-assistance plans and discussion

12:30 A.M to 12:40 A.M: Mr. Eric discussed post-assistance plans

Presentation 6: Closing remarks by request proponent of the assignment

12:40 A.M to 12:50 A.M: Mr. Trung of VNCPC presented about the background of the request and the work that VNCPC has worked on prior to this assignment, notably the RECP (Resource efficiency and Cleaner Production) project in the rice and coffee sector. This project focussed on improving energy efficiency improvement in rice mills, such as energy efficient lighting, higher efficiency motors and efficient paddy drying equipment. Examples were provided by technical solutions but also in the introduction of 'proper housekeeping' which does not require anything else than staff taking better care of equipment and act consciousness with regard to efficiency and energy saving by simple measures.

Based on the observations and analysis of the RECP the response request to the CTCN was developed. It was also well noted that rice husk was underutilized and sometimes dumped at the time of the request formulation but that this has changed dramatically over time. VNCPC agreed with Eric's presentation on biochar and ASA business models.

Closing remarks

12:50 A.M to 1:00 P.M: Mr. Tan closed the workshop and mentioned

- Discussions were very supportive, clear and specific.
- Thanked SNV's effort on this assignment and many thanks for rice mills attending the workshop.
- The project was successful, activities met the requirements
- From NDE, supports follow up and expects to receive proposals from participants.
- NDE will coordinate with SNV and CTCN.

Annex III: Field visits

In the context of the workshop, a field visit to JIC and Song Hau Food Company was organized.

Visit JIC Vietnam factory: 30 August

Welcome remarks: Mr. Norimoto introduced JIC Japan and JIC Vietnam in An Giang province. JIC is a Japanese company that is producing thermal insulation material from crystalline rice husk ash and lime. Their factory is located in An Giang as commonly rice is cultivated 3 times per year ensuring a year-round availability of husk. Lime originates from Thailand but they are considering of obtaining it from the north of Viet Nam if the quality is high enough.

Their calcium silicate material is sold in various Asian countries including Vietnam. Uses include insulation of steam pipes, boilers and other high thermal applications. They produce around 1000 ton per year. The market for their products is difficult as companies are very price conscience and are not willing to pay a higher price for a superior product. The factory is unique in the world and the only one that is producing this material from rice husk ash. For that reason, the factory was visited. The participants were impressed and enthusiastic about the process. There are opportunities for UNIDO to work this factory for their project that focusing on improving energy efficiency of boilers. The insulation of JIC which is heat resistant to 1000 degrees Celsius could for example insulate certain parts. SNV also expressed interest in the material as it could be used to insulated clean cooking stoves.

Visit production area: Mr. Norimoto introduced facility and utility area of JIC Vietnam factory, includes:

- Boiler system: produce heat and ash with high silica content
- Autoclave: mixes lime with silica.
- Die presses
- Drying area and product storage.
- R&D room.

Visit Song Hau food company: 31 August

Welcome to Song Hau: Mr. Đỗ Hoàng Thanh on behalf or Song Hau Food Company introduced Song Hau's business.

Questions and answers:

Mr. Nguyen Duc Quyen: he proposed a cooperation with SHF in investing in power and silica production system.

Mr. Nguyen Van Huy: He is expecting to support for rice mill regarding on TA. He also wants to evaluate effective from the project. Addition, will consider sustainability of the project and demands on the next steps.

Mr. Thanh: After setting up a joint stock company, SHF will be focus on expanding raw material and invest new branch in other districts (Vinh Thanh, Co Do, Thoi Loi). A briquette business plan in Vinh Thanh is one of plan that SHF will implement in the future. By using valorisation tool helped SHF more information that aim to make a decision properly.

Mr. Nguyen Van Huy: shared with audience about cooperation between Vietnam and Japan in mechanism of emission reduction. NDE will support rice mills in connecting with Japan's enterprises.

Mr. Hoang Mai Van Anh: She wants to know the effectiveness of UNIDO's projects through RECP and CTCN.

Mr. Nguyen Thanh Trung: he shared with audience that SHF's representative presented the RECP's result in VNCPC's workshop on March 2017.

Mr. Thanh regarded the RECP intervention and the business plan very useful.

Visit to production area:

Mr. Thanh showed the following to the participants

- Tra Noc' port area
- Fluidized bed dryer area
- Polishing area
- Paddy storage