Criteria for Design of Facilities for Coffee Processing by the Wet Method in Colombia

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Facilities for coffee processing on farms in Colombia are called beneficiaderos. It is necessary to bear in mind the location of, materials used in and access to these facilities, with the purpose of completing coffee processes in a suitable and acceptable manner. In every coffee property in Colombia it is necessary to have separate areas for coffee processing, drying and storage, distant from facilities for the storage of other products such as tools, equipment and fumigation chemicals, fertilizers, fungicides, insecticides and other agricultural products.

Location:

Facilities for coffee processing should be located in an isolated site distant from any unsanitary source that may represent a potential risk for the contamination of the coffee being processed. The activities and operations carried out in coffee processing facilities should not risk the health and the well-being of the community, their accesses and the environs should remain clean and free from any garbage accumulation (Puerta & Rodriguez, 2001; Republic of Colombia Decree 3075, 1997). It is also recommended that the beneficiadero is located near the house to be able to watch it. It should also be built where there is a slope in order to facilitate the flow of the coffee from reception to packing, as well as locating the beneficiadero near necessary services such as water and electricity (Echeverri et al., 1988).

Design:

Facilities for coffee processing should include delimited areas for the location of equipment related to: pulping, tanks for fermentation, washing devices, solar and mechanical dryers, disposal and treatment of residue and coffee waste water, and areas for the storage of parchment coffee beans in appropriate conditions. The beneficiadero should be designed and constructed in a fashion that protects against dust, rain, dirt or other polluting agents, as well as preventing the entrance of animals. Therefore, sun dryers like the parabolics and elbas must be protected by means of a metallic or plastic fence (Puerta & Rodriguez, 2001). The beneficiadero should have the adequate capacity for the placing, operation, repair and maintenance of equipment, as well as for the circulation of personnel,

1 The views expressed in this publication are those of the author(s) and do not necessarily reflect the views of the Food and Agriculture Organization of the United Nations.
and for processing the amount of coffee cherries produced during an annual maximum production day.

The equipment used for coffee processing should be located according to the logical sequence of the process, from the reception of the coffee cherry to the storage of the dry parchment coffee beans, in such a way that cross-contamination is avoided (Puerta & Rodriguez, 2001). Before construction of the beneficiadero detailed structural and architectural plans are necessary as well as an expert builder in order to achieve functional and safe facilities. It is recommended to take advantage of the slope of the terrain, and to do calculations for the size of the beneficiadero depending on the amount of coffee production expected on the property (Echeverri et al., 1988).

The floors must have slopes of 2% (as a minimum), and at least a drainage of 10cm diameter by each 40m$^2$ of served area to avoid the stagnation of water, and the presence of other sources of contamination for coffee being processed.

Floors, walls and surfaces of coffee processing facilities and tanks should be constructed from inert materials, which do not generate substances or toxic polluting agents, they should be resistant, not readily corroded, waterproof, non-absorbent and non-sliding and free of cracks which may difficult cleaning, disinfection and sanitary operations. The use of revoked surfaces (or at least covered with materials like cook clay) is recommended, which may facilitate sanitary maintenance (Puerta & Rodriguez, 2001).

Joints between the walls, walls and floors, and walls and ceilings must be sealed and be rounded form in the corners to prevent the accumulation of dirt, and to facilitate cleaning. Ceilings should be designed and built so that the accumulation of dirt and the formation of moulds are avoided. In addition false or double ceilings should be avoided. Doors should be made from a smooth surface, resistant and of sufficient amplitude for equipment and containers. The openings between the outer doors and the floors should not be greater than 1cm, with the purpose of preventing animal entrance (Puerta & Rodriguez, 2001).

Coffee processing areas should have a suitable and sufficient illumination (either natural or artificial), achieved by means of an appropriate distribution of windows, skylights and lamps (Puerta & Rodriguez, 2001).

**Treatment of residues and by-products:**

It is necessary to design, construct (and keep well repaired) all facilities associated with the suitable disposal and treatment of pulp, mucilage, garbage, coffee waste water, sewage and other residues from the farm. This will avoid either, i) that these residues constitute a source of contamination in the areas where coffee is exposed, or, ii) that they cause pollution in the wider environment (Puerta & Rodriguez, 2001; Zambrano et al., 1999; Republic of Colombia Decree 1594, 1984; Republic of Colombia Decree 901, 1997).
Coffee waste water from washing and processing should be channeled and treated in anaerobic reactors, independently from sewage and wastewater from cleaning and disinfection operations. Reactors should be placed at least 20m from housing and located in such a way that the difference of terrain levels between the exit of coffee waste water and the treated water from reactors is 6m. For coffee productions of up to 12 tons of dry parchment coffee beans a year, 20m$^2$ is required for anaerobic digesters and their components. For larger coffee productions it is necessary to increase the area proportionally. Sewage and wastewater from cleaning and disinfection of facilities and equipment may be mixed and treated with that of septic systems (Zambrano et al., 1999).

For pulp management, each property should have a room near the pulping operation on a lower level of terrain in order to transport pulp by gravity. Rooms for pulp composting should be separated at least 20m from solar dryers. This room may be built from bamboo, using fired clay and zinc roofs. The floor should have a slope of 2% and a layer of bamboo 15cm off the soil to allow drainage towards appropriate systems of treatment. The walls should be covered with a mesh cloth to avoid the proliferation of flies and to avoid cross-contamination by microorganisms. 4m$^2$ rooms 2m height are required for each ton of dry parchment coffee beans produced a year.

The area for earthworm composting of pulp and organic residue from housing should be located 5m from the pulp rooms; have roofs; the cultures should be placed isolated from direct soils; and should have a 2% slope to allow drainage towards appropriate treatment. Separated from pulp facilities should be a room of sufficient area for the disposal and storage of recyclable material like glass, aluminum, cardboard, and plastic (Rodriguez, 2003; Davila & Ramirez, 1996; Roa et al., 1999).

**Storage facilities for coffee beans:**

Ventilated and hygienic rooms should be available in the farm for the temporary storage of coffee beans. Coffee sacks should be stowed over clean surfaces at least 30cm from soils, walls and ceiling, and packing material should be clean.

**Water supply:**

Water for coffee processing should be from a known source and free from any pathogenic and other chemical contaminants that may risk the health of persons, or the quality and safety of coffee beans. It is recommended to have at least two tanks on the farm for storing the necessary volume of water for processing the amount of coffee produced on a maximum production day on the farm. The tanks must be constructed from resistant materials that are non-corrosive, without irregularities that can catch solids or microorganisms (which could affect the sanitary quality of the water), and should be kept covered to avoid any cross-
contamination. Additionally, the tanks should be washed and disinfected periodically (Puerta & Rodriguez, 2001).

**Washroom and lavatory facilities:**

Close to the area for coffee processing adequate facilities for the hygiene of personnel should be available (Puerta & Rodriguez, 2001).

**Equipment and utensils:**

The following equipment is necessary for coffee processing using the wet method: hoppers, equipment for separation of damaged fruits and beans, tanks for fermentation of mucilage, equipment for separation of mucilage (e.g. ‘Becolsub’), solar dryers, rakes and shovels. The equipment and utensils used in coffee processing should be designed and placed according to the sequence of the process, and in such a way that repair and cleaning procedures may be done without causing contamination of coffee beans (Puerta & Rodriguez, 2001; Puerta, 2003).

**Hoppers**

Should be used exclusively for receiving coffee cherries and channeling the cherries to the pulpers. It is recommended to use hoppers made from inert materials such as cement, fired clay or wood, but covered with aluminum lamina. The unloading pipe of the hopper may be made from PVC tube and should have a floodgate to control manually the flow of cherries. It is recommended to avoid the use of water for transport cherries between hoppers and pulpers. The size of hoppers should be enough to receive 70% of the coffee produced on an annual maximum production day (Echeverri et al., 1988).

**Pulpers**

Must be used exclusively for pulping coffee, it is recommended to adjust them in such a way that pulping is done without water (Alvarez, 1991). Before pulping it is necessary to verify the adjustment of the pulper according to the quality of cherries. The number of pulpers required should be calculated considering their power and the amount of coffee produced on the farm. When several pulpers are needed, it is recommendable to use the same brands and of the same power (Echeverri et al. 1988).

**Devices for classification**

For the separation of defective fruits and beans and any impurities, it is necessary to have in coffee facilities equipment like siphon tanks, screens, cyclones, channels, meshes, etc. These devices should be used for controlling the processes at every stage from reception to packing. The power of equipment used for separation operations should correspond to the power and capacity of the other equipment such as pulpers, tanks, and dryers (Puerta, 2003; Echeverri et al., 1988).
**Tanks**

Should be used exclusively for processing coffee beans. The tanks should have a rectangular shape with rounded corners (Zambrano, 1993), the walls should be covered with an inert and resistant material such as fired clay, its design should include a slope to facilitate the drainage of the ‘rests’ obtained after fermentation of the mucilage as well as washing water. Its height should be maximum 1.20m, to facilitate their use by the personnel. All *beneficiadero* should have at least two tanks for fermentation, each with a sufficient capacity to process the amount of coffee produced on an annual maximum production day (Echeverri *et al.*, 1988).

**‘Becolsub’**

The amount and power of the *desmucilaginadores* or Becolsub machines must be calculated considering the coffee annual production of the property (Roa *et al.*, 1999).

**Dryers**

Solar dryers should be located in such a way that good ventilation is obtained, sun energy is received and cross-contamination is avoided. *Elbas* and patios for sun drying should have a minimum slope of 1%, the material of surface should be uniform like cement or any resistant material to solar radiation, but inert to coffee beans. *Paseras* and mobile drying devices may be constructed from wood or metallic structures, but covered with inert materials, the floor should be a mesh from stainless steel (Echeverri *et al.*, 1988). The area required for sun drying is at least 2m² per 62.5kg of parchment coffee beans produced per year. For greater productions (up to 1 ton) it is recommended to construct several dryer units. The dryers may be used for drying other agricultural products in the property, but it is indispensable that the cleaning and disinfection procedures are always carried out before using them for coffee beans again. Mechanical dryers should be designed from inert and hygienic materials such as cement and stainless steel meshes. It is indispensable that the system includes a suitable ventilator, as well as a heat exchanger, thermometer for the control of the temperature of the drying air, system of floodgates and the written and proven procedures for the safe handling of fuels. It is recommended that low cost fuels are used, which are available in each region. For calculation of the necessary dryers and their capacity the coffee production on the farm and the heat capacity of the selected fuels need to be considered (Roa *et al.*, 1999; Echeverri *et al.*, 1988).
Bibliography


