

# Potential Re-utilization of Composted Mangrove Litters for Pond Environment Quality Improvement

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# Potential Re-utilization of Composted Mangrove Litters for Pond Environment Quality Improvement

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## 1. Introduction

In order to achieve optimum productivity of aquaculture, supportive environment condition should be developed. Unfortunately, the environment quality of pond area had been degraded due to unsustainable coastal development and utilization [1]. Water and sediment quality was the most affected aspects. Degradation of pond environment quality had caused significant decrease on pond productivity, and thus the economic sustainability of local society as well [2].

Recently, various efforts had been conducted to improve environment quality of ponds. Improvement of pond environment quality is needed to provide suitable environment for fish [3]. Thus, fish could grow properly and increase the productivity [2]. Further impact would be better benefit for farmers. Even though, improvement of pond environment quality is not cheap and easy. Pond recovery and environment quality improvement costs are expensive and take long time. Thus,



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various techniques are developed in order to achieve effective method in pond environment improvement.

Several technique had been applied in aquaculture activities in order to achieve improvement on fish production, including silvofishery [4] integrated polyculture with weed/algae [5], water treatment [3], application of probiotics [6], utilization of manures [7], etc. Unfortunately, some of them require high cost, long noticeable impact or had particular side effect.

Preferred environment quality improvement could be conducted through the utilization of local resources. Extensive application of silvofishery had significantly improve the stability of coastal ecosystem, including ponds area [8]. It also provide positive impact on primary productivity and expected to improve fish productivity through product diversity [9]. Application of compost could also be considered in the improvement effort of pond environment. Compost had been used in agriculture to improve soil fertility and stability [10]. The application had also been expanded since the negative impact of artificial fertilizer utilization were noticed.

Maintenance of silvofishery pond included the pruning activities of dense mangrove plants [11] in order to provide better air circulation and light penetration [12] to the pond surface. This produced mangrove litter which mostly would end up as organic waste. Fortunately, this could be used as source of organic material for compost. But, composting activities would be needed to generate compost production. Compost produced from this activities could be used in pond fertilization. Expected impact included increasing pond water fertility and stability of pond sediment. The advantages of this effort would be lower treatment cost to improve pond productivity.

The effort on compost production from mangrove litter continued by the utilization of mangrove compost in silvofishery pond would provide a closed nutrient cycle within pond. This may improve the effectiveness of silvofishery management to provide optimum advantages of mangrove plants for ponds. Unfortunately, production of compost from mangrove litter is least known as well as its quality and the impact of compost application on pond quality. Thus, this research aimed to analyze the nutrient composition compost produced from mangrove litter and to describe the effect of compost application on pond quality.

## 2. Methodology

This study was conducted in Mangunharjo Villvage, Tugu District, Semarang City. The study included composting process of mangrove litter and application of compost on silvofishery ponds. Composting activities involved local community Kelompok Usaha Bersama, Pembibitan Penanaman Perawatan Mangrove Lestari and Kelompok Tani Nelayan Asih Samudra which works on mangrove rehabilitation in Mangunharjo. Activities were focused on composting of mangrove litters produced from scheduled mangrove pruning activities.

Composting activity used composting container with 250 litres gross volume capacity. Composting container consisted of two chambers, top chamber is used for solid compost while bottom chamber is used to accomodate liquid compost. Composting process was conducted for 45 – 60 days. Compost products were then analyzed in laboratory to measure its N, P and C content. Analysis was conducted on the C / N ratio of produced compost. Compost produced from mangrove litter composting was then applied on silvofishery pond. Application of compost for pond fertilization in this study utilized 2 kg compost for 25 m<sup>2</sup> pond. Particular pond without compost application was taken as control. The effect of compost application was observed visually through the changes of pond water. Observation was conducted 1 week and 2 months after compost application. Statistical data analysis was conducted to compare the nutrient concentration between solid and liquid compost produced. Analysis was conducted through t-test.

## 3. Results

Compost material sources was collected from mangrove pruning in silvofishery ponds. Pruning on mangrove plants in the silvofishery ponds is conducted frequently by local community in order to provide optimum environment condition for fish culture. This activity produced mangrove litters as

organic materials wastes. Some of the litter was used as feed for goats, but most of it ended up as waste. Thus, it was collected and then processed for composting. There are several mangrove species grown in silvofishery ponds, but *Avicennia marina* and *Rhizophora mucronata* are the most popular plants. Hence, composting trial was conducted with both species, partially and mixed.

Two compost products were produced from the composting activity, including solid compost and liquid compost. Nutrient composition analysis showed that there were differences in nutrient concentration among sources. Generally, N composition was higher in the liquid compost than solid compost. Inversely, P and C organic concentration were higher in the solid compost than liquid compost. Thus, C / N ratio in the solid compost was higher than in liquid compost. Detailed laboratory analysis result on nutrient concentration of compost is shown in Table 1.

**Table 1.** Nutrient composition of solid and liquid mangrove compost

No.	Nutrient	Mangrove					
		Avicennia marina		Rhizophora mucronata		Mixed	
		Solid	Liquid	Solid	Liquid	Solid	Liquid
1.	N (%)	0.47	0.69	0.52	0.62	0.50	0.64
2.	P (%)	0.36	0.32	0.44	0.24	0.41	0.27
3.	Organic C (%)	5.45	3.98	6.23	4.45	6.39	4.26
	C / N Rasio	11.60	5.77	11.98	7.18	12.78	6.66

Table 1 showed nutrient composition of solid and liquid compost produced from mangrove litter. This result showed that source of mangrove litter provide different nutrient concentration. Analysis on the C / N ratio showed that solid compost had average value of 12.12, while the liquid compost was only 6.54. Statistical analysis of nutrient concentration between both compost types showed that there were significant differences on nutrient concentration between solid and liquid composts. T-test analysis on N, P and C concentration resulted t value of -6.040 (p = 0.004), 3.839 (p = 0.018), and 5.589 (p = 0.005). While t-test analysis on C / N ratio resulted t value of 10.361 (p = 0.000).

Application of compost on silvofishery pond showed noticeable impact at the first observation (1 week after application). Visual observation showed that ponds with compost application had less turbid water compared to control pond (without compost). Another noticeable impact was the presence of klekap (lab-lab) which is known as natural feed for certain fish. Thus, the application of compost showed significant effect on water quality. Even though, the impact was only temporary. Second observation (2 months after application) showed that water quality on compost applied pond was similar to control pond. Thus, application of compost should be conducted regularly to provide optimum and continuous advantages.

#### 4. Discussions

In order to maintain optimum atmosphere condition of mangrove ecosystem, pruning of mangrove canopy and thinning of mangrove density had been applied. Mangrove pruning had been conducted to stimulate root growth [13] Plant pruning had been recommended both on shoot and root in order to maintain the balance above- and below-ground organs metabolism as well as carbon storage [14]. Mangrove growth forms dense canopy which affect to higher shading on mangrove floor, while dense population might restrict mangrove development [15]. Competition of space might occur causing ineffective stand growth [16]. Thus, artificial effort on mangrove pruning and thinning is required to maintain optimum ecosystem development. Pruning activity enhance the chance of mangrove development and stimulate quality improved shoots [17]. Pruning activities is also needed in order to maintain hydrological condition of mangrove ecosystem, providing more better water circulation [18]. Mangrove thinning is also considered as important activity to avoid the loss of exploitable resources such as timber since unthinned population would impact smaller stem diameter which might affect its ecological role [19].



Particularly for mangrove pruning, natural litter fall might require long decomposition time. Thus, composting of mangrove litter produced from mangrove pruning and thinning might improve the decomposition rate and could be re-utilized in fertilization of mangrove related ecosystem such as silvofishery pond. Hence, mangrove ecosystem management could be applied more effectively.

Analysis on the nutrient concentration of compost showed that the concentration of N and P as well as the C/N ratio of solid compost had fulfilled the requirement determined in Indonesia National Standart. Unfortunately, C concentrations were still lower than expected value. Standart N concentration for compost should be  $\geq 0.40\%$ , while P should be  $\geq 0.10\%$  and C should be 9,80-32%, while C/N ratio should be between 10-20% [20]. Based on Directorate of Production Facility (2006), standart concentration of organic carbon for liquid fertilizer should be  $\geq 4.5\%$  [21]. This showed that C concentration of liquid compost produced from this research had not fulfill the requirement. Even though, C/N ratio of liquid compost resulted in this research was still higher compared to Hartz et al [22] which only 1.6-6.0.

This result was related to basic concentration of nitrogen and carbon in mangrove litters. N concentration of mangrove organs ranged from 0.334-0.740% in dry season and 0.58-0.644% in wet season, while organic C concentration was between 25.58-53.33% [23]. Higher N concentration in liquid compost was caused by leaching process of composted mangrove litter. Nitrogen was released from litter, leached and accumulated in liquid compost [24].

Difference on concentration trend between N versus P and organic C was determined by the solubility of each nutrient. Nitrogen was known to be the more volatile compared to P and C. Thus, N is easily leached and evaporated [25,26]. This explain why the concentration of N was higher in the liquid compost than in the solid compost. Inversely, most of P and C in the soil are immobilized [27]. Thus, the concentration of both nutrient were higher in the solid compost than in the liquid compost.

Cleaner water quality in the compost applied pond indicated that solid compost was capable of binding dissolved materials [28]. Thus, dissolved materials suspended faster than normal condition. Compost plays important role in binding dissolved organic materials in ponds. But, it doesn't last for a long time since compost would be rapidly suspended into the pond floor. Application of compost might also increase organic material decomposition since compost contain decomposing microorganism [29]. Thus, the application of compost in the pond should be conducted regularly in order to provide cleaner water for cultivation. Possible impact of this would be improvement of dissolved oxygen and plankton enrichment [30]. It was proven by the increasing abundance of klekap (lab-lab) a week after compost application in ponds. This indicate nutrient enrichment within ponds. Thus, application of compost produced from mangrove litter favored water quality improvement and natural feed enrichment. Hence, this could reduce management and production cost of aquaculture activities.

## 5. Conclusion

This research concluded that mangrove litters produced from mangrove pruning in silvofishery ponds could be utilized in compost production. The quality is close to Indonesia National Standart for compost. Application of compost in silvofishery ponds had short period positive advantages including the improvement of water quality and enrichment of natural feed, suggesting periodic application of compost to provide optimum and continuous support for fish culture.

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## References



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PAGE 1

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PAGE 2

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PAGE 3

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PAGE 4

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PAGE 5

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PAGE 6

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