



INSTITUTE OF RURAL ECONOMY



Japan International Research Center for  
Agricultural Sciences

# TECHNICAL COMPOSTING



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Appendix: Technical Manual 6

"Guide for the Management and Natural Resource Conservation"



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THE MINISTER OF AGRICULTURE

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INSTITUTE OF RURAL ECONOMY

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REPUBLIC OF MALI

One People - One Goal - One Faith



Technical sheet

## TECHNICAL COMPOSTING

**Type of production: Plant Production**

authors:

Tahirou Tangara, Livestock, CNRA, Mali Email:

tahirou.tangara@yahoo.fr Tel: +223 66 72 12 36

Adama Coulibaly, Agronomist, IER - Sotuba Mali Email:

adama\_c@yahoo.fr Tel: +223 76 26 42 11

Seydou Sidibe, Animal Nutrition Laboratory, IER - Sotuba Mali Email:

seydousidibe@hotmail.com Tel: +223 66 98 49 03

John S. Caldwell, Agronomist, member of the project oversight committee GERENA, Japan Email:

caldweljoverseas@hotmail.com Togo Shinohara, Physiology vegetable, JIRCAS, Japan Email:

tshinohara@affrc.go.jp Tel: +81 29 838 6690

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## **1. Foreword**

In rural villages in Mali, farmers' access to fertilizer for cereal crops is limited due to insufficient financial resources. In addition, organic fertilizers, animal manure such as manure, which can replace chemical fertilizers, can not be produced in sufficient quantity to cover the needs of farmers in early winter is the installation period cultures. It is necessary, therefore, to introduce a composting technique using the organic matter in the villages and not used and thus produce fertilizers in sufficient quantities to be used by farmers. The use of compost helps maintain and significantly improve the fertility of agricultural land.

## **2. Definition of "compost"**

Compost is the result of the decomposition of carbon-containing organic materials and nitrogen through a natural process due to the action of microorganisms, air and water, which allows the use to easily cultures. Going through this process, we can recover waste such as crop residues, animal wastes, municipal waste.

## **3. Objectives of the activity**

- Improving Compost making technique
- Extend the areas which can be amended with compost
- Improve fertility of agricultural land by spreading compost
- Alleviate the financial burden of buying chemical fertilizers
- Lowering the costs of agricultural production through the development of local resources

## **4. Expected Results**

- More and better organic fertilizers used by farmers
- Extension of the areas which may be amended with compost
- Increased grain harvests
- Increase agricultural income

## **5. Detailed technical**

### **5.1 Conditions for making compost**

Compost can be crafted in all sorts of places. We can accumulate the material in small piles, put them in as and in a pit in a house with a roof or even in a fully enclosed space. However, regardless of location,

composting principles must always remain the same: You have to create the optimal environment conditions under which the microorganisms performing the decomposition of organic material through composting. The composting process takes place in two phases: a first microorganisms activation phase which occurs at a temperature less than 50 °, and a second phase for activating the microorganisms which occur at high temperature (50-70 °) . The high temperature phase particularly contributes to disabling weed seeds and pests eggs. In addition to temperature include as material terms of composting the following:


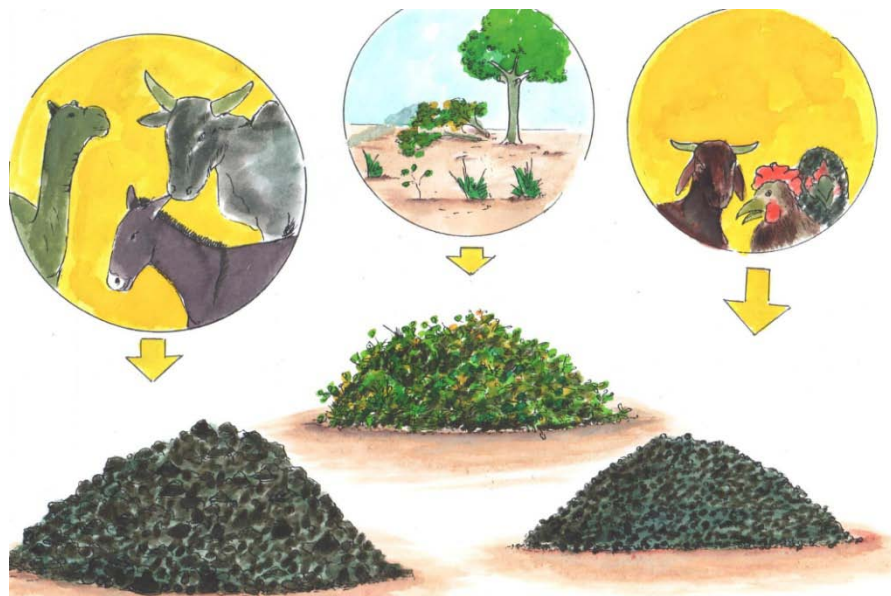
aeration (oxygen conditions)                      humidity,      pH,      The report  
carbon / nitrogen (C / N), the shape of the carbon compounds, etc.

- The aeration (oxygen conditions): It is desirable to ensure good oxygenation, the decomposition of organic material is mainly the fact of aerobic microorganisms.
- Humidity: Some moisture is essential for microorganisms performing the decomposition work organics. However, there is a relationship between humidity and aeration which means that, if the humidity is too large, it becomes difficult to ensure oxygenation, and it is feared that the decomposition is delayed . This is why it is desirable that the humidity is around 50-60%.
- pH: A basic medium is most suitable for composting, decomposition not advancing in an acidic medium. The acidity is mainly generated by the production of butyric acid and lactic acid in the anaerobic fermentation effect due to lack of ventilation.
- The carbon / nitrogen ratio: In the decomposition process, the carbonic material from organic materials **are used by microorganisms and released as CO<sub>2</sub>**. If, during the composting process, the carbon / nitrogen (C / N ratio) of organic materials is less than 15, a nitrogen loss is expected. If also the C / N ratio is too high, the decomposition process is slowed considerably. The C / N ratio is optimal between 15 and 30.
- Form of carbon compounds: The shape of the carbon compounds affects the rate of decomposition of organic matter. Simple carbohydrates, starches, hemicellulose, pectins or amino acids etc. break down readily. Celluloses are more resistant and lignins are difficult to break down.



## 5.2 Materials and equipment for making compost

The materials used for the manufacture of the compost can be divided into two broad categories, those organic materials with a high carbon content and the organic matter with a high nitrogen content.

Examples of organic materials with a high carbon content	
<ul style="list-style-type: none"><li>• Straw, rice husks, hay, dry leaves</li><li>• Household waste, wood ashes, sawdust, shavings</li><li>• Cardboard</li><li>• Cotton, wool</li></ul>	
	
Examples of organic materials with a high nitrogen content	
<ul style="list-style-type: none"><li>• Animal manure (cattle, sheep, goats, donkey, chickens, guinea fowl)</li><li>• Fresh leaves (cut leaves of the hedges-bright, mown grass, leaves from the tree pruning)</li><li>• Remains of fruit and vegetables</li></ul>	
	

### Example compost recipe

We now present a crafted compost recipe with residues

crops (straw, rice husks, hay) and dung: As the amount of materials is based on the quantities that can find the peasants here we will give the amounts for total compost mass from 500 to 1500 kg. Nevertheless, the most important is not the quantity of materials, but the balance between high-carbon materials and those with high nitrogen content, ie materials with high carbon content (crop residues): materials high nitrogen content (small and large animal droppings) 1: 1 \*.

\* The more of high nitrogen materials, the more decomposition is rapid.

Materials rich carbon		high content of materials nitrogen	Total weight	Water <sup>1</sup>	(Urea) <sup>2</sup>
Residues of millet	rice husks, hay, etc.	Droppings of small animals (sheep, goats)			
750 kg	-	750 kg	1500 kg	600 l.	1.5 kg
700 kg	50 kg	750 kg	1500 kg	600 l.	1.5 kg
650 kg	100 kg	750 kg	1500 kg	600 l.	1.5 kg
600 kg	150 kg	750 kg	1500 kg	600 l.	1.5 kg
550 kg	200 kg	750 kg	1500 kg	600 l.	1.5 kg
500 kg	250 kg	750 kg	1500 kg	600 l.	1.5 kg
500 kg	-	500 kg	1000 kg	400 l.	1 kg
450 kg	50 kg	500 kg	1000 kg	400 l.	1 kg
425 kg	75 kg	500 kg	1000 kg	400 l.	1 kg
400 kg	100 kg	500 kg	1000 kg	400 l.	1 kg
375 kg	125 kg	500 kg	1000 kg	400 l.	1 kg
350 kg	150 kg	500 kg	1000 kg	400 l.	1 kg
250 kg	-	250 kg	500 kg	200 l.	500 g
225 kg	25 kg	250 kg	500 kg	200 l.	500 g
200 kg	50 kg	250 kg	500 kg	200 l.	500 g
175 kg	75 kg	250 kg	500 kg	200 l.	500 g
150 kg	100 kg	250 kg	500 kg	200 l.	500 g
125 kg	125 kg	250 kg	500 kg	200 l.	500 g
100 kg	150 kg	250 kg	500 kg	200 l.	500 g

<sup>1</sup> The amount of water is that necessary for turning the compost. The water content of easily changing, you need to make adjustments when necessary.

<sup>2</sup> The urea intake lowers the C / N ratio, and has the effect of accelerating decomposition. The amounts listed are the minimum quantities. It is understood that if the farmer can not get them, it is not mandatory to put.


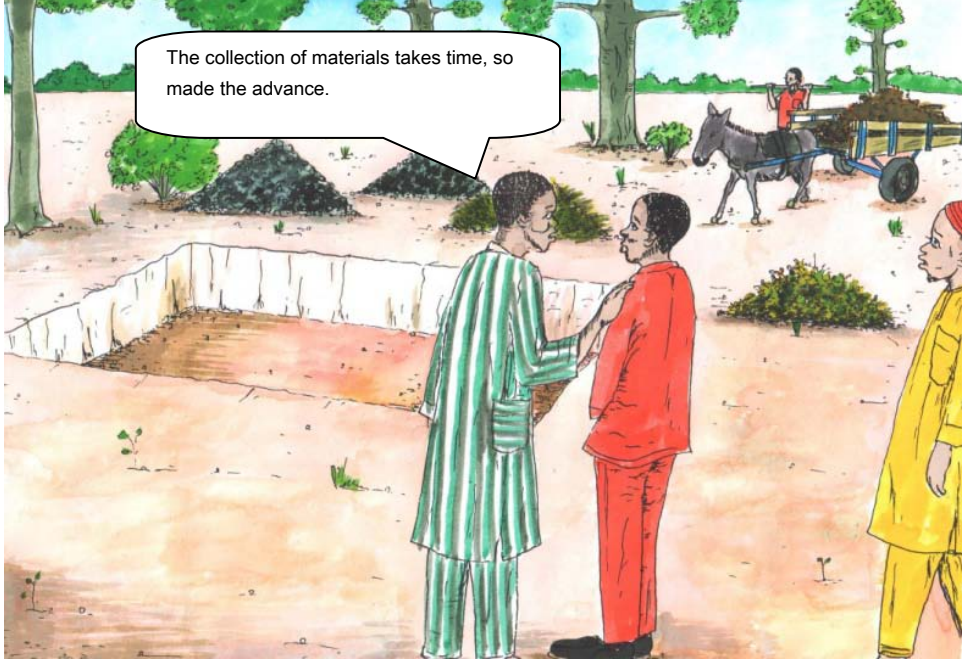
The materials needed to make compost differ depending on the mode of preparation.

**Can be found below the material commonly used:**



- Shovel, pick (digging pits)
- Machine cutting or machete (to cut materials)
- Cart / wheelbarrow (collection of material, carrying water)
- metal can, sprinkler, bucket (water intake)
- plastic sheet or cereal bags (cover compost)

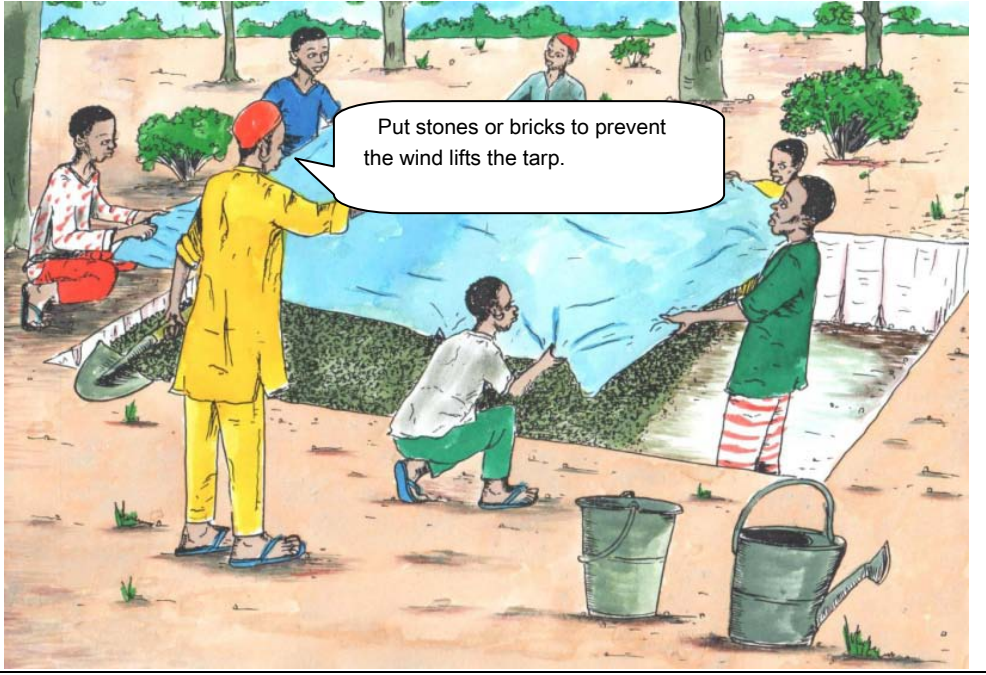



### 5.3 Process us of making compost


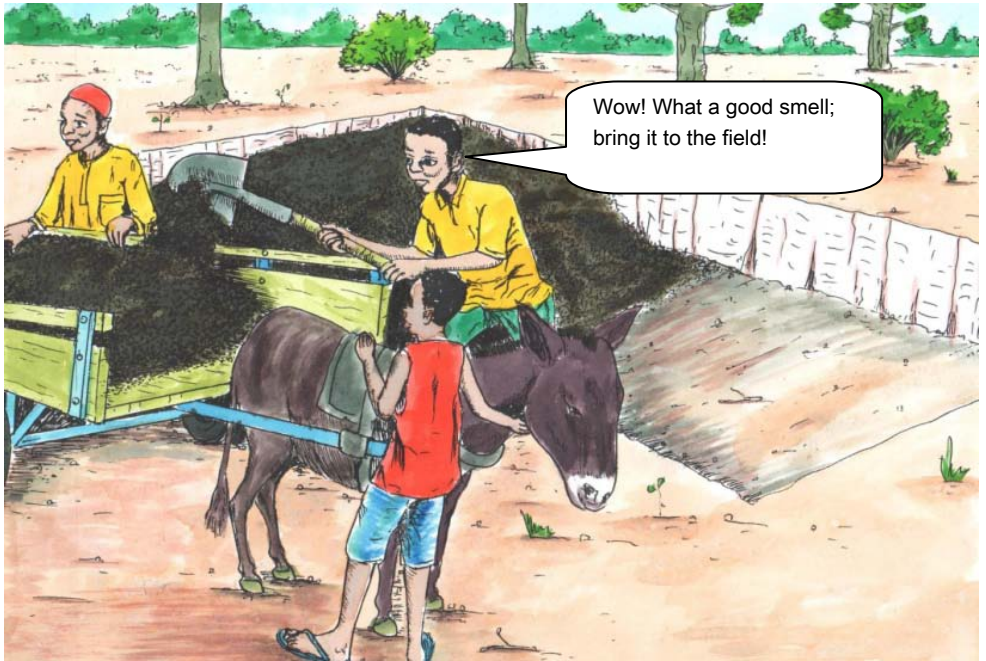
Process	Drawing
1. Making the pit	 <p>Let's dig a pit a depth of 1 - 2m!</p> <ul style="list-style-type: none"> <li>· It is desirable that the location of the grave is near a water source, while being protected from wintering in flood risk.</li> <li>· Pit dimensions vary according to the amount of compost, but dimensions of 3 x 5 m. or 2 x 4 m. facilitate the work.</li> </ul>
2. Collection of materials	 <p>The collection of materials takes time, so made the advance.</p> <ul style="list-style-type: none"> <li>· As the collection of materials requires time, allow sufficient time before the preparation of the compost.</li> </ul>



Process	Drawing
3. Cutting materials	 <p>The small pieces are better!</p> <ul style="list-style-type: none"> <li>· With the machine cutting or machete, cut the material to the size of a clenched fist. If we do not have tools to use materials as bedding for cattle or goats etc. allows to reduce the size.</li> </ul>
4. Establishment of the materials in the pit	 <p>Mix the materials together!</p> <ul style="list-style-type: none"> <li>· Put the same time into the pit of different materials allows to mix evenly. If we put them in layers of the same material, decomposition progresses less easily.</li> </ul>

Process	Drawing
5. Cover the pit with a tarpaulin	 <p>Put stones or bricks to prevent the wind lifts the tarp.</p> <p>· To prevent the tarpaulin being carried by the wind and keep the temperature of the pit, have around stones or bricks.</p>
6. Flipping compost	 <p>Compost is hot now.</p> <p>· The turning of the compost is done by all , three times: the first time after 2 weeks , the second time after 6 weeks and the third time after 9 weeks. Compost is completed 3 weeks after the third reversal ie 12 weeks after filling the tank.</p>



Process	Drawing
7. Adjustment of the water content of the water content	 <p>Water everywhere!</p> <ul style="list-style-type: none"> <li>· The adjustment of the water content is made during upturns.</li> <li>· He is using a watering etc. and take care to water so that the water will spread throughout the compost.</li> </ul>
8. The compost is ready.	 <p>Wow! What a good smell; bring it to the field!</p> <ul style="list-style-type: none"> <li>· The finished compost is loaded onto a cart and routed to the fields.</li> </ul>

#### 5.4 Important points of technique

- Cutting of materials by cutting the material to the size of a clenched fist, over a length of 10 to 20 cm, it increases the contact surface between the organic matter and microorganisms, and decomposing is done more efficiently. we will use for cutting in a cutting machine (see process 3 . Cutting materials), machete, use as animal bedding (cutting due to trampling by animals), etc.
- Weighing matter: weighing materials can be simplified to convert the number of carts. In our case, the cartload was converted to 250kg. However, given the weight of the material that can be loaded into wagons depends on the type of material and size of the truck, we recommend you to first check each subject at the site.
- Adjusting the water content is necessary to prevent the evaporation of water by direct exposure to sunlight, to maintain humidity whenever possible. This may be done to avoid excessive evaporation by covering the compost a large plastic tarp or empty sacks of grain (see the process 5. Cover the pit with a tarpaulin). Take a ball of compost in hand. If the ball is dry and Effrit, compost needs water. But if the water comes out when strongly held, it shows that there is too much water, and should not be watered again.
- Flipping: Going back compost helps aerate and reduce the disparities in the distribution of moisture, which makes it more homogeneous. We operate with a shovel and a pick, etc. So that this work can be done easily in the pit, you can during filling to the composting materials gathered in one half of the pit to transfer during turning in the other half empty which allows swap many matters were up and those that were low (see the process 6. Turning compost).
- 3. Contribution of urea: Urea lowers the C / N and has the effect of accelerating decomposition. If farmers are able to get them at the first and second reversal, it will be effective to apply the appropriate dose, and so well distributed.
- Good compost can be distinguished by color and smell





- Good compost is dark black with an earthy smell of wood, which means it well fermented and decomposed. If the color of the material remains with a bad smell, it proves that it is not broken, it needs to be improved





Good compost fermentation and advanced decomposition (left) and bad compost decomposition does not succeed (right).

## 6. Using compost

Spreading compost is made at the beginning of the rainy season, when grain crops are started. With a plow which allows to mix the compost to the soil of the field, the decomposition of organic compost materials is still ongoing, and the nutrients are easier to use for plants. The dosage of compost spread depends on the amount of compost, but for millet and sorghum, it is desirable to spread at least 5 tons (about 20 carts) about compost per hectare.

Process	Drawing
1. Unloading	 <p data-bbox="453 954 927 981">· Unloading compost from the cart in the field.</p>
2. Arrangement in small heaps	 <p data-bbox="453 1675 943 1702">· Making small regular remote heap in the field.</p>



Process	Drawing
3. Spreading	 <p data-bbox="453 875 1378 949">· Before plowing, spreading using shovels etc. . compost around small piles so as to evenly distribute over the entire surface of the field.</p>
4. Labor	 <p data-bbox="453 1644 1378 1668">· On the occasion of plowing, mixing the compost with soil.</p>

## 7. Locations and application areas

Compost can be used of course for cereals such as millet and sorghum, but also for fruit trees and vegetable crops. As for the areas of application, there are no restrictions from the moment the materials needed to make compost and water are available.

## 8. Cost Structure introduction

Costs related to the introduction of this technology fall into two broad categories: the cost of materials and equipment on the one hand, and those of the other labor costs. It is not necessary to acquire the material if farmers are already filled. Below is given a numerical estimate of the costs for the production of 1.5 tons of compost in a holding:

Costs of materials and equipment	28,450 CFA
labor costs	15,000 CFA
<b>Total</b>	<b>43,450 CFA</b>

### Details of charges of materi the hardware and Section

	Amount	Price per unit (CFA)	Total (CFA)
Excavators	2	2,000	4,000
picks	2	2,000	4,000
metal can	1	10,000	10,000
watering	1	3,500	3,500
plastic sheet	1	6,500	6,500
Urea	1.5 kg or more	15,000 (50kg)	450
		Total	<u>28,450 CFA</u>

### Breakdown of labor costs Work Section

	Entire workforce (number of pers. /day)	Retribution (CFA / person Franks. / Day)	Total (CFA)
Making the pit	9	500	4,500
Collection of materials	3	500	1,500
Placing materials	3	500	1,500
Reversal (3 times)	9	500	4,500
Watering (3 times)	3	500	1,500
Transport	3	500	1,500
		Total	<u>15,000 CFA</u>

We have taken for this estimate assuming a cut of materials being by animal trampling in the litter.

## **9. Acknowledgments**

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**JIRCAS** ( Japan International Research Center for Agricultural Sciences) Department of Rural  
Development

Address: 1-1 Ohwashi, Tsukuba, Ibaraki 3058686, Japan Phone: +  
81-29-838-6690 Fax: + 81-29-838-6683

Email: [tshinohara@affrc.go.jp](mailto:tshinohara@affrc.go.jp)