INTERNATIONAL RICE RESEARCH INSTITUTE

# Project: Scalable straw management options for improved livelihoods, sustainability, and a low environmental footprint in rice-based production systems

# Business model for a rice straw collection service provider in Vietnam

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## 1. Introduction

Rice straw is a byproduct of harvesting paddy. After traditional manual harvesting, rice straw is usually collected, carried out from the field, and saved for other uses. However, with farmers' wide adoption and use of combine harvesters that leave the rice straw spread out in the field, gathering it has become more difficult and tedious. This has resulted in the increased cost of gathering straw which, together with the heavy labor requirement during harvesting, makes manual collection of rice straw unfeasible.

In Vietnam, the total area planted to rice is about 7.5 million ha, with a total grain yield of 40 million tons (Mt). About 55% of the country's rice production occurs in the Mekong River Delta (MRD). Correspondingly, about 13 Mt of rice straw, which makes up 60% of the rice straw produced in the MRD, is considered surplus and left to be burned in the field or considered as waste material. The remaining 40% is collected for mushroom and livestock production or for use as mulching material. In the MRD, about 90% of the paddy is combine-harvested. The straw left in the wet field is difficult to collect efficiently. Farmers' only option is to burn the straw in the field. Research shows that partial removal of rice straw from the field does not significantly affect grain yield. Off-field rice straw can be used for nonenergy purposes such as biochar, fertilizer, mushroom production, animal bedding, and fodder. It can also be converted into energy products such as fuel to generate heat or electricity.

Mechanization of rice straw collection in Vietnam has rapidly developed since its introduction in 2013. Contributing to this development, the BMZ-funded rice straw management project of the International Rice Research Institute (IRRI; www.ricestraw.irri.org) has researched, promoted, and demonstrated sustainable practices such as mechanized collection, compacting services, mushroom production, etc. Through these interventions, about 20–30% of the rice straw produced during the dry season in the MRD is now used for producing mushrooms, livestock fodder, or mulching materials.

Rice straw business practices recently developed in Vietnam include collection and transportation services and mushroom farming and processing. However, there is limited literature on developing these business practices because most were farmer-developed or were extensions of other existing services. Based on recent assessments, this executive summary describes a business model for a rice straw baling service provider that was set up in 2016 Tien Giang provinces.

## 2. Business description

### 2.1 Business model canvas

Figure 1 shows the business model canvas for straw collection that involves key partners, activities, value propositions, and customer relationships and segments.

### 2.2 Supply chain of rice straw

Figure 2 shows the existing rice straw supply chain in Vietnam, including all key processes such as collection, handling, transportation, compacting, storage, pre-processing, and processing to provide the corresponding markets. Because rice straw cost consists of more than 70% from collection and transportation, straw collection and densification are considered as the bottlenecks in the supply chain (Figure 3).

**Key partners**
- Farmers and/or farmer groups
- Machine manufacturers
- Maintenance/ repair services
- Transportation services
- Dairy farms/ companies
- Mushroom producers
- Other trading actors (e.g., for bedding, protection for transportation of fragile products

**Activities**
- Procurement of rice straw spread in the field (from farmers
- Collection
- Transportation
- Storage
- Procurement of straw bales
- Marketing
- Business and production management

**Resources**
- Rice straw
- Infrastructure
- Labor

**Value propositions**
- Value added from this business
- Value added to rice production and farmers
- Enabling feedstock for further production (cattle feed, mushroom, etc.) ➔ value added from these businesses
- Reducing environmental footprint caused by traditional practices (burning, incorporation)

**Customer relationships**
- Contract with farmers (feed stock)
- Contract for selling product (straw bales)

**Channels**
- Selling round bales to mushroom, small-scale cattle farms
- Selling round bales to further pre-processing such as compacting bales for hi-end markets, dairy farms

**Customer Segments**
- Farmers/farmer groups
- Rice straw traders
- Rice straw-based food and feed producers
- Rice straw-based compost producers
- Bio-energy producers

**Cost structure**
Salaries, depreciation, operating

**Profit**

**Revenue streams**: Income from sales and service provision

**Figure 1. Business model canvas for straw collection.**

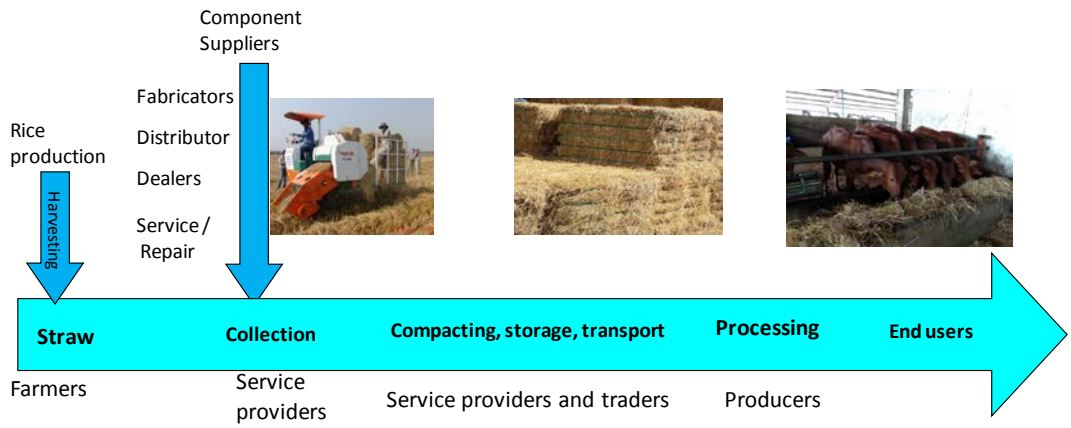



**Figure 2. Rice straw supply chain in Vietnam's MRD.**

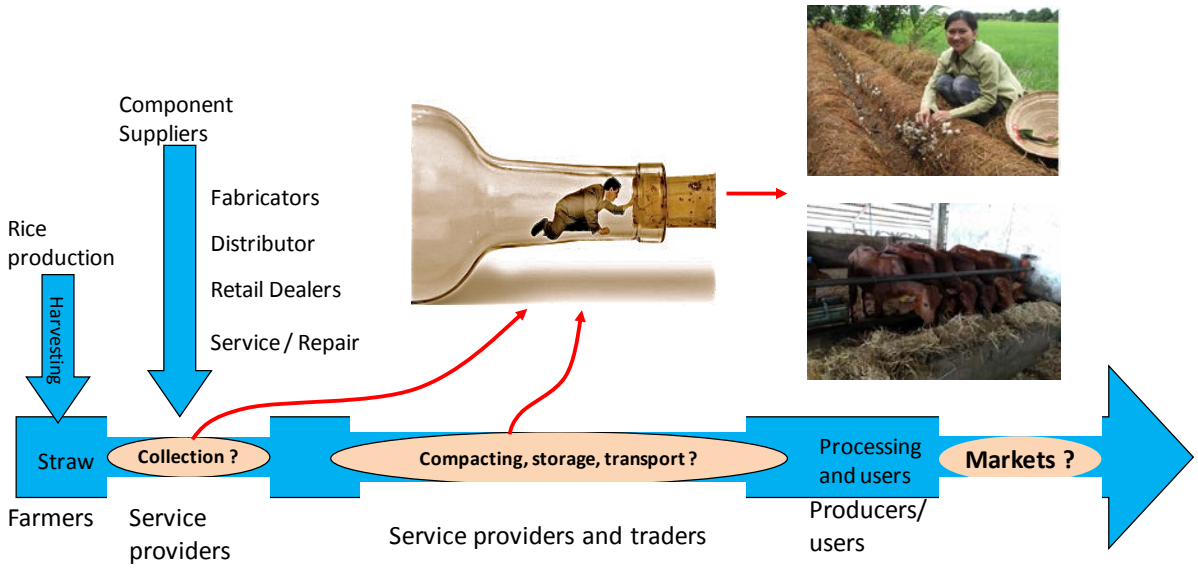



**Figure 3. Bottlenecks in the rice straw supply chain.**

### 2.3 Technology options for rice straw balers

Straw collection involves three main operations: (1) picking up loose straw in the field, (2) compacting it into bales, and (3) transporting the bales to the bunds. To mechanize these activities, a baler, which collects the straw and compacts it, is most commonly used. A stationary baler with only a compaction unit can properly compact the straw expelled and piled by a stationary thresher. A mobile baler (either self-propelled or pulled by a tractor) is better used for collecting rice straw left spread out in the field by the combine harvester. There are two types of balers as defined by the operating principle of the compacting unit. The roller-type makes round bales (Figure 4a); the piston-type makes square bales (Figure 4b).

Table 1 shows the type of balers currently used for collecting rice straw in Southeast Asia (SEA). These include:

1) Large-scale round baler (500 kg/bale; 3–4 t/h; Figure 5a): The baler is pulled by a tractor and gathers the straw in a bale but leaves the bales in the field to be collected and transported to the bund in a separate operation. This baler cannot work continuously but must be stopped to tighten and unload the bales.
2) Small-scale round baler (13 kg/bale; 1.3–1.6 t/h; Figure 5b): Operation is the same as for large-scale round balers.
3) Self-propelled baler: (13 kg/bale; 1–1.3 t/h; Figure 5c): This machine combines, bales, and delivers the bales to the bund. Although this baler uses a higher-capacity engine (45 hp) than the small-scale round baler (30 hp), its collection capacity is slightly lower as it move on rubber-chain wheels. However, due to these wheels, this baler can work in wet fields.

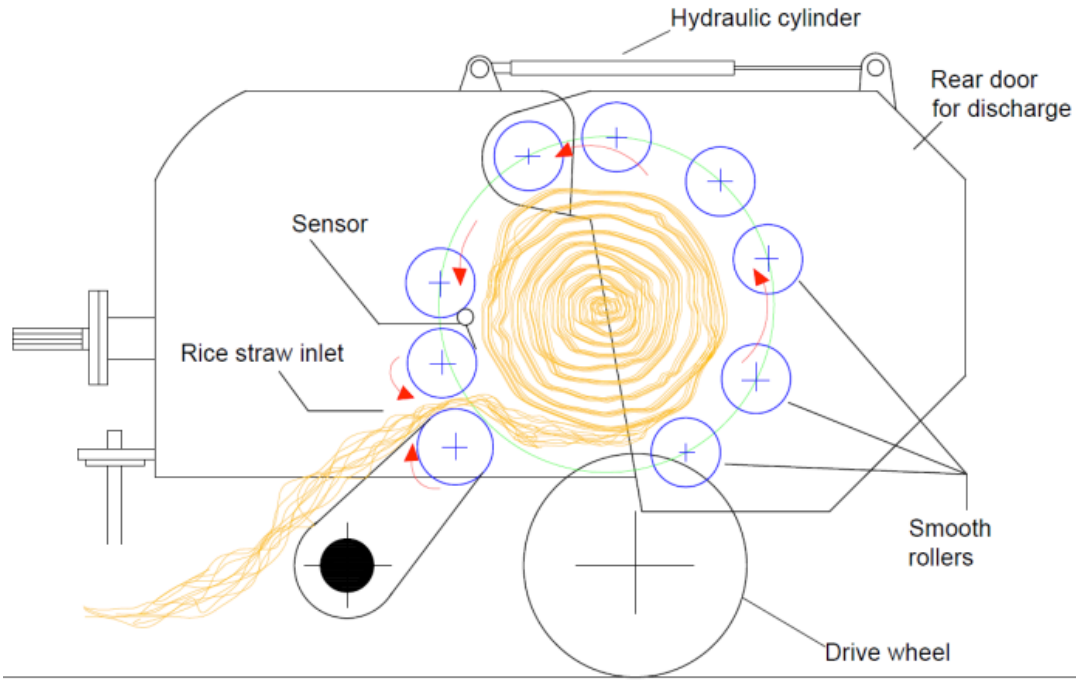



**Figure 4a. Roller-type straw baler (right side view).**

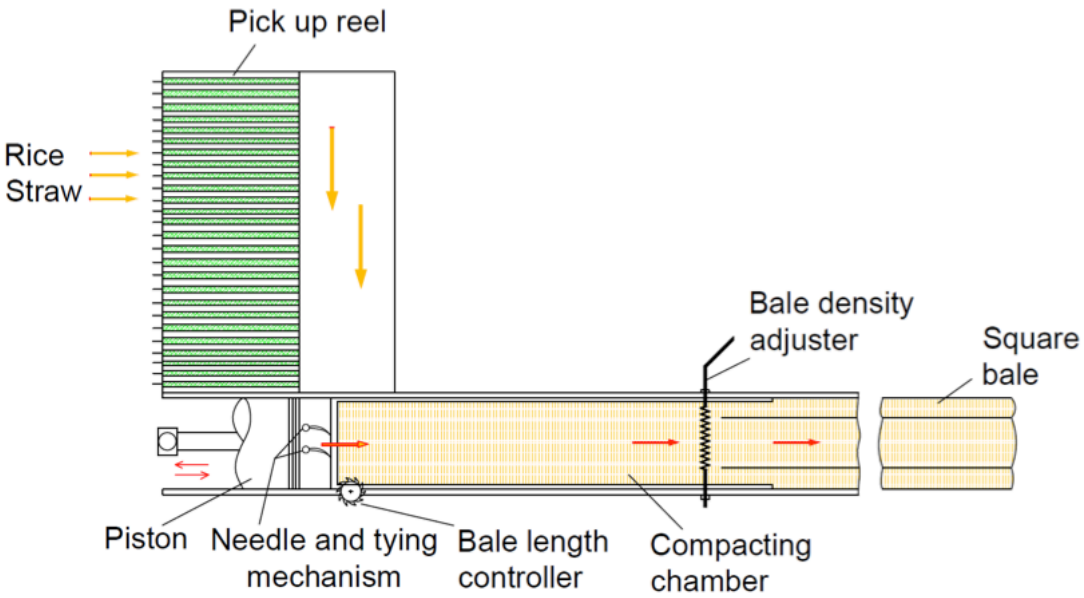



**Figure 4b. Piston-type rice straw baler (top view).**

4) Square baler (15–20 kg/bale; 1.5–2 t/h) (Figure 5d): This machine operates similarly to (1) and (2) but makes square bales. It uses a piston, as illustrated in Figure 4b, for compacting and making the bales. It can move continuously without having to stop to unload bales.

**Figure 5a. Large-scale round baler (500 kg/bale).**

**Figure 5b. Small-scale round baler (13 kg/bale).**

**Figure 5c. Self-propelled baler.**

**Figure 5d. Piston-type square baler.**

**Table 1. Characteristics of currently used balers for rice straw collection.**

| Features | Large-scale round baler | Small-scale round baler | Self-propelled baler | Square baler |
|---|---|---|---|---|
| Capacity (t/h) | 3–4 | 1.3–1.6 | 1–1.3 | 1.5–2 |
| Bale weight at 14% moisture (kg/bale) | 500–600 | 13–15 | 13–15 | 15–20 |
| Investment cost, 2016 (USD) | 19,000–25,000 | 5,000–8,000 | 12,000–15,000 | 16,000–18,000 |
| Engine, pulled by tractor (hp) | 80 | 30 | 45 | 50 |
| Fuel (diesel) consumption (L/ton of straw) | 3–4 | 2–3 | 3–4 | 3–4 |

The small-scale round baler is best for this business model because:

- it is more suitable for its size and can navigate in wet fields; and
- it has a lower investment cost making it better for a business startup in a developing country.

### 2.4 Feedstock and markets

#### 2.4.1 Rice straw availability in Vietnam

Open-field rice straw burning is common in the MRD, but it is rare in the cental provinces. Based on data from our recent asessments during 2013-17, estimates of rice straw volume and amount of straw burned in the field are summarized in Table 2.

**Table 2. Rice straw statistics for four regions in Vietnam.**

| Region | Straw volume (Mt/year) | Straw burned in the field (Mt/year) |
|---|---|---|
| Central Vietnam | 3.39 | 0.40 |
| Mekong River Delta | 13.76 | 3.59 |
| Red River Delta | 10.30 | 1.53 |
| Southeastern Vietnam | 2.17 | 0.37 |
| Total | 29.62 | 5.89 |

There is a marked difference between provinces in the MRD and those in central and northern Vietnam. In the Deltas, from 40 to 60% of the rice straw is burned in the field (Figure 6).

**Figure 6. Rice straw being burned in the field.**

### 2.4.2 Market for rice straw and straw bales

Table 3 shows rice straw cost during the dry seasons in the MRD for the 2013–15. Demands for rice straw and straw baling services affect the straw cost. In 2013, there were few rice straw baling services available and a few traders buying rice straw out of the field. At that time, farmers were selling their in-field spread straw to traders for about 10–15 USD/ha.

Through the introduction of balers in subsequent years, there arose a significant increase in baling services and traders to buy the bales. This resulted in competition for rice straw purchased and increasing in-field rice straw costs. However, the growth of baling services subsequently led to a reduction in the price of straw bales by 2015. However, as the status of baling service providers and the market became balanced, in-field rice straw costs and bale prices did not change much over the 3-year period.

**Table 3. In-field rice straw costs and round bale prices in MRD during 2013–15.**

| Year | Spread in the field (USD/ha) | Baled straw* at the field (USD/t) | Baled straw at the market** (USD/t) |
|---|---|---|---|
| 2013 | 10–15 | 90–95 | 110–115 |
| 2014 | 15–20 | 80–85 | 100–105 |
| 2015 | 20–25 | 60–65 | 95–100 |

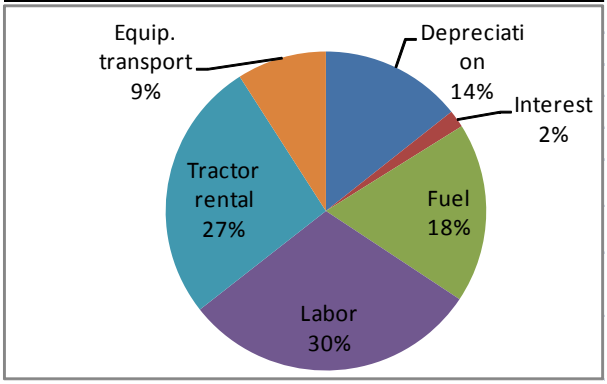
** Baled straw 13–16 kg/bale at 15–18% moisture content, collected in the field and placed on the bund.*

*** Baled straw 13–16 kg/bale at 15–18% moisture content, transported to and sold at the storage house or shop within a distance of from 100 to 200 km.*

## 3. Financial analysis

| Financial analysis of rice straw baler service provider | | | Input data |
|---|---|---|---|
| STT | Investment | $US | |
| 1/ | **Investment cost** | **5,455** | |
| 1 | **Equipment** | **5,000** | |
| | Baler | 5,000 | |
| 2 | **Workshop for parking and maintenance** | 455 | |
| 2/ | **Depreciation** | **2** | |
| 1 | Life span of equipment (year) | 5.0 | |
| 2 | Life span of workshop, (year) | 7.0 | |
| 3 | Working time a day, (hour/day) | 8.0 | |
| 4 | Maintenance coefficience | 1.5 | |
| 5 | Capaity (hour/ton) | 0.45 | |
| 6 | Working days each year, (days/year) | 90 | |
| 7 | Capacity per year, (tons/year) | 1,584 | |
| 8 | Depreciation of equipment per year, | 1,000 | |
| 9 | Depreciation of workshop per year, | 65 | |
| 10 | Depreciation cost of equipment ($US/tons) | 0.63 | |
| 11 | Depreciation cost of workshop ($US/ton) | 0.04 | |
| 12 | Total depreciation cost ($US/ton) | 0.67 | |
| 13 | **Total depreciation and maintenance cost ($US/ton)** | **1.01** | |
| 3/ | **Interest, ($US/ton)** | **0.21** | |
| 1 | Bank interest, (%/year) | 12.00 | |
| 2 | Anualy interest ($US/year) | 327 | |
| 3 | **Interest cost ($US/ton)** | **0.21** | |
| 4/ | **Labor ($US/ton)** | **3.53** | |
| 1 | Baler driver (hour/ton) | 0.45 | |
| 2 | Baler driver ($US/day) | 13.64 | |
| 3 | Handling bales to the bund (hour/ton) | 2.20 | |
| 4 | Labor for handling ($US/day) | 9.09 | |
| 5 | Management ($US/day) | 4.55 | |
| 5/ | **Fuel consumption ($US/ton)** | **2.13** | |
| 1 | Diesel price ($US/liter) | 0.82 | |
| 2 | Fuel consumption for tractor 25-30 Hp, (lit/ton) - hauling baler | 2.60 | |
| 6/ | **Tractor rent cost ($US/ton)** | **3.10** | |
| 1 | Tractor renting price, ($US/h) | 6.82 | |
| 2 | Tractor renting cost, ($US/ton) | 3.10 | |
| 7/ | **Transportation of tractor and baler, 10% of baling cost ($US/ton)** | 1.06 | |
| 8/ | **Total cost before tax, ($US/ton)** | **11.82** | |
| 1 | Total cost before tax, ($US/ton) | 11.71 | |
| 2 | Tax 10%, ($US) | 0.11 | |
| 9/ | **Straw baling service fee ($US/ton)** | 15.00 | |
| 10/ | **Net Profit, ($US/ton)** | **3.18** | |

| Total baling and transport cost | $US/ton | % |
|---|---|---|
| Depreciation | 1.68 | 14.4 |
| Interest | 0.21 | 1.8 |
| Fuel | 2.13 | 18.2 |
| Labor | 3.53 | 30.2 |
| Tractor rental | 3.10 | 26.5 |
| Equip. transport | 1.06 | 9.1 |
| **Total** | **11.71** | 100 |




**9/ Capital return**

| | | |
|---|---|---|
| Income ($US/year) | **23 760** | |
| Total cost ($US/year) | 18 720 | |
| Net Profit ($US/year) | 5 040 | |
| Time of capital return (year) | 1.08 | |

**10/ IRR**

| End (year) | $US | Note |
|---|---|---|
| 0 | - 5 455 | Invest |
| 1 | 5 040 | Profit |
| 2 | 5 040 | |
| 3 | 5 040 | |
| 4 | 5 040 | |
| 5 | 5 040 | |
| **IRR** | **88. 5** | |