Environmental Case Study

Chocolate

Do you love chocolate? If you can’t live without chocolate, you are not alone—chocolate may well be the most popular food in the developed world. Scientists tell us that this is because chocolate has a particularly complex taste as it is made up of more than 500 flavor components—almost 200 more than the other top candidate the strawberry (so chocolate-covered strawberries must be the ultimate food!). On average, Americans consume about ten pounds of chocolate per person per year—that’s 25 giant Hershey or Cadbury bars! Amazingly that’s not even close to the record—the inhabitants of the main chocolate producing countries Switzerland, Belgium, Germany and Austria manage twice that amount! Many people consider themselves chocolate experts, but in fact few know how chocolate is produced and why there are such large differences in taste.

Most of us think of chocolate as something sweet. However, cocoa is not sweet at all—in fact it is quite bitter. Cocoa grows on a tree called theobroma cacao, which translates literally as “food of the gods”. The tree is quite difficult to grow. As it needs year-round warm temperatures and adequate moisture, it can only be grown in tropical areas between 20° N and S (Figures 1-5).

Figure 1: Cocoa growing areas (2003)
(Source: Adapted from www.infozentrum-schoko.de)
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Figure 2: On this cocoa plantation in the Ivory Coast, cassava (in the foreground) is also grown to provide food for the family.
(Source: Mamadou Coulibaly)
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Figure 3: Cocoa is difficult to grow, as it requires even temperatures and moisture supply. The fruits on the left did not receive enough moisture and died. (Source: Mamadou Coulibaly)
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Figure 4: Unripe fruit
(Source: Mamadou Coulibaly)
Theobroma is an unusual plant, as the tree flowers from small cushions right on the trunk, rather than at the branches. Once these flowers have been pollinated, they develop into a pod that contains 30-40 cocoa beans. The beans are surrounded by a sweet, juicy pulp (Figure 6 and 7).
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Figure 7: Opened cocoa fruit. The sweet pulp completely surrounds the beans. (Source: http://www.infozentrum-schoko.de)

When the fruits are harvested, the beans are separated from the pulp (Figures 8 and 9).

Figure 8: Cocoa is harvested by hand. (Source: www.infozentrum-schoko.de)

Figure 9: Opening of the cocoa fruits. (Source: www.infozentrum-schoko.de)

Beans and pulp are put in heaps and covered with banana leaves (Figure 10).
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Figure 10: For fermentation, the beans and the pulp are covered with banana leaves.
(Source: www.infozentrum-schoko.de)
Through fermentation, the pulp disappears, and the beans become dark and develop the typical chocolate taste. As soon as the beans are dried they are exported (Figures 11 and 12).

Figure 11: After fermentation, the cocoa beans are dried.
(Source: www.infozentrum-schoko.de)

Figure 12: Cocoa beans ready for export
(Source: www.infozentrum-schoko.de)
Since geographers are concerned with the spatial distribution of features, chocolates provides an interesting example of a product that is grown in a different region than where most chocolate is consumed. As said above, cocoa can only be grown in tropical regions, but there are differences between the growing regions. The criollo bean, grown in Central America, is considered the best bean with the most complex flavors. The forastero bean, grown in Africa and Asia, is hardier and has higher yields. It accounts for 95% of the world supply, explaining why countries like the Ivory Coast, Indonesia, Ghana and Cameroon are now the leading cocoa producers (Figure 13).

Finally, trinitario cocoa is produced on the Caribbean island of Trinidad.

Before the European colonization brought cocoa to Africa and Asia, cocoa was only known in Central America, or Mesoamerica, as most archaeologists prefer to call the region. The ancient high cultures of the region domesticated theobroma cacao. The Olmecs and Aztecs were the first people who made drinking chocolate. They roasted and ground the dried cocoa beans, then mixed them with water and spices. Their drinking chocolate was bitter and spicy—in fact, their word for cocoa—xocoatl—means exactly that. The Mayas, too, liked it spicy—they were known to have added chili peppers to it! The importance of cocoa, however, went way beyond its use as a drink in ceremonies. In fact, for a long time, cocoa beans were used as currency by Mesoamericans! (Figure 14)
When the Spanish conquistadors came to Mesoamerica, they encountered drinking chocolate. For most of them, the Aztec or Maya chocolate was way too spicy, but they discovered that they really liked it with sugar or honey, and as a hot rather than cold drink. For a long time only the elite in Europe drank chocolate, but the invention of steam power to grind the beans made the production much cheaper, and it soon became available to the general population (Figure 15).

In 1828 Dutch chemist van Houten invented a hydraulic press that made it possible to press the cocoa butter from the cocoa bean (Figures 16 and 17).
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Figure 16: A press removes the cocoa butter.
(Source: www.infozentrum-schoko.de)

Figure 17: Cocoa butter
(Source: www.infozentrum-schoko.de)

The remaining mass could be pulverized and used as chocolate powder (Figure 18).

Figure 18: Grinding of chocolate powder
(Source: www.infozentrum-schoko.de)

As opposed to the ground cocoa beans, his powder resulted in a much smoother, richer hot chocolate. The biggest breakthrough in the history of chocolate came in the mid-19th century, when Fry discovered in Britain that when he mixed the cocoa powder with cocoa butter instead of using water, he could pour the resulting paste into a mold (Figures 19 and 20).
Thus the first chocolate bars were born. Other chocolate producers quickly caught on to the idea, and soon chocolate bars were popular throughout Europe. In addition to transforming chocolate from an expensive drink into a cheap food, this invention also marked the geographic shift from the southern European countries involved in colonization to the central and northern European countries that are now the main consumers of chocolate products.

Further innovations improved the quality of the chocolate. In 1867 Nestlé, a Swiss chemist, discovered that he could evaporate milk to produce milk powder. This milk powder could then be added to the chocolate to create milk chocolate. Two years later, Lindt invented a machine with granite rollers that allowed him to knead the chocolate. This process—known as conching—significantly improves the quality of the chocolate. It breaks the raw materials into much smaller pieces, resulting in a very rich and smooth chocolate. Even though American chocolate manufacturers bought their chocolate machinery from European manufacturers, American chocolate continues to be quite different from European chocolate. The attitudes of Americans towards chocolate also seem to be different from those of Europeans. On both sides of the Atlantic there is an intense discussion about the benefits of chocolate (some people argue that some of its ingredients help against depression) and the risks associated with chocolate consumption (e.g. tooth decay and weight gain). Most Americans consume their chocolate in candy bars, chocolate chip cookies, or ice cream or cake toppings, while most Europeans prefer their chocolate as
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bars and with lots of different flavors or fillings. Furthermore, most Americans see chocolate as an indulgence, while Europeans tend to consider it a serious food, probably explaining why they eat so much more of it!

Chocolate Quality
Already in 1877, Stollwerck, a German chocolate manufacturer, pushed for the implementation of strict quality standards. They were concerned that other chocolate manufacturers mixed their chocolate with cheap ingredients such as cocoa bean shells, potato starch, animal fats and olive oil, or even with sand, chalk or ground brick. To this day, many countries in Europe adhere to high quality standards, and prefer the better criollo bean over the cheaper forastero bean. As opposed to American chocolate manufacturers, they also prefer a higher cocoa and lower sugar content. However, within Europe there is some disagreement about the exact combination of ingredients. The debate became so heated that some people now refer to them as the European Chocolate Wars.

In addition to the quality of the ingredients, the manufacturing process itself determines the quality of the chocolate. European chocolate manufacturers conch their chocolate for about 72 hours, while American manufacturers only do so for 18-20 hours. As a result, American chocolate tends to be gritty compared to the smooth European chocolates.

Chocolate Wars
When the United Kingdom joined the European Union (EU) in 1973, it insisted on being exempted from the strict regulations imposed by the main chocolate producing countries of Belgium and Germany. After a bitter fight, the UK obtained permission to use vegetable fats rather than pure cocoa butter in its chocolates. As more and more countries joined the EU and demanded exemption from the strict guidelines, new regulations became necessary. In 2000 a new chocolate law was passed that legalizes the use of other fats, but the traditional chocolate producing countries continue to insist that quality chocolate can only contain cocoa butter.

Selected References: