ID China bio-gas experimentations
法国发起发展组织昆明办公室“沼气池优化管理”及“沼渣沼液多用途”系列研究

USING BIO-SLURRY AS A COMPOST ACTIVATOR
利用沼渣沼液活化作用堆肥研究

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Nicolas Borchers, ID China Agriculture Officer[1]
Xu Nengwei, ID China Agriculture Assistant[2]

Table of Contents

1 ABSTRACT 摘要

As part of its commitment to provide continuous support to the more than 2500 families using a biogas digester build by Initiative Développement (ID), the NGO has engaged in a one year study focused on optimising the management of biogas digesters, as well as researching the various uses of the bio-slurry.

As part of this project, ID has researched how the bio-slurry could be used by the households as a compost activator. The bio-slurry is indeed rich in water (up to 99%) and mineral nitrogen (up to 0.2%), both of which are needed for the aerobic composting process. This research has focused on a field trial in Baisha 白沙 village, group 3, Qinggangling 青冈岭 township, Zhaotong 昭通 prefecture, Yunnan 云南 province, China.

The family selected for the trial, which is one of ID's biogas beneficiaries, provided a stack of pine needles and corn stalk, which was mixed in July 2012 with bio-slurry from their own tank and left to compost in a specially constructed shed. Measurements of temperature and pH were taken on the terrain, and samples were sent to a laboratory. By January 2013, the compost was ready for use on the fields.

The experiment showed that the mix of pine needles and bio-slurry composted very efficiently, reaching maximum temperatures comprised between 30°C and 56°C. The highest temperatures were recorded close to the surface, while in the centre of the stack, the lower temperatures hint at a lack of air supply. It is therefore concluded that the ideal heap should be smaller, and that the presence of a shed with walls is not only unnecessary, but also counterproductive. The optimal proportions of pine needles to bio-slurry were optimised at around 1:1 in weight. Humidity balance showed that the rain compensated in good proportion for the losses in evaporation, and that covering the heap with a roof or a sheet is therefore unnecessary in the climate of this region of South-West China.

Although the efficiency of the composting process itself is convincing, surveys carried out in parallel amongst ID beneficiaries show that few farmers can provide dry agriculture or forest residue for a compost, since most of the biomass is already used in the local agriculture for either feeding or bedding. Most piles of manure/compost stocked outside the houses in the region are already very high in humidity and nitrogen. Adding bio-slurry to these existing wet piles of manures would lead to soaking and thus present the risk of leaching and release of GHG. Therefore, ID shall be careful when promoting the use of bio-slurry as a compost activator.

法国发起发展组织 Initiative Dévelopement (以下简称 ID)为 2500 余户农村家庭建设了户用沼气池，为了向受益者提供持续的项目后期维护，ID 进行了为期一年的“沼气池优化管理”和“沼渣沼液多种用途”研究。

作为项目的一部分，ID 在云南省昭通市青岗岭乡白沙村三组，进行了农户如何利用沼渣的活化作用来堆肥的试验。沼渣沼液富含水（最高含量可达 99%）和矿物氮（最高含量可达 0.2%），两者均有助

于好氧堆肥过程。

我们选择了一家 ID 户用沼气池项目的受益农户来协助试验。该农户提供了一堆松针和玉米秸秆，在 2012 年 7 月与从他们自己的沼气池里取出的沼渣沼液混合，并放置在专门修建的棚里堆肥。而后，我们在实地对温度和 pH 值进行了测量并把样本送到实验室进行分析。2013 年 1 月，堆肥成熟并可施用于田间。

试验结果表明，松针和沼渣混合能够促进堆肥的效果，使堆肥达到 30 至 50 摄氏度的高温。肥料堆表层的温度最高，而在肥料堆的中心，因缺少氧气供应，温度较低。因此，小型的肥料堆更有利于堆肥除此之外，搭棚是非但没有必要，还会起反作用。松针和沼渣在重量上的最佳配比是 1:1，湿度平衡显示，降雨正好补充了肥料堆蒸发的水分。因为中国西南部的气候特点，在这个地区进行堆肥时，没有必要在堆肥时覆顶或薄膜。

虽然堆肥过程本身的效能是具有说服力的，而在 ID 受益农户中同时开展的调查显示，很少有农户能够提供干燥的农林残余来堆肥，因为大部分的有机材料已用于饲养家畜。在屋外的肥料堆在湿度和氮含量上已非常高。给这些已经潮湿的肥料里增加沼渣会使整个肥料堆浸透而释放温室气体。因此，ID 在提倡农户利用沼渣的活性进行堆肥时应该多加注意。

2 EARLY EXPERIMENTS

A first composting experiment was carried out by ID's training assistant Zhu Hong in 2011. A biogas beneficiary was chosen in Baisha 白沙 village, group 3. A composting shed was built next to the beneficiary's biogas digester, according to designs inspired by the NADEP semi-aerobic composting method.

The composting shed measures 4.3 by 2.7 meters and is surrounded by a 1 meter high brick wall with regular spaces for air supply. A sloped roof was fitted above the shed.

The shed was entirely filled in September 2011 with pine needles gathered by the beneficiary, together with a minor fraction of corn stalks. Liquid bio-slurry from the biogas tank was then poured over the organic material. In the following months, the decomposition process was observed. Unfortunately, the compost dried up quickly, effectively putting an end to all biological processes.

When the experiment was inspected in June 2012, the material was found to be hardly degraded, and the whole pile of material was dry from bottom to top.

It was decided to relaunch the experiment using the same composting shed, thoroughly remixing the available dry material with bio-slurry again. A close management was planned, in particular for water content, to ensure an effective composting process. Alongside, a protocol of regular measurements was defined to follow-up the decomposition process through relevant indicators.

Illustration 1: The composting shed used for the experiment

3 RESEARCH GOALS


Illustration 2: Mixing of the material

- In general, evaluate the feasibility of co-composting agricultural/forest residue with bio-slurry;
- Test in practice what proportion of bio-slurry shall be used for co-composting, and evaluate how much bio-slurry would be absorbed by a compost heap;
- Assess the speed of the process, in particular the time needed for the compost to reach maturity for use on the field;
- Test the suitability of the compost shed and evaluate whether a built structure is needed at all;
- Evaluate whether the compost heap needs to be covered (roof, sheet, etc...) to maintain a proper humidity level, and whether the loss of humidity through evaporation would exceed the gain through precipitation;
- Measure the temperature of the compost, to evaluate the sanitation achieved by the process, as well as the potential for insulating/heating a biodigester by covering it with a compost heap;
- Assess the ease of use of the compost shed;
- Assess the quality of the compost obtained, and its suitability for agriculture.

4 METHOD

4.1 Experiment planning and preparation

4.1.1 Calculation of the relative proportion of bio-slurry

The relative proportions of bio-slurry to dry material were calculated to obtain an optimal mix for composting. Two crucial parameters influence the quality of the composting process: the humidity level and the C:N ratio. Optimal starting conditions, according to the literature, should be close to **40% humidity** and a **C:N of 35**.

Concerning the dry biomass, the humidity was estimated to be 10%. The proportion of C and N were estimated at 36% and 0.61% (C:N=60) according to various literature and internet sources (pine needles and corn stalks were found to have very similar C:N ratio). Concerning the bio-slurry, the carbon, nitrogen, and humidity content were first estimated according to book values. As shall be seen below, these values were later corrected according to the results of the laboratory analysis.

Although some bio-slurry had already been added to the shed 9 months prior to the start of the experiment, it was postulated that most of the nitrogen had been lost through volatilisation, since the bio-slurry was applied on the surface and dried up quickly.

It should be noted that it is generally not possible to find a proportion (bio-slurry to dry material) that both optimises the humidity level as well as the C:N ratio. A compromise has therefore to be found. In general, it would be wise to avoid excessive water content (which would lead to anaerobic conditions) even if this entails an over-optimal C:N.

After calculation we decided to use a proportion of 60% dry material for 40% bio-slurry, which would blend into a compost with 42% humidity and a C:N of 42. The calculation is shown in table 1.

	C %	N %	C:N	Humidity	Proportion in compost mix
Dry material	36%	0.61%	60	10%	60%
Bio-slurry	4.50%	0.51%	9	90%	40%
Total	24%	0.57%	**42**	**42%**	

Table 1: Prior calculation of the optimal proportion in compost mix

4.2 Initial setting of the experiment

On the 4th of July 2012, the composting shed was emptied of its content. The material was mainly composed of pine needles, with a minor fraction of corn stalks.

The shed was then refilled with the same material mixed together with liquid bioslurry. The bio-slurry was extracted from the digester's hand pump, and was thus very low in solids (humidity > 99%). The filling was accomplished as follows:

1. A load of dry biomass was weighted in a basket (using an electronic hand-held scale) and then layered in the shed.
2. A bucket of liquid bioslurry was extracted from the biogas tank with the hand pump, weighed and carefully poured evenly over the dry material of point 1.
3. The material was thoroughly mixed with a pitchfork.

Illustration 3: Bio-slurry buckets. Notice the holes in the wall for aeration.

Illustration 4: Weighing of the dry biomass

It was soon realised that the mix, despite the previous calculation, was in practise too dry. We then decided to adapt the proportions to 50:50, instead of 40:60.

A total of **1360 kg bio-slurry and 1360 kg dry organic residue** were thus weighed and mixed. The individual proportions of pine needles and corn stalk were not measured, but it is assumed that the proportion was close to 90% and 10%, respectively. Table 2 shows the initial composition of the compost.

A sample of bio-slurry was taken on the 23rd of August (see appendix 1). Amongst others, C and N content were determined. The table 3 below shows the actual composition of the compost, updated with the lab values:

	Mass (kg)	% (mass based)
Pine needles	1224	45%
Corn stalk	136	5%
Liquid bio-slurry	1360	50%
TOTAL	**2720**	

Table 2: Initial composition of the compost

	C %	N %	C:N	Humidity	Proportion in compost mix
Pine needles	36%	0.61%	60	10%	45%
Corn stalk	36%	0.61%	60	10%	5%
Bio-slurry	0.34%	0.19%	2	99%	50%
Total	18%	0.40%	**46**	**55%**	

Table 3: Calculation of the initial compost parameters

4.3 Experiment follow-up

Three parameters were selected for regular follow-up: temperature, pH and water content. Temperature and pH were measured, while water content was estimated.

The reason for choosing temperature measurement as a main follow-up parameter is linked to its ease of measurement. Temperature gives a good estimation of the intensity of the aerobic biological processes in the compost, and can thus assess the stage reached by the compost (initial/thermophilic – stable – curing). Furthermore, the temperature determines the level of sanitation achieved in the process.

The temperature was measured as regularly as possible, depending on our presence on the field. Usually, a temperature measurement was taken every two weeks. The frequency was higher in the beginning of the experiment, when the temperature variation was important.

The pH was measured less frequently, about every month, or once every two/three temperature measurement.

4.3.1 Temperature measurement

Three stations were defined for temperature measurement, at three different locations in the compost shed. At each station, two sensors were buried in place at 30 and 60cm depth. In addition, the temperature was also measured at 10cm depth for each station, with a hand-held probe. Nine measurement points were thus defined.

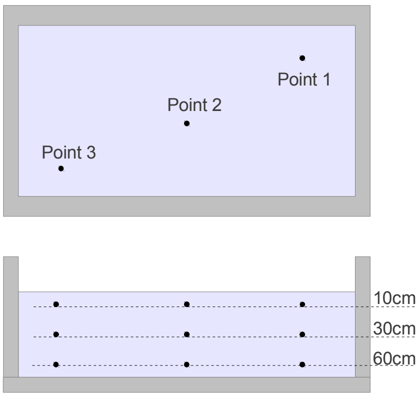

Illustration 5: Position of the temperature measuring points in the compost

The temperature probes were type K thermocouples. These thermocouples have an accuracy of +/- 2°C, which was considered sufficient for the experiment, since measured temperatures stretched over a range of 20°C to 55°C. However, towards the end of the experiment, two probes showed signs of failure. It was therefore decided to remove all probes and put an end to the measurements, since the temperature had already stabilised. A possible explanation is that the probes' thin wire corroded after staying in place for 4 month.

For future similar experiments, it would be preferable to use temperature probes that are corrosion proof and approved for long-term measurement in liquid environments. Thermocouples are a cost-effective temperature measurement technology, but their accuracy is limited by their measurement principle to about 2°C. Thermocouples are therefore usually chosen for measuring high temperatures with limited precision. If a more precise measurement is needed, especially in a ambient temperature range, thermistors or pt100 probes shall be chosen instead.


Illustration 6: Temperature measurement with type K thermocouple

4.3.2 pH measurement

The pH was measured at the same three depths as the temperature (10, 30, 60cm). For each depth, a mixed sample was taken from five different locations or more by digging a hole.

The compost sample was mixed with deionised water in the proportion 1:1, and then shaken regularly for 5 minutes. The pH was then taken with a Hanna HI 98130. A second measurement was done on the same sample, replacing the deionised water with a 0.01M $CaCl_2$ solution.

4.3.3 Turning the compost

The compost was turned once on the 23nd of August. The top and bottom layers were thoroughly inverted and the temperature probes were re-installed.

4.3.4 Compost humidity management

Although the initial water content of the compost was determined at mixing time, the water content does evolve according to the water balance. Two factors contribute significantly to the water balance: as for the inputs, precipitations; as for the outputs, evaporation. Since the summers in northern Yunnan are generally cloudy and rainy, it was anticipated that the water balance might be positive, with more precipitation than evaporation. For this reason, a roof had been previously built above the compost shed. The experiment was started under the roof, but it was established after 4 weeks that the compost was getting too dry, and it was decided to remove the roof for the remaining time of the experiment.

5 RESULTS

5.1 Temperature

The temperature of the material in the shed at the start of the experiment was measured to 26°C. The next day, after mixing with the bio-slurry, the initial temperature of the compost had fallen to 22°C.

The initial temperature rise occurred in the first few days after mixing and culminated after 10 days between 30°C and 56°C degrees. This first phase lasted for 3 weeks before temperatures dropped in the mesophilic range again. The following curing phase saw the temperature stabilise to near ambient. A significant temperature rise did not occur after turning the compost. A slow but steady temperature decrease was

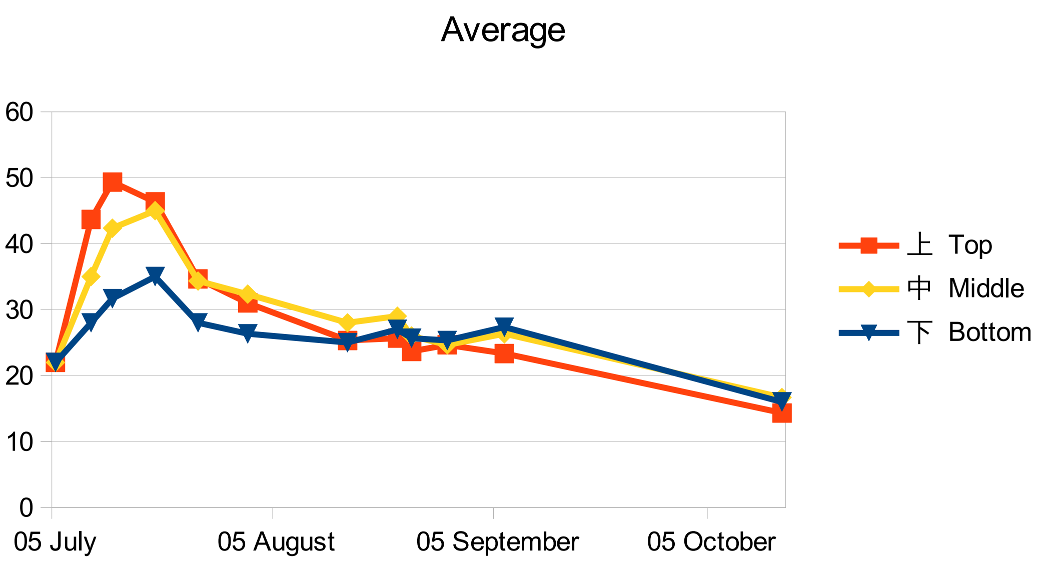

Illustration 7: Compost temperature - average per depth

observed in the following months. The temperature was significantly higher near the surface and decreased with depth.Results of temperature measurements are reported below in illustrations 7, 8 and 9.

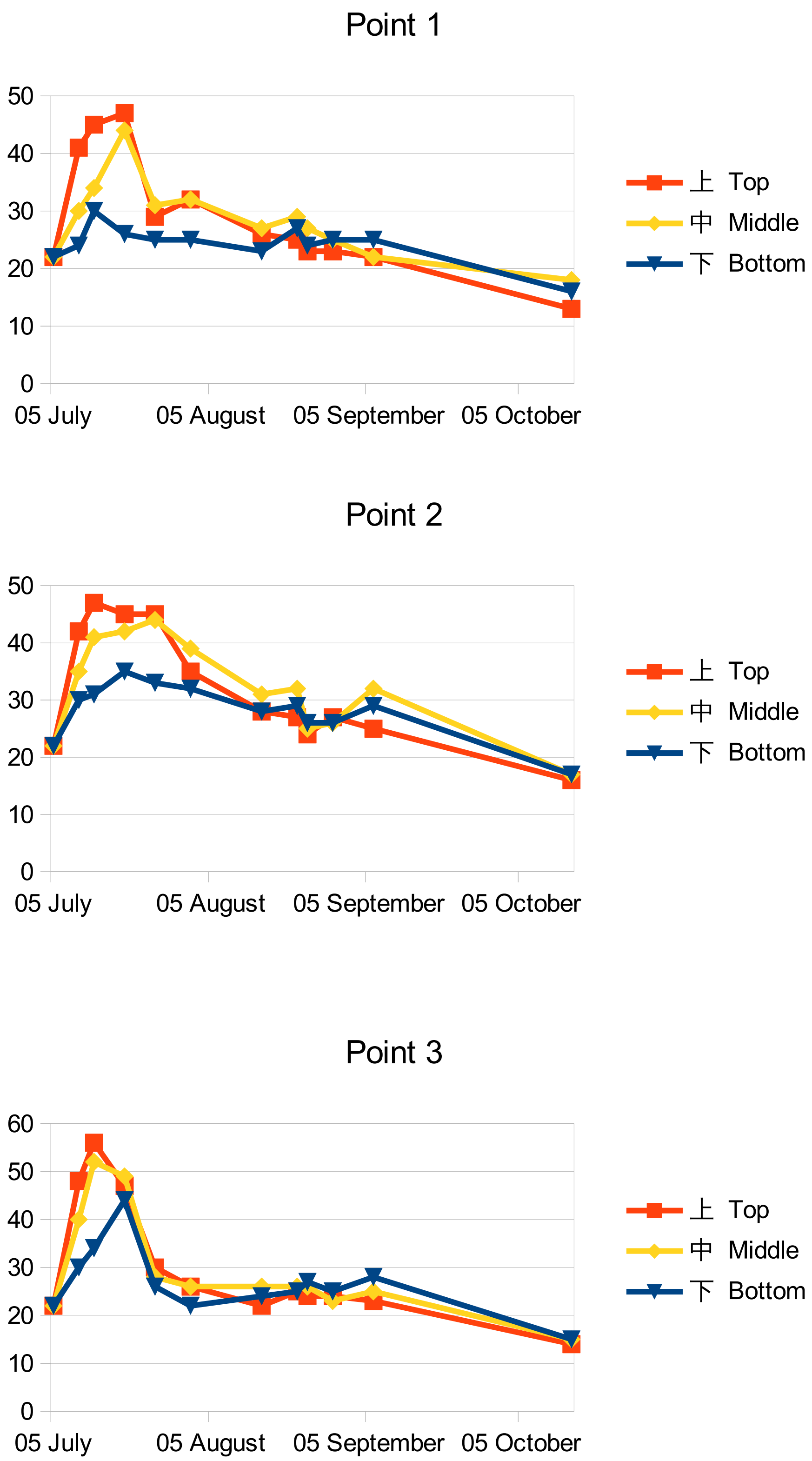

Illustration 8: Compost temperature at 3 locations

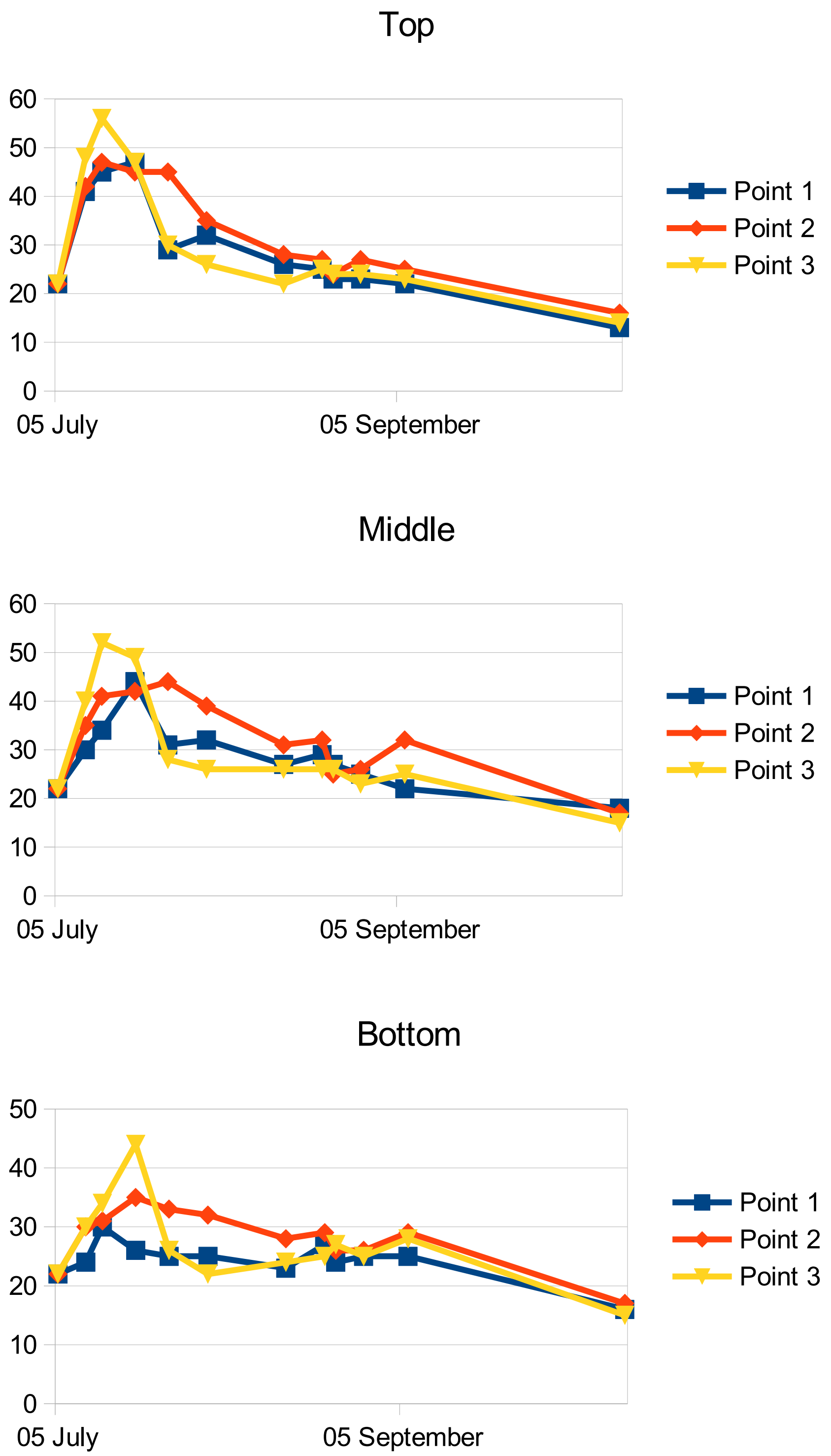

Illustration 9: Compost temperature - by depth

5.2 pH

The pH values measured in the CaCl2 solution are reported below in illustration 10.

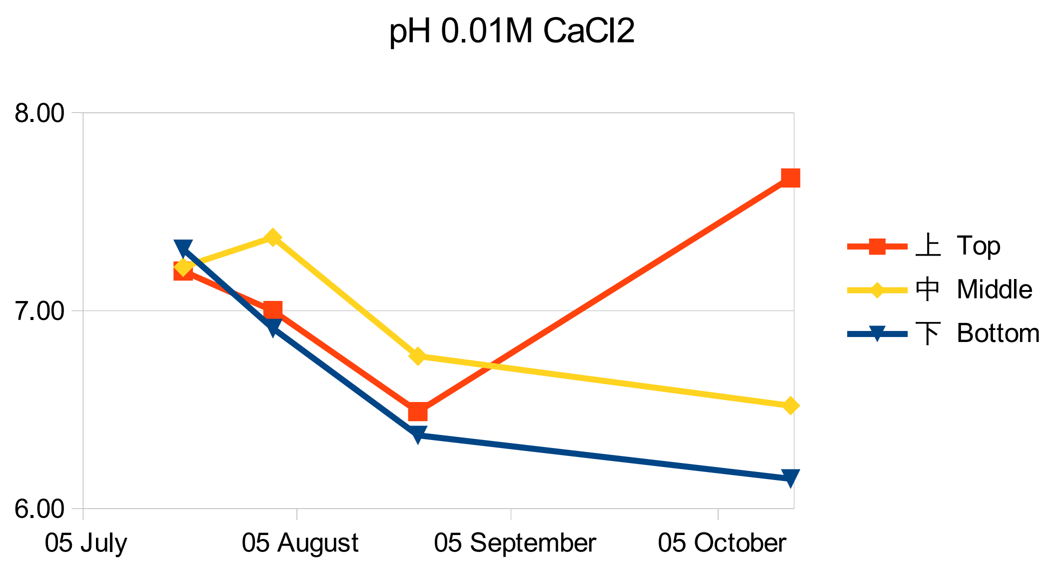

Illustration 10: Compost pH - per depth

5.3 Volume and mass

The total volume of the compost shrunk by an estimated 25% between July and November 2012. The mass of the final product was not measured.

5.4 Laboratory analysis

A sample of compost was taken on the 23 August and sent to the Yunnan Academy of Agricultural Sciences in Kunming. The analysis returned the following values (table 4).

pH	6.83
OM	77.77 %
N	1.34 %
P	0.20 %
K	1.00 %
NH_4^+ - N	0.73 mg/kg
NO_3^- - N	112.73 mg/kg
Available P	431.94 mg/kg
Available K	9907.64 mg/kg
Humidity	44.79 %

Table 4: Results of compost analysis

Based on these analysis, the following parameters could be calculated (table 5):

Total C	45.11 %
C:N	33.66
Total mineral N	113.46 mg/kg
Total N	13400.00 mg/kg
Mineral N : total N	0.85%
Total P	2000.00 mg/kg
Available P : total P	22%
Total K	10000.00 mg/kg
Available K : total K	99%

Table 5: Values calculated from lab results

5.5 C:N ratio

Two points are available for the estimation of the compost C:N ratio. The first value can be estimated at the start of the experiment through calculation based on the compost ingredients and ratio (see table 3 page 8). The second value is obtained through calculation based on the result of the lab analysis (see table 5). These values are shown in table 6.

Date	C:N ratio
05/07/12	46.1
23/08/12	33.7

Table 6: Compost C:N ratio

5.6 Workload

Filling the compost shed with the mix of dry material and bio-slurry required three people working during two days and represents a total workload of 28 hours-man.

Turning the compost required 6 hours-man.

6 Discussion

6.1 Compost humidity management

The follow-up of the compost humidity shows that no rain protection is needed under northern Yunnan climate conditions, in the period July-December. Local precipitation contributes to balance the evaporation during this period.

The water balance could even be negative for other periods of the year. Since the winter precipitation is low, a winter compost might need to be supplemented with humidity. Bio-slurry could be used for this purpose, since the experiment shows that the limiting factor to the quantity of bio-slurry that can be absorbed by a defined quantity of dry biomass is the humidity, and not the C:N ratio. Adding bio-slurry to a drying compost could therefore supplement with additional nitrogen.

6.2 Compost turning

Although it is widely reported that compost heaps should be turned at least once during the process, turning the pile did not boost the decomposition process, as attested by the stability of the temperature. It is likely, however, that this homogenisation allowed for better sanitation and decomposition of the heap, by digging the non decomposed upper layers towards the inside.

6.3 Temperature, sanitation

The temperature results of the experiment are consistent with a general model of a compost pile temperature distribution governed by the two following principles:

- the heat production is a function of the biological aerobic activity, which is itself function of the oxygen supply
- the heat losses are function of the insulation layer, therefore inversely related to the depth in the pile

It can be postulated that the higher temperatures of the upper layers (peaks 47°C, 47°C, 56°C for points 1,2,3 respectively) are due to a better air supply, but that this rise in temperature was moderated by the important heat losses of the upper layer to the surrounding air.

The middle depth (30cm) temperature was only slightly lower than the top layer (peaks 44°C, 44°C, 52°C for points 1,2,3 respectively), which can be explained by a lower heat production coupled with a better insulation than the top layer.

The deepest layer (60cm) reached a relatively moderate temperature (peaks 30°C, 35°C, 44°C for points 1,2,3 respectively), which can be explained by a sub-optimal aeration coupled with moderate heat losses.

Differences were particularly pronounced during the early phase of the compost, during which the temperature rise and the oxygen demand are maximal due to the presence of easily degradable compounds.

The minimum peak temperatures recorded were 30°C, 44°C, 47°C for the bottom, middle and top layers, respectively. The reduction of pathogens was therefore satisfying in the top and middle layers, but the achieved sanitation through heat should be considered insufficient in the bottom layer.

Turning the compost did not lead to a significant temperature rise. The temperature was slightly increased in the bottom and middle layers, however this was probably due to the import of already warmer material from the upper layer.

6.4 Suitability for agriculture

Organic material should not be applied to crops at a C:N below 25, because of the risk of nitrogen immobilisation. A final analysis of the C:N ratio was not made in January 2013 as the compost was mature, but it can be postulated that the C:N value continued declining to below 30, thus approaching a suitable value for use on the field.

The nutrient content is consistent with typical values for a compost, as illustrated in table 7. As it can be seen, the phosphorus content is comparatively low. Nitrogen is mostly bound in organic form (99.15%), but its total availability on the field will be higher due to mineralisation (a 5% N availability in the first year can be assumed).

	Total content	Thereof in mineral form
N	1.34%	0.85%
P	0.20%	22%
K	1.00%	99%

Table 7: Compost - nutrient content and availability

Although there was some prior concern regarding the acidity of pine needles, the measured values are well within the range for composting. The pH showed a slow decrease during the composting process. It can be postulated that the high pH at the start of composting was due to the contribution of the alkaline bio-slurry, and that the decrease in pH is due to both the immobilisation of ammoniacal nitrogen and the decomposition of the organic matter into organic acids.

As could be expected, the achieved compost is therefore not a significant source of nutrient for the crops, apart from a moderate supply in potassium. It can be regarded however as a good amendment for improving the organic content of the soils.

6.5 Composting location, heap size and need of a built structure

A proper balance has to be found between a large compost heap (high volume to surface ratio favouring insulation, but poor oxygen supply to the centre) and a small heap (important heat losses, but good insulation). The temperature discussion above shows that the compost was globally well aerated in the upper layers. The oxygenation of the lower layers were slightly insufficient. It would be therefore recommended to reduce the size of the compost heap by a half. A proper size would be about 1.5 x 1.5 x 1m (heap), or 1.5 x 1m (if disposed in windrows).

Furthermore, since the walls are an obstacle to air supply despite the holes, a better oxygenation would be obtained without walls. Besides, since the water balance was better adjusted without covering, a roof is not necessary. Consequently, it is not necessary to build an ad-hoc structure. The compost can simply be made in a heap directly in a suitable location on the soil.

Besides, the walls were found to be very non practical for filling/emptying the shed, since all materials had to be shovelled over. Such a compost shed, if used, should at least have one side open for this purpose.

Finally, since the compost did not show any leakage in these mixing proportions and climate conditions, a concrete slab with collection of the leakage to the biogas tank is not a necessity. Composting could be done without further losses of nutrients by percolation on any flat and solid surface, as long as it is away from water circulation (such as precipitation runoff). A mud/clay surface is suitable for this type of composting.

6.6 Consumption of bio-slurry

Although the efficiency of the composting process itself is convincing, surveys carried out amongst ID beneficiaries show that few farmers can provide dry agriculture or forest residue, since most of the biomass is already used in the local agriculture for either feeding or bedding.

The total consumption of bio-slurry in the experiment was 1.3t for 11m^3 of initial dry biomass.

Considering the local agriculture characteristics, 11m^3 is rather an upper limit to the amount of dry biomass that can be gathered by a farmer.

Based on a typical annual production of bio-slurry comprised between 6t and 14t (corresponding to the average manure production of 5 pigs, or 1 cow and 3 pigs, respectively), **the total amount of bio-slurry needed for making an aerobic compost heap of this size represents between 9% and 22% of the total annual bio-slurry production.**

Adding higher amounts of bio-slurry, or adding bio-slurry to wet piles of manures (commonly found outside the houses in the region) would lead to soaking and therefore present the risk of leaching nutrients, favour anaerobic conditions, and potentially release ammonia, methane and nitrogen oxides from the heap.

6.7 Using an aerobic compost pile for insulating a biogas digester

A pile of warm aerobic compost could be used as an efficient insulation/heating for a biogas digester during the winter. The heap could be placed directly above the digester over a sufficient radius.

However, it has been shown above that the strong heat production is limited to the first 3 or 4 weeks after the compost is initiated. Instead, the compost could be made layer per layer throughout the winter, which would further have the advantage of spreading the workload and the use of bio-slurry.

The limitations of this method of insulation should be kept in mind, since other experiments have shown that placing insulating material on top of the biogas digester during the winter, has little or no efficiency. The insulating performance of a pile of aerobic compost is therefore dubious. This solution could be experimented in practice with a compared trial of two insulated and uninsulated biogas digesters.

7 CONCLUSIONS

The experiment has shown the feasibility of using bio-slurry as a compost activator for dry pine needles, and the excellent efficiency of the composting process. The proportion of bio-slurry to dry biomass has been established, and the need for a built structure or a roof has been discarded. It has been shown that the compost reaches maturity within the season, achieves good sanitation levels through heating, and that regular turning is optional.

However, surveys amongst ID biogas beneficiaries have shown the limited availability, within the local agriculture, of dry biomass for making compost with liquid bio-slurry. A prime interest that had motivated this study was the potential of "stocking" bio-slurry throughout the year by absorption in a compost. By increasing their use of bio-slurry, the biogas users could indeed free space in their digesters to input more manure, and therefore increase their biogas production. It is now known that only few farmers do have sufficient available dry biomass.

Even where dry biomass is available, the experiment shows that less than a quarter of the typical yearly bio-slurry output of a family could be used in the compost. Adding higher amounts of bio-slurry, or adding bio-slurry to wet manure piles, would lead to potential emissions of green house gases, and should therefore be avoided.

Using bio-slurry as a compost activator should be promoted with care, in a targeted way and preferentially in villages where biomass is known to be available, such as the villages bordering forest areas. Wherever dry biomass is easily available, the use of bio-slurry as an activator for composting will be an excellent solution combining the two advantages of freeing space in the digester, and the preparation of a quality amendment for the fields.

8 APPENDIX

8.1 Analysis results of two samples of bioslurry

A – Water Chamber **B – Hand pump**

云南省农业科学院农业环境资源研究所分析检测中心检验结果报表

NO:2012672（1） 共2页，第2页

送检单位：法国发起发展组织 样品名称：沼液

检验结果	项目名称			
		分析编号	20123072	20123073
		样品编号	A	B
		计量单位	实测数据	
	pH值	/	7.7	7.62
	有机质	g/L	3.49	5.83
	全氮(N)	mg/L	1679.58	1910.82
	全磷(P)	mg/L	34.98	66.86
	全钾(K)	mg/L	1532.97	1517.61
	铵态氮	mg/L	220.68	315.65
	硝态氮	mg/L	44.57	96.49
	水分	%	99.16	99.04
备注	------------。			

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8.2 Analysis results of one sample of compost

云南省农业科学院农业环境资源研究所分析检测中心检验结果报表

NO:2012672（2） 共2页，第2页

送检单位：法国发起发展组织 样品名称:沼渣

检验结果	项目名称	分析编号	20123074
		样品编号	C
		计量单位	实测数据
	pH值	固液比=10：1	6.83
	有机质	%	77.77
	全氮(N)	%	1.34
	全磷(P)	%	0.20
	全钾(K)	%	1.00
	铵态氮	mg/kg	0.73
	硝态氮	mg/kg	112.73
	速效磷（P）	mg/kg	431.94
	速效钾(K)	mg/kg	9907.64
	水分	%	44.79
		以下空白	
备注	结果以风干样重计。		