Degrading ecosystems to prevent climate change

Can Czech forests and soils survive the dash for biomass?

Zdenek Postulka

Hnutí DUHA (Friends of the Earth Czech Republic)

A report produced by FERN and Hnutí DUHA (Friends of the Earth Czech Republic), *June 2012*

Hnutí DUHA

This report was prepared with the financial assistance of the Dutch Ministry of Infrastructure and Environment and the European Commission. The views expressed do not however imply the expression of any opinion on the part of any of the donors. The donors are not responsible for any use of the information contained within this report.

ISBN: 978-1-906607-27-2

June 2012

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List of abbreviations

BAP	Biomass Action Plan
CGS	Czech Geological Survey
CR	Czech Republic
DNLP	Department of Nature and Landscape Protection
EU	European Union
GEOMON	Global Earth Observation and Monitoring network
GJ	gigajoules
GWh	gigawatt hours
MoA	Ministry of Agriculture
MoIT	Ministry of Industry and Trade
MWh	megawatt hours
NREAP	National Renewable Energy Action Plan
PER	Pure Energy Ratio
RE	renewable energy
ÚHÚL	Czech Forest Management Institute
URD	Unit for Rural Development

Foreword

In evaluating the European Commission's 2011 Biomass report,[1] it is important to judge whether national schemes have sufficiently and appropriately addressed sustainability issues relating to the use of biomass from inside and outside the European Union (EU). At the time of writing, it is not clear how many countries are developing their own national schemes; but, even for those countries without a national scheme for imported biomass — such as the Czech Republic (CR) — it is important to ask whether the existing legal and regulatory frameworks are sufficient to guarantee sustainable biomass production, and if not, why?

In answering this question, this report will focus principally on solid and gaseous biomass use in the CR, but not biofuels or bioliquids.

1 http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/192

1 Current and projected biomass supply and demand

Solid biomass has been (and undoubtedly will be) the most important renewable energy (RE) resource for the CR. As a proportion of the total timber harvest, fuel wood has increased from five per cent in 1995 to 11 per cent in 2007, latterly representing 1.8 million m^3 of wood. Such high levels of energy-wood production were last achieved in the 1960s.[2] The CR exports biomass to Austria and Germany, despite there being a prospective shortfall in supply for domestic consumption, which stands at almost 6 million tonnes of biomass annually. However, a much greater supply will be required in future: projections made by the National Renewable Energy Action Plan (NREAP) indicate consumption of almost 11.7 million tonnes of biomass in 2020.

1.1 Electricity production from biomass

In 2009, a survey[3] of 32 bioenergy producers indicated that 1,396 GWh (5 million gigajoules (GJ) of electricity was generated from 1.1 million tonnes of biomass. The sources of the biomass were as follows: 650,061 megawatt hours (MWh) of electricity was produced from wood chips (664,955 tonnes); 500,511 MWh was from black liquor (242,229 tonnes). This represents an increase in consumption of approximately 200,000 tonnes, compared to 2008, when electricity production was 1.171 GWh. A similar growth was seen from 2007 to 2008.[4] To date, electricity from biomass has been generated in larger installations — all 32 respondents in the survey were large producers.

1.2 Heat production from biomass

43 million GJ of heat was produced in 2009. Heat production in larger plants (of more than 200 kW capacity) consumed 1.9 million tonnes of biomass, while producing 15.5 million GJ of heat. Meanwhile, households consumed 3.4 million tonnes of biomass to produce 27.5 million GJ of heat.[5]

Until the end of 20th century, biomass was principally burnt in domestic households. In recent years however, biomass use in other sectors has grown rapidly, leading to a doubling of biomass consumption since 1995 — from 3 million tonnes in 1995 (household consumption) to approximately 6 million tonnes in 2009 (combined industrial and households use). According to statistics provided by the Ministry of Industry and Trade (MoIT), biogas provided another 3 million GJ of energy for heating and electricity,

2 Bufka, 2009

3 Bufka 2010

4 Bufka, 2010

5 Bufka, 2010

and the total energy produced from biomass totalled 51 million GJ.[6]

The Ministry of Environment (MoE) provides slightly different figures for the same period, possibly due to differences in methodology. According to Petr Holub, former director of the Department of Sustainable Energy and Transport, 61 million GJ of energy was produced from biomass in 2009. He estimates a future increase to 98.3 million GJ in 2013, based on:

- Projects under construction — 6.6 million GJ;
- Planned medium and large projects — 17.1 million GJ;
- Co-firing by the state energy giant ČEZ — 7.1 million GJ;
- Consumption by households and small producers — 6.5 million GJ.

It would require approximately 11.9 million tonnes of biomass to produce this energy. The potential for biomass energy (heat and electricity) production in 2020 is said to be 129 million GJ, requiring 15.5 million tonnes of biomass.[7]

These figures have been reviewed recently and the new Biomass Action Plan (BAP) will provide reliable data on amounts of biomass available for energy production. The NREAP numbers are less optimistic, but with predictions of 9.9 million tonnes of forest biomass; one million tonnes of biomass from agriculture; 663,000 tonnes from waste products; and total production of 105.6 million GJ, they are still far in excess of estimates by the MoE's Department of Nature and Landscape Protection (DNLP) which identified only four million tonnes of accessible forest biomass.[8]

1.3 Potential sources to meet increased biomass demand

Thus far, it has been believed that these levels of production can be achieved without substantial increases in imports, but to match even the more modest NREAP predictions, the CR would need another 6 million tonnes of biomass from agriculture, newly-established coppice, and short-rotation coppice stands. Preliminary analysis by the MoIT shows that to achieve even the NREAP targets, it must be assumed that the use of biomass for industry would increase from 2.9 million tonnes in 2009 to 6.5 million tonnes in 2020. Only one million tonnes would be sourced from agriculture; the rest would be from wood. Depending on one's point of a view, this could be considered either very ambitious or highly unlikely.[9] Certainly, there is not enough excess wood in the market to meet such a growth in demand. It would, therefore, need to be diverted from other users, e.g. households. Large co-generation units will be competing with each other, and smaller production units (mostly heat plants), will lose competitiveness, as at the time of writing, only electricity production is covered by feed in tariffs. The increased demand will drive wood prices higher, increasing input costs for paper mills, furniture manufacturers and the wood industry. Even if the CR was to burn an additional 3.5 million tonnes of biomass in 2020 in large combustion plants, it will not solve the problem of coal: coal power plants consume 53 million tonnes of coal every year.[10]

For households, these developments would be costly and force a switch to non-renewable energy. Since 1992, the price of fuel wood has increased five-fold. Continued scarcities of supply, and high prices for fuel wood, have created a demand for imports of coal from Germany and Poland. If large combustion

6 Bufka, 2010

7 Holub, 2010

8 Dolejský, 2009

9 Bufka, 2010

10 Bufka, 2009

plants further increased demand, and therefore the price of wood rose, household demand for coal would increase further. Imports of cheap coal for households, already at 250,000 tonnes per year, will also increase. This will obviously undermine the greenhouse gas (GHG) reduction targets that lie behind biomass energy initiatives.[11]

A solution could be production of biomass from arable land. There are approximately one million hectares (ha) of drained arable soil in the CR, which needs to undergo restoration of the water regime. Since 1950, agricultural production has been intensified and approximately one million ha of wet meadows, hedgerows, orchards and small woods were destroyed and replaced with arable land, these ecosystems are now missing. The NREAP proposes that 977,000 ha of arable soils be used to produce biomass for energy.[12]

It is evident therefore, that various, and sometimes conflicting, strategies for biomass use are being developed.

1.4 Biomass targets and the Czech NREAP

Mr. Marek Světlík from the Ministry of Agriculture (MoA), the head of the department of renewable energy sources and environmental strategies has stated that the Czech NREAP has to be reviewed every two years, and in his opinion the data provided by the NREAP at that time was not accurate, because the BAP was yet to be finalised (expected end of summer, 2012).[13] The BAP will be based on detailed analysis of different production methods and until that time it is unlikely to provide sufficient data about biomass production up to 2020.

1.5 Recent biomass supply and use

Table 1

	Biomass Supply, 2006 (NREAP) (tonnes)	Imports from Ukraine & Poland 2006 (NREAP) (tonnes)	Exports to Germany & Austria 2006 (NREAP) (tonnes)	Predicted sources of biomass, 2020 (NREAP) (tonnes)
Forestry Direct	3,268,000	12,000	139,000	4,412,000
Forestry Indirect	2,599,000	43,000	378,000	5,489,000
Agricultural	-	-	-	1,000,000
Wastes	-	-	-	663,000

NREAP Forestry Direct

In 2009, 1,396 GWh of electricity from biomass was produced, an increase from 1,171 GWh in 2008. This is based on data provided by 32 producers. Fifty-five per cent of electricity went to the grid, the rest was consumed by the producers (including energy lost in production). Biomass energy accounted for 30 per cent of total renewable electricity.[14]

11 Bufka, 2009

12 NREAP, 2010

13 This was finally released in September 2012.

14 MPO, 2010

1.6 Import and export of biomass

While the CR remains a net exporter of timber (see Table 1), the establishment of sustainability criteria for imported wood is not a priority. Defining and enforcing criteria on domestic biomass production is more effective. If future imports increase, then these criteria should be extended to biomass imports. It is essential that the biodiversity risk analysis for imports is done as soon as possible, as wood is already being imported from pristine Ukrainian and Slovakian forests.

1.7 Measures to mobilise future biomass supply

The NREAP suggests that by 2020, biomass will be mostly sourced from logging and saw residua and, to some extent, wood from landscape and public parks management (see Table 1).

These targets for forestry will be very difficult to achieve, and would only be possible using methods harmful to the environment.

1.8 Impact on other sectors of increased biomass energy demand

Due to state support for energy from biomass, increased demand for fuel wood is pushing up prices and it is becoming increasingly difficult to protect old trees in the countryside. The demand for wood chip is one of the main incentives for municipalities to cut more old, large trees as they renovate old parks (reconstructions of parks are often supported from ERDF).The impacts of rising prices on the furniture and wood sectors are not known yet, but are predicted to be significant.[15]

1.9 The use of biomass by operators smaller than 1 megawatt (MW)

According to statistics from the MoIT, households consumed 3.3 million tonnes of biomass in 2009. This was a slight decrease from 2007, caused by rising fuel-wood prices, due to increased demand (see above) and the availability of cheaper coal imported from Germany and Poland.

15 Bufka, interview, 2011

2 Government legislation and proposals.

2.1 The Czech Government and biomass criteria

Forest management in general is governed by the Forestry Act (No 289/1995 Sb.).

To date, there is no approved, legally binding system prescribing limits for forest biomass use, but new regulations governing the extraction of logging residua are under development, based on the evaluation of logging residua extraction, the application of biodiversity standards, and soil fertility and soil erosion patterns. The methodology is being devised for the MoE by the Czech Forest Management Institute, ÚHÚL, with additional input from staff at the MoA. The methodology will be used by forest advisory services and will be binding for state forests, and may possibly apply to private landowners too. The use of forest residua certainly has some logic, because the clearcut method of forest management results in a lot of residua being burnt on the spot, to clear the area for re-plantation. But at the same time, there is pressure to introduce alternative management methods such as selective logging and natural renovation of forest stands. If accepted, these methods would reduce the amount of forest residua available, and the economic feasibility of its extraction, compared to clearcutting.[16]

In 2008, the DNLP launched a study: 'Analysis of risks of logging residua use and its impact on soil and nutrient cycles'. The analysis was provided by the Czech Geological Survey (CGS).

CGS has calculated amounts of logging residua and its content of base cations for four catchments in the Global Earth Observation and Monitoring network (GEOMON). They predicted outcomes for soil cations in 2050, applying three different harvesting scenarios. This research was used as part of the background material for the study 'Differentiation of forests in the Czech Republic from the point of view of soil chemistry in accordance with harvesting of logging residua for energy purposes'. The study was presented in 2009.

In this second study, the CGS completed the calculation for base cations in biomass and soil for another ten catchments in the GEOMON. The main outcome was a ''Map of sensitivity of forest soils to acidification,' which combines geology, sulphur deposition, nitrogen deposition, forest stands, precipitation, and temperature. The map describes four categories: the first category (the least sensitive soils) contains eight percent of all forest soils; the second contains 71 per cent; the third contains 21 percent; and the fourth category (the most sensitive) contained 0.1 per cent. The first and second categories (representing a combined 79 percent of forest soils) were judged as available for forest residua abstraction, when nutrient cycling and acidification were taken into consideration. The remaining 21 per cent of forest soils were excluded. After this, the area with allowable extraction of logging residua decreased from 79 per cent to 64 per cent of forest soils. This is a delineation based on soil nutrient capacity, but not taking into account biodiversity and soil erosion.

2.2 Methodology for private forest advisors

The methodology is based on the Decree No. 83 of the MoA (19 April 1996), giving procedures for forest management plans and delineation of forest management units. The guidelines are based on altitude — lowland stands are more suitable for forest residua extraction than mountainous forest stands. Only forests in vegetation belts one to five (belt one is oak, belt five is fir–beach) are recommended for forest

16 Dolejský, 2009

residua extraction. In more highly situated forest belts (beech, spruce), extraction of forest residua is not recommended.

There are also specific edaphic categories and forest stands, where forest residua can be extracted. These are usually deep soils; soils on flat terrain; nutrient-rich soils; and forests outside protected nature areas. This preliminary delineation will be monitored in the medium and long terms and can be revised in the future, depending on changes in soil chemistry, erosion and biodiversity.[17] The methodology also identifies soils where extraction of logging residua is not viable. These are, for example: wetland and peatland forests; forests on slopes; forests with a high content of stones; National parks; first zones of Protected landscape areas; National natural reserves; Natural reserves; National natural monuments; Natural monuments; forests protecting soil against erosion; forests protecting water sources; forests in Natura 2000.[18],[19] When taking into account these soil vulnerability criteria, the area from which logging residua can be extracted is reduced to 930,000 ha (36 per cent of forests). If nature-protection criteria are taken into account, only 500,000 ha is available — just 19.2 per cent of the total forested area.[20]

Yet another study, published in 2010, analysed the energy efficiency and life cycle of logging residua extraction. This study evaluated available technologies and concluded that nine per cent of Czech forested territory is inaccessible for environmentally sound and energy-efficient extraction of forest residua, while another 20 per cent of forest is not easily accessible. Depending on the terrain and the technology used, the production of one tonne of dry matter of chips would require an input of between 1,558 and 2,644 MJ. Nonetheless, the Pure Energy Ratio (PER) of forest harvest residue production and transfer is approximately eight to 12, depending on the specific technological chain used. When the final efficiency of the energy source is taken into account, the PER value is significantly reduced. When combined with end-of-pipe technology, the most efficient are modern biomass technologies with 85 to 92 per cent efficiency; and household heating systems of 80 to 90 per cent efficiency. The lowest PER is achieved in large-scale condensation power stations, co-firing wood and coal, with an efficiency of just 23 to 27 per cent. This means a gain of just 1.25 to 1.31 more energy than consumed by inputs (where inputs = 1).[21] When we factor in that clearcuts are the most cost efficient method for maximising forest harvest residua, and take into account the release of GHG due to clear cuts, we would probably cross the red line for GHG balance within bioenergy production – meaning that production would increase rather than reduce GHGs.

2.3 The Biomass Action Plan

The BAP is now close to completion but at the time of writing only background studies have so far been available. The BAP uses the data from the above-mentioned studies. One of the most important sources, combining all previously mentioned studies, is 'Analysis of the potential of biomass in the Czech Republic',[22] according to which, 62 per cent (or 1.6 million ha) of forest land is available for extraction of harvest residua. However, it lacks sufficient evaluation of the potential for soil erosion, if the maximum amounts of harvest residua are extracted on slopes.

17 ÚHUL, 2009

18 A network of protected areas defined in the EU's Habitats Directive and Birds Directive see: http://www.natura.org

19 ÚHUL, 2009

20 Total forest cover is 2.7 million ha

21 ÚHUL, 2010

22 Havlíčková et al, 2010

3 Conflicts and issues

3.1 Conflicts between Government policies

So far, the demand for wood for biomass energy has not exceeded supply, but targets in the NREAP for 2020 are already very high. There is an urgent need to produce more biomass on arable soils, and to create subsidies for the establishment of production systems. There is a special working group within the MoA, preparing subsidies for biomass production, at the Unit for Rural Development (URD). Mr. Marek Světlík, the head of the department of renewable energy sources and environmental strategies of the MoA stated that support for short-rotation coppice will not be a part of the solution in the recent RDP. So, until 2013 there will be no support for new plantations of coppice stands.

Within the forestry sector there has been disagreement between different National Forestry Programme Working Groups. The outcome of the group focusing on biomass for energy was seen to be that if there is a need to produce enough logging residua for energy, clearcuts should still be used as a main logging method; whereas working groups looking at adaptation to climate change, water retention and biodiversity took a different position, favouring selective logging and natural regeneration of forest stands.

3.2 National estimates of how much wood is available from domestic forests for different uses (energy purposes, timber industry, etc.)

About 15.5 million m^3 of wood is harvested in the CR every year (equivalent to approximately 13 million tonnes).[23] Table 2 illustrates the significance of the NREAP plans for biomass for energy. At 9.9 million tonnes, it would consume more than three quarters of the total annual wood harvest. This volume of demand would undoubtedly significantly threaten other sectors, though no exact analysis of its impact has been completed. The analysis of Mr. Vladimír Dolejský, former director of the MoE[24] shows a different picture: by his reckoning, four million tonnes of wood are annually available in Czech forests (including harvest and processing residua).

Table 2 Potential production of all forest biomass[25]

Potential dendromass from forests	NREAP predictions for 2020 (tonnes)	MoE data, 2005 (tonnes)
Fire wood	4,412,000	1,016,750
Harvest and wood processing residua	5,489,000	2,372,140
Total	9,901,000	3,388,890

(Source: Dolejský, 2009)

23 ÚHUL, 2009

24 2009

25 Dolejský, 2009

3.3 Problems presented by increased Czech biomass production

3.3.1 Biodiversity

Logging residua, whole tree harvesting

Twenty per cent of forest biodiversity is dependant on the presence of dead wood.[26] Decaying wood represents a key habitat for a number of beetles, for example long horn beetles (*Cerambycidae*), jewel beetles (*Buprestidae*), the hermit beetle (Osmoderma eremita), stag beetle (*Lucianus cervus*) and European rhino beetle (*Oryctes nasicornis*). Research in Czech floodplain forests found 389 beetle species and 14 ant species dependant on dead wood.[27] Dead wood is virtually absent in intensively managed forests. On average (including reservations), there are seven m^3 of dead wood per ha in Czech forests (National forest inventory).[28] In intensively managed forests the amount is even less, and it mostly consists of bark and branches. But research in the few remaining Czech ancient forests shows that near-natural forest contains from 50 to 345 m^3 of dead wood,[29] while the dead wood content of ancient forests usually ranges from 100 to 150 m^3. Decaying wood creates 23 to 30 per cent of the total wood content of near-natural forests.[30] In Razula National Nature Reserve it is 61 per cent of total wood content (345 m^3 of dead wood per ha on average).[31]

The long-term effects on soil macroarthropods and enchytraeids of the addition or removal of logging residues, were examined in Scots pine (*Pinus sylvestris L.*) stands. The study was performed 15 to 18 years after the treatments had been applied after clearcutting in 1976. Compared with plots receiving roughly twice the normal amount of residues, removal of logging residues (above-ground whole-tree harvesting) resulted in decreases in the total numbers of Collembola (springtails), gamasid mites, spiders, predatory insects and dipterous larvae, whereas no significant effects on enchytraeids and diplopods could be detected. It is concluded that whole-tree above-ground harvesting may result in long-term decreases in the abundances of many soil animal groups. When the possible impact of decreased abundances of fungivores and predatory arthropods on nutrient cycling and site productivity is considered, the direct effects of these changes on nitrogen mineralisation are likely to be small. However, the possibility that the soil fauna may be involved in a negative feedback loop towards lower site productivity means that the observed long-term decreases in several organism groups should be of concern, at least on sites dominated by internal nutrient dynamics.[32] In all clearcuts, slash removal caused a shift in dominance with an increase in generalist species and a decline in forest species. The results show that removal of residua may have long-lasting effects on the carabid community composition and structure. Hence, in forest landscapes with large-scale biofuel harvest, generalist carabid species may increase their abundance.[33]

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26 Siitonen, 2001

27 Schlaghamerský, 2000

28 http://www.uhul.cz/en/il/index.php

29 Vrška and Hort, 2001

30 Vrška et al. 2005

31 Vrška and Hort, 2001

32 Bengston et al, 1997

33 Nitterus, 2007

Box 1 Example: endangered Natura 2000 species and dead wood

Buxbaumia viridis: **one of the indicator species for dead-wood presence. It occurs only in decayed wood and requires biotops with stable temperatures and light conditions. Clearcuts can destroy its populations. Its dispersion rate is very small and it needs sufficient amounts of dead wood in different stages of decay.[34]In intensively managed forests these species are dying out.[35]**

Rosalia alpina**: a priority Natura 2000 species. For its development it needs dead wood — specifically logs of beech. The larval stage lasts at least three years. The cause of its disappearance is clearcutting and removal of dead wood.[36]**

It can be argued, therefore, that extraction of wood for fuel will interfere with EU biodiversity policies, if biodiversity is not made a binding indicator. Biodiversity evaluation should be a precondition for delineation of areas suitable for different intensities of logging and logging residua extraction.

3.3.2 Biomass from agricultural soils

As there is no targeted support for short-rotation coppice in place, it is unlikely that production from short-rotation coppice will ease the pressure on forests earlier than 2020. Furthermore, there is insufficient support for the use of biomass from grasslands. For example, in the Netherlands the producers of biogas for energy can source a maximum of only 50 per cent of their biomass from arable crops, with the remainder coming from grasslands and another perennial crops. This regulation ensures a demand for grassland biomass. In the case of short-rotation coppice, the most immediate threat is the use of non-native species of willows and poplars. However, compared to the damage caused by overexploitation of forests, these risks are relatively small. In regard to systems producing biomass from herbs, there have been trials of a hybrid sorrel from Caucasus (*Uteusa*) and also the highly invasive herb, Japanese knotweed. Alternatively, reed (*Phragmites communis*) would be more environmentally beneficial and is comparable in terms of volume of harvest and energy produced. Biogas production presents a different challenge: it is produced mostly from maize, and it results in severe soil erosion in some regions.

So, the most serious threats from biomass produced from agricultural land are

- Introduction of non-native and invasive tree species;
- introduction of non-native and invasive species of herbs;

34 Wiklund 2002

35 Hallingbäck 1998

36 Biomonitoring, 2010

- increased demand for arable land for energy crops;
- and fertilising of energy crops, leading to water pollution.

On the other hand, if production systems on arable land are well designed and managed, they could deliver an increase in biodiversity. If properly sited, short-rotation coppice; coppice-with-standards; agroforestry systems; and reed beds would provide sufficient amounts of biomass with positive effects for biodiversity and landscape.

3. 4 Conflicting policies concerning water retention and soil protection

The following section explores the contradictions between EU water and adaptation (to climate change) policies and policies to maximise the extraction of forest biomass for energy production.

3.4.1 Soil carbon

Both clearcutting and the use of harvest residues for energy production decrease soil carbon stocks and damage water and nutrient cycles. Changes in soil carbon stocks are much greater than other GHG emissions caused by the use of forest residues for energy. Soil carbon stocks play an important role in forest carbon balances.[37] Adding information on taxonomic order and organic carbon content to the textural class brings a 10 per cent and 20 per cent improvement in water retention estimation, respectively, as compared with estimation from the textural class alone. Using total clay, sand and silt along

37 Liski, 2005

with organic carbon content and taxonomic order results in a 25 per cent improvement in accuracy over using textural classes. At high organic carbon values, all soils show an increase in water retention. The largest increase is in sandy and silty soils.[38]

When it comes to forest management, issues of soil quality and carbon content become even more complex. Spruce monocultures are very common in the CR. Harvesting of spruce monocultures is typically by clearcutting areas of one ha. Spruce is easily replanted, so clearcuts are restocked with spruce. However, spruce creates the worst form of soil carbon — an overlaying humus called mor. Mor is acidic and not beneficial to larger soil biota (makroedafon). But clearcuts are the only economic way to extract logging residua and many forest managers argue that without clearcuts we cannot fulfil our renewable energy targets. Most near-natural forests in the CR are fir–beech forests, lime–acer forests, alnus–ash forests and oak–hornbeam forests. These forests have a much better influence on soil and create soil carbon forms called mol and mul. These forests types are not suitable for clearcutting, meaning logging residua cannot be extracted economically from near-natural forests using sensitive logging methods. But sometimes these forests can be managed in the form of coppice and coppice-with-standard.

3.4.2 Forest streams and wetlands

Wherever streams and their riparian margins are sited in the forest they create their own closed and sensitive ecosystem of longitudinally-zoned, connected expansion.[39] These riparian margins and neighbouring wet forests are also habitats for tree species that are interesting from a timber perspective. The utilisation of these mainly productive sites need not be contradictory to the sensitivity of these sites and their protective functions. However, for forest management to fulfil both its productive and protective functions, it must adjust to recognise streams in their longitudinal expansion as a defined management unit, and respond with appropriate site-adapted riparian and wet-forest communities. Due to the EU Water Framework Directive's requirements to 'recreate good ecological conditions' of streams in a basin district larger than 10 km², forest owners are required to take action if their riparian forests are not in a semi-natural condition and if actions are not defined in a management plan. Many forest owners know little or nothing about ecological communities or their legal obligations to maintain and develop riparian forests. In low mountain ranges destined for large-scale plantations of fast-growing coniferous species, streams are often afforested right up to the stream bank. Often they are afforested with pure spruce stands or a large proportion of spruce.[40]

38 Rawls et al 2003

39 Osterman, 2009

40 Ostermann, 2009

Non-intervention buffer zones and selective logging zones along forest streams and wetlands from mountains to lowlands are the main precondition for the protection of the biodiversity of water-related ecosystems and for enhancement of soil protection and water retention. Within lowland streams, these buffers — which provide large fallow trees and large woody debris — influence river flow and increase water tables and flood frequency. Apart from flood alleviation, the dead-wood-rich ecosystem offers biotopes for many different species of amphibians and fish.[41] Dead wood in the form of large woody debris is essential for natural river dynamics and hydraulics, sediment transport and deposition of organic material in the river body and its floodplain.[42]

The buffer zones of mountain forest streams are often planted with spruce, when alder, ash, lime and willow would be more suitable. What is more, these streams have changed hydromorphologically due to a lack of dead wood and centuries of logging and mining operations. The recommended approach for these streams is selective logging of the spruce, enabling a near-natural forest buffer zone to develop. The felled spruce should be, where possible, left in the buffer zone, and also in the streams themselves, so they can begin to restore their natural shape.[43]

Forests in floodplains have developed in close correlation to the regular flood regime, sediment transport and nutrients in the water. Trees and bushes can colonise different sediments and environments and can influence the biotop mosaic and processes in the flood plain.[44] If the nearly-natural forests are removed from floodplains, and the amount of large woody debris decreases, large woody debris dams and induced meanders are created less frequently. Rivers then incise, so flooding in floodplain forests is less frequent, as water rushes down to the cities. If we remove the buffer zones of non-intervention forests,[45] we decrease the flood prevention capacity of unbuilt floodplain zones.[46]

When catchment and water protection are considered, there is a clear need to define distinct zones, and the harvesting methods appropriate to each: areas suitable for plantations and the use intensive forest management practices and the harvesting of logging residua; more sensitive areas, where logging residua should be left; and even more sensitive areas, where special sensitive logging methods should be applied and where a proportion of old trees, logs and trunks will remain to decay. The most sensitive zones should be declared as protected forests, where no intervention regime should be applied at all.

3.4.4 Soil fertility and soil management

Burning straw and logging residua, together with intensified logging, is a common approach to the production of biomass energy. Modelling results in forest soils has shown that most of forested Czech catchments were significantly depleted, due to high acid deposition during the second half of the 20th century. This has resulted in decreased base saturation of the soil horizons relative to pre-industrial values. Some less polluted areas with nutrient rich soils (base rich) recovered due to reduced acid loading, coupled with base cations, weathering and decomposition of litter on the forest floor. Despite large emission reductions in the 1990s, vast areas still suffer from the very high loads of acid deposition in the past and high uptake of base cations by aggrading biomass in planted Norway spruce monocultures. Soil recovery depends on future deposition loads, base cation deposition, and on forest management. In some areas, a change of tree species composition should be recommended and extraction of logging residua prohibited. Lack of dead wood, over-harvesting, and spruce and pinus monocultures decrease

41 Tockner et al 2006

42 Vajner, Simon 2005

43 Ostermann, 2009

44 Gurnell 2002

45 http://www.pro-natura.net/naconex/news5/E1_8.pdf

46 Gurnell, 2002

the ability of soils to recover, as their litter is acidic.[47] Generally speaking, a sufficient amount of dead wood and logging residua will increase the content of stable humus forms, and enables survival of numerous soil biota species due to the stable moisture and temperature of large woody debris and humus layers. Harvesting straw and logging residua as fuel for a power plant, instead of allowing them to be reincorporated into the soil, will lead to a decline in soil carbon, nitrogen and sulphur stocks. Biotic nutrient cycles will be harmed, whereas the amounts of other nutrients in the soil, like phosphorous, can be sustained if effective recycling is realised. Research indicates that the total loss of soil carbon due to straw removal might be as high as 20 to 30 times the annual net reduction of GHG from the bio-energy derived from the straw. Without return flow, the removal of straw from the field may lead to a 50 per cent drop in soil organic matter. Removal of straw also affects soil biota directly because of the reduction in organic matter available for their intake, causing changes in the total active biomass of these biota.[48] However, methods exist to increase soil organic matter content. Due to biogenic soil processes, straw and logging residua can be transformed into stable humus forms. Research on arable soils has shown that in general, soil carbon sequestration during the first decade of adoption of agricultural conservation best practice is 1.8 tonnes CO^2 per ha per year. On 5 billion ha of agricultural land, this could represent one third of current annual global emissions of CO^2 from the burning of fossil fuels, or 27 petagrammes (Pg) CO^2 per year.[49] However, strategies to mobilise biomass energy at any price would run entirely contrary to this, reducing even further the ability of soils to sequestrate carbon and nutrients.

EU legislation on soil protection is lacking, but the need to evaluate the impact of soil management, as a whole, on its nutrient, carbon and GHG balance is becoming increasingly obvious. Otherwise, any programme aimed at reducing GHG via biomass energy production will fail to achieve its aims, and may also threaten water quality, water quantity and biodiversity. For the CR, the priorities must be: to change the species composition of forests and introduce species that will help to ameliorate soil and humus quality; ban extraction of logging residua from sensitive forests; and decrease the use of straw for energy-production purposes. We recommend that if biomass for energy is to be produced on agricultural land, then this should be achieved through the establishment of perennial production systems, such as: grasslands, reedbeds, willow plantations, coppice, and coppice-with-standards.

47 Navrátil et al, 2002

48 Bidraban et al, 2009

49 FAO, 2008

4 Measures to address the problems

The methodology proposed by the MoE for logging residua extraction should, finally, be assessed and approved as binding regulation. Production of logging residua for energy should be minimised, in particular stump uprooting.

Public funding for agricultural biomass energy should be available for perennial crop systems (grasslands, reed beds, willow, poplar, traditional coppice and coppice-with-standards). Planting of non-native and invasive species should not be supported. Adaptation to climate change, biodiversity, and erosion prevention should be the most important criteria when considering funding of schemes.

The MoIT together with the MoE are preparing a new law covering state support for biomass power plants in the CR. New installations will only be eligible for state support if planning permission was obtained before the end of 2011. After that point, only installations of heating plants (with possible proportionate approved electricity co-generation) will be eligible. By using all the heat generated for households and co-generating electricity as a bonus product, a higher efficiency will be achieved. Currently, approximately 20 per cent of biomass is burned in old coal power plants of low efficiency, and principally for electricity production, with little heat generation. The solution proposed by the MoIT is to withdraw state support for co-firing, and only support co-generation if the heat is efficiently used. In 2009, the Czech energy giant ČEZ produced 327 GWh of electricity from biomass. In 2008, 350,000 tonnes of biomass was used, producing 300 GWh of electricity. Support from green bonuses amounted to EUR 50 million, in addition to approximately EUR 50 million of feed-in tariffs. Therefore, about 200,000 tonnes of coal was replaced with biomass in ČEZ installations.

Total industry biomass consumption for energy production is around three million tonnes. ČEZ heating plants consume one million tonnes of biomass; paper mills consume one million tonnes of black liquor and other residua; and sawmills consume another one million tonnes of saw dust and another residua.[50]

At the national level, various criteria for forest biomass production are proposed, but are not yet binding. Criteria for biomass from arable land are lacking. At the EU level, we need much tougher standards for arable farming (cross compliance) and also for biomass production. Straw burning should be banned. Energy biomass should only be produced using methods that support biodiversity, water retention and adaptation to climate change. Typical examples of such win–win systems are: flood-plain forests, hedgerows, coppice-with standards-forests, reed beds, meadows, woody margins, etc.

4.1 Recommendations and conclusions

Hnutí DUHA (the Czech Friends of the Earth) has advocated strict standards for forest residua extraction. Large protected areas, poor-quality forest soils, or forest soils susceptible to erosion, should be protected from forest residua extraction. In some protected areas there is an interest in nature protection to re-establish coppice and coppice with standards or pasture forests instead of high monoculture forests. Stump uprooting should be prohibited as a method for energy biomass mobilisation, as it is damaging to soil and biodiversity.[51]

To achieve responsible and sustainable biomass production, we propose a combination of EU policies covering water, biodiversity, soil protection, and adaptation to climate change. We propose the

50 Bufka – interview, 2011

51 (ÚHUL, 2010)

replanting of up to 150,000 ha of floodplain forests (at least on agriculture soils with up to 5-year return frequency of flooding); 50,000 ha of agroforestry systems; and 200,000 ha of hedgerows and wetlands on vulnerable arable soils before 2050, managed as coppice-with-standards, orchards and willow stands, reed beds, or used as carbon sinks (non-intervention forest). Also we propose the conversion of approximately 200,000 ha of the most vulnerable spruce plantations to near-natural forests within next 20 years —providing an interim source of biomass — until newly-established coppice and coppice-with-standards are ready for the first harvest.

Arable land in wetlands is susceptible to water erosion

In conclusion, we call on the MoA to deliver a biomass action strategy that respects all above-mentioned EU policies and that supports environmentally friendly and responsible methods of biomass production.

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FERN office Belgium

Rue d'Edimbourg, 26,1050 Bruxelles, Belgium.
Tel: +32 2 894 4690
info@fern.org

FERN office United Kingdom

1c Fosseway Business Centre, Stratford Road, Moreton-in-Marsh,
Gloucestershire GL56 9NQ, UK.
Tel: +44 1608 652 895
Fax: +44 1608 652 878
info@fern.org

www.fern.org

Hnutí DUHA

Hnutí DUHA (Friends of the Earth Czech Republic)

Údolní 33
602 00 Brno
Tel.: +420 545 214 431
info@hnutiduha.cz

www.hnutiduha.cz