

The yields obtained from cocoa trees vary considerably. Yield depends on the variety of cocoa grown, the growing system (tree density, shade levels, fertilisation, irrigation), the age of the trees, the farming practices (e.g. maintenance), the local environment (weather, soil fertility), and losses caused by pests and diseases. Yields of dry beans can vary from 150 kg/ha (132 lb/acre) in a poorly maintained small-holding, through typical West African levels of 250–450 kg/ha (220–400 lb/acre) to that achieved on some plantations, which can be over 2500 kg/ha (2200 lb/acre).

### **2.2.9 Environmental and sustainability aspects of cocoa cultivation**

In the past, expansion of cocoa production has been from new small-holdings in former areas of primary forest that previously have been logged for timber. This is not a sustainable model for the future. There is potential to increase productivity by better control of pests and diseases, improved higher yielding and disease-resistant planting material and better farming practices.

If an area of primary forest has been logged, then cocoa growing becomes one of the most environmentally beneficial uses of the land. Essentially this is because it is a stable tree crop, often grown as part of a mixed cropping system including shade trees. Cocoa farms support a relatively high biodiversity and have been shown to be an important habitat in Central America for migrating birds. Tropical tree crop systems such as cocoa cultivation are important in providing vegetative continuity with residual areas of primary or secondary tropical forests.

Sustainability programmes (e.g. CocoaAction, coordinated by the World Cocoa Foundation) aim at improving the social conditions and livelihood of cocoa farmers, and ensure the long term supply of cocoa to the industry. Most of these programmes involve governments, industry and non-governmental organisations (NGOs) working together in a coordinated manner. To provide consumers with confidence and trust, there are several certification schemes such as Rainforest Alliance™, Fairtrade International® and UTZ Certified™ who carry out inspections and allow their logos to be used on product packs (see Section 2.5).

### **2.2.10 Labour practices on farms**

Cocoa production in West Africa is mainly on small family farms using labour-intensive methods (see Section 2.5). Following media allegations about forced child labour in Côte d'Ivoire there have been some independent studies into labour practices (e.g. Gockowski, 2006; Fair Labour Association, 2012). The vast majority of labour on cocoa farms in West Africa is adult and is in one of three basic categories: full time seasonal, casual labour for a specific task or a share-cropping tenancy (where the share-cropper provides labour on part of the farm in exchange for a share in the crop proceeds). Family children are involved, especially during busy harvest periods and can be exposed to hazardous tasks

such as using a machete or carrying heavy loads. Gockowski (2006) also reported that less than 1% of cocoa farms employed adolescent workers, that child slavery was uncommon and cocoa producing households sent more of their children to school when compared to non-cocoa producing households. There is no doubt that cocoa growing provides significant benefits to many rural economies. Most sustainability programmes include elements on the elimination of child labour.

## **2.3 Fermentation and drying**

The immediate post-harvest processes of fermentation and drying are normally carried out on the farm. They are essential steps during which the cocoa flavour precursors are formed. Drying produces a stable, non-perishable commodity making the crop ideal for small-holders in remote locations.

### **2.3.1 Fermentation**

Fermentation is carried out in a variety of ways and some of the common practices will be described below. The fermentation stage is usually very simple (see Figure 2.9). The fresh beans are heaped in a pile or in a wooden box, typically for five days. Natural yeasts and bacteria multiply in the pulp, causing the breakdown of the sugars and mucilage. Much of the pulp then drains away as a liquid. Different types of cocoa require different amounts of fermentation.

If the fresh beans are dried without any fermentation, the nib will be a slaty, grey colour rather than the brown or purple-brown colour of fermented dried cocoa beans. Chocolate made entirely from slaty, unfermented beans tastes very bitter and astringent with little cocoa flavour. It also has a greyish brown appearance. Beans from some origins are only partially or insufficiently fermented. Generally these beans can be used to manufacture cocoa butter, but if they are used to make other cocoa products, they require blending with fully fermented cocoas.

In West Africa, where smallholders grow nearly all the cocoa, fermentation is usually done in heaps enclosed by banana leaves. Heaps can be used to ferment any quantity from about 25–2500 kg (55–5500 lb) of fresh cocoa beans, although intermediate amounts are desirable. Some farmers will mix the beans on the second or third day. The fermentation usually lasts about five days and the end point is determined by experience. This traditional low input system produces well fermented cocoas.

In plantations, fermentation is normally carried out in large wooden boxes that typically hold 1–2 t of wet/fresh beans. Well-designed boxes have provision for the liquefied pulp (the sweatings), to drain away and for entry of air. This is usually achieved by means of small holes in the bottom of the box or preferably through a floor of slats each separated by about 6 mm (0.25 in). Boxes usually measure 1.0–1.5 m (3.3–5.0 ft) across and may be up to 1 m (3.3 ft) deep. However,