8. FINANCIAL EVALUATION AND IMPLICATIONS OF SAWING RECOVERY OF CHAINSAWS AND MINI-BANDSAWS IN SMALLHOLDER TIMBER PROCESSING

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A trial was conducted in late 2008 and early 2009 to compare the sawing recovery rate using chainsaws and mini-bandsaws in small-scale timber processing on Leyte Island, the Philippines. The sawing recovery rate for chainsawing was found to be 39% while that for the mini-bandsaw was 52%. The financial feasibility of using both saws in processing timber from smallholder tree farms on the island as well as its policy implications are evaluated in this paper. The net revenue of small-scale sawn timber processing is PhP873/m^3 from chainsawing and PhP1895/ m^3 for bandsawing. Profitability of sawn timber processing was found to be highly sensitive to sawing recovery rate and therefore both the use of saws with a smaller kerf and training of the saw operators are recommended. Profitability was also found to be highly sensitive to haulage distance of sawn timber. Negative returns were predicted for a hauling distance of more than 2.25 km and 3 km for chainsawn timber processing and bandsaw milling, respectively. It is recommended that farmers, extension agents at local government units and Foresters of the Department of Environment and Natural Resources (DENR) should consider road access in forestry promotion if tree farming is oriented towards the sawn-timber market.

INTRODUCTION

On Leyte Island, the Philippines, chainsaws and mini-bandsaws are the two most common types of saws used for converting logs into lumber. These two types of saws differ in saw kerf (blade thickness). The kerf for chainsaws is approximately 10 mm, and for mini-bandsaws about 6 mm. There is a poor understanding, particularly among farmers on Leyte Island, of the impact of sawing recovery on overall returns of smallholder tree farm enterprises. In this paper, the answers to the following questions are sought:

Given a choice between a chainsaw and mini-bandsaw, which machine would yield a higher net revenue in smallholder timber processing?
To which factors is the profitability of smallholder timber processing net revenue most sensitive?
How far from a road should the trees be located to achieve positive net revenue for both sawing machines?

These are the critical questions that smallholder tree farmers, timber processors (chainsawers and mini-bandsawers), and timber retailers may consider in marketing smallholder timber.

The next section of this paper describes how the analysis was carried out. A simple financial model comparing the net revenue of timber processing using a chainsaw and a mini-bandsaw is then presented. The results from a sensitivity analysis and the scenario analyses are discussed in the fourth section. The paper concludes with answers to the research

questions, and a discussion of the implications of sawing recovery of chainsaw and mini-bandsaw for smallholder tree farm enterprise.

RESEARCH METHOD

Sawing trials were conducted in Bato and Matalom on Leyte Island between September 2008 and February 2009, to compare recovery rates of chainsawing and mini-bandsawing and to investigate if saw operators influenced the sawn timber recovery rate for the two saw types. An add-on objective of the sawing trial was to investigate some of the financial and policy implications of sawing recovery rate from chainsaws and mini-bandsaws. Key informant (KI) interviews and *participant observations* were conducted to estimate costs and revenue of small-scale sawn timber processing. Bandsaw operators, tree farmers, chainsaw operators, and carabao skidders involved in the trials were interviewed as key informants. Cost and revenue estimates made by Bato KI were validated by the Matalom sawing trial cooperators. Most information gathered from Bato KI was found by Matalom KI as reasonably correct except for felling and hauling cost which was believed by Matalom KI to be high, relative to what they pay in Matalom. The felling and bucking cost was therefore re-estimated by Matalom KI. The sawn timber recovery rate was estimated using data from the sawing trial as reported by Cedamon *et al*. (these proceedings).

Snapshots of small-scale chainsaw milling and bandsaw milling enterprises are modelled in this paper. The model represents the processing of 1 m^3 of sawn timber, involving purchasing standing trees from a farmer, hauling of logs and sawn timber by carabao skidders, sawing by chainsaw and bandsaw, and transporting logs or sawn timber to sawmill and customers respectively. Transaction costs and costs related to obtaining harvest and transport permits are not included in the model. Standing trees were purchased from a smallholder tree farm that is approximately 0.5 km from the barangay road. The distance from the barangay road to the town centre where most customers and the bandsaw mill are located is 3 km. The rent for sawing equipment (bandsaw mill and chainsaw) and accessories per unit of timber sawn is assumed to be sufficient to cover the cost of maintenance and replacement of the machine parts.

Table 1 presents the estimated parameters of the simple financial model. The financial model was set-up in Excel and the Table and Scenario functions were used to undertake sensitivity and scenario analysis. The Excel chart function was also used to present scenarios meaningfully.

The financial model assumes that the hauling distance from tree farm to the nearest road is 0.5 km and the distance of the mini-bandsaw mill from the barangay road is 3 km. It is also assumed that the distance from the barangay where the trees were sawn by chainsaw to the customer is 3 km. The bandsaw motor power in this analysis is 3 horsepower (hp) which has implication for the timber turnout per day. The volume unit of timber considered in the subsequent financial analysis is cubic metre, on a sawn timber basis.

Table 1. Parameters in the simple financial model for small-scale sawn timber processing

Physical and financial parameters	Chainsaw	Bandsaw
Saw log market price (PhP/m^3)	770	770
Felling and bucking cost (PhP/m^3)	740	740
Off-road hauling cost for lumber (PhP/m^3/km)	490	0
Off-road hauling cost for log (PhP/m^3/km)	0	400
On road hauling cost (PhP/ m^3/km)	100	100
Total wage expenses for 2 men crew (PhP/day)	700	500
Wage for operator (PhP/day)	400	300
Wage for helper (PhP/day)	300	200
Timber turnout (m^3/day)	1.23	0.72
Log requirement for m^3 sawn timber (m^3)	2.56	1.92
Sawn timber recovery rate	0.39	0.52
Rent for machine and accessories (PhP/day)	400	318
Fuel and lubricant for chainsaw cost (PhP/m^3)	600	0
Electricity cost for bandsaw (PhP/ m^3)	0	100
On-road distance from barangay road to customers or selling outlet (km)	3	3
Off-road hauling distance from tree farm site to barangay road (km)	0.5	0.5
Bandsaw motor power (hp)		3
Sawn timber market price (PhP/board foot, bft)	16	16

THE FINANCIAL MODEL COMPARING THE NET REVENUE OF TIMBER PROCESSING USING CHAINSAW AND MINI-BANDSAW

The cost and revenue of producing 1 m^3 of sawn timber using a chainsaw or bandsaw is calculated on the basis of the parameters and assumptions presented in Figure 2. The first column of Figure 2 lists the cost and revenue items, the second and third columns report the calculated costs and revenues for chainsawing and mini-bandsawing while the fourth column shows the difference between cost and revenue items for the two sawing equipment types. The negative sign in the fourth column indicates that bandsaw milling cost or revenue is lower than that for chainsaw milling. There are key differences in costs between the two sawing options. For example, bandsaw milling has a lower log cost, felling and bucking cost, and also milling cost compared to chainsaw milling, while chainsaw milling has a lower transport and labour cost than bandsaw milling. The lower log cost and the felling and bucking cost in bandsaw milling is due to the fact that bandsaw milling requires less log timber per cubic metre of sawn timber than does chainsaw milling, due to the higher recovery rate. In addition to this, the lower cost for bandsawing is brought about by lower rental charges on machinery and accessories. It is apparent that the saving on log cost in the case of bandsawing is sufficient to cover the transport cost differential. Based on the parameter estimates and assumptions presented above, the net revenue of processing 1 m^3 by chainsaw is PhP873 and by mini-bandsaw is PhP1895.

Microsoft Excel - revised cost and revenue analysis 7 May

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	A	B	C	D	E
1	Revised financial analysis				
2	**Physical parameters**	Chainsaw	Bandsaw		
3	Sawn timber recovery rate	39%	52%		
4	Log requirement for 1-m^3 sawn timber (m^3)	2.56	1.92		
5	Timber turnout (m^3/day)	1.23	0.72		
6	On-road distance (km)	3	3		
7	Off-road hauling distance (km)	0.5	0.5		
8					
9	**Financial parameters**				
10	Log market price (PhP/m^3)	770	770		
11	Felling and bucking cost (PhP/m^3)	740	740		
12	Off-road hauling cost for lumber (PhP/m^3/km)	490	0		
13	Off-road hauling cost for log (PhP/m^3/km)	0	400		
14	On-road hauling cost (PhP/ m^3/km)	100	100		
15	Total wage expenses per day 2-man crew (PhP/day)	700	500		
16	Wage for operator (PhP/day)	400	300		
17	Wage for helper (PhP/day)	300	200		
18	Rent for machine and accessories (PhP/day)	400	318		
19	Fuel and lubricant for chainsaw cost (PhP/m^3)	600	0		
20	Electricity cost for bandsaw (PhP/ m^3)	0	100		
21	Sawn timber market price (PhP/board foot)	16	16		
22					
23	**Cost and Revenue Analysis**				
24	Cost/revenue item	Chainsaw	Bandsaw	Difference	
25	Log cost (PhP/m^3)	1974	1481	-494	
26	Felling and bucking cost (PhP/m^3)	1897	1423	-474	
27	Total transport cost	545	962	417	
28	Hauling off-road cost (PhP/m^3/km)	245	385	140	
29	Hauling on-road cost (PhP/m^3)	300	577	277	
30	Labour cost (PhP/m3)	569	694	125	
31	Mill cost (PhP/m^3)	925	329	-596	
32	Fuel and lubricant (PhP/m^3)	600	100	-500	
33	Rent for machine and accessories (PhP/m^3)	325	229	-96	
34	Total cost (PhP/m^3)	5911	4889	-1022	
35	Revenue (PhP/m^3)	6784	6784	0	
36	Net revenue (PhP/m^3)	873	1895	1022	

Sheet1 Sheet16 **Sheet13** rev cost analysis cost

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Figure 1. Simple financial model of small-scale sawn timber processing by chainsaw and bandsaw

SENSITIVITY AND SCENARIO ANALYSES

To investigate the sensitivity of net revenue to individual cost parameters, a sensitivity analysis was undertaken using the Table function in Excel. Parameters listed in Table 3 were adjusted by plus or minus 20% to represent optimistic and pessimistic values. The net revenue was calculated for the estimated optimistic and pessimistic values for each parameter in turn with the other parameters held constant at their most likely values. The

sensitivity analysis reveals that the net revenue of small-scale sawn timber processing using a chainsaw and bandsaw is both highly sensitive to sawing recovery rate and log market price. The sensitivity ranks of parameters in Table 2 provide an explanation as to which parameter the net revenue of small-scale sawn timber processing is sensitive to.

Table 2. Sensitivity analysis for the small-scale sawn timber processing model

Cost or revenue item	Pessimistic		Current		Optimistic		Sensitivity rank	
	Chainsaw	Bandsaw	Chainsaw	Bandsaw	Chainsaw	Bandsaw	Chainsaw	Bandsaw
Recovery (%)	31	42	39	52	47	62		
Net revenue (PhP)	-126	975	873	1895	1532	2519	1	1
Hauling distance off-road (km)	0.6	0.6	0.5	0.5	0.4	0.4		
Net revenue (PhP)	824	1818	873	1895	922	1972	7	5
Hauling distance on-road (km)	3.6	3.6	3	3	2.4	2.4		
Net revenue (PhP)	813	1780	873	1895	933	2011	6	4
Labour cost (PhP)	840	600	700	500	560	400		
Net revenue (PhP)	759	1756	873	1895	987	2034	4	3
Fuel and lubricant or electricity (PhP)	720	120	600	100	480	80		
Net revenue (PhP)	753	1875	873	1895	993	1915	3	7
Rent for machine and accessories (PhP)	480	382	400	318	320	254		
Net revenue (PhP)	808	1849	873	1895	938	1941	5	6
Log market price (PhP)	924	924	770	770	616	616		
Net revenue (PhP)	478	1599	873	1895	1268	2191	2	2

In a scenario analysis, the optimistic, most likely and pessimistic values of parameters listed in Table 3 were simultaneously adjusted in calculating the net revenue of sawn timber processing. Using the Scenarios function of Excel, the net revenue of small-scale chainsaw and bandsaw milling was calculated and the resulting values are presented in Table 3. For the pessimistic scenario, the values of parameters are set at adverse levels (costs items increased and revenue items decreased by 20%) and for the optimistic scenario the values of parameters are set at favourable levels. For the pessimistic scenario, the net revenue from chainsaw milling is predicted to be negative while that of bandsaw milling is positive. This indicates that small-scale chainsaw milling is a bigger risk than small-scale bandsaw milling.

The net revenues of small-scale chainsaw and bandsaw milling were predicted for various levels of sawing recovery rates and off-road hauling distances. The Table function of Excel was used to predict net revenues for most likely scenarios at each specified level of sawing recovery rate and hauling distance holding other estimated parameters values constant. Line graphs were generated to present scenarios meaningfully. Figure 2 shows the net revenue of small-scale chainsaw milling and bandsaw milling at varying recovery rates. At about 49.3% sawing recovery rate, the net revenue lines for both saw types converge. Below 49.3% recovery rate, chainsaw milling is more cost-effective than bandsaw milling and above this convergence point, bandsaw milling has lower cost, *ceteris paribus*.

Table 3. Scenario analysis of small-scale chainsaw and bandsaw milling financial model

Parameter	Scenario for chainsaw milling			Scenario for bandsaw milling		
	Most likely	Pessi-mistic	Opti-mistic	Most likely	Pessi-mistic	Opti-mistic
Sawing recovery rate	0.39	0.31	0.47	0.52	0.42	0.62
Log market price	770	924	616	770	924	616
Fuel and lubricant or electricity	600	720	480	100	120	80
Labour cost	700	840	560	500	600	400
Off-road hauling distance	3	3.6	2.4	3	3.6	2.4
On-road hauling distance	0.5	0.6	0.4	0.5	0.6	0.4
Rent of sawing equipment	400	480	320	318	382	254
Net revenue	873	-1031	2267	1895	165	3133

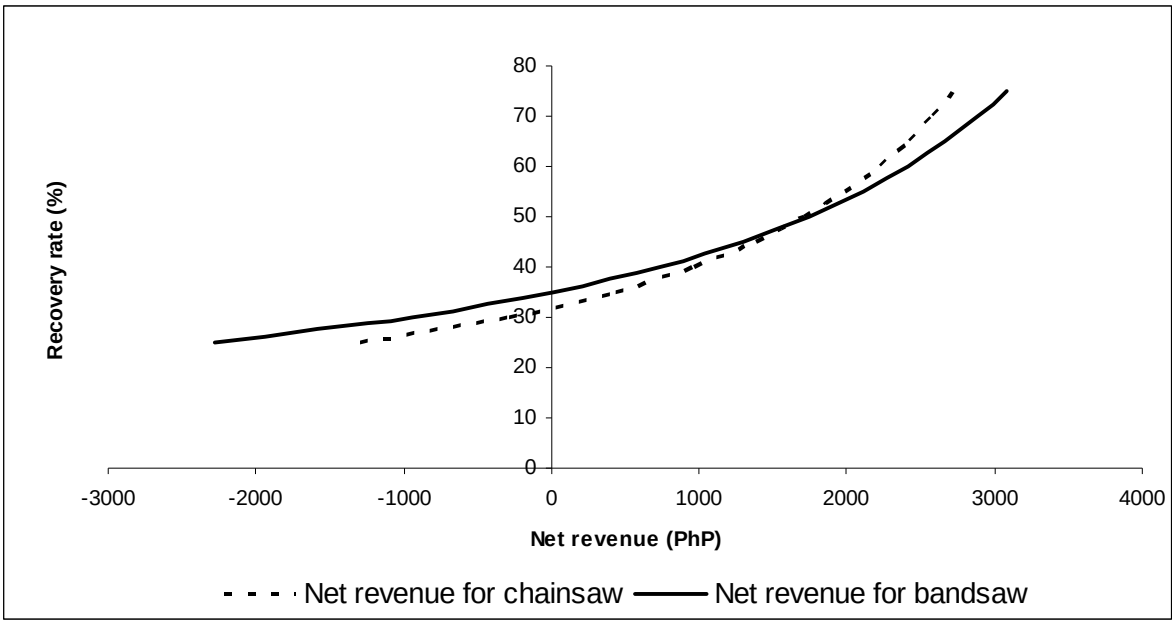

Figure 2. Line graph of predicted net revenue of small-scale chainsaw milling and bandsaw milling at various sawing recovery rates

The relative profitability for the two saw types in relation to distance of tree farms from a road is examined by plotting the predicted net revenues for various distances. Figure 3 presents the line graph of net revenue of the saw types at various distances of the tree farm from a road. Figure 3 shows that chainsawing and bandsawing would have positive net revenue for trees located no further than 2.25 km and 3 km from a road, respectively, assuming all other parameter values are held fixed. It is also notable in Figure 3 that bandsawing has a higher positive net revenue than chainsawing. This may be due to the small differential in off-road hauling cost.

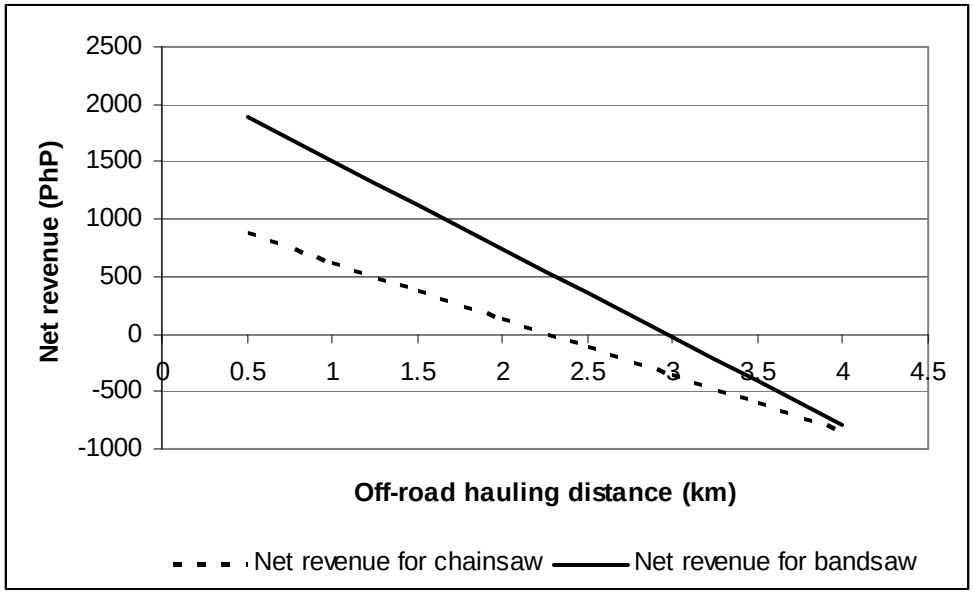

Figure 3. Net revenue of small-scale chainsaw milling and bandsaw milling in relation to off-road hauling distance

RESEARCH IMPLICATIONS AND CONCLUDING COMMENTS

Cedamon *et al*. (2009) found a significant and large difference in sawing recovery rate between chainsaws and bandsaws. The financial implication of sawing recovery rate differential was evaluated by developing a simple financial model considering some costs that may perhaps be incurred in a sawn timber processing business. The net revenue of bandsawing is more than twice what of chainsaw milling because of the higher sawn timber recovery rate. A sensitivity analysis showed that the profitability of sawn timber processing is highly sensitive to sawing recovery and sawn timber processors should place a high priority on improving the sawn timber recovery rate. Apparently, using saws with a smaller kerf can increase sawing recovery. Cedamon *et al*. (2009) reported that skilled operators achieve a higher sawing recovery, which suggests that improving skills through providing training for sawers is a feasible option. Holding-Anyonge and Roshetko (2003) commented that training and certification of mobile powersaw operators will not only increase returns in the timber industry, but the improvement in the timber conversion rate will also increase the quantity of timber reaching local and national markets and enhance the sustainability of planted trees on-farm and natural timber resources. The line graph of net revenue at varying off-road hauling distances reveals that to obtain a positive net revenue, trees should be located not further than 2.25 km from a road if processed using a chainsaw and 3 km in bandsaw milling. Obviously, the trees should be relatively near roads or have road access to minimize off-road hauling costs. This result is relevant for extension agents at local government units and Foresters of the Department of Environment and Natural Resources in providing recommendations for tree farmers planning to establish new (or expand existing) tree farms.

REFERENCES

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Holding-Anyonge C and Roshetko J (2003) Farm-level timber production: orienting farmers towards the market. *Unasylva* 212(54): 48–56