Poplars and other fast-growing tree species in Germany

Report of the National Poplar Commission 2016-2019

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Abstract

Poplars and other Fast-Growing Trees in Germany: Report of the National Poplar Commission. Progress report 2016 - 2019

Every four years, the National Poplar Commissions report on the progress of the International Poplar Commission IPC, one of the oldest, firmly established organizations of the FAO (Organization for Food and Agriculture of the United Nations). The reports will be collected and published for the 26th session of the International Poplar Commission in Rome in October 2020. For Germany, the Thünen Institute for Forest Genetics is compiling the report on behalf of the Federal Ministry of Food and Agriculture.

With the reform of the poplar commission, the range of tree species was expanded to include fast-growing tree species in the reporting period. In addition to poplars and willows, Germany has decided to add hybrid larch and black locust for the time being.

Based on the numbers from the Federal Forest Inventory (2012), the area with fast growing trees can be estimated as follows: poplars 147,000 ha (approx. 17,000 ha natural regenerated and 130,000 ha planted), willows 75,000 ha (natural regenerated), hybrid larch 3,000 ha (planted), and black locust 42,000 ha (planted).

The current cultivation of poplars and willows is largely limited to short rotation coppice plantations (SRC). Several factors are responsible for this: attractive alternative crops, in particular maize cultivation for biogas, combined with the extensive ban on the conversion of grassland as well as a lack of impetus from the Greening Regulation passed at EU level in 2014. The total SRC surface in Germany is currently stagnating at 7,000 hectares.

During the reporting period, two poplar clones were approved in the category "tested". 13 further poplar clones were proposed for preliminary approval for the use of biomass production in short rotation due to their significant superiority in the biomass characteristic. Furthermore, the recommendation was made to approve of family parents for the production of forest reproductive material from 2 *Populus tremula* combinations was made.

A total of 13 research projects and ten joint research projects (with together 33 projects), carried out at 22 institutions on genetics and breeding, cultivation, physiology, resistance of poplars and willows as well as wood utilisation were funded by third parties and have been included in the report. Also, 90 publications are listed in the report.

Key words: poplar, *Populus*, willow, *Salix*, hybrid larch, *Larix × eurolepis*, black locust, *Robinia pseudoacacia*, cultivated area, short rotation coppice, forest reproductive material, research projects, publication

Zusammenfassung

Pappeln und andere schnellwachsende Baumarten in Deutschland: Bericht der nationalen Pappelkommission. Fortschrittsbericht 2016 - 2019

Alle vier Jahre berichten die Nationalen Pappelkommissionen über den Fortschritt der Internationalen Pappelkommission IPC, ist eine der ältesten, festverankerten Organisationen der FAO (Organisation für Ernährung und Landwirtschaft der Vereinten Nationen). Die Berichte werden gesammelt und zur 26. Tagung der Internationalen Pappelkommission in Rom im Oktober 2020 veröffentlicht. Für Deutschland stellt das Thünen-Institut für Forstgenetik im Auftrag des Bundesministeriums für Ernährung und Landwirtschaft den Bericht zusammen.

Mit der Reform der Pappelkommission wurde in der Berichtsperiode das Baumartenspektrum auf schnellwachsende Baumarten erweitert. Deutschland hat sich entschieden neben Pappeln und Weiden vorerst die Hybridlärche und die Robinie neu aufzunehmen.

Anhand der Zahlen aus der Bundeswaldinventur (2012) lässt sich die Fläche mit schnellwachsenden Baumarten wie folgt schätzen: Pappeln 147.000 ha (ca. 17.000 ha natürlich verjüngt und 130.000 ha gepflanzt), Weiden 75.000 ha (natürlich verjüngt), Hybridlärche 3.000 ha (gepflanzt) und Robinie 42.000 ha (gepflanzt).

Der aktuelle Anbau von Pappeln und Weiden beschränkt sich weitgehend auf Kurzumtriebsplantagen. Dafür verantwortliche Faktoren sind attraktive Alternativkulturen, insbesondere Maisanbau für Biogas, verbunden mit dem weitgehenden Verbot der Umwandlung von Grünland sowie mangelnde Impulse aus der auf EU-Ebene 2014 beschlossenen Greening-Verordnung. Die gesamte Kurzumtriebsplantagenfläche stagniert in Deutschland derzeit bei 7.000 Hektar.

Im Berichtszeitraum wurden 2 Pappelklone in der Kategorie „Geprüft“ zugelassen.13 weitere Pappelklone wurden auf Grund ihrer signifikanten Überlegenheit bei dem Merkmal Biomasse zur vorläufigen Zulassung für den Verwendungszweck Biomasseproduktion im Kurzumtrieb vorgeschlagen. Weiterhin erfolgte die Empfehlung zur Zulassung von Familieneltern für die Erzeugung von forstlichem Vermehrungsgut von 2 *Populus tremula*-Kombinationen.

Dreizehn Forschungsprojekte und zehn Verbundprojekte (mit zusammen 33 Einzelvorhaben) wurden durch Drittmittel an 22 Institutionen in Deutschland zur Genetik und Züchtung, Anbau, Physiologie, Resistenzen von Pappeln, Weiden sowie Ernte und Verwertung ihres Holzes gefördert. 90 Veröffentlichungen sind im Bericht erfasst.

Schlüsselworte: Pappel, *Populus*, Weide, *Salix*, Hybridlärche, *Larix × eurolepis*, Robinie, *Robinia pseudoacacia*, Anbaufläche, Kurzumtriebsplantage, forstliches Vermehrungsgut, Forschungsprojekte, Veröffentlichung

Poplars and other Fast-Growing Trees in Germany: Report of the National Poplar Commission Progress report 2016 - 2019

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I. POLICY AND LEGAL FRAMEWORK

Policy

In Germany, forests are a defining part of the cultural landscape. The forest area is approximately 11.4 million hectares, which is 32 percent of the land area. Forestry controls forest development and thus secures the indispensable usage, protectional and recreational functions of forests that go far beyond wood production. The forests in Germany fulfill a variety of functions simultaneously and in the same area. Forestry in Germany is sustainable and multifunctional. The federal forest law stipulates that the forest must be preserved, enlarged if necessary, and that proper management must be sustainably ensured.

The composition of tree species in our forests is changing. The conversion of the forest to more hardwood is desirable from a silvicultural and ecological point of view, but technologically it is a challenge, especially for the established sawing industry, which is geared towards softwood. Like other industrial branches, forestry is subject to the style of a period, too.

The waves that forest tree breeding has gone through are particularly evident in poplar breeding. In the 1950s, the demand for fast-growing tree species to cover the wood demand boomed. However, this collapsed in the mid-1970s with the dissolution of the National Poplar Association. A new wave started ten years later when it came to producing wood in short rotation coppice plantations on agricultural sites that are no longer used for food production. In the mid-1990s, however, it had already subsided. In 2008, poplar breeding experienced a renaissance in Germany with the call for wood from short rotation coppice plantations as a renewable energy resource. Well-growing poplar clones and progenies were quickly required here. The previously set breeding programs were reactivated with great effort. Within the framework of several projects funded mainly by the Federal Ministry of Food and Agriculture (BMEL) via the FNR (Fachagentur Nachwachsende Rohstoffe e. V.) - especially FastWOOD - new crossings and tests were carried out with poplar offspring in order to provide propagation material of the category "tested". In not even a decade, breeding was once again stopped. In the meantime, politics had started to rely on biogas and the raw material maize. The ecological advantages of short rotation coppice plantations were not taken into consideration. Poplars are still insignificant in forestry.

Legal framework

The "Act on the Conservation of Forests and the Promotion of Forestry" (Federal Forest Act) is the most important instrument for protecting forests in Germany. It is implemented and supplemented by the forest laws of the federal states. In Germany, all forests are under the protection of the federal forest law and the state forest laws. The forest laws protect the forest from improper treatment, overuse, overexploitation and loss of land. They oblige forest owners to manage the forest properly and sustainably and to reforest bare forest areas.

With the amendment of the Federal Forest Act of July 31st, 2010, short rotation coppice plantations and agroforestry sites are no longer legally valid as forests. This implies that no afforestation authorisation is required for the establishment of short rotation coppice plantations

or agroforestry sites, respectively, with a rotation time of max. 20 years outside forest areas. The area can also be converted back for food production at any time without having to apply for a clearing or conversion authorisation. This is intended to make it easier to establish short rotation coppice plantations outside the forest, but has so far not led to an increased number of such areas. Obviously, there are other reasons, e.g., unfavorable general conditions, reduced operational flexibility of farmers and high profit margins for the cultivation of alternative agricultural products.

The “Act on Forest Reproductive Material” (FoVG) regulates the trade in forest reproductive material (seeds and planting material, parts of plants). It serves to preserve and improve the forest in its genetic diversity and is intended to protect forest owners and the forest from the use of unsuitable propagation material. The regulations of the FoVG also apply to short rotation coppice plantations and agroforestry sites, since the cultivation of tree species for wood production also pursues a forestry purpose on agricultural land.

This means that the provisions of the FoVG have to be implemented for the production of propagation material, the establishment of stool beds and marketing. The marketing of sticks is only permitted by companies registered in accordance with FoVG. These regulations serve consumer protection, since, e.g., there are large differences between the individual poplar clones in terms of growth performance, resistance to biotic and abiotic damage events and the ability to regenerate after pruning.

All poplars and the species of hybrid larch and black locust treated below are subject to the FoVG, but not the willows.

Short rotation coppice plantations and agroforestry sites are classified as eligible permanent crops. However, the possibility of eligibility under the single farm payment exists only for certain types of wood (BLE 2010). Eligible tree species mentioned in this report are currently poplars, willows, black locust. In 2014, greening (direct payment regulation) was introduced in the EU agricultural promotion. It stipulates that the creation of short rotation plantations can be counted as ecological priority areas, but only with a factor of 0.3. It should be taken into account that no mineral fertilizers or pesticides may be used. Fewer tree species are permitted for cultivation on ecological priority areas than are generally permitted for SRM eligible for operating bonuses. In the case of willows and poplars, these are only certain species and hybrids. Here, black locust is not included.

II. Technical information

1. Taxonomy, nomenclature and registration

Taxonomy, nomenclature

A long-established and standardized set with 18 nuclear microsatellite markers is available for genotyping **poplars**. This is very well-suited to carry out clone identification and lineage analysis as well as to obtain taxonomic information. The standard marker set was used to identify breeding material from clone archives, material from trial areas and from seed plantations, and was also used for pedigree analysis for cross-bred offspring and for off-flowering offspring.

The existing nSSR markers for the genus ***Salix*** were supplemented and validated. This allows the species to be determined as far as possible and the clones to be identified.

11 microsatellite loci are currently being considered for the genetic characterization of **larch**. The genetic variation recorded here is usually sufficient to differentiate between different genotypes or to recognize genotypes at the same time. The assignment to the species *Larix decidua*, *L. kaempferi* and the hybrids of the first generation is possible with a high degree of certainty.

An established standard set with 14 microsatellite markers is available for **black locust** (*Robinia pseudoacaia*). This makes it possible to distinguish between the clones used in Germany, which have a high genetic variation.

Approval, registration

According to §4 of the “Act on Forest Reproductive Material” (FoVG), clones are only approved in the "Tested" category. The vegetative production of forest reproductive material that is to be placed on the market may also only take place from raw material of this category (§7 FoVG).

A total of 15 poplar clones were proposed for provisional approval for a period of 10 years as a basic material for the production of forest reproductive material of the category "tested" for the use of biomass production in short rotation due to their significant superiority in the biomass characteristic (**Table 1**).

Table 1: Compilation of the 15 poplar clones that were proposed as basic material for the production of forest reproductive material

Clone (working title)	Parent species	Number of the registered clone
NW07-197 S (FastWOOD 1)	*P. maximowiczii* × *P. trichocarpa*	953 07
NW07-226 B (FastWOOD 2)	*P. maximowiczii* × *P. trichocarpa*	953 08
NW07-177 T (FastWOOD 4)	*P. trichocarpa*	
NW07-204 A (FastWOOD 5)	*P. maximowiczii* × *P. trichocarpa*	
NW09-0048 F	Open pollinated *P. maximowiczii* 124/66	
NW09-0064 A	Open pollinated *P. maximowiczii* 124/66	
NW09-0065 B	Open pollinated *P. maximowiczii* 124/66	
NW09-0077 R	Open pollinated *P. maximowiczii* 124/66	
NW09-0255C	Open pollinated *P. maximowiczii* 15/65	
NW09-0281H	Open pollinated *P. maximowiczii* 15/65	
NW09-0297C	Open pollinated *P. maximowiczii* 15/65	
NW09-0309S	Open pollinated *P. maximowiczii* 121/66	
NW09-0313W	Open pollinated *P. maximowiczii* 121/66	
NW09-0315Z	Open pollinated *P. maximowiczii* 121/66	
NW09-0364G	Open pollinated *P. maximowiczii* 121/66	

Furthermore, the Advisory Board for the Approval of Basic Material for the Production of Forest Reproductive Material in the Category “tested” [*Sachverständigenbeirat für die Zulassung von Ausgangsmaterial für die Gewinnung von forstlichem Vermehrungsgut der Kategorie „Geprüft*”] advocated an extension of the approval of the poplar clones Max 1, Max 3 and Max 4 (*P. nigra* × *P. maximowiczii*) by a further 10 years.

The Advisory Board for the Approval of Basic Material for the Production of Forest Reproductive Material for the Production of Forest Reproductive Material in the Category “tested” recommended preliminary approval for the following family parents of *P. tremula* as basic material for the production of forest reproductive material in the category "tested" (**Table 2**). The recommendation was based on the significantly superior growth performance of the tested offspring with average high survival rates.

Table 2: Family parents for the production of forest reproductive material from *P. tremula* combinations

Female parent	Male parent	For the production of forest reproductive material of the *P. tremula* combination
P. tremula clone Großdubaru 6 (mother tree, ZNR 375)	*P. tremula* clone Milstrich 2 (father tree, ZNR 97)	SBS 2011/25 (375×97)
P. tremula clone Großdubaru 6 (mother tree, ZNR 375)	*P. tremula* clone Großdubaru 3 (father tree, ZNR 113)	SBS 2011/27 (375×113)

To date, the Joint Expert Committee [*gemeinsame Gutachterausschuss* (gGA)] has recommended a minimum test period of 10 years when examining the poplar genus. The Advisory Board for the Approval of Basic Material for the Production of Forest Reproductive Material in the Category "tested" sees no need for a separate recommendation for the short rotation. The provisional approval instrument leaves sufficient opportunities for approval before within the 10 years.

The Federal Agency for Agriculture and Food (BLE), Bonn, maintains the register of clones, clone mixtures and poplar family parents approved in Germany by the bodies responsible under state law. The federal states keep their own registers for all other tree species subject to the FoVG.

A list of poplar clones, clone mixtures and family parents can be downloaded from the following link: https://www.ble.de/SharedDocs/Downloads/DE/Landwirtschaft/Saat-und-Planzgut/Pappelklone_mischungen.pdf?__blob=publicationFile&v=3

An overview of the poplar mother quarters and the responsible regional offices can be downloaded under the following link: https://www.ble.de/SharedDocs/Downloads/DE/Landwirtschaft/Saat-und-Planzgut/Pappelmutterquartiere.pdf?__blob=publicationFile&v=3

Table 3 shows the approved basic material for the production of forest reproductive material for the tree species subject to the FoVG (*Populus*, hybrid larch and black locust).

Table3: Compilation of the basic material for the production of forest reproductive material (number and ha) (status 01.07.2019)

Tree species	Category „selected“	Category „qualified“	Category „tested“			
	Stand	Seed orchard	Seed orchard	Clone	Clone mixture	Family parents
Populus spp.	30 (23 ha)		1 (0.1 ha)	112	9	12
Larix × eurolepis			5 (14 ha)			1
Robinia pseudoacacia	37 (112 ha)	4 (2 ha)				

In Germany, stool beds are registered for the production of cuttings of 69 poplar clones.

Protection of plant varieties

For some of the poplar clones mentioned above, plant variety protection applications have been made to the Community Plant Variety Office (CPVO) in Angers / France. The procedure is still ongoing.

2. Domestication and conservation of genetic resources

Domestication of genetic resources

In the context of multifunctional forestry, the sustainable use of forest genetic resources is used to provide the useful, protective and recreational services of the forest. In addition to the location and the silvicultural treatment, the highest possible biological diversity of the forests is a crucial basis for their performance. Above all, genetic adaptability and adaptability ensure the stability of the forests, which is necessary for all uses. In particular, they ensure the reactivity of the forests through resistance to biotic and abiotic harmful factors.

The cultivation of poplars, willows and other fast-growing tree species has so far played only a minor role. In view of the dramatic forest damage caused by drought, storms and beetle damage in 2018 and 2019, this could change. This allows cultivation of these tree species in the forest, in whose protection the target tree species can be introduced and develop. By using the forest tree species, the forest owner can achieve proceeds early. Various types of poplar and their hybrids and hybrid larches are particularly suitable as forest tree species.

Forest tree breeding in particular depends on the conservation and use of forest genetic resources and their diversity. The aim of forest plant breeding is to provide propagation material with high adaptability, growth performance and quality. In addition, propagation material with special stability and production characteristics can be made available for forestry by breeding. In November 2013, the "Strategy for the medium and long-term supply of high-quality forest reproductive material through breeding in Germany" was published (LIESEBACH et al. 2013, Thünen Report 7). The strategy was prepared against the background of the predicted climate change and includes the sycamore maple (*Acer pseudoplatanus*), Douglas-fir (*Pseudotsuga menziesii*), pedunculate oak (*Quercus robur*), sessile oak (*Q. petraea*), Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*), and larch (*Larix decidua, L. kaempferi*), as well hybrid larch (*L. × eurolepis*).

The implementation of the breeding strategy takes about 15 years and was started with the projects "FitForClim" and "AdaptForClim" funded by the Forest Climate Fund. In the first step, plus trees were selected; grafts were harvested from them, propagated through grafts and planted in clone archives to protect genetic resources. Afterwards, seeded plantations are to be created with the secured plus trees, which produce high-quality, adaptable, powerful and resistant forest seeds. Deployment zones were identified for the use of the planting material.

From 2009 to 2018, suitable poplar and willow clones were grown in three successive FastWOOD projects funded by the FNR for the production of energy wood in short rotation plantations (SRC) and test areas were created for their testing. Two clones have already been approved (See I.1). This means that in practice high-quality planting material is available which is up to 50 % superior to the poplar clones cultivated up to now and which also has better resistance to the poplar leaf rust. The newly grown poplar clones are saved in clone archives and propagated in stool beds.

Tables 4 and 5 summarize the seed harvests and the number of poplar cuttings produced in the period from 2016 to 2019.

Table 4: Seed harvests in 2016-2019

Tree species	Harvest year	Seed harvest [kg]			Plants [number]	
		Category „selected“	Category „qualified“	Category „tested“	Category „selected“	Category „tested“
***Populus* spp.**						
	2015/16			0.2	4 050	
	2016/17	18			9 820	
	2017/18	2			16 350	
	2018/19	11		3	7 500	2 080
	2019/lfd.	131				
Larix × eurolepis						
	2015/16			22		
	2016/17			185		
	2017/18					
	2018/19			82		
	2019/lfd.			17		
Robinia pseudoacacia						
	2015/16	538	81			
	2016/17					
	2017/18	0,3				
	2018/19	8,8	816			
	2019/lfd.	593				

Tabelle 5: Number of produced poplar cuttings, 2016-2019

Tree species	Harvest year	Cuttings [number]
***Populus* spp.**		
	2015/16	4 740 600
	2016/17	2 433 531
	2017/18	1 994 967
	2018/19	2 238 987

Conservation of genetic resources

The transfer of genetic resources into the next generation of stands, i.e., the rejuvenation of stands, is a crucial step for the conservation and promotion of forest genetic resources. It is fundamentally important from the perspective of forestry conservation that existing genetic resources are largely passed on to a next generation without restrictions and with a future-proof

adaptation potential. This applies regardless of whether natural or artificial rejuvenation takes place. Only within the framework of genetically fixed adaptations and adaptability from seed to tree can the performance of and in forests, e.g., be controlled and increased by silvicultural or business measures. The use of forest reproductive material with its inherent genetic information represents an intersection in the consideration of forest practice on the one hand, and the efforts to preserve and promote forest genetic resources on the other hand. Plantations (SRC) from one or fewer clones are an exception here. These are short-lived and are not intended for reproduction.

In the course of conserving forest genetic resources, efforts to conserve pure black poplar (*Populus nigra*) relics have been continued. Collections have been established and supplemented in several federal states for the black poplar, which are to be used in the future as a seed orchard or stool bed. The selection of the mother trees was accompanied by genetic tests to ensure the use of pure species.

Based on a recording and documentation of occurrences of the black poplar (*P. nigra*) along the larger rivers in Saxony since 2005, the species determination and characterization of stands of the black poplar, their seedling progeny and individual old trees was carried out using genetic investigation methods in the reporting period. The results of these studies served as the basis for the provision of basic material for the production of high-quality propagation material by vegetative or generative propagation. After completion of the work, several approved crops and a mother quarters with approximately 300 black poplars from all major rivers are available as basic material. After growing plants, reintroduction measures were carried out at ten locations along the rivers Elbe, Mulde and Weißen Elster since the end of 2014.

Due to the close cooperation of the forest administration with the waterway and shipping administration in Rhineland-Palatinate, it was possible to provide pure black poplars (*P. nigra*) for numerous renaturation projects from the stool beds of the local research station.

3. Plant health, resilience to threats and climate change

The breeding projects are concerned with the provision of high-quality, adaptable, high-performance and resistant propagation material. Disease is usually accompanied by weaker growth, as is observed with poplar rust.

Poplar leaf grids of the *Melampsora* genus are among the economically most important fungal diseases in poplars and willows. In general, the rust attack was low in the area. However, differences in infestation could be observed. The intensity of the infestation varied between years and regions. The infestation was higher in wetter vegetation periods and regions than in drier ones. The years 2016, 2018 and 2019 featured a low overall *Melampsora* infestation pressure, while this tended to be more pronounced in 2017. There were also differences between clones, progeny and progeny groups.

Tests confirmed that the hybrids from *P. tremula × P. tremuloides* have a high resistance to *Melampsora* rust. Progeny that is susceptible to rust should therefore not be approved for production, distribution and cultivation, even if they are currently still surviving in the trials and are showing relatively good growth. This also prevents the transmission of *Melampsora pinitorqua*, the causative agent of the rotating pine grate, to susceptible sources of the jaw.

Another disease that is dangerous for poplars in the *Populus* section is shoot tip disease or branch drought. The symptoms to be observed on leaves and branches are caused by the askomycete *Venturia macularis*, which is also well known as *Pollaccia radiosa*.

The overall infestation was very low in the reporting period. With a targeted selection of less susceptible offspring, the risk of infestation can be reduced.

Climate change and the associated increase in extreme events such as storms and drought, e.g., in 2018 and 2019, as well as the subsequent beetle infestation, pose new challenges to the tree species.

The dry years 2018 and 2019 led to significant growth losses in poplar plantations (SRC). Higher failures were observed in younger poplar plantations (SRC). On the other hand, failures in young test areas with hybrid aspens were hardly noticeable.

Larger failures due to insect infestation (e.g., bark beetle) after drought occurred in larch stands, particularly in central Germany. However, no distinction was made in the reports between the larch species.

No significant damage is known for the black locust, which is considered to be tolerant to heat and drought.

4. Sustainable livelihoods, land-use, products and bio-energy

Sustainable livelihoods, land-use

The energy transition that has been initiated is associated with climate change and poses further challenges. With the general rise in energy prices, there is a simultaneous increase in the demand for firewood. Wood has become increasingly important as a heat source in climate-neutral heating. This increases the competition between the woodworking industry and the use of wood for energy generation and domestic heating.

On agriculturally (less productive) usable areas, energy wood (wood chips) can be produced in short harvest intervals in SRC with fast-growing tree species. The focus is on tree species that have the property of sprouting again after harvesting. Depending on the type of soil and the amount of precipitation, poplars, willows and black locus are particularly suitable. The aim is a sustainable timber yield of 10-12 t absolute dry matter per year and hectare.

For example, Energy Crops GmbH, a company of the Vattenfall Group, manages around 2,000 ha of SRC in Brandenburg and in neighboring western Poland. The company is supplying some of the

wood chips to the biomass thermal power station Märkisches Viertel in Berlin. Energy Crops also offers a long-term secure fuel supply for the housing industry and other heat users. The company relies on close, long-term cooperation with regional agriculture. The cooperation aims to produce and offer the wood fuel over 20 years and at clearly calculable prices.

In times of fluctuating producer prices, the energy crops offer planning security and an additional perspective of sustainable management. It also provides the housing industry and other heat users a stable framework for regenerative heat supply in a time that is difficult to understand in the energy sector.

Products and bio-energy

The poplars, willows, hybrid areas and black locust are used in conventional rotation times according to the usual forestry methods. The sorting is done according to the legal regulations on legal trade classes for raw wood.

The biomass produced in SRC is primarily important as a solid fuel, which is mainly burned as wood chips and to a small extent as pellets in specially adapted boiler systems. Processes for the gasification of wood biomass (pyrolysis) or liquefaction for fuels (Fischer-Tropsch process) have not yet reached practical maturity.

5. Environmental and ecosystem services

Forest management in Germany is extensive compared to other forms of land use. This supports and preserves the diversity typical of the habitat. Willows and black locust, as well as most poplars, are characterized by special ecological tree characteristics (e.g., coarse bark, bark pockets, tree hollows, dead knots) with increasing age, which are habitats for numerous living things.

The biodiversity of the forests interacts with the landscapes and ecosystems adjacent to the forests. Woody structures have always played an important role in agricultural landscapes. They still perform important functions today. For example, they represent a habitat for numerous species, offer wind protection, shape the landscape in different ways and connect biotopes.

Agricultural wood with fast-growing trees for energy production has great potential, particularly in cleared agricultural landscapes, to enrich structural diversity and other habitat resources and thus biodiversity, especially that of insects. This applies both to agricultural wood in plantations and to agroforestry systems.

The management of a SRC is generally extensive because it requires little or no use of fertilizers or chemical pesticides. The latter is usually limited to the establishment phase. This results in a lower CO2 balance and significantly higher biodiversity than with many other bio-energy sources.

III. GENERAL INFORMATION

1. Administration and operation of the National Poplar Commission or equivalent organization

The National Poplar Commission is chaired by the head of Department 5 (Forestry, Sustainability, Renewable Resources) of the German Federal Ministry of Food and Agriculture. The secretariat of the National Poplar Commission is maintained by the Federal Ministry of Food and Agriculture.

Germany hosted the well-attended conference of the International Poplar Commission (IPC) in Berlin from September 12-16, 2016.

Two representatives from Germany were elected to the Executive Committee of the IPC at the 25th meeting during the conference of the International Poplar Commission (IPC) in Berlin (September 12-16, 2016).

One representative has regularly attended the Executive Committee meetings over the period, such as the 49th Executive Committee meeting in Rome on July 18, 2018, the unscheduled IPC reform decision meeting in Rome on July 19, 2018 and at the 7th International Poplar Symposium from October 28 to November 4, 2018 in Buenos Aires, Argentina. He also took part in several conference calls and voting by email. At the international level, Germany is active in standardising the production and distribution of forest reproductive material at the OECD.

The other representative has since retired and resigned his position on the committee.

2. Literature

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3. Relations with other countries

Knowledge transfer

The scientists of the research institutions and universities in Germany are in active exchange of information with those abroad through international conferences.

Plant propagation

In Germany, 21 poplar clones are cultivated *in vitro* and the plants supplied to Sweden are.

Transfer of reproductive material

In cooperation with the poplar technology center of the University of Talca, Chile, pegs were made available for trial cultivation by the plywood manufacturer GARNICA in Spain.

Reference database

In the reporting period, leaf samples were exchanged from several species and varieties of poplar in order to expand the reference database for differentiating individuals from different sections and species.

EUFORGEN/EUFGIS

European conservation activities are coordinated and implemented within the framework of the *European Forest Genetic Resources Program* (EUFORGEN). EUFORGEN aims to promote the conservation and sustainable use of forest genetic resources for the benefit of current and future generations. The *European Information System on Forest Genetic Resources* (EUFGIS) documents forest genetic resources in the pan-European area.

The federal states are responsible for selecting suitable conservation stocks in accordance with EUFORGEN guidelines. Conservation stocks are reported via the National Focus Point (NRP) of the participating countries. In order to comply with the different requirements of the federal states with regard to the integrity of the data, the conservation stocks can be updated by the NRP at any time or, if desired, deleted without justification.

As of May 2019, the database contains over 3,308 conservation stocks of 107 tree species from 35 countries. Germany is currently represented in the database with 131 conservation stocks spread over 22 tree species. These include eight conservation populations of black poplar, which are located in three federal states (Brandenburg: 1; Bavaria: 6; Saxony: 1). However, the selection of tree species and the designation of the conservation stocks for EUFGIS are handled differently by the federal states, which means that the tree species are represented differently.

GenTree

Against the background of climate change and a developing demand for forest products and forest services, the goal of GenTree, a Horizon2020 project, is to equip the European forestry sector with better expertise, methods and tools for the management and sustainable use of forest genetic resources in Europe. Three German partners are involved (Thünen Institute of Forest Genetics, Bayerisches Amt für Waldgenetik and the Phillips University Marburg).

GenTree improves the state of in-situ and ex-situ conservation of forest genetic resources and supports the designation, conservation, characterization, evaluation and use of important forest genetic resources in breeding and forest practice as well as in politics. The project also intends to standardize, rationalize and improve the management of existing collections of genetic resources and specialist databases. The European strategy for cooperation in research and development will also be strengthened.

The project develops new strategies for the dynamic conservation of forest genetic resources in Europe. These are based on an improved phenotypic and genotypic characterization of important European tree species (including the black poplar) in their distribution area and derived adaptation reactions to possible environmental changes. Finally, new forest management scenarios and political framework conditions are developed, which include all aspects of genetic conservation and breeding, in order to better adapt forests and their management to changing environmental conditions and socio-economic requirements.

4. Innovations not included in other sections

Research founding

In the reporting period (2016-2019), 12 research projects and six joint research projects with a total of 20 sub-projects on genetics and breeding, cultivation, physiology, resistance of poplar, willow, hybrid larch and black locus, harvesting, and recycling of their wood were completed, supported by the federal government (mainly BMEL) and the federal states (**Table 6**). Furthermore, two research projects and four joint research projects with a total of 13 sub-projects were approved and started (**Table 7**). This shows the role of fast-growing tree species for the future supply of wood as a renewable resource. Both the material and the energetic use of the wood are equally in focus.

Table 6: Third-party funded projects on poplar and other fast growing trees species finalised during 2016-1019 (SP= sub-project)

No	Subject matter	Begin	End	Donee
Research projects				
22008411	Short rotation coppice plantation at disposal areas / old disposal sites for sustainable supply of biomass (KUPAD)	15.03.2012	31.03.2016	HAWK Hochschule für angewandte Wissenschaft und Kunst - Hildesheim/Holzminden/ Göttingen
22030211	PioWood: Utilization of fast growing pioneer trees in young forest stands to increase biomass supply of small-dimension timber	01.02.2013	31.03.2016	Albert-Ludwigs-Universität Freiburg
22018611	Development of a process for the direct liquefaction of biomass or lignin, respectively basing on coal liquefaction processes	01.08.2013	31.12.2016	Sondervermögen Großforschung beim Karlsruher Institut für Technologie (KIT)
22024011	Selection of drought-tolerant black locust from international seed sources for the production of woody biomass	01.04.2013	30.06.2017	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei
22030511	Increasing the efficiency of breeding fast-growing tree species using chlorophyll fluorescence measurement as a prediagnostic performance parameter	01.12.2014	30.04.2018	Nordwestdeutsche Forstliche Versuchsanstalt
22016714	Testing of poplar clones from other EU-countries for short rotation coppice	01.11.2015	30.09.2018	Bayerisches Amt für Waldgenetik
22008013	Optimising the cultivation of short rotation poplar coppice by minimising the impact of insect pests - illustrated by the great red poplar leaf beetle (*Chrysomela populi* L.)	01.02.2016	30.11.2019	Technische Universität Dresden
28100401	Increasing productivity, resistance and adaptability of Poplar - gene marker for Aspen in Russia (MaRussiA)	01.07.2015	30.06.2018	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei
AiF 18577 N	Minimization of 2- and 3-MCPD, glycidol and their fatty acid esters in smoked and thermally treated fish products	01.03.2015	31.10.2017	Max Rubner-Institut, Bundesforschungsinstitut für Ernährung und Lebensmittel

N007, KS/15/01	Groundwater donation among short rotation coppice plantations - effects of rotation length, site conditions and varieties on groundwater recharge and leachate quality	01.11.2015	31.03.2019	Bayerische Landesanstalt für Wald und Forstwirtschaft (LWF)
TI-FG-08-PID1556	Molecular analysis of activation-labeled trembling aspen-Populus variants II (Activation tagging 2)	01.09.2014	31.08.2017	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei
EW/13/40	Supply of the local heating network at the TFZ with SRC wood including accompanying research	01.04.2013	31.12.2016	Technologie- und Förderzentrum im Kompetenzzentrum für Nachwachsende Rohstoffe **(TFZ)**
Joint research projects				
Potential of agricultural land for woody biomass production at the North German Plain in consideration of water supply and competitiveness of short-rotation plantations				
22012410	SP1: Identification and modelling of cultivation sites	01.07.2012	30.04.2016	Freie Universität Berlin
22014812	SP2: Analysis of water utilization efficiency of fast-growing trees	01.07.2012	30.04.2016	Hochschule für nachhaltige Entwicklung Eberswalde
Minimize deprivation of nutrients when harvesting wood - by using debarking harvester felling aggregates				
22013213	SP 1: Examination and further development of the debarking harvester felling aggregates	01.09.2014	31.08.2017	Fakultät Wald und Forstwirtschaft
22012214	SP 2: Technical assessment and process concepts	01.09.2014	31.08.2017	Kuratorium für Waldarbeit und Forsttechnik e. V. (KWF)
Agroforestry systems with an added value for society and environment				
22031112	SP 1: Value timber and cultures as part of a complex system	01.01.2015	31.12.2017	Albert-Ludwigs-Universität Freiburg
22015714	SP 2: Influence of trees on agricultural production and the environment as well as their economic effects	01.01.2015	31.12.2017	Landwirtschaftliches Technologiezentrum Augustenberg
Breeding of fast-growing tree species of the Genus *Populus*, *Robina* and *Salix* for the production of renewable resources in short rotation coppice plantations (FastWOOD III)				
22000414	SP 1: Evaluation, breeding, genetic characterization and variety testing of black and balsam poplars and willows	01.12.2014	30.04.2018	Nordwestdeutsche Forstliche Versuchsanstalt
22000514	SP2: Breeding and characterisation of poplars of the section *Populus* and black locust	01.12.2014	31.01.2019	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei

22000614	SP3: Evaluation and breeding of poplars (section *Leuce*) and testing of new and old clones to abiotic resistance.	01.12.2014	31.08.2018	Staatsbetrieb Sachsenforst
22000714	SP4: Testing of available and newly bred black and balsam poplar clones for short rotation coppice (SRC)	15.02.2015	30.08.2018	Bayerisches Amt für Waldgenetik
22000814	SP 5: Assessment and optimization of anatomical / physiological parameters for the breeding of fast-growing tree species	01.12.2014	30.05.2018	Technische Universität Dresden
22000914	SP6: Early diagnosis of eco-physiological efficiency pattern of local Black Locust (*Robinia pseudoacacia* L.) stands – A contribution to bioecomics in forest plants breeding	15.02.2015	14.02.2018	Landesbetrieb Forst Brandenburg
22001014	SP 7: Early testing of the ecophysiological performance of black locust (*Robinia pseudoacacia* L.) from local stocks	15.02.2015	14.11.2017	Forschungsinstitut für Bergbaufolgelandschaften (FIB) e.V.
Tree-SINE: Development of molecular markers based on retroposons for the identification of varieties, clones and accessions as base for breeding, management of genetic resources and quality control of Poplar and Hybrid larch				
22004012	SP1	01.01.2015	30.04.2018	Technische Universität Dresden
22004112	SP2	01.02.2015	30.09.2018	Staatsbetrieb Sachsenforst
22031714	SP3	01.01.2015	31.08.2018	Technische Universität Dresden
Procurement of highly productive and suitable forest reproductive material for future forests under climate change (FitForClim)				
22WB400701	SP 1: Oaks, Norway spruce	01.01.2014	30.04.2019	Nordwestdeutsche Forstliche Versuchsanstalt
22WB400702	SP 2: Sycamore maple	01.01.2014	30.04.2019	Bayerisches Amt für Waldgenetik
22WB400703	SP 3: Larches	01.01.2014	30.04.2019	Staatsbetrieb Sachsenforst
22WB400704	SP 4: Douglas-fir, Scots pine	01.01.2014	30.04.2019	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei

Table7: Third-party funded projects on poplar and other fast growing trees species started (approved) during 2016-1019 (SP= sub-project)

No	Subject matter	Begin	End	Donee
Research projects				
22008013	Optimising the cultivation of short rotation poplar coppice by minimising the impact of insect pests - illustrated by the great red poplar leaf beetle (*Chrysomela populi* L.)	01.02.2016	30.11.2019	Technische Universität Dresden
22038318	Biomethane and peat substitute from poplar wood	01.04.2019	31.03.2021	DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Joint research projects				
Property profile and application spectrum of fast-growing culture products for the woodworking industry (Wood for Industry)				
22035014	SP1	01.03.2017	31.05.2020	Staatsbetrieb Sachsenforst
22019116	SP2	01.03.2017	29.02.2020	Institut für Holztechnologie Dresden gemeinnützige GmbH
22019916	SP3	01.03.2017	29.02.2020	Technische Universität Dresden
22019816	SP4	01.03.2017	28.02.2020	Technische Universität Dresden
22020316	SP5	01.03.2017	30.04.2020	Technische Universität Dresden
Evaluation of the invader potential of black locust (*Robinia pseudoacacia*) in Brandenburg (InvaRo)				
22WC412501	SP1	01.01.2018	31.12.2020	Forschungsinstitut für Bergbaufolgelandschaften (FIB) e. V.
22WC412502	SP2	01.01.2018	31.12.2020	Humboldt-Universität zu Berlin
Use of hardwoods and woods from short rotation plantations as peat substitute for the development of plant substrates, grow bags and grow blocks				
22002118	SP1	01.03.2019	28.02.2022	Georg-August-Universität Göttingen
22027718	SP2	01.03.2019	28.02.2022	Kleeschulte Erden GmbH & Co. KG
Principles and strategies for the procurement of high quality and adaptable forest reproductive material under climate change (AdaptForClim)				
22WB415201	SP 1: Oaks, Norway spruce	01.01.2017	30.06.2020	Nordwestdeutsche Forstliche Versuchsanstalt
22WB415202	SP 2: Sycamore maple	01.01.2017	30.06.2020	Bayerisches Amt für Waldgenetik
22WB415203	SP 3: Larches	01.01.2017	30.06.2020	Staatsbetrieb Sachsenforst
22WB415204	SP 4: Douglas-fir, Scots pine	01.01.2017	30.06.2020	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei

IV. SUMMARY STATISTICS

Questionnaire on Poplars and Other Fast-Growing Trees Sustaining People and the Environment 2016-2019

Contact information:

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Question 1: Total area 2019, and area planted from 2016 to 2019 (area change over the last 4 years) (estimated, based on forest inventory data 2012)

Land use category*		Total Area 2019 [ha]	Total area by forest function in %				Area planted from 2016-2019 [ha]
			Production		Protection [%]	Other [%]	
			Industrial Roundwood [%]	Fuelwood biomass [%]			
Natural regenerating forest							
	Poplars	16 764			20	80	n/a
	Willows	74 788				100	n/a
Planted forest							
	Poplars	130 000	50			50	~550
	Black locust	42 239	100				n/a
	Hybrid larch	3 070	100				n/a
Plantation forest							
	Mix of P&W	6 600		100			n/a
Grand total		273 461					550

*definition see Annex

Question 2: Wood removals in 2019

Forest category* and species, cultivar or clone		Wood removals 2019 in m³				
		Total removals	For industrial round wood			For fuelwood, wood chips
			Veneer/ plywood	Pulpwood	Sawnwood	
Natural regenerating forest						
	Poplars	0				
	Willows	0				
Planted forest						
	Poplars	492 000			246 000	246 000
	Black locust	136 000			136 000	
	Hybrid larch	19 000			19 000	
Plantation forest						
	Mix of P&W	88 000				88 000
Grand total		735 000			401 000	334 000

*definition see Annex

Question 3: Forest products in 2019

Forest category*		Fuel-wood	Chips	Industrial roundwood (logs, pulpwood)	Wood-pulp (mech. or chem.)	Particle-board fibreboard (MDF, hardboard)	Veneer sheets	Ply-wood	Sawn-wood
		'000 m³ (r)							
Planted forest									
	Poplars	246 000		246 000					
	Black locust	82 000		54 000					
	Hybrid larch			19 000					
Plantation forest									
	Mix of P&W		88 000						
Grand total		328 000	88 000	319 000					

*definition see Annex

<u>Question 4</u>: Please reflect on the prevailing trends until 2030 in the development of poplars and other fast growing trees in your country.

	increase	decrease	remain as it is	no comment
1a. The conversion of **naturally regenerating** forests of poplar to other land uses will …			X	
1b. The conversion of **naturally regenerating** forests of willow to other land uses will …			X	
1c. The conversion of **naturally regenerating** forests of other fast growing species to other land uses will …				X
2a. The conversion of **planted** forests of poplar to other land uses will …	X			
2b. The conversion of **planted** forests of willow to other land uses will …			X	
2c. The conversion of **planted** forests of other fast growing species to other land uses will …		X		
3a. The area of poplars for bioenergy plantations will…			X	
3b. The area of willows for bioenergy plantations will…			X	
3c. The area of other fast growing trees for bioenergy plantations will…			X	
4a. Government investments in poplars will …			X	
4b. Government investments in willows will …			X	
4c. Government investments in other fast growing trees will …	X			
5a. Private sector investments in poplars will …	(X)		X	
5b. Private sector investments in willows will …			X	
5c. Private sector investments in other fast growing trees will …	X			
6a. The significance of poplars for **productive** purposes will …			X	
6b. The significance of willows for **productive** purposes will …			X	
6c. The significance of other fast growing species for **productive** purposes will …	X			
7a. The significance of poplars for **environmental protection** purposes will …	X			
7b. The significance of willows for **environmental protection** purposes will …			X	
7c. The significance of other fast growing trees for **environmental protection** purposes will …	X			
8a. The rejection by environmental groups of poplars will …			X	
8b. The rejection by environmental groups of willows will …			X	
8c. The rejection by environmental groups of other fast growing trees will …			X	
9a. The **acceptance** by the general public of poplars as important natural resources will …			X	
9b. The **acceptance** by the general public of willows as important natural resources will …			X	
9c. The **acceptance** by the general public of other fast growing trees as important natural resources will …			X	

V. REFERENCES

This report is primarily based on the specialised contributions of the following institutes (in alphabetic order):

Bundesanstalt für Landwirtschaft und Ernährung (BLE), Referat 331 - Informations- und Koordinationszentrum für Biologische Vielfalt (IBV), Deichmanns Aue 29, 53179 Bonn, www.ble.de/DE/Themen/Wald-Holz/Forstliches-Vermehrungsgut/forstliches-vermehrungsgut_node.html;jsessionid=322D0D9B3E1E2CE336DC3B5D145F420C.2_cid335, fgrdeu.genres.de

Bund-Länder-Arbeitsgruppe „Forstliche Genressourcen und Forstsaatgutrecht“, www.genres.de/fachgremien/blag-forstliche-genressourcen-forstsaatgutrecht/

Energy Crops GmbH, Überseering 12, 22297 Hamburg, www.energy-crops.de

Fachagentur Nachwachsende Rohstoffe e.V. (FNR), Dorfplatz 1, 18276 Gülzow, www.fnr.de

Forschungsinformationssystem Agrar und Ernährung. Informationsportal des Bundes und der Länder, fisaonline.de

LFB Ministerium für Umwelt, Landwirtschaft und Energie Sachsen-Anhalt, Referat Wald- und Holzwirtschaft, Leipziger Straße 58, 39112 Magdeburg, mule.sachsen-anhalt.de/startseite-mule/?no_cache=1

Thünen-Institut für Forstgenetik, Sieker Landstr. 2, 22927 Großhansdorf und Eberswalder Chaussee 3a, 15377 Waldsieversdorf, www.thuenen.de/de/fg/

Thünen-Institut für Internationale Waldwirtschaft und Forstökonomie, Leuschnerstr. 91, 21031 Hamburg-Bergedorf, www.thuenen.de/de/wf/

Thünen-Institut für Waldökosysteme, Alfred-Möller-Str. 1, 16225 Eberswalde, www.thuenen.de/de/wo/

Annex

Terms and definitions

The main FAO categories of land with a tree component are classified as[1]:

Naturally regenerating forest	Forest predominantly composed of trees established through natural regeneration *Explanatory notes* 1. Includes forests for which it is not possible to distinguish whether planted or naturally regenerated. 2. Includes forests with a mix of naturally regenerated native tree species and planted/seeded trees, and where the naturally regenerated trees are expected to constitute the major part of the growing stock at stand maturity. 3. Includes coppice from trees originally established through natural regeneration. 4. Includes naturally regenerated trees of introduced species.
Planted forest	Forest predominantly composed of trees established through planting and/or deliberate seeding. *Explanatory notes* 1. In this context, predominantly means that the planted/seeded trees are expected to constitute more than 50 percent of the growing stock at maturity. 2. Includes coppice from trees that were originally planted or seeded.
Plantation forest	Planted Forest that is intensively managed and meet all the following criteria at planting and stand maturity: one or two species, even age class, and regular spacing. *Explanatory notes* 1. Specifically includes: short rotation plantation for wood, fibre and energy. 2. Specifically excludes: forest planted for protection or ecosystem restoration. 3. Specifically excludes: Forest established through planting or seeding which at stand maturity resembles or will resemble naturally regenerating forest.
Agroforestry	"Other land with tree cover" with temporary agricultural crops and/or pastures/animals. *Explanatory notes* 1. Includes areas with bamboo and palms provided that land use, height and canopy cover criteria are met. 2. Includes agrisilviculturural, silvopastoral and agrosilvopastoral systems.
Trees in urban settings	"Other land with tree cover" such as: urban parks, alleys and gardens

Forest	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. *Explanatory notes* 1. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters in situ. 2. Includes areas with young trees that have not yet reached but which are expected to reach a canopy cover of 10 percent and tree height of 5 meters. It also includes areas that are temporarily unstocked due to clear-cutting as part of a forest management practice or natural disasters, and which are expected to be regenerated within 5 years. Local conditions may, in exceptional cases, justify that a longer time frame is used.

[1] See the Global Forest Resources Assessment 2020 Terms and Definitions, http://www.fao.org/3/I8661EN/i8661en.pdf

	3. Includes forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific environmental, scientific, historical, cultural or spiritual interest. 4. Includes windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 hectares and width of more than 20 meters. 5. Includes abandoned shifting cultivation land with a regeneration of trees that have, or are expected to reach, a canopy cover of 10 percent and tree height of 5 meters. 6. Includes areas with mangroves in tidal zones, regardless whether this area is classified as land area or not. 7. Includes rubber-wood, cork oak and Christmas tree plantations. 8. Includes areas with bamboo and palms provided that land use, height and canopy cover criteria are met. 9. Includes areas outside the legally designated forest land which meet the definition of "forest". 10. Excludes tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations, olive orchards and agroforestry systems when crops are grown under tree cover. Note: Some agroforestry systems such as the "Taungya" system where crops are grown only during the first years of the forest rotation should be classified as forest.
Other land with tree cover	Land classified as "other land", spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity. *Explanatory notes* **1. Land use is the key criteria for distinguishing between forest and other land with tree cover.** 2. Specifically includes: palms (oil, coconut, dates, etc), tree orchards (fruit, nuts, olive, etc), agroforestry and trees in urban settings. 3. Includes groups of trees and scattered trees (e g trees outside forest) in agricultural landscapes, parks, gardens and around buildings, provided that area, height and canopy cover criteria are met. 4. Includes tree stands in agricultural production systems, such as fruit tree plantations/orchards. ln these cases the height threshold can be lower than 5 meters. 5. Includes agroforestry systems when crops are grown under tree cover and tree plantations established mainly for other purposes than wood, such as oil palm plantations. 6. The different sub-categories of "other land with tree cover" are exclusive and area reported under one subcategory should not be reported for any other sub-categories. 7. Excludes scattered trees with a canopy cover less than 10 percent, small groups of trees covering less than 0.5 hectares and tree lines less than 20 meters wide.

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