

Mechanized village-level handmade papermaking

Handmade papermaking using abaca fiber (*Musa textilis*) is a potential income-generating and livelihood opportunity in the village especially in areas where labor is cheap and raw materials are abundant. However, the usual manual way of papermaking entails high production cost. Mechanizing some operations can lessen the production time, thus minimizing costs while increasing the production output.

Handmade papermaking process

The basic steps are cutting the fiber, cooking, pulping, sheet forming, couching, pressing, and drying.

- ❑ Fiber cutting. Cut the abaca fibers with lengths of about 5 cm each.
- ❑ Cooking. Boil the cut fibers in a stainless vat with water and caustic soda for three to six hours.

- ❑ Pulping. Wash the boiled fibers then beat with a mallet or pound using mortar and pestle until the consistency of the resulting pulp is uniform. Bleach the brown pulp with calcium hypochloride solution. After bleaching, discard the solution while washing the pulp thoroughly with water.
- ❑ Sheet forming. Dilute the pulp with water and put inside a vat. Dip a mold with a deckle (board) into the vat, shake evenly, and lift as the pulp is formed into a wet sheet.
- ❑ Couching. Transfer the wet pulp onto a cloth or felt sheet to remove the excess water.
- ❑ Pressing. Press, using a hydraulic press, several wet sheets that are stacked together to remove about 40% of the remaining moisture.
- ❑ Drying. Dry by hanging the pressed sheets or lay these on smooth surfaces such as GI sheets or formica top and dry under the sun.



Fig. 1. Abaca pulper

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Machines and equipment to aid in handmade papermaking

The manual method of sheet forming produces a distinct quality handmade paper. Operations like pulping, removing the water, and drying are easier done with the following machines and equipment developed by the Philippines' Leyte State University (LSU):

Village-level abaca pulper

The abaca pulper (Fig. 1), powered by a 2-hp, single-phase electric motor, has a liquid capacity of 60 L and a pulping capacity of 0.5 kg pulp/hour. The shearing action between the beaters and the grooves of an adjustable bedplate located below the roller crushes the pulp.

Paper dryer

The paper dryer is fuelled by liquefied petroleum gas. It can dry 40 sheets of A4-sized handmade paper in less than an hour.

Excess water expeller

The conventional method of sheet forming using sponge and blotting sheet (cheesecloth) takes at least three minutes per sheet to form and extract the excess

water. This method makes the wet sheet very difficult to remove from the mold. With the excess water expeller (vacuum box) (Fig. 2), the time for sheet forming and water extraction can be reduced to one minute per sheet. A household wet-and-dry vacuum cleaner is used in the setup by connecting its hose to the vacuum box.

Household electric blender

For the easy disintegration of the pulp, a household electric blender can be used. The blender improves the pulp's homogeneity and uniformity, thus producing a smoother and finer paper.

Effectiveness

In their tests, the developers of the mechanized system produced 285 sheets of quality paper per day, more than the 50 sheets produced by the manual system. Further, a more uniform quality of papers was produced. A minimum of three hours of cooking and three hours of pulping yielded the highest pulp recovery of almost 85%, resulting in lower pulp losses of only around 15%.

The developed dryer could attain a potential production of 577 sheets/8 hours per day at a shorter drying time with a maximum production of only 36 minutes, compared with sun-drying which has a maximum of only 133 sheets. Sun-drying required more than two hours while air-drying took almost 17 hours.



Fig. 2. Excess water expeller