RICE HARVEST HANDLING TO REDUCE YIELD LOSSES IN SOUTH SULAWESI
(Penanganan Panen untuk Menekan Kehilangan Hasil Gabah di Sulawesi Selatan)

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Abstract

Milled rice is main food has to priority to increasing the productivity. There was yield losses at the harvesting time. The best harvest handling by using thresher machine could be reduce yield losses and time allocation. Experiment was conducted at South Sulawesi, during May - December 2009. The objectives the experiments were to known the effect of rice harvest machineries on save yield losses. The replication arranged in randomized complete design with three replication. Treatment consist of 1) Chandue harvester machine, power thresher and sembada variety, 2) Chandue harvester machine, power thresher and Cisantana variety, 3) Chandue harvester machine, power thresher and impari 9 variety, 4) Hoe panicle cutter, power thresher and Ciliwung, 5) Hoe panicle cutter, foot tool thresher and chiherang variety, 6) Hoe panicle cutter, manual thresher and Cigeulis. The result of the experiment indicated that The farmar in Pinrang District used chandue at harversting time and in Maros District used hoe. Chandue machine could be harvest rice 0.37 – 0.42 ha/hour or equivalent 2.37 – 2.60 ton grain field dry /hour. While traditional thresher tool range 2.76 – 3.09 ton/hour. Manpower capability to harvest 0.0129 ha/hour or 0.093 ton/hour (equivalent 25 man/chandue). Grain Yield losses about 3.3 – 7.56%. Variabel labour, time and chandue thresher have positive effect, while variable hoe pedal and hoe slam were negative. Economic feasibility as NPV of 15% Rp 4,020,056; IRR of 22.64; B/C of 0.37 and periode return of investment on second year. For reduce yield losses and time allocation on harvest we suggest as first, rice harvest agriculture machinery specially chandue need to improve in order yieldlosses could be reduce. Secondly, Pinrang government official need to train for chandue operator and third chandue to promote at in other area to support 400 rice planting Index.

Key words: harvest, grain, yield losses.

INTRODUCTION

Milled rice is main food in some area in Indonesia, so that rice has strategic value as well as economic, environment, social and politic. Milled rice is a commodity that must be constantly improved its production year by the year. Rice is the most profitable commodity to be developed. Position as the main ingredient that makes it worth to be developed. Up to now rice still prioritized in food crop sector development, beside has important role in food secure also contribute to national product domestic bruto (PDB) about 3.5 % on 2003 (Hafsah, 2005).

Rice milled demand always increase causing by population increase, indicated that rice milled demand have to follow up by increasing rice productivity. Agriculture
Institute research program and development launching 400 rice index planting program on 2009 (Head of Agriculture institute research and development, 2008). The rice increasing effort need efficient both time and labor for rice harvest, so the next cropping can be hunt, late harvest will be influence to the late next rice cultivation.

Rice harvest handling has important role to reduce yield losses. There were yield losses about 18.6% in processing rice panicle to grain and equivalent yield rice at least 3,229,912 ton/year (BPS Prov. South-Sulawesi, 2005), so yield losses obtained 738,039 ton/year. This yield losses value could be reduced and substituted to support food crop subsystem and as source of income product domestic bruto in South Sulawesi. Reducing yield losses will be pushed by using the best power thresher.

Harvesting late 1 week could be increasing losses 3.35% to 8.64%. Harvesting with bad method could be yield high losses at harvest time and thresh losses achieved 18.6% (Setyono, et al., 1990). Yield losses process with time period of delay thresh after harvest, if delay 1 night will be loss 0.87%, 2 night 1.35% and 3 night become 3.12% (Nugraha, et al., 1990).

Rice thresher with 3,600 rpm engine and 561 rpm as thresher (loading) has processed capacity 752 kg/hour and can be reduced yield losses 5.17% (Anonym, 1998). Operation thresher type ANM-G2 system knockdown should reduce yield losses 3.15% (Hasbulah, 2008). Operation this thresher saving yield losses in South Sulawesi 559,481 ton/year (73,039 ton/year – 178,558 ton/year). Rice harvest-ing with labour group 20-30 member/group and thresh with power thresher could reduce yield losses 15 - 16% to 4.31 - 4.91% compare with individual harvest labour with manual bamboo thresher (Anonim, 2008).

Operation thresher tool varied in South Sulawesi. Farmer in the village use manual thresher by using hoe knife and hit down. Basically assessment rice harvest handling need to conduct in effort specific area reduce yield losses due technically applicable, economic feasible and social acceptable.

RESEARCH METHOD

This assessment conducted in Pinrang and Maros District on May - December 2009 by considering the wide or rice field and location of integrated crop management farmer boarding school field in South Sulawesi.

Preliminary activity in the site was PRA. PRA conducted Associations of farmer group whom their member cultivated rice. There were 50 participants in PRA implementation who are farmers, farmer group member, village officer and agriculture government officer and extensions agent.

Harvester laborer efficiency get from ratio thresher capacity in kgs/hand harvester capacity in kgs/ha. Efficiency labor harvest be gotten from ratio between grain thresh capacity (kgs/hours) with labor harvest capacity (kgs/hours/person). By this way we can estimate how many labour need to harvest if uses special thresher. The formula will be use is

\[ E_{\text{Harvesting}} = \frac{K_{\text{pt}}}{K_{\text{op}}} \]

Where is harvester laborer efficiency, \( K_{\text{pt}} \) is power thresher capacity at certainty speedy, and \( K_{\text{op}} \) is harvested labour by certainly. To know efficiency and feasibilities of power thresher, data will gathering power thresher harvest is operating with 50 sample time harvesting. Lewangka (2003) stated that the minimum sample is 30 samples.

The effect of harvesting tool and thresher in grain yield losses by using randomized complete block design with 3 replication and consist of 6 treatment as follows;

1. Chandue machine harvester, power thresher, and Sembada variety.
II. Chandue machine harvester, power thresher, and Cisantana variety.

III. Chandue machine harvester, power thresher, and 9 Inpari variety.

IV. Hoe knife, power thresher, and Inpari variety.

V. Hoe knife, thresher pedal, Ciherang variety.

VI. Hoe knife, Manual thresher, Ciugelis variety.

Data gathered:

a. Yield loses at harvesting time (grs/m² size harvest plot)

b. Yield losses at temporary store before thresh (gr/25m² Size harvest plot)

c. Yield losses at threshering time (%)

d. Harvester labor capacity (kg/hour/person)

e. Thresher pattern capacity each tool (kg/hour)

f. Number of harvest labor need each unit thresher tool (person/unit)

g. Kind of cost (Rp)

Data will be tabulated then descriptive abstract. Technically efficiency, time allocation analysis. The production Cobb-Douglass (Soekartawi, 2003) as analysis tool has formula as follows;

\[ Y = a X_1 b_1 X_2 b_2 X_3 b_3 X_4 b_4 e^{\mu} \]

Where;

- \( Y \) = Product (kg),
- \( a \) = Intercept,
- \( X_1 \) = Harvester labor (person)
- \( X_2 \) = Fuel use (litre)
- \( X_3 \) = Cylinder speed (rpm),
- \( X_4 \) = Engine / machine
- \( b_1 \ldots b_4 \) = regression coefficient,
- \( e^{\mu} \) = number e due kuadrat with error term (\( \mu \))

Amount of \( b_1, b_2, b_3, \) and \( b_4 \) determine size of product elasticity (\( return \ of \ scale \) are;

- \( \sum b > 1 \), step of product elasticity increase.
- \( \sum b = 1 \), step of product elasticity increase.
- \( \sum b < 1 \), step of product elasticity decrease.

Labor and fuel efficient, calculate with formula; \( NPM_x = P_x \), where \( NPM_x \) is marginal value product, and \( P_x \) is input price. If value \( NPM_x/P_x = 1 \), input use optimal/efficient. Value \( NPM_x/P_x > 1 \), input use not optimal/efficient yet. Value \( NPM_x/P_x < 1 \), input use not optimum.

Rice power thresher feasibility with using 3 investments criterion were Net Present Value (NPV), Internal Rate of Return (IRR), and Net Benefit Cost Ratio (NBC). The each formula as follows;

\[ NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1 + i)^t} \]

\[ IRR = i' + \frac{NPV \ of \ i'}{NPV \ of \ i'' - i'} \]

\[ \frac{NB}{C} = \sum_{t=1}^{n} \frac{B_t - C_t}{\sum_{t=1}^{n} C_t - B_t} \]

\( (B_t - C_t > 0 \ and \ B_t - C_t < 0) \)

Where:

- \( n \) = Tool economic ages.
- \( i' \) = Lowest discount rate.
- \( i'' \) = Highest discount rate.
- \( B_t \) = gross benefit at year t.
- \( C_t \) = cost at year t.

All data gathered on trial analyzed F test, and continued by Duncan’s multiple range test, if treatment effected to parametric response. Feasibility test analyze will indicate the closeness of the test variables to each other with the help of spss. Relationship between duration of use isthe means and will to describe significantly. The same goes with other measures such as coefficient of lowest discount rate and highest discount rate with total expenditu rescan bemeasured clearly. Statistical
analyze use software spss 17 with degree of confidences 95 %.

RESULTS OF RESEARCH

Rice System Analysis

The farmers as manager has a role to decide what the commodity will they planting in their own land, commodity they crop, input, cost return and profit cropping system shown in Table 1.

Table 1. Cost Analysis, Gross Margin, and Net Gross Margin Rice Farming in One Season in Bantimurung Sub-District, Maros District, 2009.

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Volume (unit)</th>
<th>Unit cost (Rp/unit)</th>
<th>Amount (Rp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Product input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Seed (kg)</td>
<td>40</td>
<td>6,000</td>
<td>240,000</td>
</tr>
<tr>
<td></td>
<td>b. Urea</td>
<td></td>
<td>1,200</td>
<td>120,000</td>
</tr>
<tr>
<td></td>
<td>c. Fertilizer (kg)</td>
<td>100</td>
<td>1,800</td>
<td>180,000</td>
</tr>
<tr>
<td></td>
<td>d. NPK (kg)</td>
<td>100</td>
<td>3</td>
<td>51,000</td>
</tr>
<tr>
<td></td>
<td>e. PPC (lt)</td>
<td>3</td>
<td>17,000</td>
<td>51,000</td>
</tr>
<tr>
<td></td>
<td>f. Organic fertilizer (kg)</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>2</td>
<td>Labor cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Land preparation (ha)</td>
<td>1</td>
<td>400,000</td>
<td>400,000</td>
</tr>
<tr>
<td></td>
<td>b. Planting (ha)</td>
<td>1</td>
<td>250,000</td>
<td>250,000</td>
</tr>
<tr>
<td>3</td>
<td>Harvest cost (kg)</td>
<td>1,428</td>
<td>2,500</td>
<td>3,520,000</td>
</tr>
<tr>
<td>4</td>
<td>Gross margin</td>
<td>8,800</td>
<td>2,500</td>
<td>22,000,000</td>
</tr>
<tr>
<td>5</td>
<td>Net Margin</td>
<td></td>
<td></td>
<td>16,239,000</td>
</tr>
</tbody>
</table>

Source: PRA data analysis, 2009.

Problem Rice Harvest

On Participatory Rural Appraisal (PRA) some problem in rice harvest faced by farmer as follows; a) Harvester labor search on harvesting time, b) On threshing activity many grain still in panicle especially on manual thresh (hit down) and pedal thresher, c) less post for drying, and d) After cut panicle the labor put down on ground without plastic for collect the grain fall accumulation at harvest while not using a layer of tarpaulin in the fields. While the power thresher power used in areas that already use the tool chandue harvest. In areas that are still harvested using a sickle to deteriorate the grain is still using the pedal thresher, pedal thresher modified with 4.5 hp engine, and the slam.

Post Harvest Handling

Agriculture machinery operation in harvesting time more influence upon the productivity and yield losses. In handling harvest the farmer use chandue and power thresher Patampanua Sub-District. In this area there were 60 power thresher with average labor 10 - 24 person/unit. Engine capacity 13 HP, chandue and power thresher could be proceed 70 – 100 bag/day.

Rice Harvest Capability

There were two way the farmer handling harvest; first the farmer cut panicle by using hoe knife than use thresher and secondly use chandue machine. Both way haves difference capacity.

Chandue capacity is 0.37 – 0.42 ha/hour or 2.37 – 2.60 ton field dry grain (GKP)/hour, equivalent with 2.59 – 2.94 ha/day. While man power harvest capacity about 0.0129 ha/hour/person or 0.093 kg field dry grain/hour/person. Comparison between chandue and man power harvest is 1 : 28 person.
Chandue could be solve the limited man power available on harvesting time and the other hand chandue will be support index planting (IP) rice 400 the Agriculture Agency Research and Development program (Head of AARD, 2008).

**Grain Losses at Harvesting Time by Using Chandue**

Harvesting activity in Pinrang district is usually use chandue, but in Maros district isn’t yet. By use chandue as harvester is very efficient because in 1 day will be covered 2.59–2.94 ha. Equivalent with 26 harvest laborer. Grain loses with chadue showed at Table 2.

### Table 2. Percentage of Grain Losses on Harvesting Time With Chandue in Pinrang, 2009.

<table>
<thead>
<tr>
<th>No</th>
<th>Treatment</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sembada rice variety</td>
<td>4.48 a</td>
</tr>
<tr>
<td>2</td>
<td>Cisantana rice variety</td>
<td>8.75 b</td>
</tr>
<tr>
<td>3</td>
<td>Inpari 9 rice variety</td>
<td>2.63 a</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>5.29</strong></td>
</tr>
</tbody>
</table>

Table 2 shows that rice harvest by using chandue significantly different upon rice variety. Inpari 9, sembada and Cisantana rice variety has archived grain losses 2.63 %, 4.48 % and 8.75 % respectively. The average grain losses is 5.29 %. This average is lower than value target 4.5 % or there was different 0.79 %. Of the above information can be seen that the use of opium should be increased both in terms of capacity and user tools. Increased use chandue training as a tool to consider future alternatives. Training will be carried out in several areas that are conducive to supporting their training and obtain maximum results. The result of chandue operation lower than target cause by the skill operator of chandue still low and need to increased it. Result discussion with Ir. Faisal (owner Chandue Tanindo) and Ir. Yonas (Post harvest handling section head of Agriculture department Pinrang District) first chandue need to make perfect and Pinrang district agriculture department need to attend training for chandue operator to increase their skill. Increased chandue as a tool to reduce the grain losses at harvesting needs to get a very deep concern going forward, especially from the benefits generated.

**Grain Losses in the Temporary Store in Hoe Knife Practice**

The farmer attend temporary store 1-2 day before threshering. Average grain loss at the temporary store is 0.24 % and in time of store have significantly different on grain lost (Table 3).

### Table 3. Percentage of Grain Losses at Temporary Store With Use Hoe Knife Maros District, 2009.

<table>
<thead>
<tr>
<th>No</th>
<th>Treatment</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hoe knife cut and thresh soon</td>
<td>0.14 a</td>
</tr>
<tr>
<td>2</td>
<td>Hoe knife cut and thresh 1 day after</td>
<td>0.24 b</td>
</tr>
<tr>
<td>3</td>
<td>Hoe knife cut and thresh 2 day after</td>
<td>0.34 c</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>0.24</strong></td>
</tr>
</tbody>
</table>

Table 3 shows that after cutting panicle rice and directly thresh, temporary store 1 and 2 day then trash indicated that there were grain losses significantly different on the longtime of temporary store. Then it will facilitate intaking the right decision in determining the best storage duration.

**Grain losses upon the varied harvester tool and rice variety**

To reduce the amount of grain losses during harvest, we need to observe some important things such as tools used in and rice varieties. Both of these become important things, use tools that are not friendly to cause much crop is lost. Neither type of rice used Purple will help reduce crop loss. Harvester tool usually use by the farmer in South Sulawesi were chandue and hoe knife. Thresher tool were power thresher, thresher pedal, and by hand hit down. The average of grain losses each thresher tool and rice varieties archived 5.41 %, significantly different (Table 4).
Table 4. Percentage of Grain Losses Upon the Varied harvester Tool and Rice Variety in Pinrang and Maros District, 2009.

<table>
<thead>
<tr>
<th>No</th>
<th>Treatment</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chandue + Power Thresher + Sembada</td>
<td>4.67 ab</td>
</tr>
<tr>
<td>2</td>
<td>Chandue + Power Thresher + Cisantana</td>
<td>7.56 c</td>
</tr>
<tr>
<td>3</td>
<td>Chandue + Power Thresher + Inpari</td>
<td>3.30 a</td>
</tr>
<tr>
<td>4</td>
<td>Hoe knife + Power Thresher + Ciliwung</td>
<td>4.00 a</td>
</tr>
<tr>
<td>5</td>
<td>Hoe knife + Thresher Pedal + Ciliwung</td>
<td>5.98 bc</td>
</tr>
<tr>
<td>6</td>
<td>Hoe knife + Hand hit down + Ciugelis</td>
<td>6.97 c</td>
</tr>
</tbody>
</table>

Average 5.41

Base on Table 4 indicated that the lowest grain losses archived by treatment Chandue + power thresher + Inpari 9 and hoe knife + power thresher Ciliwung. Significantly different with other treatment. Inpari 9 has grain weight more than the other rice variety and at last influence to grain losses at harvesting with used chandue, while Chandue + power thresher + Cisantana and hoe knife + hand hit down + Ciugelis have grain losses high significantly different than the other treatment.

Efficiency of Rice Harvest Activity

Using some harvester tool have efficiency value. Variable who influence to efficiency were labor and time of harvest. While some variable entree in analysis were; harvester tool Chandue and power thresher, hoe knife and power thresher, hoe knife and thresher pedal, and hoe knife and thresh by hand hit down harvester tool Chandue and power thresher, hoe knife and power thresher. Time Variable significantly different and has positive value. It’s mean that if there 1 minute adding so that will the result of threshering increase to 44.781 kg, while hoe knife + thresher pedal negative significantly different. It’s mean that 1 unit hoe knife + thresher added pedal will be decrease threshering result as 238.521 kg. Same also variable hoe knife + hand hit down negative significantly different. It’s mean that 1 unit hoe knife + hand hit down added could be decrease result trashering 238.445 kg.

Chandue and Power Thresher Machine Feasibility

Criteria of activity feasibilities is analysis tool to know activity capability to achieved profit or lost. Analysis tool to evaluate in rice harvesting activity feasible, were Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (B/C), and pay back periodic (Table 5).

Table 5. Rice Harvester Feasibilities at Pinrang District, 2009.

<table>
<thead>
<tr>
<th>No</th>
<th>Mark</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tool economic ages</td>
<td>5 years</td>
</tr>
<tr>
<td>2</td>
<td>NPV with discount rate 15 %</td>
<td>Rp 40,020,056</td>
</tr>
<tr>
<td>3</td>
<td>NPV with discount rate 20 %</td>
<td>Rp 35,689,840</td>
</tr>
<tr>
<td>4</td>
<td>IRR</td>
<td>22.64</td>
</tr>
<tr>
<td>5</td>
<td>B/C</td>
<td>0.37</td>
</tr>
<tr>
<td>6</td>
<td>Pay back periode (year)</td>
<td>2</td>
</tr>
</tbody>
</table>

Source : primer data analyzed, 2009
Base on Table 6, that chandue and power thresher economic ages is 5 (five) year. while NPV analysts use discount rate 15 % and 20 %. Value of NPV (15 %) archived Rp 40,020,056 5 year duration. So that archived Rp 8,000,000/year. If the value NPV (20 %) will be archived value Rp 35,689,840. it’s mean that operation of candue harvester and power thresher is feasible. IRR level archive 22.64 %. In order this project feasible the investor have to use capital with discount rate lower 22.64 %, . While B/C ratio is 0.37 with pay back period 2 year.

Conclusion and Suggestion

1. The farmer at Pinrang district used chandue harvester on harvesting time, and Maros district use hoe knife as panicle cutter and both hand hit down and power thresher as thresher. Chandue capacity 0.37 – 0.42 ha/hour equivalent 2.37 – 2.60 ton field dry grain/hour. While power thresher capacity 2.76 – 3.09 ton/hour.
2. Labor harvester capacity is 0.0129 ha/hour or 0.093 ton/hour (equivalent 26 person/chandue)
3. Grain losses by using t chandue and, power thresher achieved of 3.3- 7.56 %.
4. Labor, time and chandue thresher variable positive influence, and variable hoe knife + thresher pedal and hoe knife + hand hit down are negative.
5. Project feasibilities NPV of 15 % Rp 40,020,056; IRR of 22.64; B/C of 0.37 and payback period of 2nd year.
6. Pinrang district government especially, Agriculture district departemen need to sponsored for attend a training chandue operator to increase their skill, in order grain losses could be reduce.
7. Support to another area to promote chandue as rice harvester to save time allocation on rice harvest activity, for an encourage rice index planting 400.

REFERENCE

