Chapter 10
Climate-Smart Forestry Case Study: Czech Republic

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Abstract Forestry in the Czech Republic is facing a historically unprecedented, mostly drought-induced decline in spruce-dominated stands, accompanied by an extensive bark beetle infestation that has spread across most of the country. As a result, the share of sanitary felling has dramatically increased, driving the total harvest to record-high levels in recent years. As a result, current forest management in the country practically resembles a crisis management dealing dominantly with unplanned disturbances. The Czech case shows clearly the essential, non-separable linkage between forest adaptation and mitigation—a simple recognition that, without adaptation, there is no mitigation. It also demonstrates the importance of tailoring the general climate smart forestry approach to regional circumstances. The current priorities of Czech forestry must be to halt forest decline, restore the lost vegetation cover on clearcut soils, and intensify adaptive management in order to create resilient forest ecosystems than can cope better with changing climate and extreme climate events.

Keywords Adaptation · Mitigation · Ecosystem carbon balance · Drought · Bark beetle

10.1 Czech Forestry

Climate-smart forestry (CSF) (Nabuurs et al. 2017) is a proposal aimed at complementing current national strategies for implementing actions under the Paris Agreement (Verkerk et al. 2020). Specifically, CSF advocates for measures to better utilise forestry potential to achieve a stronger climate-change mitigation impact in European countries. This chapter examines how this mitigation concept is applicable to the specific conditions and circumstances of the Czech Republic.

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Currently (as of 2020), forestry in the Czech Republic is facing a historically unprecedented, mostly drought-induced decline in spruce-dominated stands, accompanied by an extensive bark beetle infestation that has spread across most of the country. As a result, the share of sanitary felling has dramatically increased, driving the total harvest to record-high levels in recent years (Fig. 10.1.). Correspondingly, the share of planned harvest interventions (thinning and final cutting) has declined. Thus, current forest management in the country practically resembles a crisis management dealing dominantly with unplanned disturbances.

Several factors have contributed to the current forest decline in the country, perhaps the most important being: (1) The problematic transformation of Czech forestry following the collapse of the communist regime in the early 1990s. This resulted in, among other things, insufficient personnel in the field and the separation of organisational responsibility and actual forest management. The latter has been driven by an inflexible tender model, which has seriously delayed urgent sanitary interventions in infested (or otherwise damaged) forest stands. (2) Inadequate adaptive forest management and a lack of recognition of the risks associated with the changing climate. Despite relevant targets having been formulated in the second Czech National Forest Programme (Krejzar 2008) and later strategic forestry plans in the country, the implementation of adaptive forest management has been insufficient to significantly increase the resiliency of forest stands. There has been insignificant support for adopting more progressive, close-to-nature forest management, avoiding the clearcut model of even-aged monocultures, utilising natural regeneration, or adequately changing the species and structural composition of forest stands. (3) Objectively exceptional drought conditions and heatwaves in Central Europe in

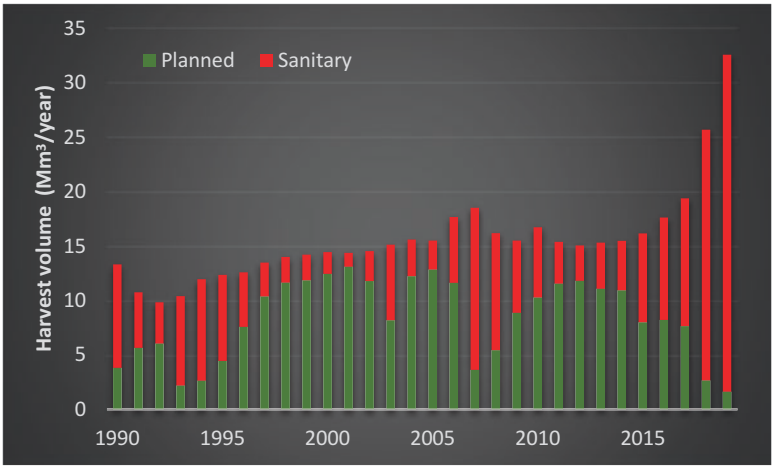

Fig. 10.1 Harvest volume for the period 1990–2019 showing planned and sanitary felling interventions. In 2019, the share of sanitary felling of the total harvest reached 95% at the country level. Apart from the volume of 32.6 Mm^3 extracted from the forest in 2019, there is an additional ~6.3 Mm^3 of unprocessed wood volume, mostly of dead standing trees, due to an insufficient harvesting capacity. (Czech Statistical Office 2020)

Table 10.1 Selected key characteristics of Czech Forestry

	1990	2018[a]
Forest ownership	95% public	55% public
Employment in forestry	58,600	13,600
Forest area and forestation[b]	2.63 Mha, 33%	2.67 Mha, 34%
Share of conifers[c]	76%	70%
Growing stock per hectare[d,e]	218 m^3/ha	270 m^3/ha
Harvest level (5-year period)	11.8 Mm^3/year (1988–1992)	22.3 Mm^3/year (2015–2019)
Share of sanitary felling[f]	47% (1988–1992)	70% (2015–2019)

[a]Data as of 2018, unless stated otherwise
[b]Cadastral forest area, excluding tree vegetation elsewhere
[c]Data from forest management plans linked to the cadastral forest area
[d]Data from forest management plans (sample-based statistical forest inventory data show significantly higher values)
[e]All wood-volume data represent merchantable underbark dimensions (minimum diameter 7 cm)
[f]The relatively high proportion of salvaging around 1990 reflects a period of a significant air-pollution impact on forest stands, manifested by both direct damage to tree foliage and soil disturbed by acidification and nutrient degradation. The latter harmful effect on the soils remains apparent today, with acidified soils impacting root systems and the mycorrhiza, leading to a greater sensitivity of the (mainly coniferous) trees to drought

recent years (Zalud et al. 2020). (4) An inadequate response from the responsible state authorities and the Czech Forests state enterprise to the accelerating forest dieback in the country (Czech News Agency 2020). The Czech Forest Act includes specific expectations for forest owners or entrusted bodies to fulfil their forestry obligations—for various reasons, mostly linked to issue 1, above—and these have not been adequately executed.

In the next section, the CSF principles are outlined, and their alignment with the urgent need to manage current Czech forest decline, create more resilient ecosystems and improve the outlook for Czech forestry (Table 10.1) is assessed.

10.2 Climate-Smart Forestry in the Czech Context

10.2.1 The CSF Concept

The CSF concept (Nabuurs et al. 2017, 2018; Verkerk et al. 2020) builds on three pillars: (1) as a climate-mitigation service, by enhancing carbon storage in forests and wood products, in conjunction with other ecosystem services; (2) through adaptive forest management to increase resilience and improve the health of forest stands; and (3) in the substitution of non-renewable carbon-intensive materials, by using sustainably produced wood resources. The CSF concept represents a more mature strategy than the early, overly carbon-accounting-focused approaches and policies, such as those driven by the Kyoto Protocol. Those policies prioritising mitigation actions using forest resources disregarded the following essential aspects

(and not only from the Czech forestry point of view): (1) the long-term forestry production cycle; (2) the importance of other ecosystem services, such as water retention, soil protection and biodiversity; and (3) perhaps most importantly, the essential, non-separable linkage between forest adaptation and mitigation—a simple recognition that, without adaptation, there is no mitigation. In other words, specifically under changing environmental conditions, adaptation management must be prioritised in order to secure the sustained provisioning of ecosystem services, including climate mitigation. Failure to adequately adapt forests and forestry (within an appropriate time and scope) is predestined to result in undesired reverse effects, with forestry turning into a significant source of emissions instead of the expected sink. This risk is being increasingly internationally recognised (Anderegg et al. 2020), and is also plainly demonstrated by the current situation in Czech forestry, as detailed in the following sections.

CSF clearly links essential ecosystem services, stressing adaptation to secure forest health and increase resilience, and promoting the important substitution function that wood products offer. However, CSF should also consider other fundamental constraints, such as governance issues and the legacy of past management. When reviewing the factors responsible for the current forest decline in the Czech Republic, as highlighted above, it becomes clear that a holistic CSF approach also needs to address factors relating to governance, business models and/or specific management actions against bark beetle outbreaks (Hlasny et al. 2019).

10.2.2 Forestry-Based Climate Mitigation

An earlier CSF case study using the Czech Republic (Nabuurs et al. 2018) included, among other things, a mitigation-impact projection based on a calibration period up to 2015. The model projection up to 2100 reported that the anticipated adaptive management would result in a smaller sink in Czech forests in relation to the business-as-usual scenario, only providing additional mitigation benefits after 2080, together with more resilient forest stands. That study, however, did not anticipate the scale of the current drought-induced forest decline that the Czech Republic has been experiencing since 2015. This development significantly and negatively affects the mitigation outlook for Czech forestry for the coming decades.

The carbon budget of Czech forestry, as reported in the recent greenhouse gas emissions inventory submission (National Inventory Report, CHMI 2020) is illustrated in Fig. 10.2. The effect of the recent decline in coniferous forest stands is obvious in the rapidly declining sink that became an emissions source in 2018, for the first time since 1990. This means that the forest sector, which used to offset about 6% of Czech national emissions, has turned into yet another source category, with a notable magnitude of emissions. The contribution of harvested-wood products (HWPs) still counts, mostly acting as a sink in the Czech circumstance, and corresponding to the generally increasing total harvest volume (Fig. 10.1). However, the annual offset represented by HWPs is estimated to be about 1 Mt. CO_2 for the

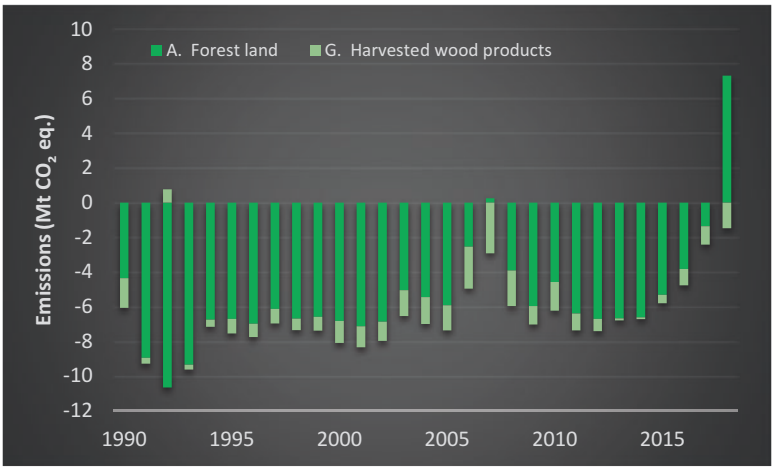

Fig. 10.2 Emissions contribution from the Czech forestry sector (preliminary data of IFER as of April 2020). Negative values represent the sinking of emissions, positive values represent a source of emissions. The data shown distinguish between the major United Nations Framework Convention on Climate Change emissions categories: A—forest land, where emissions are determined mainly based on changes in living biomass; G—HWPs, where emissions are determined based on changes in this pool

period 1990–2020, which is small in comparison to the total emissions of the country (134 Mt. CO_2 eq. as of 2018). Overall, the emissions contribution from forestry, including the HWPs offset, is currently 4.5% of the total emissions of the country (Czech Hydrometeorological Institute 2020).

Data on woody material used for bioenergy remains uncertain, but has been estimated to represent about 12% of the total harvest, annually (i.e. close to 2 Mm^3 of wood volume or about 1 Mt. of biomass), as of 2018. However, the extent to which this amount contributes indirectly as a substitution effect in the energy sector is difficult to ascertain due to the inherent uncertainty in the related statistics and/or missing information.

In addition, there is the contribution of fast-growing woody plantations for energy purposes, which is commonly accounted for under agriculture. In the Czech Republic, the spatial extent of such systems is only about 3 kha, and this has stagnated for various reasons, with the result of currently producing only a marginal climate-mitigation effect.

10.2.3 Towards Adaptive Forest Management

The forest policy-makers in the country did recognise the need to significantly improve forest-stand resilience, specifically in the second National Forestry Programme (Krejzar 2008). In the progamme's Key Action 6, 12 measures were

defined and developed, their implementation designed to alleviate the impact of climate change and extreme events on the forest sector (Cienciala 2012). It stressed the need to grow diversified forest stands, employing the maximum use of natural processes, diverse species compositions, natural regeneration, and a spectrum of silvicultural practices to enhance the resiliency of forest stands. The accompanying measures included specific actions to broadly support the main goals. Evidently, implementation of these measures has been too slow and has not gone far enough to reduce the large-scale, drought-induced decline and bark beetle outbreak in spruce-dominated coniferous stands (as well as in pine and larch), as witnessed in recent years (Hlasny et al. 2019). For example, the spatial representation of more-resilient broadleaved tree species has increased by only by 5% in 2000–2018. Similarly, the share of natural regeneration has only increased from 13.5 to 16.1% in the same period (Ministry of Agriculture 2019).

The more-recent National Action Plan on Adaptation in the Czech Republic (Ministry of the Environment 2017) stressed two fundamental prioritized measures applicable for the forestry sector, namely

1. Support of the natural adaptive capacity of forests and strengthening of their functioning under changing climate; and
2. protection and revitalisation of the natural water regime in forests.

The explicit implementation issues in the above measures have been undermined by a sustained preference for the clearcut system and linked forestry operations, and the unsupportable hoofed game stocks that effectively hinder use of natural regeneration.

Obviously, these measures implicitly recognise that the precondition for any mitigation effect realised in Czech forestry is to ensure the resiliency of forest stands under changing climate conditions, with a specific focus on the water regime and the prevention of drought. Also important to note is the emphasis on soil conditions—the elementary resource for life and an essential part of forest ecosystems. Only functional forest ecosystems can deliver the spectrum of expected ecosystem services, with climate mitigation being only one of these, and being fully dependent on the success of the adaptation measures.

The evolution of the situation in Czech forestry has led to the swift adoption of an actual guiding forest-policy document—Conception of the governmental forestry policy until 2035 (Ministry of Agriculture 2020). Its declared four long-term goals are:

1. Ensure sustained and full provisioning of all of forest ecosystem services for future generations.
2. With respect to changing climate, increase biodiversity and the ecological stability of forest ecosystems while retaining their productive functions.
3. Ensure competitiveness in forestry and linked sectors, and their importance in regional development.
4. Enhance advisory services, education, research and innovation in forestry.

The development of Czech forest policy reflects the growing urgency and better comprehension of the wide role of forest resources in society, with a notably increased accentuation of environmental services and sustainability. In this respect, Czech forest policy is becoming fully consistent with the current trends in European policy, as expressed by Forest Europe, among other entities. For example, the Concept (of forestry policy: Ministry of Agriculture 2020), in its goals, accords with the recently announced ambitions of the European Commission's Mission on Soil Health and Food (Veerman et al. 2020) under the Horizon Europe Research and Innovation Programme, which also concerns forestry.

The CSF principles align, in part, with the declared long-term goals of the Czech Concept up to 2035. Specifically, the CSF pillars 2 (adaptive forest management) and 3 (enhanced use of HWPs) address the goals of Concept 2035. However, it is still to be seen to what extent the CSF's primary goals of enhanced carbon storage mitigation is prioritised as part of the current Czech forestry strategy, which has very much been focused on the immediate management of the current local environmental crisis.

10.2.4 Mitigation Outlook for Czech Forestry

What is expected, in terms of mitigation, from the Czech forestry sector in the coming decades? The most recent outlook for mitigation was presented in the Czech National Forest Accounting Plan (Ministry of the Environment 2017), in conjunction with setting a national forest reference level (FRL) under EU regulation 2018/841. The two presented scenarios were prepared using the calibrated CBM-CSF3 model (Kull et al. 2016), and present a rather pessimistic outlook for Czech forestry, in which it is projected to lose much of its carbon sequestration capacity in the coming decades. In Fig. 10.3, we show two corresponding scenarios of emissions (red and black), together with a third scenario (green) representing the most up-to-date (as of June 2020) projection estimates (IFER—unpublished data 2019) for combatting the current drought-induced bark beetle outbreak.

Each of these scenarios include emissions from the change in biomass carbon stock and the HWP contribution, combined. The red scenario represents a development with re-occurring bark beetle outbreaks each decade, whilst the black scenario shows the pessimistic outlook of bark beetle outbreaks resulting in a reduction in spruce growing stock by 80% by 2050, with the corresponding remaining areal representation of spruce reduced to 10–15%, compared to ~50% as of 2018. The green scenario counts on a more rapid stabilisation of forest health, with a resulting reduction in spruce management approaching 20% by forest area. This green scenario means a return to an overall carbon sink in the forest (biomass + HWPs) by 2030. The sink capacity would then remain strong for the following two decades, mainly due to the significantly reduced harvesting potential of conifers and the only gradually increasing harvesting possibilities in broadleaved tree species.

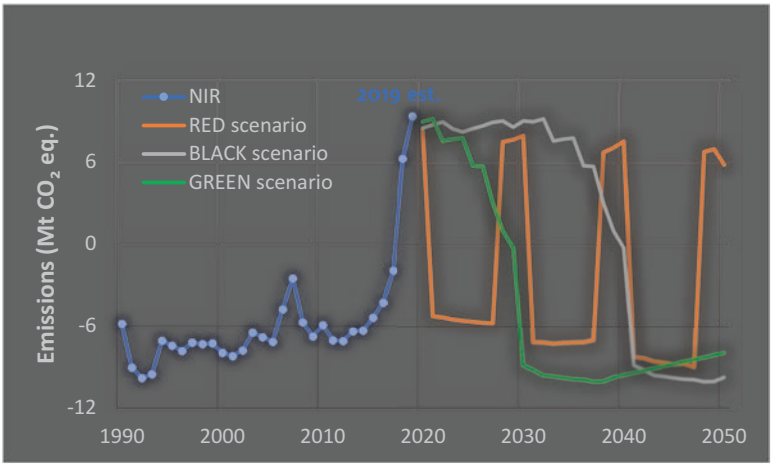

Fig. 10.3 Outlook of the emissions balance in Czech forestry to 2050, expressed by three scenarios, each including the biomass carbon pool and the contribution of harvested wood products (IFER—unpublished data as of June 2020). See the text for the narrative of individual scenarios

Obviously, this possible development will have a significant impact on the economics of forest owners. The requisite sanitary measures are, and will remain, costly, and will not be compensated for by wood sales. As is already known, the wood price has dropped significantly due to a current wood oversupply in European countries. The Czech Republic currently sells its wood also to China, despite low prices and increased transaction costs. The fact that the country is not able to increase its own wood-processing capacity to make products with increased value does not help the situation. However, with respect to the key mitigation instrument of the EU—regulation 841/2018 on accounting for the land use, land-use change and forestry sector during the 'Paris' period of 2021–2030—the Czech Republic faces a challenge. The key element of this regulation is setting the FRL based on management practices (including harvesting level), as of 2000–2009. With the current down-correction imposed by the European Commission, the FRL for the Czech Republic is set to ~6.1 Mt. CO_2 eq. for 2021–2025. With respect to the projected emissions in the green scenario, this FRL would be surpassed by 14 Mt. CO_2 annually, representing an unforeseen economic loss for the country, realised through the emissions allowance system. Clearly, there is a need to adjust the reference level using technical correction, considering the major changes Czech forests have been experiencing recently as a result of the disturbances.

10.3 Conclusions and Policy Implications

The case of the Czech Republic shows the importance of tailoring the general CSF approach to regional circumstances. The bark beetle disturbance/calamity of recent years has progressed to such a massive scale that the most immediate task for CSF would be to enhance the adaptation and resilience of Czech forests, thereby also seeking to increase their carbon sink potential in the long term. One important part of CSF in the Czech case is that it needs to be institutional, organisational and have governance aspects in general. These need to be fine-tuned and updated in a way such that more efficient measures can be undertaken for adapting and improving forest resilience, and sustaining the long-term environmental and social requirements of Czech forests. It is further stressed that:

1. Mitigation is to be understood as only one of the vital ecosystem services provided by forest ecosystems. Under the Czech conditions, soil protection, water regulation and hosting biodiversity are increasingly being recognised as priority services that are important to local society.
2. Preserving and increasing carbon storage in the long term is possible only through the establishment of healthy, resilient and sustainably used forest ecosystems, well adapted to changing growth environments, which implies that adaptation must be prioritised to ensure a sustained mitigation effect from forestry.

The current priorities of Czech forestry must be to halt forest decline, restore the lost vegetation cover on clearcut soils, and intensify adaptive management in order to create resilient forest ecosystems than can cope better with changing climate and extreme climate events.

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