



Green Industry

Resource Efficient and Cleaner Production for Sustainable Rice Milling in Cambodia

Teaching Note

CASE SUMMARY

The case study is based on the first-hand experience from UNIDO's ongoing technical cooperation work with pilot companies, namely small-scale rice mills in Cambodia, while focusing on the experience of Vinh Cheang Rice Company in Kampong Cham Province. This company is used here to illustrate challenges that are typical and common to any enterprise in the rice milling sector in Cambodia. It makes use of tools modified from UNIDO's Cleaner Production Toolkit which was developed by the Cleaner and Sustainable Production Unit of UNIDO's Environmental Management Branch and also draws from UNIDO's related work in this area of agro-industry.

For Asia's 4 billion people, rice is the main staple food and is therefore the subject of many studies which tend to focus on sustainable agricultural practices - how to achieve greater efficiency and higher yields with fewer inputs. This case study differs looking at both rice cultivation and processing it focuses mainly on rice milling. Key to the approach in the project is UNIDO's Green Industry Initiative which launched in 2009, a two-pronged strategy which comprises, firstly, the '*greening of industries*' or reductions in the use of natural resources and of the generation of waste and pollution in any business and secondly, the creation of '*green industries*' which bring to market high quality environmental goods and services in an effective and industrial manner.

LEARNING OBJECTIVE

- To promote resource efficient and cleaner production (RECP) for better informed policymaking



TIPS FOR FACILITATORS

Problem

- Achieving cleaner production in rice milling in Cambodia as triple-bottom line solution to increased profits for companies through greater efficiency and a better bottom line, greater food security through the minimisation of post harvest losses and environmental sustainability through comprehensive utilisation of rice husks, bran and broken rice.

Learning Points

- RECP has been empirically demonstrated by UNIDO and UNEP amongst others as a successful win-win approach delivering savings and improving environmental sustainability at enterprise-level. Such tools can also offer policymakers a framework to examine and appreciate complex problems from the micro-level perspective of the company and its routine operations. In tackling sustainable production and consumption, this grasp of production systems and how cleaner production (CP) techniques can be applied to optimize processes allows for triple-bottom-line considerations to be more fully reflected in policy decisions.
- The importance of preventing post harvest losses, typical challenges faced by rice mills in Cambodia, and recommendations of specific cleaner production options in rice milling based on UNIDO’s technical cooperation work

FACILITATION OF THE LEARNING PROCESS

Strategy for the Session

The purpose of the case study is to show the value that RECP as a methodology can offer to policymakers. Ideally all five tasks would be taught in sequence (as below) so that participants have a good grasp of the “full picture” scenario to allow them to make more informed policy recommendations.

Note: the sample solutions in the teaching note are for reference only and are *not* exhaustive.

Approximately two to two and half hours should be allowed for the session as below. However, if scheduling does not so permit suggestions follow of how to save time.

Following the introductory presentation, approximately half an hour should be allowed for each task and each table to be completed in small groups including discussion then led by the instructor.

Task 1: Sustainable Development Baseline: this exercise is straight forward and important to understanding the underlying problems. The instructor should therefore go through the value chain map in full.



Task 2: Process Flow Diagram: if there is insufficient time than the Instructor should provide the flowchart and simply work through it with the participants.

Task 3: Cleaner Production Options for Rice Mills: ideally following discussion in small groups, the Instructor should go through and explain the challenges of each production process in detail and work with participants to identify all possible cleaner production options. However, with limited time, focus could be placed just on those problems and CP options identified by participants giving some other pertinent examples as appropriate.

Task 4: Rice Husk Utilization: more time can be spent on this exercise with a more technical audience following completion of the table in small groups. With limited time, the information can be taken at face value and participants can simply decide which option is best based on the context.

Task 5: Suggestions for Policy Recommendations: while the first four tasks focus on that information presented in this case study,¹ this exercise is intended to be very open-ended and allow participants to offer their insights from their own experiences. There would be the possibility of more innovative solutions than those presented in the teaching note given the complexity of the problems presented. To allow for greater discussion and given that participants will already have examined in great detail the scenario at hand, Task 5 could also be carried out as a plenary brainstorming session without completing Table 5 in small groups first to save time and allow for more discussion.

Other Options:

The purpose of the case study is to show the usefulness of the RECP approach for an insight from the company's perspective for better informed policymaking. If time for the session is limited and/or assuming a narrower focus excluding policy considerations, a more in-depth stand alone session on RECP is also possible focusing just on Tasks 2-4, as described above.

¹ It should be emphasized that the case study is a simplified illustration of the actual scenario tackled in the joint programme and that RECP and Value Chain Diagnostics methodologies are actually more complicated and involve more steps and require a lot more comprehensive information than can be tackled in the space of a half-day classroom session.



Task 1: Sustainable Development Opportunities – Solution

Using the following table, please characterize the baseline situation of the rice sector from the different sustainability perspectives and identify opportunities and constraints for enhancing the sector’s contribution to sustainable development and poverty alleviation.

Aspects	Current situation	Potential (what are potential benefits from rice sector development)	Challenges (what needs to change to realize these potential benefits)
Agronomy and productivity	<ul style="list-style-type: none"> - Production is increasing - Resource intensive – excessive use of pesticides and fertilizers - Climate change - Water scarcity – irrigation, seawater intrusion by coastal areas - Intensive rice production – monoculture, loss of soil fertility 	<ul style="list-style-type: none"> - Increased yields - Most sustainable agriculture practices – conservation agriculture - Better livelihoods for farmers 	<ul style="list-style-type: none"> - Reduce factor inputs, including water, fertilizers, pesticides etc. - Good quality seeds - Machinery - Meteorological data - Awareness, information - Agricultural extension services - Loss of agricultural land to other land uses
Incomes and employment	<ul style="list-style-type: none"> - Large rural population - subsistence still way of life 60-80% of people - Important employer 	<ul style="list-style-type: none"> - Greater incomes and better livelihoods 	<ul style="list-style-type: none"> - Less waste - Increased productivity
Food security	<ul style="list-style-type: none"> - Closely linked with rural poverty - Little crop diversification - Low profits from rice cultivation - High malnutrition rates 	<ul style="list-style-type: none"> - Greater food security and poverty alleviation 	<ul style="list-style-type: none"> - Improved agricultural and market infrastructure – storage facilities - Support for areas with known absolute poverty
Markets	<ul style="list-style-type: none"> - Local and international - Poor market infrastructure - High transaction costs 	<ul style="list-style-type: none"> - Increased exports and export income 	<ul style="list-style-type: none"> - Production bottlenecks - Greater information - Finance - Policy



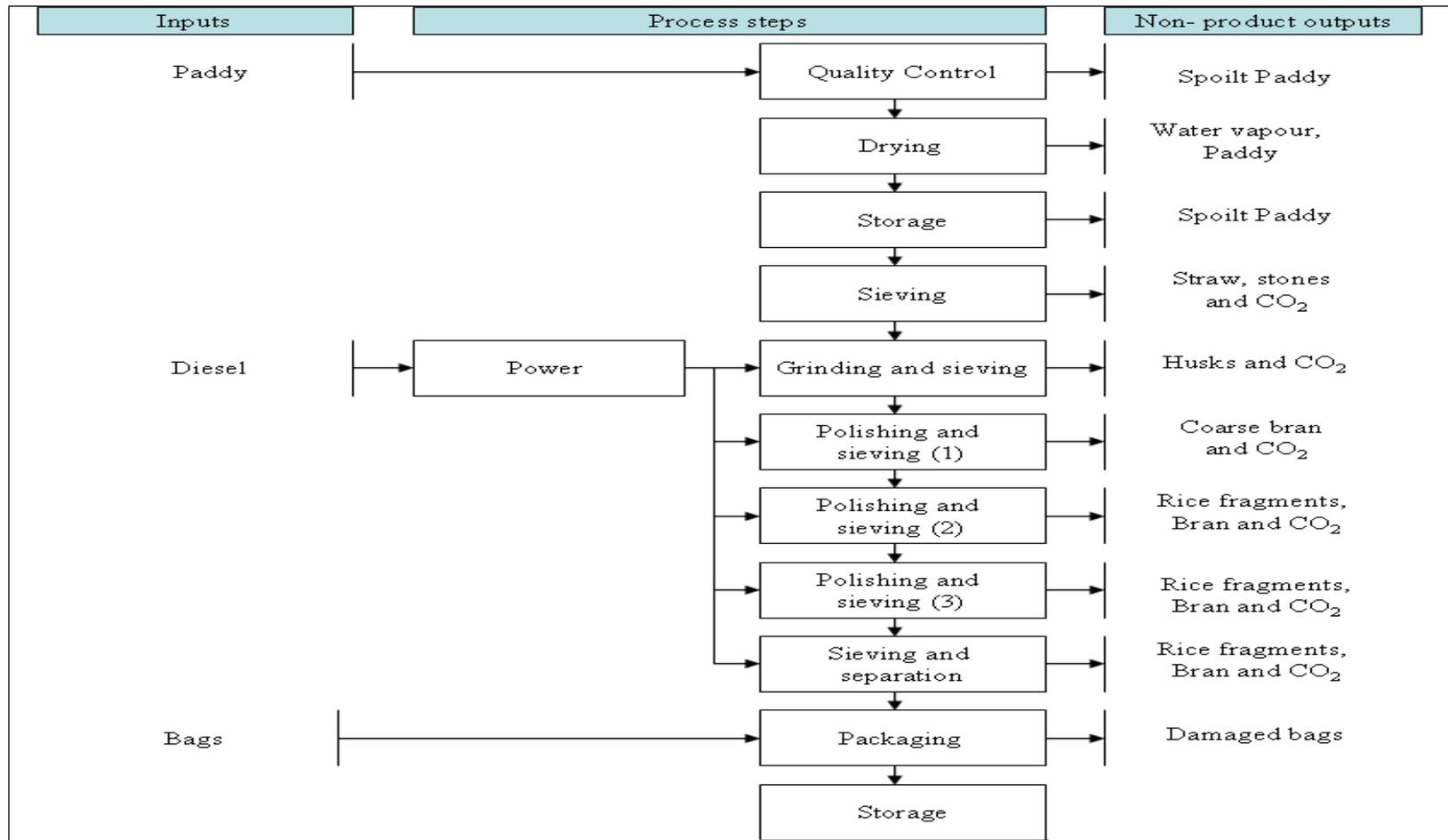
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Development of learning materials and methodological support on Sustainable Production and Consumption**

Resource use and environment	<ul style="list-style-type: none">- Water consumption in cultivation high- High energy consumption in milling- Energy supply problematic, price higher than neighbouring countries	<ul style="list-style-type: none">- Potential energy and water savings	<ul style="list-style-type: none">- Reducing usage of water and other resource inputs
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Task 2: Rice Milling – Process Flow Diagram

Waste and emissions arise from the points of production where materials are used, processed or treated, by identifying and analysing points of origin, volumes and causes of waste and emissions it is easier to find solutions to tackle them. From the description given in the case study, draw out below the process flow diagram showing the inputs, production processes and non product outputs at each stage of the rice-milling process.



Task 3: Cleaner Production Options for Rice Mills – Sample Solution

Following the process flow in the rice mill, identify Cleaner Production opportunities that might reduce wastage and energy consumption and improve rice quality. In doing so, please consider the specific applicability of five key techniques, namely:

- Good housekeeping – better work procedures
- Input substitution – use of alternative input materials
- Equipment modification – modifications of productive equipment
- Reuse and recycling – opportunities for making use of waste and turning these into by-products
- Product modification – changes in product specifications

Technique	Potential applications in rice milling
Good housekeeping	<ul style="list-style-type: none"> - Dry properly before storing - Store and process different types of paddy separately to avoid breakage - Keep workshop environment clean to avoid contamination of food - Ensure that sieves, grinding plates etc. are cleaned regularly and well maintained
Input substitution	<ul style="list-style-type: none"> - Use rice husks as biomass fuel to replace diesel oil - Buy rice at right time (when it is properly dried to mill efficiently) - Pick good quality rice (lower content of straw, sand, stones, broken grain etc.) - Introduce reusable bags for supply of rice from farmers
Equipment modification	<ul style="list-style-type: none"> - Use a mechanical dryer to dry properly, avoid spoilage and breakage - Introduce better ambient control of moisture, temperature and



	ventilation in storehouse - Apply more energy-efficient milling machine
Reuse and recycling	- Make use of rice husks as biomass fuel (as above) - Make use of broken rice as rice flour - With the right technology, rice bran makes a good binder for animal feed and bran oil can be used a vegetable oil for cooking; note bran tends to be underutilised in developing countries
Production modification	- Insert second bag inside rice sack to ensure that product is dry and does not spoil - Use bulk bags for milled rice

Task 4: Rice Husk Utilization – Solution

Consider the alternative use scenarios for rice husk, taking into consideration the dispersed generation of the total volume of rice husk from numerous small mills spread around the country. For each of these value-adding applications, identify the key market/economic potential and challenges for realization.

Use Scenario	Potential	Market Challenges
Combustion: production of heat	- No cost secondary material for rice mill - No additional transport costs if used on-site - Briquetting could produce a higher density fuel that might be easier to handle	- Bulky and dusty - Do not combust easily and slag easily, making it difficult to handle and clean - Rice husks are high in silica and therefore difficult to ignite - Rice dryer could be installed making use of waste process heat - Standards and technical regulations

		<ul style="list-style-type: none"> - Awareness raising on equipment and safety measures for domestic use
Insulation material	<ul style="list-style-type: none"> - Resistant to moisture penetration and fungal decomposition, - Use of rice husk - a secondary resource – avoids the need to mine and produce virgin materials - Do not burn very easily, and do not require flame/ smoulder retardants 	<ul style="list-style-type: none"> - Lack of awareness, conceptions/ misconceptions - Bulky – difficult to handle - Transport costs - Need to identify a suitable market/ buyer - Standards and technical regulations - Awareness raising
Pozzolan: pozzolanic cement	<ul style="list-style-type: none"> - Rice husks are high in silica and have good cementitious properties - Lower kiln temperatures needed compared to ordinary Portland cement (OPC) - Lower environmental impact of cement making due to reduction of process related GHG emissions - Improved durability, resistance to chemical attack, reduced shrinkage and permeability and better insulation than OPC concrete - Free of charge rice husks could be processed into cheaper cement. 	<ul style="list-style-type: none"> - Need to identify a suitable market/ buyer who can process pozzolanic cement - Transport costs - Standards and technical regulations for use of pozzolanic cement in the building industry - Awareness raising - Fiscal incentives - Further research and development
Gasification: power generation	<ul style="list-style-type: none"> - Gasification produces synthesis gas that can be utilized to produce electricity - independent power production - Reduce consumption of diesel - Rice dryer could be installed making use of waste process heat 	<ul style="list-style-type: none"> - Technology and capacity building needed - Lower energy content than natural gas - Diesel oil still required: at the moment, gasifiers mostly rely on dual fuel mix of diesel oil and producer gas - Capacity building, maintenance, after-sales support and spare parts - Demonstration projects

Case 10:
Resource Efficient and Cleaner Production for Sustainable Rice Milling in Cambodia



		<ul style="list-style-type: none">- Emphasis on localization -modification of technology to suit local context- Finance
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Task 5: A sectoral strategy for the Rice Cultivation and Production

From your understanding of the rice cultivation and production and the wider socio-economic context in Cambodia, identify the key development priorities in each of the areas below and make your suggestions for policy recommendations in this regard.

	Development priorities	Policy recommendations for an enabling environment
Agriculture and Rice Cultivation	<ul style="list-style-type: none"> - Increased rice productivity - Greater crop diversification - Sustainable agriculture 	<ul style="list-style-type: none"> - Promote research and development, innovation and studying of best practice at an international level
Rice Production	<ul style="list-style-type: none"> - Reduced PHL - Increased efficiency 	<ul style="list-style-type: none"> - Business advisory services
Livelihoods	<ul style="list-style-type: none"> - Training for farmers, rice mills 	<ul style="list-style-type: none"> - Capacity development
Food Security	<ul style="list-style-type: none"> - Crop diversification 	<ul style="list-style-type: none"> - Identify and provide targeted support to food insecure areas
Resource use and environment	<ul style="list-style-type: none"> - Comprehensive utilization of rice husks 	<ul style="list-style-type: none"> - Create targets for uptake utilization - Promote awareness raising of environmental best practice
Markets	<ul style="list-style-type: none"> - Find new overseas markets but meeting the needs of local market first 	<ul style="list-style-type: none"> - Investment in infrastructure

FURTHER SOURCES OF INFORMATION

FAO Global Information and Early Warning System on Food and Agriculture (GIEWS),
Cambodia Country Brief, 27th June 2012:

<http://www.fao.org/giews/countrybrief/country.jsp?code=KHM>

International Rice Research Institute: www.irri.org

National Cleaner Production Office – Cambodia: www.cambodian-cpc.org/en/

Rice Knowledge Bank: www.knowledgebank.irri.org

UNIDO Cleaner and Sustainable Production Unit Homepage: www.unido.org/cp

UNIDO 2011, *UNIDO Green Industry – policies for supporting Green Industry*, UNIDO,
Vienna