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The potential of Ettawa goat manure and urine management to support the productive and sustainable farming

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ABSTRACT

This research was integrated with the empowerment programme namely IBM (Science and Technology for the People) which aimed to find the solid organic fertilizer (SOF) and liquid organic fertilizer (LOF) of ettawa goat to support the productive and sustainable farming.The programme was carried out in Yogyakarta Province during May to November, 2012 involving partners like KUBE Co-operative Business Association- Adi Jaya and KUBE Rizki Annisa in Sleman District as well as Institute of Joglo Minar Tani in Bantul District of Indonesia. The research which was integrated to the empowerment programme was carried out through serial process of training for corporate people; procurement of SOF and LOF production devices and materials; production process of SOF and LOF; demonstration in plots (demoplots) and laboratory test for fertilizers' quality. The process and the results of the demoplots were recorded and were measured through economic approach to know the farm potentials. 20 demoplots for rice crops each of size 200 m^2 while the vegetables were planted in the back yard and garden consisting of purple egg plant, green egg plant, tomato, chili, and dark mustard greens. Demoplots for rice crops were cultivated using local variety namely Menthik Susu through implementing method of System of Rice Intensification (SRI) in pro-organic version while the vegetables were done in pure organic version. The laboratory test report for LOF created by partners contents N, P and K as well as the other essential elements such as Ca, Fe, Mn, and Mg. The demoplots results show that SOF and LOF made from ettawa goat manure and urine have a good potential for rice farming as depicted through B/C ratio of 12.44 higher than 5.83 of conventional system through the reduced use of synthetic fertilizers uses by 58.3%. Implementation to vegetable crops using self-produced SOF and LOF also shows considerable business feasibilities that B/C values of 33.28, 43.52, 40.00, 47.04 for purple egg crops, green egg crops, tomato and chili respectively.

Keywords: Ettawa goat, essential elements, organic fertilizers and SRI method

Goat manure and urine scientifically are good materials to be processed into quality organic fertilizers either solid or liquid form. Based on data presented in Table 1, it is visible that nitrogen (N) and potassium (K) contents of sheep manure are higher than cow, chicken and duck manure while Phosphorus (P) and calcium (Ca) contents are only lesser than chicken manure.

Sutanto (2002) asserts that N, P and K contents for fertilizers made from sheep manure and urine are 0.65% , 0.22% : 0.12% and 1.40% : 0,01% : 0.54% respectively. The compositions show that liquid organic fertilizer (LOF) contents higher N and K than solid organic fertilizer (SOF) moreover, it also concludes that sheep or goat manure and urine have good potentials to be managed to supply quality organic fertilizers.

Table 1: Composition of organic fertilizer based on cattle manure and fowl manure

Sl. No.	Macro nutrient	Nutrient contents of manure (pon ton^{-1})			
		Cow	**Chicken**	**Duck**	**Sheep**
1.	Nitrogen (N)	10.0	25.0	10.0	28.0
2.	Phosphorus (P)	2.0	11.0	2.8	4.2
3.	Potassium (K)	8.0	10.0	7.6	20.0
4.	Calcium (Ca)	5.0	36.0	11.4	11.7

Source: Rosmarkan and Yuwono (2002)

The cattle owners of Ettawa can be characterized by-

1. Most of the cattle owners are not yet capable of managing the way to collect goat manure and urine particularly oiented to the waste processing;
2. Most of the cattle owners are not yet capable of processing technology of goat manure and urine for the production of quality organic fertilizers;
3. Low intentions of the cattle owners to optimize the organic fertilizers uses to their farming activities.

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The impact which emerges as the consequence of the above considerations is the environmental condition getting dirty, odor and unhealthy, and finally it is going to disturb the cattle and the people. Related to the correlation between organic material and farming, Iswandi *et al.* (2011) assert that the rising of organic materials will foster the increasing of soil organisms such as Azospirillum and Azotobacter having role in N fixation and P soluble microbes (*Aspergillus niger*). Lin *et al.* (2011) assert that the addition of organic fertilizers improve the rizosphere area of plants.

Optimized use of organic fertilizer improves the ecology of the environment as well as economy of the farmer concerned. Research findings show that by means of the increasing organic fertilizers and decreasing synthetic fertilizers accompanied with appropriate rice cultivation system enable to raise the rice farming feasibility through diminishing cost of production, increasing the harvest and selling price (Ferichani and Prasetya, 2011; Uphoff *et al*, 2011 and Sato, *et al*., 2011). Increased use of organic fertilizers in organic horticulture also renders positive B/C (benefit cost ratio) values for several kinds of crops such as carrot, shallot and lettuce (Pracaya, 2012).

Price will be better for food crops, vegetable crops and fruit crops which are cultivated organically. This is an agribusiness opportunity, particularly for farmers who have resources as raw materials for SOF and LOF. Based on the brief description above, this action research was aimed to know the potential of ettawa goat manure and urine management towards productive horticulture and rice cultivation; and the organic fertilizers business.

MATERIALS AND METHODS

The research was integrated with an empowerment program namely IBM (Science and Technology for the People) from Dipa BLU Funding, Directorate of High Education of Indonesia, decentralized by University of Sebelas Maret, and was carried out in Yogyakarta Province during May to November 2012 through the involvement of partners like KUBE (Co-operative Business Association) *Adi Jaya* and KUBE *Rizki Annisa* which in Sleman District as well as Institute of Joglo Minar Tani in Bantul District. KUBE *Adi Jaya* is an ettawa goat cattlemen association while KUBE *Rizki Annisa* is an ettawa goat cattlemen's wives association in Sayegan subdistrict of Sleman district. Institute of Joglo Minar Tani (Jomint) is an organization which focuses on sustainable agriculture and rural development in Bantul district.

The research was carried out through training, procurement of SOF and LOF production devices, production process of SOF and LOF in demonstration plots (demoplots) and tested in laboratory for fertilizers' quality. The process and the results of the demoplots were recorded and were measured through economic approach to know the farming potential.The number of demoplots for rice crops were 20 plots of 200 m^2 while the vegetables constituted of purple egg crop (40 crops), green egg crop (40 crops), tomato crop (40 crops), chili crop (40 crops), and dark mustard green crop (20 m^2; 600 crops; 20 × 15 cm for wide spacing) and were planted in the back yard and garden. Demoplots for rice crops were cultivated with local variety namely *Menthik Susu* adopting method of System of Rice Intensification (SRI) in pro-organic version compared to conventional method while the vegetables were grown as pure organic. Used LOF and SOF in this research were made by the co-operativecooperative cattlemen and co-operative farmers.

SRI is a farming method which encompasses several basic elements *i.e*. using young seedling (8 – 15 days); using single seedling; using wider spacing generally 25×25cm or 30×30cm; shallow transplanting (just below the surface 1 to 2 cm); weed management to aerate the soil to reduce bio-physic-chemical competition; enhancing use of organic matters as much as possible; intermittent irrigation through no continuous flooding of paddy fields (Laulanie, 1993). The pro-organic SRI method in this research was carried out by decreasing synthetic fertilizer to only 25 kg 1000 m^{-2} (Urea 19kg+ 3kg of SP36+ KCl 3kg) from 60 kg 1000^{-1} m^2 as the common usage of the local farmers. The doses for SOF were 1.5 ton 1000^{-1} m^2 and that of LOF was 250 ml 14 $liter^{-1}$ sprayed every10 days.

The conventional method of rice cultivation at the study area encompasses several elements such as flooding the farming land regularly and dominantly; burning the rice straws; spacing of 20×20 cm or (18×18 cm) even some of them using irregular order; the use of synthetic fertilizers of around 60kg 1000^{-1} m^2 and synthetic pesticides; using old seedlings in transplanting from 25 to 40 days old; using of seeds about 7 to 10kg 1000^{-1} m^2. The study was taken up for the farmers using both the conventional and SRI method of rice cultivation. The measurement was done based on cooperative farmers' yields at the same crop season with the implementation of SRI.

The dosage of LOF in cultivating vegetables either for green egg crop, purple egg crop, tomato or chili was 150 ml 10 to 14 ltr^{-1} of water sprayed every 7 days while the SOF was given by 1.5 kg per hill. A treatment for dark mustard green was different for the dosage of SOF unless for LOF that it was 1.5kg m^{-1}, and there is no additional synthetic fertilizer for horticulture.

RESULTS AND DISCUSSION

Through an apt management of Ettawa goat manure and urine, both can be potential SOF and LOF both for cattlemen and farmer households. Use values of SOF and LOF are for improving and for increasing farming yields through environmental improvements while the economic value is reflected from the business potentials of them. Both values were provable along the action research on horticulture in the backyard and garden as well as on rice cultivation in the farming land owned by Jomint's staff.

Table 2: Nutrient contents of LOF derived from Ettawa goat urine

No	Element	Content (%)
1.	N	0.56
2.	P	0.013
3.	K	0.993
4.	Ca	0.04
5.	Fe	31×10^{-4}
6.	Mn	99×10^{-4}
7.	Mg	0.078

Source: The Report of Laboratory Test No. 6981.a/LPPT-UGM/U/IX/2012

LOF and SOF was made by co-operative cattlemen from ettawa goat urine and manure as the primary material along with the addition of some materials such as bio-activators, sugar, rotten fruits, bamboo leave, etc. Bio-activator known as local microorganism, in this case have a function as decomposers of the materials which can be propagated by using local materials such as chops of pineapple, banana, shallot, etc; by adding sugar and fermenting for couple of days. The primary materials and additional materials are used since those facilitate fermenting as well as increase the content N, P, K and minerals (Sutanto, 2002). Their combination of primary materials and additional materials finally will be completing each other. For SOF process, primary and additional materials are united in bulk; are watered with solution of bio-activators plus sugar; and cover it with rice stems or others. The same process should be followed to create LOF, but the materials of LOF are to be placed in a pail, drum or other container which has a casing to cover to optimize the un-aerobic process.

The results of laboratory test on LOF at Laboratory of Integrated Research and Test, University of Gadjah Mada, can be seen in Table- 2. Those contents indicate that LOF is able to be complementing each other with SOF to improve environmental quality and to accomplish nutrition needs of crops, and finally they will raise the yield.

The influence in implementing of SOF and LOF to rice crops by means of SRI method compared to conventional method can be seen in table- 3. Optimizing SOF and LOF to support implementation of SRI is able to increase the yield higher than conventional method by 25% whereas implementation of SRI done through decreasing of synthetic fertilizers use by 58.3%. Economically, this is capable of raising the B/C value of SRI compared to conventional 12.44 vs. 5.83. B/C value by 12.44 points means that every unit of cost is going to give back revenue by 12.44 times. Decreasing uses of seeds and synthetic fertilizers supported by optimizing ettawa goat manure and urine based SOF and LOF uses obviously can reduce the total variable cost, and it raises the market sentiment over the price of pro-organic rice grain becoming higher than non-organic one.

The other findings through this action research are the application of SOF and LOF to horticulture that can be seen in table -4. These also give good results shown from considerable feasibility of vegetables farm supported by SOF and LOF which render B/C values of purple egg crops, green egg crops, tomato and chili reaching up to 33.28: 43.52: 40.00: and 47.04, respectively. While for the farmers who have no resources of ettawa goat manure and urine, based on general price of organic fertilizers both liquid and solid, keep having an agribusiness opportunity shown from the B/C value of them *viz.* 6.12: 7.00: 6.35: and 7.65 respectively. The implementation of SOF and LOF on dark mustard green crops gives good feasibility proven from the value higher than 1 point *viz*. 12.55 while if it is considering SOF and LOF as outside resources, B/C value keeps feasible *viz*. 3.88. The other important point is that vegetable commodities yielded in this research were sold to the local booth in the rural area under standard prices of non organic products, so the revenue and B/C value of them can be raised relatively since price of organic products are higher 3 to 6 times than non organic ones.

Table 3: Comparison between SOF and LOF supported SRI and conventional method per 1000 m^2

SOF and LOF supported SRI			Conventional method		
Details	**Value per unit ($US)**	**Amount ($US)**	**Details**	**Value per unit ($US)**	**Amount ($US)**
Synthetic fertilizers (25 kg)			Synthetic fertilizers (60 kg)		
a. Urea (19 kg)	0.25	4.75	a. Urea (40 kg)	0.25	10.00
b. SP36 (3 kg)	0.25	0.75	b. SP36 (10 kg)	0.25	2.50
c. KCl (3 kg)	0.50	1.50	c. KCl (10 kg)	0.50	5.00
Seeds (1kg)	0.75	0.75	Seeds (4.26 kg)	0.75	3.20
Tillage (1000 m^2)	10.00	10.00	Tillage (1000 m)	10.00	10.00
Transplanting (1000 m^2)	6.00	6.00	Transplanting (1000 m^2)	6.00	6.00
Bio-activator		0.50			
Materials of SOF		1.50			
Materials of LOF		0.20			
Total variable cost		**26.05**	**Total variable cost**	**36.70**	
Yield (kg of pre-sun drying grain)	810.00		Yield (kg of pre-sun drying grain)	648.00	
Value (kg)	0.40		Value ($US kg^{-1})	0.33	
Revenue	324.00		Revenue ($US)	213.84	
Profit	297.95		Profit	177.14	
B/C ratio	12.44		B/C ratio	5.83	

Source: Primary data analysis, 2012

For most people particularly cattlemen, manure and urine of cattle are neglected things which render the environment getting dirty and odor, so finally they will be disturbing the health of goats itself, cattlemen and neighborhood. Yet, it seems becoming a trend for most of them unless for some of them who have been active in organic farming movement as trending issues at current era.

Those of ettawa goat through several process encompassing collecting, materials procurement, processing and storage are going to be valuable things as organic fertilizers. Collecting urine and manure particularly the former is only need a little effort through modifying the cages in order to make them collected well. Materials procurement itself actually is *a piece of cake* proven through this action research since they are provided around the people like what have been explained above. Composing process of manure can be done at roofed or opened area, but the former is better, while for urine can be done in a pail, drum, etc.

For a consideration, 33.1% organic materials of sheep manure contents 0.70% N: 0.22% P: 0.24 K: 0.33 Ca (Sutanto, 2002). It means that 1.5 tons of manure like in this research enables to provide 10.5 kg N: 3.3 kg P: 3.6 kg K: 4.95 Ca, indeed if the percentage of organic material is more than it, the nutrition contents will be bigger relatively. LOF itself is provided as a complement fertilizer to support the other macro and micro nutrition. This obviously enables to reduce the synthetic fertilizers uses and also to reduce the variable cost. Environmentally and economically, SOF and LOF have given good benefits to farming both rice cultivation and horticulture proven through this research.

Considerable feasibilities of agribusiness as the results of this research is duly able to boost the cattlemen, farmers even government to realize pro organic move massively through optimizing manure and urine of ettawa goat or others to their farms either on their rice field, back yard, garden, etc. As an alternative and eco-friendly energy sources, ettawa goat manure and urine are basis of quality organic fertilizers which enable to raise the crops productivity. Finally, this habitual change is able to raise food security although in household level.

Table 4: Cost and results of horticulture using organic fertilizers based on Ettawa goat manure and urine

Cost	SOF and LOF as outside resources									
	Purple-egg crop		Green-egg crop		Tomato		Chili		Dark mustard green	
	SOF and LOF by buying									
	Value unit^{-1}	Amount ($US)	Value unit^{-1}	Amount ($US)	Value per unit	Amount ($US)	Value unit^{-1}	Amount ($US)	Value unit^{-1}	Amount ($US)
SOF ($US kg^{-1})	0.05	3.0	0.05	3.0	0.05	3.0	0.05	3.0	0.05	1.5
LOF ($US liter^{-1})	1.50	3.0	1.50	3.0	1.50	3.0	1.50	3.0	1.50	0.9
Seedlings ($US stem^{-1})	0.02	0.8	0.02	0.8	0.02	0.8	0.02	0.8	1*	0.5
Total ($US)		6.8		6.8		6.8		6.8		2.9
Yield (kg)	104.00		162.00		100.00		42.00		75 bunches	
Value ($US kg^{-1})	0.40		0.40		0.50		1.40		0.15	
Revenue	41.60		54.40		50.00		58.80		11.25	
Profit	34.80		47.60		43.20		52.00		8.35	
B/C ratio	6.12		7.00		6.35		7.65		3.88	

Cost	SOF and LOF as self-products									
	Value stem^{-1}	Amount ($US)	Value stem^{-1}	Amount ($US)	Value stem^{-1}	Amount ($US)	Value stem^{-1}	Amount ($US)	Value pack^{-1}	Amount ($US)
Seedlings ($US per stem)	0.02	0.80	0.02	0.80	0.02	0.08	0.02	0.08	1*	0.50
Bio activators ($US)		0.15		0.15		0.15		0.15		0.15
Materials of SOF ($US)		0.15		0.15		0.15		0.15		0.15
Materials of LOF ($US)		0.15		0.15		0.15		0.15		0.10
Total ($US)		1.25		1.25		1.25		1.25		0.90
Yield (kg)	104		162.0		100.0		42.00		75 bunches	
Value ($US kg^{-1})	0.4		0.4		0.5		1.40		0.15	
Revenue ($US)	41.6		54.4		50.0		58.80		11.25	
Profit ($US)	34.8		47.6		43.2		52.00		8.35	
B/C ratio	33.28		43.52		40.0		47.04		12.5	

*Note: * $US per pack, Source: Primary data analysis, 2012*

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