BIODIVERSITY FACT SHEET

Permanent Crops

Cultivation of Cacao

CONTENT

1. INTRODUCTION

The LIFE Food & Biodiversity project supports food standards and food companies to develop efficient biodiversity measures and to include these measures in their pool of criteria or sourcing guidelines.

In this Biodiversity Fact Sheet, we provide information on the impacts of the production of cocoa in tropical and subtropical regions on biodiversity.

The Fact Sheet is aimed at everyone who takes decisions on product design and development, supply chain management, product quality, and sustainability aspects in food processing companies and food retailers in the EU. We wish to raise awareness on the importance of biodiversity in the field of providing key ecosystem services as the fundamental basis for agricultural production.

2. AGRICULTURE AND BIODIVERSITY

Biodiversity loss: time for action

The loss of biodiversity is one of the biggest challenges of our time. Species loss driven by human intervention occurs around 1,000 times faster than under natural circumstances. Many ecosystems that provide us with essential resources are at risk of collapsing.

Conservation and the sustainable use of biodiversity is an environmental issue and, at the same time, a key requirement for nutrition, production processes, ecosystem services and the overall good quality of life for mankind.

Biodiversity is defined as the diversity within species (genetic diversity), between species and of ecosystems

The main drivers of biodiversity loss are:

- **Habitat loss due to land use changes and fragmentation.** The conversion of grassland into arable land, land abandonment, urban sprawl, and rapidly expanding transport infrastructure and energy networks are causing large habitat losses. 70 % of species are threatened by the loss of their habitats. In particular, farmland flora and fauna has declined by up to 90 % due to more intensive land use, the high use of pesticides and over-fertilisation.
- **Pollution.** 26 % of species are threatened by pollution from pesticides and fertilisers containing nitrates and phosphates.
- **Overexploitation of forests, oceans, rivers and soils.** 30 % of species are threatened by overexploitation of habitats and resources.
- **Invasive alien species.** 22 % of species are threatened by invasive alien species. The introduction of alien species has led to the extinction of several species.
- **Climate change.** Shifts in habitats and species distribution due to climate change can be observed. Climate change interacts with and often exacerbates other threats.

Agriculture and biodiversity – A symbiosis

The main task of agriculture is to provide a secure food supply for a fast-growing world population in order to ensure stable livelihoods. Consumption patterns in industrialised and emerging economies have led to an intensification of agriculture and a more globalised food market, resulting in a vast exploitation of agricultural land, highly intensive production systems and a simplification of agricultural landscapes.

Agriculture depends on biodiversity and at the same time plays an important role in shaping biodiversity. Worldwide a significant number of species depend on habitats linked to agro-ecosystems and coevolved with these systems. This symbiotic and beneficial relationship between agriculture and biodiversity has altered fundamentally over the last decades towards a massive loss of biodiversity on agricultural land and its surroundings due to a non-sustainable agricultural production.

The food sector can substantially contribute to biodiversity conservation. The appropriate integration of biodiversity as a factor into sourcing strategies allows the evaluation of risks for internal operations, brand management or legal and policy changes, improves product quality, and helps to ensure a secure supply to retailers and end customers. A good strategy for biodiversity conservation, i.e. a positive biodiversity performance, opens up opportunities in terms of differentiation in the market, value proposition, meeting consumers' demands and more efficient sourcing strategies.

3. CACAO

Cacao (*Theobroma cacao*) is an evergreen, tropical tree (fig. 1) that originates from the understory of South and Central American (lowland) rainforests.

To flourish a cacao plant requires an annual mean temperature of 22–25°C and an annual precipitation of approximately 2,000 mm – without longer dry periods. Cacao is produced from sea level to approximately 1,000 metres above.

In their natural environment, cacao trees reach heights of up to 15 meters. In permanent cultures, farmers cut trees to a maximum height of 4 metres to facilitate harvesting. Approximately 4–5 years after planting cacao trees come into fruit. Depending on the cultivation method and soil conditions, cacao trees produce their maximum yield between 10–15 years of age.

Fig. 1 Cacao tree

Fig. 2 Cauliflory with cacao pods growing directly from the trunk

Cacao is pollinated by tiny flies or "biting midges" from the family Ceratopogonidae. The pollination rate is very low with, in general, only 0.5 %–5 % of flowers and never more than 10 % being successfully pollinated.[1 2] Cacao trees are cauliflory (fig. 2) with fruits (called cacao pods) growing directly from the trunk and the largest branches. The pollination rate and hence fruit production might be increased directly by hand-pollination or indirectly by the presence of certain ant species that protect natural pollinators from predation. Increasing the pollination rate by 10 % to 40 % doubles the cacao yield.[3]

Each cacao pod contains 30–60 seeds called cacao beans. Beans are covered by a white fruit pulp.

Following the harvest, pods are opened and beans are fermented (usually) together with the pulp. During fermentation typical cacao aromas develop. Fermentation also kills the seedling and hence prevents germination.

There are various fermentation methods (fermentation in bags, pits, on piles or in wooden boxes). Fermentation methods differ widely between regions and depend highly on the expertise of the producer. Fermentation has a major influence on cacao quality. Fermented beans are dried and traded by the producers.

In most cases, fermented, dried cacao beans are exported from producing countries. Further processing into chocolate liquor, cacao butter, cacao powder and chocolate usually takes place in the consumer countries.

[1] http://www.worldcocoafoundation.org/wp-content/uploads/files_mf/adjaloo2013genomicsphysiologypollination.pdf
[2] Falque, M., Vincent, A., Vaissiere; B.E. et al. Sexual Plant Reproduction (1995) 8: 354. https://doi.org/10.1007/BF00243203
[3] Groeneveld et al. (2010), doi:10.1016/j.ppees.2010.02.005

4. CACAO PRODUCTION

Due to the climatic demands of the cacao tree, cacao production is still restricted to tropical regions. Today most cacao grows on the small strip 10 degrees north and south of the equator, and hence in an area superimposed with the regions that contain the highest biodiversity on our planet. Since zones of cacao production are congruent with (former) rainforest areas, negative effects on biodiversity always occur. Depending on the production system, the degree of negative effects differs dramatically (see below). Many of the agricultural methods applied today are not well suited to permanent production on tropical soils, leading to a steady demand for new fields – often resulting in the encroachment of (sometimes) untouched tropical ecosystems.

Cacao production systems display a wide range of intensification, from harvesting wild cacao pods in primary rainforests, over complex agroforestry systems, plantations with many or one shade tree species, to intensive monocultures without shade trees, as well as the massive input of industrial fertilisers and the wide application of pesticides. Following this gradient, the negative impact on biodiversity increases dramatically. With the transition from natural rainforests to extensive agroforestry systems – with a set of different shade trees – species diversity decreases by 11 %. Studies comparing primary rainforests with intensively farmed monoculture species show that diversity decreases by – on average – 46 %.[4]

Even though cacao originates from South America, today most of it is produced in Africa. In 2016, world production was approximately 4.5 million tons, led by Côte d'Ivoire with 33 % (1.5 million tons) of global production, followed by Ghana with 19 % (860.000 tons) of the total.[5] A smaller share of 700,000 tons (17 %) is produced in Central and South America, and roughly 350,000 tons (<10 %) in Southeast Asia.

In the past, cacao production followed so-called boom-and-bust-cycles with new production countries rising and flourishing, while in other countries, the cacao harvest collapsed. Venezuela – the most important cacao exporting country in the 18th century, was replaced by Ecuador (19th century), Brazil (early 20th century) and today Côte d'Ivoire, Ghana and (decreasingly) Indonesia.[6]

These boom-and-bust-cycles were always accompanied by increasingly rapid deforestation.

4.1 Intensification of production

Approximately 90 % of cacao globally is produced on small farms of 2–5 hectares. Between these small-scale farms, there are massive differences in terms of intensification of land use, shade tree diversity, the use of pesticides and industrial fertilisers and hence effects on biodiversity.

Traditionally, in South and Central America plantations with more shade trees, a higher variety of cacao production systems are common, while in Africa, Asia and other cacao production regions, there is a trend to more intensification.

For most production countries, data is available on the amount of cacao exported, while data on the size of the total production area, the use of pesticides and industrial fertilisers, and production methods applied is lacking.

4.2 Monocultures vs. Agroforestry systems

The most intensively managed cacao plantations are monocultures (fig. 3) with cacao being the only crop produced and harvested. In young plantations, a mix of banana and cacao is sometimes planted to provide shade for small cacao trees.

In contrast, agroforestry systems (fig. 4) usually contain a high diversity of other crops such as spices, vanilla, cardamom, pepper, etc.; fruits such as mango, avocado or brazil nuts; and trees to produce timber, raw material for arts and crafts, medical plants, natural plant fertilisers for animal feed. A large diversity of indigenous shade trees adds to the heterogeneous structure of agroforestry systems leading to rather high levels of biodiversity.

Fig. 3 Small monoculture plantation of cacao in Côte d'Ivoire

[4] De Beenhouwer et al. (2013) A global meta-analysis of the biodiversity and ecosystem service benefits of coffee and cacao agroforestry. Agriculture, Ecosystems and Environment 175: 1– 7

[5] „Cocoa beans production in 2016, Crops/World regions/Cocoa beans/Production quantity from pick lists". United Nations Food and Agriculture Organization, Statistics Division (FAOSTAT). (2017).

[6] Merijn M Bos and Simone G Sporn Biodiversity conservation in cacao agroforestry systems. http://edepot.wur.nl/250675

Fig. 4 Agroforestry cacao production system

4.2

Even though the net economic cacao yield is lower in agroforestry systems compared to intensive cacao production systems, total economic gain can be compensated or even outperformed through additional revenues from trade or consumption of the above-mentioned crops and by-products. In addition, a high yield of monocultures can only be produced for limited periods of time – requiring a higher financial input for agrochemicals – while agroforestry systems remain productive over many decades.

Compared to agroforestry systems, only protected areas show higher levels of biodiversity.[7]

Cacao agroforestry systems with balanced ecosystem services, low disease and pest levels and relatively stable cacao yields over long time periods, combined with low financial input, are hence good loopholes for small-scale farmers to exit the dilemma of economic needs and ecological responsibility.

4.3 Soil treatment

Cacao is mainly produced on former rainforest plots, some of which have been cleared decades or even centuries ago. Effects on biodiversity resulting from cacao production systems are large, even in those cases where biodiversity-friendly farming methods are applied. Clearing of primary ecosystems for the development of new plantations is still common. Particularly severe deforestation relating to cacao production took place in the years 2001 to 2014 in West Africa. Over this time period, Côte d'Ivoire alone lost almost 2,000 km^2 while in Ghana as much as 7,000 km^2 have been transformed into cacao plantations.[8] Between 1996 and 2016, the global cacao production area increased from 6,574,000 ha[9] to 10,196,727 ha[10].

Slash-and-burn agriculture (fig. 5) is the common way to open new production sites. Rainforests (in West Africa often bush/tree savannahs) are clear-cut and dead plant material is burned 4–6 weeks later. Following fires, plots are often first farmed with corn, soy, manioc or bananas before young cacao trees are planted. Slash-and-burn agriculture leads to massive habitat loss, erosion and the loss of biomass – all having vast negative impacts on biodiversity.

Fig. 5 Fire clearing

Alternatively, cacao trees might be planted in the understory of secondary forests or on degraded former pastures. In the latter case, nitrogen-fixing cover-plants (family Fabaceae) can be planted to prevent further erosion, increase soil ventilation, and promote topsoil regeneration[11]. Great expertise and longer times are prerequisites to produce cacao on former degraded land. Hence, such elaborate techniques are rarely applied aside of a few, small pilot projects.

Special soil preparation techniques or tillage of plots are usually not applied.

[7] De Beenhouwer et al. (2013) A global meta-analysis of the biodiversity and ecosystem service benefits of coffee and cacao agroforestry. Agriculture, Ecosystems and Environment 175: 1– 7
[8] http://www.mightyearth.org/wp-content/uploads/2017/09/chocolates_dark_secret_english_web.pdf
[9] FAO (1996) Agriculture Production Yearbook. United Nations Food and Agriculture Organization, Rome, Italy.
[10] http://www.fao.org/faostat/en/#data/QC
[11] Lehmann, J., Pereira da Silva, J., Schroth, G. et al. Plant and Soil (2000) 225: 63. https://doi.org/10.1023/A:1026580127965

4.4 Diseases and Pests

Annually between 30 % and 40 % of the global cacao harvest are lost to pests and diseases.[12 13] The pantropic distributed fungus "Black Pod Disease" (*Phytophthora palmivora*) alone destroys between 20 % and 30 % of the global annual cacao harvest. In South and Central America, other fungus-borne diseases such as "Witches' Broom" (*Crinipellis perniciosa*) and "Frosty Pod Rot" (*Moniliophthora roreri*) lead to additional harvest losses. In Southeast Asia and Africa, insects such as the cacao-pod-borer (*Conopomorpha cramerella*) and several capsid bugs (Miridae) are the main cacao pests.

4.4.1 Agrochemicals

Since the 1950s, insecticides, fungicides and industrial fertilisers are used in cacao farming. From the 1950s to the 1990s, application of these chemicals increased permanently and mainly without legal restrictions or regulations. From the 1990s onwards, people in consumption countries became more sensitive to environmental issues, which, in turn, led to stricter regulations and chemical threshold values in cacao and processed products. Since then the cacao processing industry tries to promote the responsible use of agrochemicals (Good Agricultural Practices, GAP) in the producing countries. The national laws and controls are often fragmentary or are not applied nationwide.

The majority of cacao (> 90 %) is produced by small-scale farmers, who (if at all) are rarely sufficiently trained applying the GAP. Pesticides and industrial fertilisers are hence often not applied according to the recommendations of manufacturers. Agrochemicals are often used in too high/too low doses, applied over too long/too short time periods, or are applied at the wrong time of day or during the wrong season. In addition, farmers are often not trained to identify pests correctly and early enough to apply the correct countermeasures. The use of agrochemicals is often considered as advanced and more suitable, and hence preferred over measures that have less negative impact on biodiversity, human health or the environment. Inexpert use leads to negative environmental impacts on water quality, soil health and biodiversity. In addition, the non-professional use of chemicals potentially harms the health of producers and consumers alike.

4.4.2 Herbicides

There is a lack of detailed data on global herbicide use. While agroforestry systems generally do not require weed management, plantations without or with little shade require permanent control of new-grown herbaceous plants.

The less shade prevalent it is, the more rapidly and densely herbs and weeds grow. Herb control can be conducted manually with machetes, sickles, brush-cutters, by planting cover plants or by applying (total) herbicides. Since the application of herbicides requires less workers and less time, it is often preferred over manual herb control.

The application of powerful herbicides leads to the complete elimination of the herbaceous understory in cacao plantations, which, in turn, facilitates the harvest and prevents nutrient-competition between herbs and cacao trees. On the other hand, the use of herbicides reduces plant diversity, flower diversity and hence the diversity of insects that are essential for the pollination of many crops. The elimination of understory reduces habitat complexity and negatively influences soil microclimate. Soil arthropods, e.g. ants and spiders, find fewer nest sites and decline. Lower soil humidity reduces the diversity of soil-dwelling insects, which, in turn, could have an adverse impact on the abundance of cacao pollinating insects negatively.

[12] ICCO 2015/16 International Cocoa Organisation. Annual Report 2015/16; www.icco.org
[13] Ploetz, R. C. 2007. Cacao Diseases: Important Threats to Chocolate Production Worldwide. Phytopathology 97, 1634-1639.
[14] Arno Wielgoss, Teja Tscharntke, Alfianus Rumede, Brigitte Fiala, Hannes Seidel, Saleh Shahabuddin, Yann Clough. Proc. R. Soc. B 2014 281 20132144; DOI: 10.1098/rspb.2013.2144. Published 4 December 2013 Interaction complexity matters: disentangling services and disservices of ant communities driving yield in tropical agroecosystems
[15] Wielgoss, A., Clough, Y., Fiala, B., Rumede, A. and Tscharntke, T. (2012), A minor pest reduces yield losses by a major pest: plant-mediated herbivore interactions in Indonesian cacao. Journal of Applied Ecology, 49: 465–473. doi:10.1111/j.1365-2664.2012.02122.

4.4.3 Insecticides

Little information exists on the global use of insecticides in cacao production systems. Insecticides are mainly applied in Africa and Southeast Asia, since harvest losses there can mainly be attributed to insect pests. In general, applying insecticides not only targets pest species but also has a negative effect on beneficial arthropods such as cacao pollinators, insectivore ants, spiders and, though indirectly, birds and bats. Application of insecticides can also change the structure of ant communities, which leads to a reduction in ant diversity.[14] The effects of insecticides in complex production systems are difficult to assess. In Indonesia, many efforts have been undertaken to eradicate *Helopeltis sulawesii*, which is a minor pest. Insecticides lead to a decrease of *H. sulawesii*, but increase the number of *Conopomorpoha cramerella* – a major pest. The application of insecticides in this case results in higher losses compared to insecticide-free farming.[15]

In general, applying insecticides often does not lead to the desired long-term increase in harvest yields. Pest resistance, the biodiversity loss of pest predators, and the above-mentioned indirect effects often foil the intended positive impacts. In addition, the financial input for purchasing insecticides might be higher than the anticipated or accomplished gain.

4.4.4 Fungicides

Black Pod (*Phythophtora palmivora*) and other fungus-borne diseases are the major causes of cacao harvest losses on a global scale. To prevent such losses, fungicides are widely applied. The direct impact of fungicides on biodiversity in cacao plantations is not well understood. Applying fungicides and intensifying farming practices usually go hand in hand. The effect of intensification and fungicide use are hence difficult to separate from each other. Fungus infections often lead to the transformation of shaded diverse cacao production systems to intensively farmed shade-free plantations. Farmers reduce the number of shade trees to improve the ventilation of plantations, reduce humidity and hence negatively impact the growing conditions for fungi.

Such radical interventions reduce the harvest losses due to fungus infections, but they also reduce habitat complexity and hence biodiversity – which, in turn, increases the risk of pest infestation. Homogenisation to shade-free monocultures is not a suitable measure to increase yields on a long-term basis.

4.5 Industrial fertilisers

There is a complete lack of large-scale scientific studies on the global application of industrialised fertilisers in cacao production and hence no reliable data on the spatial use or total amount applied exists. According to a recent study[16], industrial fertilisers were used on 13 % of all cacao plantations in Côte d'Ivoire and on 17 % of all plantations in Ghana in 2011. The amount of nitrogen fertiliser applied showed a wide range of 27 kg/ha/y in Côte d'Ivoire to 222 kg/ha/y in Ghana.

There are huge gaps in knowledge regarding the long-term effects of industrial fertiliser application. The published results derive from study designs from a few regions and short study duration – with data often not collected according to scientific standards. In addition, natural soil conditions, management techniques and effects on diseases, pests and surrounding vegetation are often not well analysed. In some cases, the studies were financed by fertiliser manufacturers decreasing their credibility.

4.6 Harvesting methods

In contrast to coffee and other cash crops, cacao harvest is not restricted to short time intervals. Depending on the region, harvesting takes place over several months or during two annual harvesting peaks. The harvesting dates vary according to the region, climate and cacao variety. In regions with distinct dry and rainy seasons, the harvest usually starts 5–6 months after the onset of the rainy season.[17]

Cacao is always harvested by hand using machetes, secateurs and (for higher trees) long harvest rods equipped with blades. Within plantations, the use of heavy machinery is rare. With over 90 % of cacao produced on small-scale farms, large transportation vehicles, such as trucks, are rarely utilised within plantations. Fermented and dried cacao is usually carried to larger access roads; hence, soil compaction is only a minor problem.

[16] Gockowski, J. & Sonwa, D. (2011) Cocoa intensification scenarios and their predicted impact on CO2 emissions, biodiversity conservation, and rural livelihoods in the Guinea Rain Forest of West Africa. Environmental Management, 48, 307-321.
[17] G.A.R. Wood, R.A. Lass, Cocoa. Longman, 4th Edition, 1985) Cocoa to 1993: a commodity in crisis. Economist Intelligence Unit, 1993, p34 Gordian 57 (1958)

4.7 Varieties and Quality

On the international markets, cacao is classified as consumption or “precious” cacao, a classification that is based neither on botanical science nor on genetic evidence. The share of the world cacao production of so-called “precious cacao” is less than 5 %. Until recently, four varieties of cacao were distinguished: “Ciollo”, “Forastero”, “Trinitario”, and “Nacional”. Criollo, Trinitario and some sub-varieties of Nacional were considered precious cacao varieties. A classification based on their fine cacao taste, the accompanying flavours, and the low level of bitterness. In general, Forastero varieties are considered consumption cacao with their heavy cacao taste, few prominent flavours and strong bitterness. About 80 % to 90 % of the world production comprises of Forastero. Recently, genetic studies have shown that the genetic diversity of cacao is much greater than expected.[18]

Cacao flavours can be influenced and improved through special fermentation and drying procedures, some of which have been especially developed for certain cacao varieties.

The most valuable cacao varieties are hand-selected during harvest. Beans infested by fungi or pests are eliminated during this selection. High quality cacao is fermented under controlled temperature conditions and then dried rapidly to prevent moulding.

[18] Thomas E, van Zonneveld M, Loo J, Hodgkin T, Galluzzi G, et al. (2012) Present Spatial Diversity Patterns of Theobroma cacao L. in the Neotropics Reflect Genetic Differentiation in Pleistocene Refugia Followed by Human-Influenced Dispersal. PLOS ONE 7(10): e47676. https://doi.org/10.1371/journal.pone.0047676

5. BIODIVERSITY FOCUS

5.1 Biodiversity loss through production site enlargement

Enlargement of agricultural areas is one of the main drivers of deforestation of (tropical) forests and the biodiversity loss associated with it. In comparison with soy, palm oil and livestock keeping, cacao plantation enlargement play a rather minor role in tropical deforestation. However, encroachment aiming to enlarge cacao production sites is concentrated on biodiversity hotspots such as the Amazon basin, the Guinean forest block in West Africa and Southeast Asian rainforests.

Compared to regeneration of old plantations, deforestation of rainforests for new plantations requires less agricultural knowledge, less manpower and shows higher short-term revenues. Hence, deforestation is often the preferred measure to increase production sites.

Exact numbers on the effect of cacao production on deforestation rates of tropical forests are lacking. According to estimates of the European Commission[19], deforestation related to the cacao value chain reached 2–3 million hectares between the years 1988 and 2008. The largest part of deforestation that could be directly allocated to cacao production occurred in West Africa where 2.3 million hectares of forest were lost during that period. The main driver for this development is the increasing global demand for cacao and cacao products. Non-sustainable land use, lack of knowledge concerning regeneration of plantations, erosion und leaching of soils combined with weak law enforcement, lack of regulations or even subsidies for enlargement of cacao production sites result in the abandonment of older plantations and the encroachment into rainforest to establish new plantations.

The enlargement of cacao production sites into protected areas in Côte d'Ivoire was responsible for a tremendous decline in primate abundances and diversity. Within a couple of years, five of the 23 protected areas studied lost about 50 % of primate species, while 13 lost all their primates.[20]

5.2 Biodiversity loss through intensification of cacao production

The transformation of primary rainforest into cacao production sites results in a major loss of biodiversity. Biodiversity loss might be alleviated to a certain extent when the transformation takes place gradually and carefully. Potential measures for a less negative impact on biodiversity are the plantation of cacao trees in existing rainforests without cutting trees. Such traditional cacao agroforestry systems may also serve as ecological buffer zones between rainforests and more intensively used agricultural land or as corridors between rainforest fragments. Complex, well-stratified agroforestry systems may contain a high level of biodiversity and high abundances of plant and animal species. Scientific studies prove that birds, bats, small mammals, primates, butterflies, ants, bugs, spiders and snakes benefit from such agricultural land use practices.[21] However, even such agroforestry systems show lower levels of biodiversity compared to natural rainforests.

Biodiversity on cacao plantations is directly linked to the use-intensity of adjacent agricultural land and surrounding landscape types. The biodiversity value of plots is influenced by many parameters such as number and diversity of shade trees, structural complexity of the canopy, the amount of dead wood prevalent, and intensity of industrial fertiliser and pesticide application. Other landscape parameters such as level of fragmentation, distance to intact rainforest, and the presence of potential corridors have a major impact on biodiversity on cacao plantations.

The last decades have seen a trend to more intensive land use and agricultural practices in all cacao-producing countries. More intensive cacao production includes the reduction of shade trees, an increase in the areas under cultivation, an increase in pesticide and industrial fertiliser application, and the planting of few, high-yield cacao varieties. This global trend can be related to an increasing demand for cacao and cacao products on the international market. Intensification measures are supported by national governments and large international cacao trading companies that aim to achieve short-term increase in total cacao yields. However, scientific evidence proves[22] that rapid intensification often leads to production systems that experience collapses in cacao yield on a mid- or long-term perspective.

Agricultural techniques required on monocultures contaminate soils; non-sustainable land use practices such as slash-and-burn eliminate shade trees, which, in turn, facilitates soil erosion. The structural and ecological homogenisation harms biodiversity and ecosystem services.

[19] Climate Focus estimates based on European Commission. The impact of EU consumption on deforestation: Comprehensive analysis of the impact EU consumption on deforestation. 2013. Technical Report 063.
[20] https://www.smithsonianmag.com/science-nature/illegal-cocoa-farms-are-driving-out-primates-ivory-coast-180954823/
[21] Schroth, G. & Harvey, C.A. Biodiversity conservation in cocoa production landscapes: an overview, Biodivers Conserv (2007) 16: 2237. https://doi.org/10.1007/s10531-007-9195-1
[22] Clough, Y., Faust, H. and Tscharntke, T. (2009), Cacao boom and bust: sustainability of agroforests and opportunities for biodiversity conservation. Conservation Letters, 2: 197–205. doi:10.1111/j.1755-263X.2009.00072.x

5.2

Increased intensification reduces the number of natural pollinators and hence pollination of cacao, already requiring hand-pollination in some cacao plantations. Along with increased intensification, important predators such as ants, birds, and bats decline, leading in turn to a higher risk of pest-outbreaks, which is counteracted by an again heavier use of insecticides. Intensive cacao plantations with few or no shade trees require more intense use of insecticides, since natural predator-prey interactions are out of balance. This effect is even more severe when plantations have been established after fire clearing and few natural habitats remain near the plantation.

Monocultures require more herbicides since more sunlight in the plantation promotes the growth of weeds. More industrial fertilisers are applied since erosion leaches out soils more rapidly. Such management techniques are not sustainable on a long-term basis leading to the abandonment of sites when yields decrease. To compensate for such area losses, new plantations, often in remote and primary rainforest areas or other valuable ecosystems are established – leading to an even more rapid loss of biodiversity.

5.3 Biodiversity-friendly cacao production

The consequent application of the Good Agricultural Practices (GAP) might be a first important step towards a sustainable, economically viable and biodiversity-friendly production of cacao. For West Africa, the guidelines have been compiled in a field guide for sustainable cacao production[23]. They cover the following main points:

Fig. 6 Agroforestry system with cover plants

- regeneration of existing plantations
- new plantations only if such regeneration is not possible
- no new plantations in forested areas
- selection of suitable cacao varieties
- competent trimming of cacao trees as a measure to prevent diseases and pest outbreaks
- early detection of diseases and pests with proper identification of causes
- responsible application of licensed fertilisers, insecticides and herbicides in the recommended dosages and at the right time and duration.

If this advice were followed, yields on existing plantations could significantly rise, while pressure on surrounding ecosystems would decrease. At the same time, the negative effects of agrochemicals on biodiversity would decrease. Biodiversity-friendly agroforestry systems are the ecological alternative draft for the non-sustainable management of cacao monocultures.

Farmers managing agroforestry systems (fig. 6) aim to obtain a high structural complexity of habitats to assure the persistence and functionality of ecosystem services. In addition, natural habitats as well as habitat connectivity are preserved as refuges and sources of biodiversity. Structural complexity is obtained through protection of shade trees, conservation of dead wood, diversity of crops, the input of cover plants, provision of artificial nesting sites etc. These measures lead to higher biodiversity and an abundance of birds, bats, ants, and spiders that all function as natural pest control agents. Biodiversity in agroforestry systems makes the application of insecticides often unnecessary.

Nitrogen-fixing cover crops and shade trees ensure the continuous functioning of nutrition cycles, which makes the application of industrial fertilisers superfluous. Fungus-borne diseases can be prevented through the application of a proper shade management, applying the GAP measures and the consistent elimination of infected pods.

[23] Asare, R. and David. S. 2011. Good agricultural practices for sustainable cocoa production: a guide for farmer training. Manual no. 1: Planting, replanting and tree diversification in cocoa systems, Sustainable tree crops programme, International Institute of Tropical Agriculture, Accra, Ghana. July 2011 version

6. LEGAL OBLIGATIONS OF CACAO PRODUCTION

Neither the "Good agricultural practices" (GAP) nor any other strict regulations concerning biodiversity have been binding for most cacao farmers to date. Small-scale farmers decide individually, usually not based on sound knowledge or proper training, on the preferred management or agricultural methods. In most cases, controls are inexistent or weak, even in countries where regulations exist.

Organic standards and their procedures are currently the only regulation systems performing controls on producing methods and products.

The EU organic standard prohibits fire clearing and the application of several pesticides, herbicides and industrial fertilisers. Biodiversity-friendly management the protection of soils and water bodies is required. However, presently only 0.5 % of cacao produced globally is organically certified[24].

Biodiversity-friendly cacao production can be promoted through the increase of organically certified cacao production. Additional measurements for biodiversity-friendly cacao production do exist, but they are currently not included in the existing standards.

[24] https://www.icco.org/about-cocoa/chocolate-industry.html

7. OVERVIEW OF THE EU LIFE PROJECT

Food producers and retailers are highly dependent on biodiversity and ecosystem services but they also have a huge environmental impact. This is a well-known fact in the food sector. Standards and sourcing requirements can help to reduce this negative impact with effective, transparent and verifiable criteria for the production process and the supply chain. They provide consumers with information about the quality of products, environmental and social footprints, and the impact on nature caused by the product.

The LIFE Food & Biodiversity Project "Biodiversity in Standards and Labels for the Food Industry" aims at improving the biodiversity performance of standards and sourcing requirements within the food industry by

A. Supporting standard-setting organisations to include efficient biodiversity criteria into existing schemes and encouraging food processing companies and retailers to include biodiversity criteria into respective sourcing guidelines.

B. Training advisors and certifiers of standards as well as product and quality manager of companies

C. Implementation of a cross-standard monitoring system on biodiversity

The project has been endorsed as a "Core Initiative" of the Programme on Sustainable Food Systems of the 10-Year Framework of Programmes on Sustainable Consumption and Production (UNEP/FAO).

European Project Team:

Global Nature Fund | Bodensee Stiftung – Internationale Stiftung für Natur und Kultur | Técnico Lisboa | Fundación Global Nature | auf! | A Good for Good | Solagro

We appreciate the support of our partner standards and companies:

Nestlé – Good Food, Good Life | Kaufland | always inspiring more... symrise | UTZ – Better farming Better future | Fairtrade Deutschland | Union for Ethical BioTrade – Sourcing with Respect | Gesicherte Qualität Baden-Württemberg | Baden-Württemberg – Ministerium für Ländlichen Raum und Verbraucherschutz

IMPRINT

Author: Agentur auf!
Editor: Global Nature Fund
Graphic Design: Didem Senturk, www.didemsenturk.de
Version: May 2018

Photo Credit: p. 5, 6 © Frauke Fischer
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The project is supported by:

Recognised as core initiative of:

EU LIFE Programme
LIFE15 GIE/DE/000737

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