

Competence in the Forestry Value Chain of Wood Energy



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Introduction

The field of forest fuel has been changing rapidly the latest years and forest fuel is beginning to be one very important assortment in the forest sector. The knowledge needed to extract and use forest fuel in a sustainable way have successively been developed as the volumes have increased. The question is if this knowledge is transferred to practice and that's the reason for this study.

Theoretical background

Competence is defined as knowledge and skills together. It means an ability to apply your knowledge in practice.

In order to have a common definition we can use definition by

The European Qualifications Framework for lifelong learning. (EQF)

“knowledge” means the outcome of the assimilation of information through learning.

Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual;

“skills” means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual

dexterity and the use of methods, materials, tools and instruments);

“competence” means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework, competence is described in terms of responsibility and autonomy.

The purpose of EQF is to obtain transparency in European Union so different competences can be understood and used in the member states

The Swedish NQF is in Appendix 1.

What is a competence profile?

Personal profile – a list of competences that a person has, regardless of how the person have acquired them (exams, courses, experience, formal or informal).

Working place profile – a list of competences needed to perform a good work in a position (operator of a machine, purchaser, researcher, manager) regardless of how the competences fits in with different exams or curriculums.

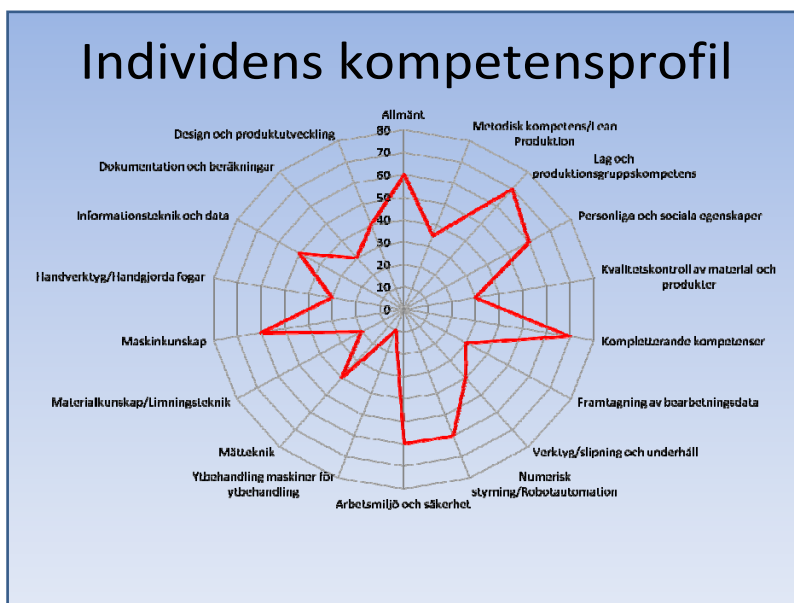
In order to evaluate or estimate personal competence profiles, different tools have been developed. They are often a combination of theoretical and practical tests. In many cases a grade from an education will give a certain competence profile but it may not be sufficient. A university degree can be a part of a competence profile but will not give information of the “soft” competences like ability to cooperate or the ability to work effectively.

Evaluation or estimation of a working place profile is made by examining the reasonable requirements you have for a job.

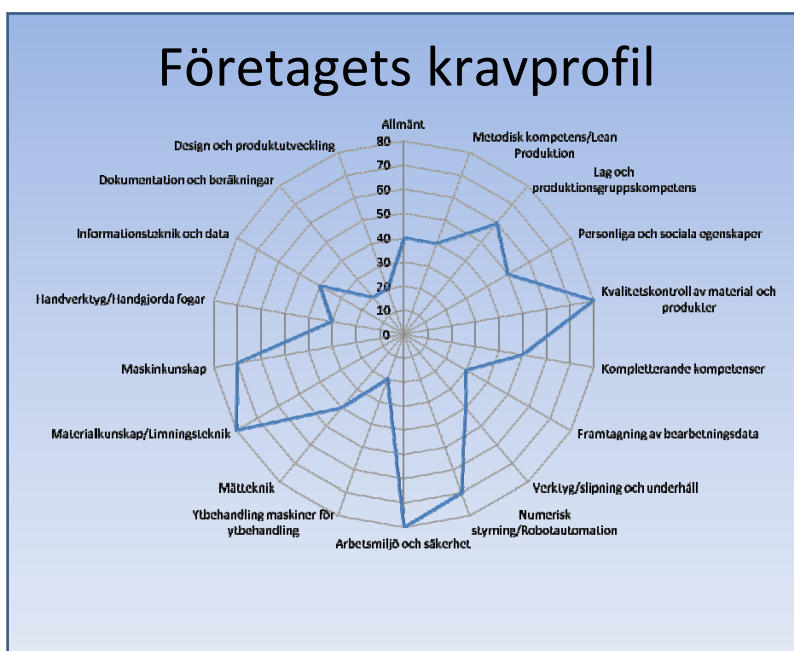
Competence gap

The gap between the competence of a person and the competence demand of a working place gives an indication of the need for competence development

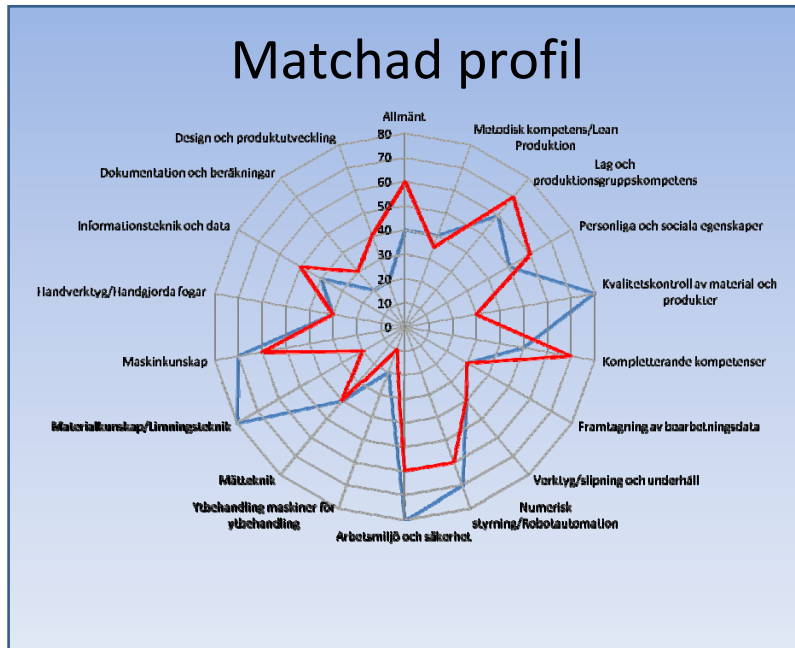
In the attached file there is an example of fields of competences for the wood and timber industry. Once you have decided what competences are relevant for different jobs in the wood energy sector you can start evaluating personal competence profiles and put them in relation to working place profiles. Examples diagrams below



Individual profile



Work place (company) profile



Matched profiles

Investigating Competence profiles in the forestry Value Chain of Wood Energy in Sweden, Estonia and Latvia.

Methods

The investigation is based on interviews with respondents of three parts of the value chain: Forest owners, forest operators and natural conservation specialists. Guidelines for interviews have been worked out by the participating partners

The interviews have been made with a selected sample of respondents and the number of respondents have been different but the answers resemble each other after a number of interviews and therefore the estimation is that the necessary information have been collected, in order to draw reliable conclusions.

Forest owners

Forest owners in Sweden, Estonia and Latvia

Compiled by Marja Gustafsson, SFA

Facts about the respondents

Sweden – 20 interviews

Average age of respondents was 55 years.

The forest owners' property > 100 ha was picked out and the average property size was 465 ha.

Out of 20 respondents 25% were women.

40% has education on university level, 30% has education upper secondary school and 30% has lower education. Study areas are situated in Småland in southern Sweden and Östergötland, south of Stockholm.

Estonia – 14 interviews

Average age of respondent was 53 years.

The forest owners property > 15 ha, biggest 600 ha and smallest 6ha, the average property size was 114 ha. All 14 respondents were male.

92% (13 of 14) had an forestry education on university level. Study areas were situated in all over in Estonia.

Latvia – 15 interviews

Average age of respondent was 50 years.

20% of respondents were female.

The forest owners property > ha,

The biggest was 190 ha and smallest was 2,1 ha, the average property size was 34 ha.

33 % has education of university level, 7 % on lower level and 53 % had no forestry education at all, no information for 7%.

Forestry management - Activity on properties during last five years

Sweden

Almost all kinds of *forestry management*, as planting, cleaning, thinning and final cutting, was performed on the forest owner's properties.

Estonia

During the last five years 85.7% of questioned forest owners have carried out forest management activities. In most cases they have done sanitation cutting and thinning, but also clear cutting and topping. In addition, in some cases, they have dug ditches and planted new trees

Latvia

Forest owners mostly have carried out some forest management activities during the last 5 years. Mainly the activities are: clear cutting, young stand thinning, forest regeneration, selection felling, and commercial thinning. And some of the forest owners have done such activities as – hybrid aspen plantation plating and planting trees in agriculture land. Only one of the respondents hasn't done any of activities last 5 years

Further education and courses

Sweden

Of the forest owners 80% participated in different kinds of *education* events. Forest days/evenings is the most common way of getting education. Elmia wood is visited by many respondents. Forest companies and Swedish Forest Agency arrange forest days/courses. All forest owners have been active last 5 years.

Estonia

All of the questioned forest owners have taken part of forestry days, conferences or practice days organised mainly by Private Forest Centre. These events take place at least once in a quarter of a year. Some forest owners have organised similar events themselves.

Forest owners get their further knowledge from other sources also. As displayed here by percentage of all questioned forest owners:

42,9% Forestry papers

42% Webb pages

35,7% Neighbors/other forest owners

14,3% Forestry advisors

28,6 % Others: university studies, through work

85,7% Forestry days/ evenings

Latvia

Mostly forest owners have been very active; they have visited different kind of seminars and trainings, have taken part in some forest day activities in different regions of Latvia. As well as some have been in some study trips to Sweden and Finland

Bioenergy assortments

Sweden

There are different bioenergy assortments in the branch

GROT (branches and tops) dominates in the northern study area with more coniferous trees.

GROT and *fire wood* assortments are both taken out in the southern study area with more broad leave tree stands.

Stump lifting is sometimes used in the northern area. Most of the respondents point out that taking out bioenergy has an added economical value. It also facilitates and lower costs for site preparation and planting.

Estonia

50% of questioned forest owners have harvested and sold bioenergy assortment during forest management activities. In cases, where assortment has not been sold, it has gone for personal use, to strengthen roads or amounts have been too small. However, selling bioenergy assortment in the future is planned.

Contractors have been used only in few cases, in most cases, forest owners have done harvesting themselves. Only 20% of forest owners recalled having any damages in the form of deep ruts or damages to trees.

Main problem is that ordering the chipping machine on site is too expensive and chipping companies accept amounts, which are impossible to gather for some forest owners. However, this problem can be overcome by cooperation among forest owners.

Because there is a lack of supervision, threat of hiring inexperienced and uneducated personnel exists. This may result in severe damages to the environment. In addition, some cases of deception have occurred, when forest owners have been paid less than promised.

However, it can be avoided by stronger supervision and regular inspection in forestry companies. It was emphasized that all personnel in companies should have proper training in their specialty

Latvia

Forest owners have some experience in selling bioenergy assortments – residues. Mostly those are tops and braches.

Some forest owners do not understand what to do with tops and branches, they stress that there is no information.

Mostly the forest owners agree that it is good to take out bioenergy. That is economically and ecologically effective. The forest is used in wholesome and the forest stays clean. But also there are some visible problems – if you have a small felling then it is not economically profitable – more money you will expend than earn.

The forest owners have not got the damages in forest connected to bio energy harvesting. Mostly, because they have not harvested bio energy in large amounts. The damages that are listed are: some damages to soil – some rutted forest, and scraped trunks and roots

The forest owners who have done the bio energy harvesting are satisfied with field operator job. Some complained that there have been some problems with harvest planning

The forest owners believe that it was possible to avoid the damages by better planning and by increasing the field worker responsibility level

Mostly forest owners consider that they need more knowledge about the market, some financial information, the prices, the demand information, as well as the knowledge about the forest ecological aspects and forest site type

One third of respondents consider that they will not take the bio energy assortment in future in any cutting. They consider that it is not profitable. But others are planning to take out some bio energy assortment – they are planning to sell tops and branches from clear cutting, young stand thinning and selection felling, as well as to get some firewood.

Mostly forest owners get the information from forestry papers, web pages, neighbours, other forest owners, as well as from forestry advisors. And as important information places they mention – seminars and trainings

Effects of taking out bioenergy

Sweden

Positive effects: facilitate plantation and site preparation. Reduce use of fossil fuels. Contributes to better economy.

Negative effects: long term effects on nutrition balance. Aesthetical aspects. Not economically interesting. Risk of damages on ground, main haul roads, transportation roads and ditches.

Others: better to try to sell bioenergy on your own instead of including it in the cutting commission.

Estonia

Positive effects;

Forest is cleaned from residues, thus post-cutting view in the forest is better, in addition natural habitat of pests is removed.

After taking out residues, new trees have more light and room to grow, forest renewal is faster.

Firewood is saved up.

Harvesting bioenergy generates a need for some labour force, which lowers the unemployment rate in the area. In addition, this generates an opportunity for local farmers to have work during winter

Negative effects, Harvesting stumps is likely to damage soil and predispose erosion. However, if Finnish experiences are put to use, this can be overcome.

Latvia

The positive experience mostly is with firewood selling. Then there are no problems and forest owner become satisfied because the forest remains clean

The negative aspects are that near the place where are the forests are no place where to give to the tops and branches to make the woodchips.

Attitude towards bioenergy

Sweden

Almost all of the respondents have a general *positive attitude* of taking out bioenergy from the forest. Some point out that *nutrition balance* may be effected, that taking out bioenergy only is suitable on good soils or only once in a rotation period. *What happens in a long term perspective?* Other respondents mean it has no big effect on nutrition balance and that it is good to reduce use of fossil fuels.

Estonia

Forest owners are generally pleased to have an opportunity for extra income, although current system needs many improvements. At the moment, selling bioenergy is considered to be economically prejudicial in short-term by some forest owners

Main problem is that ordering the chipping machine on site is too expensive and chipping companies accept amounts, which are impossible to gather for some forest owners. However, this problem can be overcome by cooperation among forest owners.

In addition, in some areas bioenergy purchase prices are too low for selling to be beneficial to forest owners. Also, after paying taxes, overall profit is considered to be small. This predisposes illegal activity in several forms. One example was given:

“Forest owner was called and given two days to decide whether to sell wood at a good price and quickly. However, men, who came, did not have felling permits or any necessary documents. He earned a fair amount of money, but illegally

Damages from harvesting bio energy

Sweden

Of the forest owners 20% report damages. Additionally 15% report "damages not worse than ordinary harvesting damages". This can be interpreted that *35% of the forest owners have some kind of damages* from taking out bio energy. Damages are reported on ground, single stems, main haul roads, transportation roads and ditches. Dry weather can reduce the damages.

Of the respondents 65% are satisfied with the *contractors*. 20% are not satisfied cause of ground damages and damaged/untidy storage sites. It also costs to clean up after the heavy machines. Sometimes an excavator is needed to fix ditches, road sides and damages on roads.

Estonia

Because there is a lack of supervision, threat of hiring inexperienced and uneducated personnel exists. This may result in severe damages to the environment. In addition, some cases of deception have occurred, when forest owners have been paid less than promised

However, it can be avoided by stronger supervision and regular inspection in forestry companies. It was emphasized that all personnel in companies should have proper training in their specialty

Latvia

The forest owners who have done the bio energy harvesting are satisfied with field operator job. Some complained that there have been some problems with harvest planning. The forest owners have not got the damages in forest connected to bio energy harvesting. Mostly, because they have not harvested bio energy in large amounts. The damages that are listed are: some damages to soil – some rutted forest, and scraped trunks and roots. The forest owners believe that it was possible to avoid the damages by better planning and by increasing the field worker responsibility level

Need of education

Sweden

Education is considered to be important. There are more things that need to be done in this field. According to the answers there is a wide range of *competence levels* of contractors - from high to low. Some respondents point out the need of *new research* to find out the environmental effects of harvesting bio energy. The *logistic chain* and *cutting instructions* can be strengthened as *environmental care* and *attitudes* towards the customers.

The "number one" wish is to find a ***unified system for measuring bio energy assortments***. Today it is very difficult for the forest owners to compare prices of different companies.

Knowledge is also wanted in the fields of *nutrition balance, long term effects, best techniques, ecology and economy as in increased possibilities for education*.

Estonia

To sell bio energy assortment, forest owners should firstly know the basics of forestry. They should be familiar with cutting types and their purpose, also with harvesting techniques. In addition they must have an overview of current market situation to receive a fair price for their wood.

Creation of a web page, which has information about wood energy, cutting companies and how large amounts of wood they want is needed

Creation of a network of power plants working on wood energy is needed in order to promote using bio energy.

However, it can be avoided by stronger supervision and regular inspection in forestry companies. It was emphasized that all personnel in companies should have proper training in their specialty

Because there is a lack of supervision, threat of hiring inexperienced and uneducated personnel exists. This may result in severe damages to the environment. In addition, some cases of deception have occurred, when forest owners have been paid less than promised.

This can be avoided by stronger supervision and regular inspection in forestry companies. It was emphasized that all personnel in companies should have proper training in their specialty.

Latvia

Mostly forest owners consider that they need more knowledge about the market, some financial information, the prices, the demand information, as well as the knowledge about the forest ecological aspects and forest site type

The forest owners would like to have more information about bio energy harvesting, more seminars and advertisements. They recommend to do some work to increase the interest to harvest bio energy.

As well as there should be done some legislation changes and some tax releasing to increase their

interest to harvest bio energy

Mostly forest owners get the information from forestry papers, web pages, neighbours, other forest owners, as well as from forestry advisors. And as important information place they mention – seminars and trainings

Harvesting bio energy in the future

Sweden

Of the respondents 100% will take out bioenergy assortments in the future. A majority of the respondents plan to take out bioenergy only *in connection to final cutting*. The reason behind this is often an unsecure feeling about the long term effects of taking out bioenergy and nutrition from the forest. Some plan to take out bioenergy along road and field sides and in areas of insect attacks or in nature conservation cuttings. A few respondents consider *stump lifting*.

Estonia

Selling bio energy assortment in the future is planned in most cases.

Latvia

One third of respondents consider that they will not take the bio energy assortment in future in any cutting. They consider that it is not profitable. But others are planning to take out some bio energy assortment – they are planning to sell tops and branches from clear cutting, young stand thinning and selection felling, as well as to get some firewood.

Sources of information

Sweden

All respondents point out *forestry papers* as a good source of information. *Forestry advisors* and *forestry days/evenings* are also considered as useful to get knowledge about forestry. Some use *web pages* or ask the *neighbours*.

Estonia

100% by forestry days, conferences or practice days organised mainly by Private Forest Centre, 42,9% Forestry papers, 42% webb pages, 36% Neighbors/other forest owners, 14% Forestry advisors, 29 % others, Universities/ through their work, 86 %forestry days/evenings.

Latvia

Mostly forest owners get the information from forestry papers, web pages, neighbours, other forest owners, as well as from forestry advisors. And as important information place they mention – seminars and trainings

Ash recycling

Sweden

Of the respondents 90% has followed the discussion about ash recycling. All respondent forest owners think we *need to bring nutrients back* through ash recycling as a compensation for taking out valuable nutrients by harvesting bio energy. Some point out that the ash must be clean and free from pollutions.

Estonia

Over half of the questioned forest owners (57.1%) have followed the discussion about wood ashes. 78.6% of questioned have an opinion that we should have recycling of bio energy ashes. Ashes can be used as fertilizer.

In one case it was said that scientists should do a research and find new ways to use ashes

Latvia

Forest owners mostly have not heard any discussions about wood ashes. Only some have some idea about the wood ashes.

But they think that according to their opinion we should have recycling of bio energy ashes.

They feel that it is a good natural fertilization tool that it should be used in forest and agriculture lands

Further comments

Sweden

Among further comments from the respondents following can be highlighted: Some want to *pay for ash recycling* - other not.

Additional research is needed about bio energy. Which types of forest shall we have in the future?

From forest owners point of view there is a *need of more information*.

Better possibility to *get advice* from e.g. the Swedish Forest Agency about sustainable forestry is wanted.

Estonia

To improve general situation of forests, forest owners should be informed about the necessity of drainage canals and where to use them. This can speed up forest growth rate.

Many forest owners are not aware that they can have up to 15 hours free forestry counseling in Estonia.

It is necessary to enhance current infrastructure to access wood resources easier.

State should support forest owners by imposing tax privileges and marketing bio energy for them (act as a middleman).

State supervision system should function preemptively rather than punishing for mistakes already made. Every woodlot should have an independent supervisor for the system to be effective.

At the moment there are no companies, which could be able to offer full service from cutting to chipping wood and transporting it in a short period of time. In addition companies are mostly interested only in large amounts of bio energy,

Forest owners need a chance to notify officials of illegal activity anonymously.

Creation of a web page, which has information about wood energy, cutting companies and how large amounts of wood they want is needed.

Creation of a network of power plants working on wood energy is needed in order to promote using bio energy

Latvia

The forest owners would like to have more information about bioenergy harvesting, more seminars and advertisements. They recommend to do some work to increase the interest to harvest bioenergy. As well as there should be done some legislation changes and some tax releasing to increase their interest to harvest bioenergy

Conclusion forest owners

Competence and education

Areas of competence development

General information of the arguments for bio energy,

Nutrition balance (ash recycling),

Long term effects, best technology (harvesting methods),

Bio energy assortments in the rotation time of the forest,

Ecology (forest sites appropriate for production of bioenergy)

Economy, (overview of current market situation, how to make business with forest residues)

The present successful methods of education can be used:

Short courses

Information events (forest information days or evenings, exhibitions)

Forestry papers and web pages

Assortments and technology

GROT (forest residues mainly branches and tops) is common in all regions but it requires bigger machines and is not so easy to do by the owner. Chipper has to be hired and that is not profitable with small volumes. Market situation is difficult to handle for small forest owners. There is a need for proper training of contractors in order to promote safe and sound business.

Firewood is the second biggest assortment but it is difficult to estimate its importance since a big amount goes directly to use by households and many times on an informal basis. It is considered as a profitable assortment for the small to medium scale activity.

Stump lifting is only performed in an experimental stage. The knowledge is not reliable enough to introduce this assortment for the private forest owners at the moment.

The positive effects of taking out bio energy dominates and the negative effects can be handled by better planning, knowledge. Negative effects occur mainly because of ground conditions.

A unified system for measuring bio energy assortments has to be developed and applied

Attitudes

In general positive but depending on the revenue you can get. Sales of fire wood is profitable but the economic result of forest residues including chipping is varying a lot in the different regions.

The quality of the work of the subcontractor is important for the attitudes to bio energy.

Damages are not seen as a big problem and is mainly related to ground conditions and tracks. Most damages are related to the harvesting in general, not the bio energy assortment. Damages can be avoided by better planning and increasing field operator responsibility

Forest Operators, Harvesting extraction and chipping of wood fuel.

Compiled by Johan Palm

Sweden

This part of the report is based on interviews with harvester operators, forwarder operators, chipper operators, working operations developers and reports. The different operations described here are: harvesting, transport to roadside and chipping.

Harvesting

Harvesting is done with harvesters of different kinds. Most of the wood energy material is tops and branches, (logging residues from the harvest of timber and pulpwood), but there is also harvesting of smaller trees in thinning, overgrown grazing areas, bushy areas and roadsides. The technique for harvesting small trees in thinning is rapidly developing. (Harvesting with chainsaw operators is only used in a very small scale in Sweden and will not be described here).

Harvesting of tops and branches combined with round wood harvesting.

Description of work.

Finding the site with the help of a forestry map.

Moving harvesting equipment to the site

Inspection of site before starting the work

Read content of site directions:

Map and description of: location, type of operation, terrain classification, location of landings, soil classification, natural conservation of species, soil and water protection,, environment protection and cultural heritage objects. Other special conditions for the object.

Find site direction objects in the field

Getting started. Downtime minimisation with preserved quality of all aspects of harvesting equipment

and site directions

Adaption of harvest operations to both harvesting of round wood and tops and branches.

Put tops and branches in as big stacks as possible at places where it can stay and dry.

Select places with good drying conditions

Piles must be free from rocks, soil, uprooted small trees.

Tops and branches can be used as reinforcement of driving roads but that material will be left at the site.



Harvesting round wood and placing logging residues in separate piles



Piles after green needles have fallen off



Manual harvesting (Chain saw operation) of small trees wood energy assortment

From the above description following knowledge and skills can be extracted:

Site evaluation.

Is it possible to harvest at the actual time according to site directive?

Judgement of soil conditions in the actual situation (season, weather).

Locating special areas in the field according to site direction map

Planning work (starting point, wind considerations, adaption to transport)

Machine competence according to curriculum in vocational training (details see appendix2).

Driving skills terrain

Crane operation

Harvesting equipment operation

Maintenance skills

Computer skills

Assortments specifications
Forest compartment directives

Green card

Natural conservation knowledge
Environment protection knowledge
Knowledge of certification schemes PEFC and FSC

Reading skills

Understand instruction given in written
Understanding maps and forestry maps

Experience of: Knowing when and how to drive or not to drive a certain track in order to not get stuck, listening to machine in order to adjust, grease etc before breakdown. It is a matter of attitude of the operator which can be acquired after longer or shorter time but sometimes not. This type of attitude combined with experience is one very important factor for a profitable extraction of wood energy.

Comments: The skills of driving and harvesting are to a large extent non tangible. A long experience is needed in order to avoid costly repairs and none productive time.

The knowledge of natural conservation issues and soil and water protection is covered by the green card. In all interviews the operators take part in information activities and courses arranged by the company they work for. In general they follow the site directions, but if they discover something special they check it up by a telephone call to their company contact. The main responsibility for natural conservation, biodiversity issues and soil and water protection, lies on the person who makes the forestry management plan in the field. In all companies the directions comes from the plans. In some cases there can be harvesting operations where there are no written instructions, just a map. Even in those cases the Green Card should be enough for following the general protection connected to harvesting operations.

Harvesting of overgrown graze lands etc.

The same type of work and competence as for the combined harvesting described above.

Comments:

In this case many of the areas are not connected to a forestry management plan. It can be abandoned farmland, roadsides etc. so much of the natural conservation measures depends on the harvester operator and the communication from each landowner or client. Updated knowledge of green card is therefore necessary.

Special considerations on ground conditions. Often these sites can only be harvested during dry weather or frozen ground conditions.

Transport

Transport of tops and branches from the harvesting area to the roadside.

The piles from the harvester will be transported after the needles have fallen off

Description of work.

Finding the site with the help of a forestry map.

Moving forwarder to the site

Inspection of site before starting the work

Read content of site directions (this will normally be the same document as for the harvester)

Map and description of: location, type of operation, terrain classification, location of landings, soil classification, natural conservation of species, soil and water protection,, environment protection and cultural heritage objects. Other special conditions for the object.

Find site direction objects in the field

Find the optimal place for landing (maybe changing location in site directions), good drying conditions,

good place for lorries containers and wood cutter.

Getting started. Downtime minimisation with preserved quality of all aspects of transporting equipment and site directions

Finding correct transport tracks

Covering stack

Reporting back



Finding transport tracks



Loading forwarder



Cover material



Covered stack

From the above description following knowledge and skills can be extracted:

Site evaluation.

Is it possible to transport at this time according to site directive.

Skills on soil conditions

Machine competence according to curriculum in vocational training

Driving skills terrain

Crane operation

Cover application

Building up the pile in stable condition

Maintenance skills

Computer skills

Assortments specifications

Forest compartment directives

Green card

Natural conservation knowledge

Environment protection knowledge

Knowledge of certification schemes PEFC and FSC

Reading

Understand instruction given in written

Understanding maps and forestry maps

Chipping

The chipper will come to the stack of Wood energy 3 months up to a year after the stack has been landed.

Finding the site with the help of a forestry map.

Pre inspection of site, preparing containers and lorry transport that has to go on parallel to cutting

Lorry will work as a shuttle to the boiler or to a terminal.

Moving cutter equipment to the site and arrange container site for container transfer to lorry.

Read site directions including natural conservation of species, land and water, environment protection and cultural heritage objects.

Getting started. Downtime minimisation with preserved quality of all aspects

Start at the end of the stack where the forwarder unloaded the last bundle

Crane operations so there will be a continuous feed of tops and branches into the chipper



Feeding the chipper with the crane



Containers for lorry transport

From the above description following knowledge and skills can be extracted:

Site evaluation.

Is it possible to chip at the actual time according to site directive.

Ability to assess soil conditions

Machine competence according to curriculum in vocational training

Driving skills terrain

Crane operation

Unloading the stack with maintained stability

Maintenance skills

Computer skills

Assortments specifications

Forest compartment directives

Green card

Natural conservation knowledge

Environment protection knowledge

Knowledge of certification schemes PEFC and FSC

Reading

Understand instruction given in written

Understanding maps and forestry maps

Discussion

In general the competence profiles on operator level are not earlier described with special focus to wood energy. In this study the main findings are:

The *continuous learning* in form of information days, short courses and informal information is important for the operators in order to be updated especially in the fields of natural conservation, cultural heritage, wood fuel quality and new ways of handling the logging residues.

The *continuous communication* between harvester, transporter and chipper is very important for the improvement of work efficiency. This can be difficult since there is long time (3 months up to 6 months) between the operations. One way of solving this communication is to have the same contractor for both transporting logging residues and chipping.

Non tangible skills (such as ability to find the best road through terrain, position of chipper considering wind, mould, stability crane operation etc, avoiding breakdowns.) are the most important skills in order to keep low cost to the activities in the value chain.

Deep knowledge of *maintaining and operating machines* are just taken for granted when you are in the profession.

For a good result in the work with *natural conservation, soil and water protection and protection of cultural heritages* the most important is a correct map with all areas marked and with written site directions. The harvester is the key operator to follow the instructions in the site directions. The other parts of the value chain just have to accept that.

A *learning link* between operators and planning /management. A person who can transfer/explain and educate is of big value. This person have to have good understanding of both working conditions/operations and management/planning operation. The link can be responsible for the continuous learning and communication.

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Estonia

Companies mainly work with residues, less with small trees and overgrown grasslands. Harvest of stumps is not common in Estonia.

Instructions and education

Before starting work, field operators are always instructed specifically and they are given necessary documentation. Generally they receive advice letter, maps and instructions in written form.

Specific information for every harvesting site is always given to minimise risks to different animal and plant species, cultural heritage, soil and water. At some point it may be difficult to avoid damages, though.

Workers are always instructed on how to handle their machines, however in most cases they operate on the basis of effectiveness.

Information about transportation roads is given in both written and talking form. They contain information about road conditions, rules of road damages, storage sites etc.

Roads are made as straight as possible, however building them depends on landowners. Storage sites are created near ditches or on the edge of field in order not to block traffic.

Further transportation is organized on local roads, which have better coating. However, restrictions imposed by local governments on traffic may affect the progress negatively thus increasing local unemployment rate. Workers have to wait for dryer season when the restrictions are lifted to transport wood.

Field operators must always familiarise themselves with working conditions and possible threats. Going to the forest alone to fell trees is prohibited. When felling trees, workers have to make certain falling direction, considering the direction of wind, tree angle, pressure from other trees etc. In addition, workers have to consider the peculiarities of their machines, which may affect the course of work. Work can not be done, if workers have not received proper training or proper safety gear is missing.

Field operators must always make certain that they operate in a safe distance from the others. Therefore it may occur that workers are alone on the site. In such cases works manager has to maintain radio or visual contact with workers to make sure they are safe.

Every worker is self responsible for eating mushrooms, berries etc found in the forest. Because there is a large number of dangerous species in the forest, it must be made 100% certain that it is safe to eat something. It has to be considered that the appearance of certain plants or mushrooms may change depending on the habitat.

All the dangers can not be described in a short form. Working in forestry industry is not safe and a risk to one's life exists constantly.

Further green education is not common among operators. Acquiring further education is individual, knowledge can also be obtained through experience or literature, therefore studying in school is not mandatory. However, further green education should be complemented with more information about animals and plants, cultural heritage values and also about soil and water considerations.

Workers also need more knowledge on where and how wood can be stored and how much can be taken from the forest. In addition more knowledge on writing contracts is needed. Contracts with forest owners should contain information about what activities are going to be done, how and when.

Biodiversity Risks

Largest obstacles in making better considerations for biodiversity are lack of knowledge, time and financial resources. For some companies it is important to benefit from the forest as quickly as possible, which is why they accept certain risks to animals and plants. In addition, inexperienced workers can affect animals and plants negatively by making wrong decisions during harvest. Also the absence of alternative to fossil fuels is a threat to biodiversity as a serious risk of pollution exists.

For biodiversity it is always important to make certain that nests or dens are not damaged or destroyed during harvest.

Harvest

Timing of bioenergy harvest is very important for animals and plants. Harvesting activities should be avoided in spring due breeding season. In some areas, cutting activities are prohibited during this period.

During the planning phase, it is important to make certain the peculiarities of the site, which species are likely to live there, if any. In addition, possible nests and dens should be located in the forest to avoid killing any animals or damaging their nests. A fixed perimeter should be given, within which no activities are carried out. The forest has to be checked thoroughly by harvesting planners.

During the harvest, some residues should be left in the forest for the creation of humus for new trees. This is important for forest renewal. These residues may also offer habitat for smaller animals.

In addition, if during the harvest nests, dens, endangered species are spotted or identified then it has to be reported and harvest near them aborted. If necessary, all activities should be postponed or cancelled.

During harvest all general environment protection instructions must be followed and certain measures must be used to prevent damages.

Workers are instructed by works manager. However, they should have general knowledge on the whole process of harvesting wood energy and how it may affect biodiversity.

Cultural Heritage

Risks

If cultural heritage objects are not marked accordingly on the map, then there exists a risk of destroying or damaging them. However, proper marking is not sufficient in the case of unqualified labour force on the site, who may cause serious damages.

Cultural heritage objects, which are clearly visible in the forest generally do not get damaged. However, this does not apply to objects covered with soil. It is ineluctable that some objects are damaged or destroyed, even though no self respecting person would deliberately damage cultural heritage objects.

Lowering risks

The risks are lowest when preliminary work is properly done, objects are marked accordingly, forestry workers are informed of possible valuable objects and how to operate near them.

Harvesting planners should have knowledge on how to recognise different cultural heritage objects in the forest. The protection of these objects also depends on the forest owners, who should have an overview what might be in the forest, thus harvesting planners could locate and identify cultural heritage objects more easily.

Field operators also need to have an overview on historical/cultural objects in order to recognise them in the forest. However, some forestry companies tend not to send their workers to different courses as this would cause a temporary shortage in labour force.

Identification

75% of questioned thought they could recognise some objects when seeing them. The list comprises old stone fences, partisans bunker from WW2 era, sacrificing stones, locations of forts, ancient trees.

In addition, severe weather conditions may affect the course of work negatively, but this can be considered as *force majeure*.

Soil and Water

Risks

Possible risks for soil and water are mainly pollution from fossil fuels and oils used by the machines and creation of ruts. In the land is wet, the risks are higher, as ruts can be created more easily, also pollution may spread faster.

Lowering risks

In order to keep possible negative effects as low as possible it must be made certain whether the forest is accessible and whether harvesting can be done at the given time. If needed, access routes must be cleared and strengthened. Preferred time for harvesting is when soil is frozen or dry, this will reduce the generation of ruts. In addition, machinery must be checked regularly to detect problems and prevent possible pollution/breakdowns/accidents/fires. Also, improving harvesting planners' and field operators' knowledge on topography, soil and water can help lower the risks. Basics should be revised regularly.

There are several different obstacles in making better considerations for soil and water, however the largest is undone preliminary work, which comprises risk analysis, clearing access routes, checking machines for possible leakages, making sure employees are qualified etc.

Recycling of bio energy wood ashes

Discussion about wood ashes is followed at most out of personal interest. 87.5% of answered have not followed it. However, recycling of bio energy wood ashes is believed to be necessary as it prevents the creation of ash dumps. Wood ashes are a good fertilizer which keeps pests away from the plants.

Further Comments

A small number of interviewed field operators said that Estonian wood should be marketed rather in Estonia than across the border.

It was also said that Estonian forestry policy is too profit-oriented thus not being sustainable. However situation could be improved by following the example of Finland.

Using wood as energy resource is advisable and necessary as it is renewable. However this resource must be used sparingly, because trees should grow for decades before they can be harvested.

References Interviews with 8 operators 2011

Latvia

Summary of Questionnaire to field operators (operators of chainsaws, harvester drivers/ forwarder drivers)

The respondents usually works with harvesting small trees, cleaning / pre commercial thinning as well as Harvest of residues (tops and branches), clearing/thinning in overgrown former grasslands (deciduous forests with an origin in open to semi-open grasslands).

The documentation that they receive before the work is mainly about work safety, (how to avoid dangerous moments in your work, risks for your health, alone work, fungi etc. and secondly about transport roads, (in which conditions roads are, rules about road damages, how to choose suitable place for residues/ small trees/ stumps for storage by roads etc.

No specific instruction for every harvesting site about what to consider for animals and plants, no general instruction to follow.

The field operators have basic forestry education – for example Rankas vocational secondary school and Ogres forest technical college, no special; “Green education”.

Field operators consider that the green card – further green education – should be complemented mainly with more information about soil and water considerations and more information about cultural heritage values.

Field operators opinion about the knowledge about the laws, regulations and certification rules connected to the harvest of bio energy differs – some thinks that it is essential, others thinks that they do not need it.

As well as the opinion about the knowledge how to write contracts with forest owners, what kind of information these contracts should content, and how to formulate them – they are not having the same opinion – for some of them it is needed for other no.

Biodiversity – animals and plants (including mosses, lichens, fungi, insects etc.)

The most important thing for animals and plants when harvesting residues (tops/branches), stumps and small trees and harvesting bio energy in overgrown grasslands is considered the ecological aspects at the planning stage and optimal time choice at the harvesting stage.

The field operators thinks that it is important for animals and plants in which time of the year the final felling and harvest bio energy is done.

The largest obstacle to be able to make better considerations for animals and plants when harvesting bio energy are resources.

The field operators consider that there are necessary some training and tuition for harvesting planners and field operators to be able to make better consideration for animals and plants.

Cultural Heritage

The main risks for cultural heritage when harvesting bio energy is mentioned the un-identification and destruction.

The main possibilities how to ensure that cultural heritage values are not negatively affected when harvesting bio energy is the idea not to use them and to get known more about the culture heritage in the object.

But the knowledge how to recognize valuable culture heritage objects for field operator's lack. They do not know how to recognize them or partly can recognize some big stones or trees.

As the largest obstacle to be able to make better considerations for cultural heritage when harvesting bio energy is mentioned the economical profitability.

There is needed some training and tuition about the culture heritage mainly for the harvesting planners and field operators.

Soil and Water

The main risks for the soil and water are poisoning, soil erosion and the difference of the water level.

Main ideas how to keep low negative effects on soil and water when harvesting bio energy it to accomplish all of the safe bio energy harvesting arrangements and to notice the nature conditions.

The largest obstacle to make better considerations for soils and water are mentioned different, but the main is considered the economical resources.

As well as there is necessity for additional knowledge, training for harvesting planners and field operators about how to make better considerations for soil and water.

Recycling of bioenergy wood ashes

According to the field operator answers there is necessity to bio energy ashes recycling because it is a possibility to improve soil quality

Conclusions forest operators

Similarities

The perspective of production efficiency is dominating in all cases. The operator cannot influence biodiversity or driving routes so much. It is in the hands of the planning staff. However the operator that makes the first operation (felling the trees) can do some adjustments to preserve biodiversity, cultural heritage and soil and water conditions if he/she just have the correct knowledge.

The information to the operator before starting work is a little varying in the regions. In Sweden and Estonia the operator is informed by site directions based on the forest management plan. In Latvia the procedure is not so formal.

There is a difference in knowledge between the countries. It seems most Swedish companies keep up knowledge with continuous information and courses for the operators. The companies also demands "green card" in order to work as operator for them.

The operators prefer short courses and information events as the major source of keeping up to date in the field of forest fuels (including technological, ecological and cultural aspects).

Nature conservation specialists

Sweden

Compilation from the questionnaire

The objective of the questionnaire was not to test the knowledge of a person but rather to gather information of what they think is important from their perspective. The questions were asked by phone by Tommy Ek at the County Administrative Board in Östergötland, Sweden, in October and November 2011.

People from three forest companies (FC) and one forest owner association (FOA) were interviewed. The companies were Holmen Skog, Sveaskog, Boxholms skogar AB and the forest owner association was Södra Skogsägarna.

The compilation follows the questions asked and in the end conclusions from the interviews are drawn in a separate chapter.

How large activity is the harvest of bio energy in your company?

- a) **Harvest of residues (tops and branches)** – This is a large activity for all.
- b) **Harvest of stumps** – This is a very small activity. For two of the FCs and the FOA it is on pilot stage while one FC doesn't practise this activity at all.
- c) **Small trees, cleaning/pre commercial thinning** – This is a small activity for all.
- d) **Clearing/thinning in overgrown former grasslands (deciduous forests with an origin in open to semi-open grasslands, management in nature conservation stands (NS-skötsel)** – This is a very small activity for two of the FCs, a small but increasing activity for the FOA and a comparatively, to many other forest owners, large activity for one FC.

1. Biodiversity (BD)

1. What general effects could the harvest of bio energy have on BD?
 - a. Positive – Two FCs and the FOA means that there are larger possibilities for nature conservation management in overgrown grasslands. The outtake of bio energy is an incentive to actually carry through needed nature conservation management. Those that have a low activity in this field mean that there is a potential to increase this activity. One FC means that it is positive for plants that branches are taken away so that the sun light reaches the ground.
 - b. Negative – All four stresses the fact that in general the same negative effects as ordinary forestry occur. Two FCs mean that harvest of stumps could have a negative affect on wood living beetles/fungi. One FC and the FOA say that it might be negative for some insects, especially if thicker branches from deciduous trees, especially broad leaved trees, are removed. One FC and the FOA also stresses that it is not a problem at all for BD with outtake of tops and branches from coniferous trees.
2. What is important to consider for BD when harvesting residues (tops/branches)?

- a. at the planning stage
All four stresses the importance of taking the same nature considerations as usual, not entering valuable habitats, leaving buffer zones to water courses, retaining ecological trees, etc.

Two FCs and the FOA says that it is important to plan the outtake so that enough branches is retained to be used as protection against damages on ground and water from driving machines.

One FC mentions that it is important to make outtake only on the right forest types according to the recommendations from the Forestry Agency. The FOA mentions that it is important that the nature considerations left by the harvester is retained also in the outtake of bio energy. The FOA also mentions the risk that bird nests are destroyed if the heaps are collected during the breeding time.

- b. at the harvesting stage
All mentions that the important thing is that the planning instruction as described above are followed.

3. What is important to consider for BD when harvesting stumps?

- a. at the planning stage
One FC has no and the other three have limited experiences due to low amount of this activity. The ambition from two FCs and the FOA is to increase the harvest of stumps.

One FC and the FOA mentions that it is important to retain all deciduous stumps and one FC also mentions that it is important to retain the stumps one places were the machines should drive in order to avoid soil damages. The FOA means that this is not very important.

One FC mentions that it has been difficult to increase this activity. Either it is the wrong type of soils or the stumps become full of stone material or cultural heritage remainings are destroyed and the activity thereby stopped. In this field new scientifically based advices and rules for nature considerations are needed to be developed. The FSC certification might have demands on Environmental Impact Assessments before larger activities are started.

- b. at the harvesting stage
See above.

4. What is important to consider for BD when taking small trees, in cleanings / pre Commercial things?

- a. at the planning stage
One FC doesn't perform this activity and one is sceptical from economical reasons. The other two FCs stresses the importance to recycle the wood ashes if outtake of bio energy in cleanings/pre commercial thinnings is increased. Otherwise it might be problems to keep favourable nutrient balances.
- b. at the harvesting stage

See above.

5. What is important to consider for BD when harvesting bio energy in overgrown former grasslands?

a. at the planning stage

All four stresses that this out take is more difficult from a biodiversity point of view and requires more planning and well educated personnel. The same nature considerations as are mentioned under 2a are needed. It is important to favour deciduous trees, especially broad leaved trees, hazel bushes and other bushes and be careful to retain woody debris. If it is a nature conservation stand (NS) it is important to consider that the management should only be done for the benefit of the BC.

One FC and the FOA mentions that in addition it is important to consider the timing of the collection of the heaps of material from deciduous trees with an origin in overgrown pastures/meadows, especially if the content of broad leaved trees is large. Deciduous trees/branches should be collected within a certain date in order to avoid that rare and threatened species of beetles are laying eggs in the heaps before the collection of them. If the collection is done too late the eggs and larvae from the threatened beetles will be destroyed and the populations of these beetles affected negatively. If the collection is done later than this date the upper part of the heaps should be taken of the heaps and retained in the area as nature conservation heaps.

b. at the harvesting stage

One FC says that the timing of the collection of the heaps often not are decided at the planning stage. Therefore it is important that the people that collect the heaps are aware of this situation. Apart from this, see above and under 2a.

6. Is it important for BD which time of the year the final felling and harvest of bio energy is done? Why/why not?

The timing is important for two reasons. 1. Two FCs and the FOA mentions the aspect described under 5a. 2. The three FCs stresses that it is important to avoid wet weather etc. in order to avoid soil damages.

7. What is the largest obstacle to be able to make better considerations for BD when harvesting bio energy?

The FOA mentions that it is difficult to get wood ashes and thereby ensure that the soil nutrient balances are kept.

One FC means that the largest obstacle is lack of biological knowledge on species level. Another one is the logistical problem; it is sometimes difficult to get the right machine when it is a favourable time of the year.

One FC means that knowledge is the key issue and that further education is needed since the out take of bio energy is quite a new thing. One FC means that the individual peoples interest, level of knowledge and ambitions are important. This is nothing special for bio energy outtake but is the same for all nature considerations in forestry activities.

8. Is there any additional knowledge you think is needed in order to make better considerations for BD for:

a. Harvesting planners

All four mean that management of overgrown pastures/meadows with high nature values is difficult and that better knowledge and better instructions are needed in this field. Otherwise repeated training is needed in the same way as for nature considerations in other forestry operations but not more needed than for normal forestry.

b. Harvesters/ fieldworkers/chain saw users

The same as above. Additionally one FC means that there is a need for further education of the people collecting the heaps of bio energy material.

9. Is there anything else you would like to raise that is important for BD when harvesting bio energy?

No

2. Cultural Heritage (CH)

1. What risks are there for the CH when harvesting bio energy?

All four means that the largest risk is damaging the CH remains by driving on them. Generally the risk is not larger than when it comes to ordinary forestry operations but it is important to retain enough branches in order to cover remains and avoid damages from machines. This is not always the case.

One FC mentioned that there often are remains of cultural heritage in overgrown pastures/meadows. A positive thing is that it could be easier to recognise the remains when the residue from the harvest is taken away.

One FC said that it is a large risk that unknown remains from cultural heritage are damaged when stumps are harvested.

2. How should it be ensured that CH values not are negatively affected when harvesting bio energy?

All four meant that the crucial thing is the planning. Good instructions and markings in the field.

3. Could you recognize valuable CH objects when seeing them in the forest? Which in that case?

Yes, all four mean that the planners should be able to recognize all kinds of CH. They should also be fully aware of the already officially recorded cultural remains.

4. What is the largest obstacle to be able to make better considerations for CH when harvesting bio energy?

Two FCs said that the knowledge of the existence of the CH remains is the largest obstacle.

Two FCs said that it can be difficult to avoid driving machines when the weather conditions are unfavourable in order to avoiding damages on the soil.

One FC mentioned that it is difficult to recognize all cultural remains at certain times of the year, when the vegetation is high, etc.

The FOA meant that there are no obstacles really.

5. Is there any additional knowledge you think is needed in order to make better considerations for CH for:
- a. Harvesting planners
All four means that additional education is always positive, but that the need is not larger than for other forestry operations.
 - b. Harvesters / field workers / chain saw users
See above.
6. Is there anything else you would like to raise that is important for CH when harvesting bio energy?

One FC said that it is important to take away the branches from the remains after the forestry operation. This is not always done since the material can not be used as bio energy anymore.

3. Soil and Water (SAW)

1. What risks are there for the SAW when harvesting bio energy?

All four were concerned that the nutrient balances could be negatively affected if wood ashes are not recycled.

They also meant that there could be a leakage of nutrients and soil material when large heaps of green tops and branches are stored close to water courses. The FOA and two FCs are avoiding harvesting of green tops and branches. If this is done it is an absolute necessity to recycle the wood ashes. They also meant that the same considerations as for all forestry operations should be taken when driving across or close to water courses and ditches.

The FOA and one FC stressed that enough branches should be retained so that they could be used as protection for soil and water when driving machines.

The FOA pointed out alternative possibilities to avoid soil damages. An example is to use straw to avoid damages when driving through grasslands. Another is to use rubber protection at sensitive passages.

One FC meant that there might be a problem with transportation of soil material to water courses when harvesting stumps both through the actual impact on the ground and when heaps of stumps are affected by rain water.

2. How should negative effects on SAW be kept as low as possible when harvesting bio energy?

Two FCs meant that it is most important have enough knowledge and allocate enough time when planning the operation.

Two FCs and the FAO pointed out the necessity to use branches as protection when driving machines on sensitive ground.

3. What is the largest obstacle to be able to make better considerations for SAW when harvesting bio energy?

Two FCs meant that the outtake of green tops and branches might result in a too large outtake of nutrients. The work speed is so high that the location of heaps will be unfavourable, see above.

One FC raised the problem of logistical possibilities; sometimes it is difficult to get the machines when it is favourable weather conditions.

4. Is there any additional knowledge you think is needed in order to make better considerations for SAW for:

- a. Harvesting planners

One FC said that it is needed an education in how to handle green tops and branches and how to locate the heaps on the right places. Two FC and the FOA doesn't see a need with education.

- b. Harvesters / field workers / chain saw users
See above.

5. Is there anything else you would like to raise that is important for SAW when harvesting bio energy?

No

Recycling of bio energy wood ashes

Have you followed the discussion about wood ashes?

Yes (all four)

No

According my opinion we should have recycling of bio energy ashes?

Yes (all four)

No

Why? It is favourable for the nutrient balances to recycle bio energy ashes. Four different opinions on where the ashes should be spread.

Does your Company recycle bio ashes today?

Yes (two)

No (two)

Do you have any further comments?

One FC said that if you have the right knowledge and awareness most people are eager to take considerations in an appropriate way. The FOA said that it is important to evaluate all aspects of bio energy outtake also the positive aspects with a carbon neutral fuel.

Conclusions Sweden

Harvest of tops and branches is a straight forward activity

The largest activity is the harvest of residues (tops and branches) and the interviewed doesn't see any large difficulties with this activity, as long as it is forest with low natural values on the right soil type and normal nature considerations are taken, as in other forestry operations. It means that sensitive habitats, buffer zones towards water courses, ecological trees etc should be retained and the activities should be done in a way so that soil, water or cultural remains not are damaged while driving with machines. The problem of unknown cultural remains is the same as for other forestry activities. It is crucial that the nature considerations left by the harvester is retained also in the outtake of bio energy, which is not always the case

Concern for outtake of green tops and branches

The main concern with this activity is the method of taking out green tops and branches and storing them at the road sides. All interviewed persons were sceptical towards this activity since the risk to affect the nutrient balances in the soil of the harvested stand is large and that there is a risk of leakage of nutrients and soil material to water courses from the stored heaps of green material.

Pre commercial thinnings needs recycling of wood ashes

Outtake of bio energy from cleaning/pre commercial thinnings is a small activity and the main concern is that the wood ashes should be recycled in order to keep the nutrient balances in the soil.

Scepticism towards harvest of stumps

The interviewed were more sceptical concerning the environmental impact from outtake of stumps. This activity is on a pilot stage and there are uncertainties how to look on, and perform, this activity. At the moment they are sceptical in general and least sceptical towards outtake in spruce stands with low natural values. There was a concern that harvest of stumps could have a general negative affect on wood living beetles/fungi. It was mentioned that all deciduous stumps, and some coniferous, should be retained in the ground as well as stumps were the machines should drive when collecting the stumps.

Positive effects on overgrown former grasslands (NS-skötsel)

The interviewed meant that it is positive with an increased demand for wood energy for this kind of stands. There is a large need for increased management of overgrown former grasslands from a nature conservation point of view. This has not been done due to economic reasons. Now it is possible to make economically justifiable outtakes in nature conservation stands and thereby help with the management of these stands. The interviewed didn't see a large risk that too much material is taken out so that the stands are affected negatively. It is important though to all the time consider that the outtake in nature conservation stands (NS) always should be done only in favour of the natural values. Those that have a low activity in this field mean that there is a potential to increase this activity.

Harvest in overgrown grasslands requires knowledge and enough time for planning

All the interviewed stressed that the most difficult activity in the outtake of bio energy is to do this in overgrown former grasslands. The reason for this is that these stands often are complex with many different aspects to consider and that they often have high biodiversity values that it is important not to affect negatively. It is therefore important to have the right knowledge and enough time to plan the outtake. Deciduous trees, especially broadleaved trees, should be favoured, trees with wide crowns should be cleared from competing vegetation, bushes should be favoured and dead wood should be retained. They also often have cultural remains. Further education is needed in this field.

Heaps with deciduous branches and tops must not be traps for rare beetles

It was pointed out that there is a risk that tops and branches from deciduous trees, especially broad leaved trees, could function as traps for rare and threatened beetles if the outtake is done in the wrong way. Either the material should be taken away from the forest before the insects have had the possibility to lay eggs or the upper part of the heaps should be removed, at the time of the collection of the heaps, and retained in the forest as nature conservation heaps. This is not common knowledge among the planners and entrepreneurs and further education is therefore needed.

Retain enough branches to ensure that soil damages are avoided

The interviewed mentioned that it is important to plan the outtake of tops and branches so that enough branches is retained to be used as protection against damages on ground and water from driving machines. There is a risk that this is not always done due to the ambition to collect as much of the branches as possible as bio energy.

Planning is crucial

The most important aspect in order to make the right nature considerations is the planning of the outtake in advance to the harvest. Enough time and knowledge is the crucial aspect here. The planners are able to recognize cultural remains if they get enough time to plan the out take.

Logistics might be a problem

It was mentioned that there might be a problem to get the machines at the right time, when the weather conditions are the right to avoid soil damages.

Positive to recycle wood ashes

The interviewed were positive to recycle the wood ashes but needs to get recommendations from the Forest Agency on how to do it. It was mentioned that it can be a problem to find wood ashes to recycle since it is often used for other purposes for economical reasons.

Latvia

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How large activity is the harvest of bio energy in your company?

The companies work with harvest of residues (tops and branches), small trees, cleaning/pre commercial thinning and also Clearing/thinning in overgrown former grasslands (deciduous forests with an origin in open to semi-open grasslands)

Biodiversity (BD)

The opinion whether the general effect the bio energy harvest to biodiversity differs – some thinks that it is positive others that negative. That is according to that what is harvested.

It is important to consider for biodiversity when harvesting residues at the planning stage the soil conditions, the amount of harvesting, as well as the right time for harvesting. At the harvesting stage the soil conditions, ecological factors, technical safety.

When harvesting stumps it is important to consider the economic calculations, the situation about the plants and species, soil conditions, trees species at the planning stage for biodiversity and at the harvesting stage – it is important to consider the soil conditions, ecological aspects.

When taking small trees it is important to consider the soil conditions, bird hatching time, the convenient forest type development both at the planning and harvesting stage for biodiversity.

When harvesting bio energy in overgrown formers grasslands it is important to consider bird hatching time and animal reproduction time at the planning and harvesting stage. As well as, environment protection and the optional methods in the harvesting stage.

The environment specialists consider that it is important in which time of the year the final felling and harvest of bio energy is done. They suggest harvest in the winter when the soil is frozen – so the soil will not be damaged, and the birds and animals will be less disturbed.

The main obstacle to be able to make better considerations for biodiversity is the economical interests – to harvest more bio energy from the area. Also environment specialists as one of the obstacles mention the weather conditions.

The specialists think that the knowledge should be increased to make better considerations for bio energy for both - the harvesting planners and harvesters/ fieldworkers/chain saw users, but they³⁷

have not mentioned what kind of knowledge. As well as for the biodiversity preservation it is important to use the knowledge about the materials of bio energy and about the environment protection.

Cultural Heritage (CH)

The main risk for Culture heritage is the situation when the economical factors become the main ones.

Also environment specialists mention that the main risk is when the culture heritage is no identified. So the workman does not know about them.

To ensure that culture heritage values are not negatively affected there should be exact identification and the owner should inform the field workers.

Mainly the specialist can recognize the culture heritage objects in the forests. Mainly they are – big stones, brig trees, etc. that differs in the environment.

The largest obstacle to be able to make better considerations for culture heritage when harvesting bioenergy is mentioned the lack of information for the field operators and society and the lack of resources.

The speocialists consider that harvesting planners and harvesters / field operators / chain saw users should have some additional knowledge to make better considerations for culture heritage. Basically they should know how to recognize the culture heritage objects.

Soil and Water (SAW)

The main risks for the soil and water are the soil erosion, the pothole that the technique makes, and the procreant fraction exportation when the stubs are extracted and water poisoning.

The main possibilities how to avoid negative effects on soil and water are mentioned to choose the best time of year when to harvest bioenergy, and to employ trained specialists.

The largest obstacle to be able to make better considerations for soil and water when harvesting bioenergy is the economical aspects – the bioenergy is necessary all through the year.

All specialists agree that harvesting planners and harvesters / field workers / chain saw users should have more knowledge about how to make better considerations for soil and water.

Recycling of bioenergy wood ashes

Mostly the environement specialists have followed the discussion about wood ashes. Some of them think that they should be recycled – used as fertilizer.

Today no one of respondent companies recycles the wood ashes.

Estonia

1. Hendrik Nõmme, man, Holmen Mets AS, Pärnu mnt 105 Tallinn Estonia, phone +372 526 6265
2. Marku Lamp, man, Ministry of the Environment, Narva mnt 7a Tallinn Estonia, phone +372 6262920
3. Kuldar Tamm, man, Woodmaster OÜ, P. Kerese 31-13 Tallinn Estonia

Biodiversity

Harvest of bioenergy could have different effects on biodiversity. However, if done within certain limits, effects are positive. For example, bosky ditches are restored and with it former habitat for some species also. On the other hand, machines operating in the forest may damage trees, destroy nests etc. Timing of the harvest is also very important in order to avoid any risks to biodiversity. Risks are highest during spring, because of breeding season. If any serious threats to biodiversity are detected, then harvest should be postponed or cancelled. Depending on which assortment is harvested, different nuances should to be considered.

When harvesting residues it is important to leave a small amount in the forest for the purpose of humus generation, which is especially important for forest renewal. In addition, cutting should be done carefully, as some species may have their nests in treetops.

Harvest of stumps comprises different risks as they are a natural countermeasure against erosion thus removing them may predispose soil erosion and reduce generation of humus. These risks are especially high, if harvest is done on downslopes. In addition, beneath stumps, some species may have their nests therefore harvest can affect wildlife negatively.

Overgrown former grasslands are usually a bit softer and bushy thus it is likely to find many bird nests in these areas. On this reason it is very important to check the general condition of trees, existence of nests, possible risks and accessibility of the site before harvesting.

Several factors affect making considerations for biodiversity, the largest of them is lack of financial resources. Smaller forestry companies set benefiting from the forest as their main objective in order to survive, therefore affecting environment negatively. The second largest obstacle is lack of knowledge. Harvesting planners and field operators must have perfect knowledge in their specialty in order to minimize the risks and improve the effectiveness of their work. In addition, harvesting planners and field operators should be sent to regularly organised practice days and courses preferred to officials.

Cultural Heritage

Harvesting activity also imposes a threat to cultural heritage objects. Preliminary work, which is not done properly, poses a threat. Harvesting planners have to check the entire forest site in order to locate possible cultural heritage objects. In addition lack of information and knowledge among workers poses a threat, if they are not aware of such objects on the site and not able to identify them. This may result in serious damages to cultural heritage objects or at worst case, destruction³⁹

on such object. These risks can be however eliminated by marking cultural heritage objects locations accordingly in the forest and on the map. In the absence of specific marking, it is the task of works manager to inform workers about the existence of these objects and the location of them. Workers should have basic knowledge on the topic, but separate course is not needed.

Nature conservation specialists thought they were able to recognize partisans' bunkers, forest quarter posts, stone fences. Recognition also depends on what people consider to be CH.

Soil and Water

Main risks for SAW during harvest are: 1) soil damages (ruts etc.) 2) pollution of phreatic water in the event of fuel leakage 3) risk of erosion, if stumps are harvested

Risks can be eliminated or lowered by better timing, regular checks and improving knowledge on the topic. Best time for harvest is when soil is properly frozen to prevent creation of ruts, for example. Also, machines should be updated and checked regularly to prevent leakages which could pollute phreatic water. In addition, if any serious threat to SAW arises, then harvesting should be cancelled or postponed until the forest is again accessible to forestry machinery without complications.

Making better considerations is obstructed by lack on information, skills and knowledge. Everything depends on whether planners and workers are aware of the risks and act accordingly.

Recycling of bioenergy wood ashes

However not being an actual topic in Estonia, recycling of bioenergy wood ashes is believed to necessary, if the amounts are high, therefore preventing the creation of ash piles. Ashes could be used as a fertilizer.

Comments

One of the questioned specialists brought out that questions are concentrated on negative sides rather than positive. It is important to keep in mind that wood energy is a better option than fossil fuels. If the demand for bio energy rises forest areas will also start growing (through planting) to supply the demand.

Conclusions the field of natural conservation

Important considerations in current operations

At the planning stage the soil conditions, the amount of harvesting, as well as the right time for harvesting have to be considered.

At the harvesting stage the soil conditions, ecological factors, technical safety has to be considered
The largest obstacle is the economical aspects – the bioenergy is necessary all through the year
more knowledge about how to make better considerations for soil and water

It is crucial that the nature considerations left by the harvester is retained also in the outtake of bio energy, which is not always the case.

Enough branches must be retained to be used as protection against damages on ground and water from driving machines

Harvesting, forwarding and chipping constitutes risk for biodiversity connected to the breeding season of many birds and insects

Small amount of organic material must be left in the forest for the purpose of humus generation,

Commercial thinnings is a small activity and the main concern is that the wood ashes should be recycled

Overgrown former grasslands is a difficult biotope for extracting bio energy. The reason for this is that these sites often are complex with many different aspects to consider (e.g bird hatching time, insects and animal reproduction) and that they often have high biodiversity values that it is important not to affect negatively. But if the harvest is done properly it can have a positive effect on biodiversity.

Heaps of broadleaved trees can be traps for rare and threatened beetles if the outtake is done in the wrong way

A risk is when the culture heritage is not identified so the operator does not know about them. There has to be an exact identification and the field workers must be informed

Machines should be updated and checked regularly to prevent leakages which could pollute phreatic water.

Problem areas

Taking out green tops and branches and storing them at the road sides

Deciduous stumps, and some coniferous, should be retained in the ground as well as stumps were the machines should drive when collecting the stumps.

Harvest of stumps comprises different risks as they are a natural countermeasure against erosion

Further education is needed in this field of deciduous trees and the special requirements for retaining the high levels of biodiversity in those sites.

Lack of information for the field operators and society and the lack of resources for inventories and disseminating information

Harvesting planners and harvesters / field operators / chain saw users should know how to recognize the culture heritage objects.

The second largest obstacle is lack of knowledge. Harvesting planners and field operators must have perfect knowledge in their specialty.

Workers poses a threat, if they are not aware of cultural heritage objects on the site and not able to identify them. Workers should have basic knowledge on the topic, but separate course is not needed.

Discussion

In this report we have tried to discover problem areas and fields related to competence issues that need to be improved in the value chain of forest fuels. Interviews with different parts involved in the practical work of this chain are the base for these findings. We can see similarities and differences between the three regions but some general conclusions can be drawn:

The key operation for most aspects (technological, biodiversity, soil and water etc) is the forest management planning. In the management plan all aspects concerning biodiversity, cultural heritage, soil and water protection, harvesting operations, fuel quality can be accounted for as well as the goals of the forest owner.. Sometimes the plan is made several years before the operation and sometimes it is done in connection to the harvest. Regardless of planning structure or business type the professional competence of the person making the planning is crucial. Of course the planning can include specialists of different kinds but both for the harvesting work and for the forest owner it is important that the plan or information is reliable. This is also connected to different certification schemes such as FSC or PEFC. Many companies have secured the quality of the planning by continuous upgrading competence of planning staff.

The field operator is following the instructions given by the plan. but sometimes the operator in the field has to solve a situation not foreseen in the plan.

Desired competence levels

Competence of planner should cover biodiversity, cultural heritage objects, soil and water conditions, silvicultural aspects, harvesting operations. In general it should correspond to the general Swedish NQF5 or 6 corresponding to bachelor level or similar knowledge obtained in other ways.

Competence of operator should correspond to basic level of vocational training corresponding to the Swedish NQF4 in order to follow instructions and discover discrepancies in the field.

Competence of forest owner should make the owner able to set up own goals and evaluate the advantage or disadvantages of forest fule harvest on the actual estate.

Aside from competence also the information flow is important The information in the management plan or the contract has to be forwarded to the operators in the field. Bigger companies and organisations have secured this by routines that always are followed before harvesting starts. The same information or site directives is transferred to harvester, forwarder, chipper in order to retain the quality of biodiversity, fuel quality etc that was planned from the beginning.

For smaller companies and subcontracters this is not secured at the moment and here some development work has to be done in order to secure routines.

Recommendations

Arrange a meeting with stakeholders covering the whole value chain of forest fuel in each region to discuss regional approach of improving competence. The stake holders are for example:

Producers of raw material: Forest owners, forest companies, state forestry, forest agencies forest advisory organization, vocational training.

Harvesting operations: Subcontractors, field operators, vocational training institutes

Fuel preparation: Chipping operators, transport companies

End consumer, District heating companies, Boiler operators

Other stakeholders. Regional and local authorities

The reason for involving the whole value chain is that it is often in the transfer of information between professionals in different steps of the chain that problems can occur. One example is the quality of the fuel. The quality can change on the way from harvest to boiler and in order to keep the correct quality the different parts of the value chain have to understand each other. Another example is the importance of retaining the biodiversity consideration during the chain of operations.

The continuous learning that has been discussed earlier (p 23) in this report is important since technology is changing rapidly and new knowledge is produced all the time. So a structure for continuous learning is one important factor for the competence development in the field of forest fuels.

Appendix 1 NQF (National Qualification Framework) Sweden

Appendix 1. NQF (National Qualification Framework) Sweden

Level	Knowledge (experience-based and / or theoretical)	Skills (complete tasks and solve problems)	Competence (ability to take responsibility, to value and to act independently and to cooperate)	Exam/Education
NQF 1	Can show: Basic general knowledge in a work or study area; understanding of the essence of simple instructions and descriptions in a work or study area	Can: Perform routine tasks in a work or study area; follow simple directions and descriptions of a work or study	Can: Under the leadership to perform simple tasks, collaborate with others with supervision.	
NQF 2	Can show: Expanded knowledge in a work or study area; knowledge of how facts can be collected, collated and reported	Can: Apply stated rules, methods and tools to perform assigned duties; follow instructions and descriptions in a work or study area; search and process data in a number of work / study areas.	Can: Perform work or studies with some autonomy and take responsibility for simple tasks, cooperate under the leadership and contribute to the common results, evaluate how their own tasks done.	Primary School 2011 Special school Basic adult education *
NQF 3	Can show: Skills required to perform tasks in a work or study area; knowledge of different methods for collecting, collating and presenting information.	Can: Choosing and using information using designated methods, tools and materials, accomplish tasks both independently and in groups in a timely manner; on their own search for process information, communicate experience and knowledge in their own language.	Can: Take responsibility for their learning and to assigned tasks are completed, evaluate own and joint outcomes, evaluate information from various sources.	

NQF 4	Can show: In-depth knowledge of a work or study area; knowledge of models and methods of work or study.	Can: Select and use relevant concepts, theories, models, materials, tools and methods of work or study area; follow instructions and carry out defined practical and theoretical information in a timely manner; communicate in at least one foreign language in the current work or study.	Can: Take initiative, reflect, organize and carry out work and study independently, independently examine the content of a work or study that could lead to further learning and professional development; critically evaluate and respond independently to the choice of sources, evaluate and draw conclusions of their own and joint outcomes, take responsibility, in cooperation with others and to a limited extent, lead and evaluate the work of others.	High school graduate (Gy 2011) Upper secondary school level
NQF 5	Can show: Specialized knowledge in a work or study area; knowledge and overview of the areas adjacent to their own work or study area; knowledge of work processes and quality in a work or study	Can: Plan, perform and identify resources to carry out specialized tasks, solve complex problems in a work or study area; communicating commitments and solutions in a work or study at least one foreign language	Can: Independently treat content in a work or study that leads to further learning and professional development; monitor work or study activities, and complete prescribed projects.	Bachelor's Degree ?
NQF 6	Can show: Advanced knowledge in the work area or the main area of studies, understanding of the area's established methods of developing knowledge, deep knowledge of some part of the field and orientation of the area's current research / development	Can: Identify, formulate, analyze and solve problems and perform complex tasks, communicating commitments and solutions for work or study area, in national and international contexts.	Can: Rate information and methods of work or study area with regard to relevant social, ethical and scientific aspects, apply specialized knowledge for development work or study area; take responsibility for the management of individual and group development at work	Bologna first cycle, Eligible Bachelor
NQF 7	Can show: Very advanced knowledge in a work or study area; deep knowledge of the area's research and development methods, deeper insight into the area's current research and development	Can: Participate in research and development, identify and formulate problems, analyze, evaluate and resolve complex and sophisticated tasks, communicate research / area of knowledge and findings in both national and international context	Can: Evaluate a work or study area information, facts and methods taking into account relevant aspects, identify needs for further knowledge, evaluate an area's potential and limitations, take responsibility for and lead own work or study area; take responsibility for the outcome of own research and/or development work.	Bologna second cycle Advanced level.

NQF 8	<p>Can show: The most advanced and systematic knowledge in a field of work, study and research area, current specialist knowledge in a well defined area and an overview of related fields, mastery of techniques for knowledge in general and the specific work, study or research area in particular</p>	<p>Can: Analyze, synthesize and critically analyze and evaluate complex phenomena, issues and situations; plan and carry out development or research work and other advanced tasks, communicate results of research and development in both national and international contexts.</p>	<p>Can: Evaluate the work or study area of research or development work; create and select their own forsknings / innovation / development tasks, evaluate the qualified development work or scientific possibilities and limitations, take responsibility for the results of development or research use, take responsibility for / lead professional and organizational development.</p>	<p>Bologna third cycle. Graduate Level</p>
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Appendix 2 Curriculum harvesting machines and timber transport

Extract from:

http://www.skolverket.se/forskola_och_skola/gymnasieutbildning/2.2953/2.3021/2.3035/programs/truktur-naturbruksprogrammet/degree.htm?programCode=NB001°reeCode=NBSKO°reeName=Skogsmaskinf%C3%B6rare

Harvesting machines, 100 points

Course code: NABAVV0

The teaching of the course will address the following core content:

Technical basis

- Design and function descriptions and uses of logging machinery and technical equipment.
- Computer equipment of harvesting machines.
- Motor fuels and lubricants.
- Daily inspection, periodic inspection and service.

Work with harvesting machines

- Work with harvesting machines in a logging area.
- Management of the crane, instruments and controls.
- Ground damage and environmental impact.
- Computer based crosscutting.
- Work under the site directives, work planning of logging, reporting and monitoring.

Work environment, safety and regulations

- The work environment and ergonomics, and environmental and safety issues.
- Screening for the use of vehicles, tools and equipment.
- Fire Prevention.
- Laws and regulations in the area

Timber transport by forwarders, 100 points

Course code: NABVIE0

The teaching of the course will address the following core content:

technical basis

- Design and function descriptions and uses for forwarders and ancillary equipment.
- Motor fuels and lubricants.
- Daily inspection, periodic inspection and service.

Work with forwarders

- Work with forwarders and handling crane, instruments and controls.
- Timber Transport with forwarder in a harvest area.
- Management of additional equipment such as bands and chains.
- Driving techniques that minimize damage to land, forest and the environment and reduce fuel consumption.
- Different timber types and requirements for landings.
- Driving on roads and traffic knowledge.
- Economical driving technique.
- Work under the site directives, work planning, reporting and monitoring.

Work environment, safety and regulations

- The work environment and ergonomics, and environmental and safety issues.
- Safe handling of dangerous goods and hazardous waste.
- Screening for the use of vehicles, tools and equipment.
- Safety on the road.
- Fire Prevention.
- Laws and regulations in the area

Criteria for different grades are also mentioned in the document but not published here.

Appendix 3 Questionnaires

Competence Wood Energy and Cleantech , 2011

Questionnaire forest owners, Marja Gustafsson www.skogsstyrelsen.se

Name : _____

Sex/ age: Female Male

Age:.... Years

Forest owner`s forestry education, forestry school/forest collage/University level, if yes which?

Yes, no

Contact info,

Property name

Productive forest area (In hectare. More than 100 ha in Sweden, more that 7 in Latvia and more than 5 in Estonia)

1. Have you carried out some forest management activities during the last 5 years?

Yes,

What kind of activities?

no,

Why?

2. Have you taken part in some forestry days/-evening, courses or other forestry activities during the five last years?

Yes

Which/when

No,

Why?

3. Have you carried out some cutting activities, thinning, clear cut during the last five years?

Yes, if yes discuss following aspects. If not - go to alternative "No" below.

Did you also sell bioenergy sortiments, residues (tops/branches, stumps) etc?

If yes / What is your experiences from that?

Positive or negative/ with aspects on environment/economy/something else

Do not need money, are not interested of forest management, others, which?

No, I have not carried out some cutting activities, thinning, , clear cut during
the last five years

Why have you not cut any forest during 5 years?

Do not need money, are not interested of forest management, others, which?

4 Do you think that it is good to take out bioenergy connected to clear cutting / thinning
/ cleanings in forest?

Yes

Why, economically, ecologically, other reason

No

Why, not?

5. Did you get some damages in forest connected to bioenergy harvest?

Yes

What kind of damages, soil, water, cultural heritages etc

No

6 Are you satisfied with the field workers did when they took out bio energy?

Yes

No

Notes

7 If you got damages, do you think we could avoid these by better education of you or contractor?

Yes

What kind of education, topics

No

8 Which type of knowledge do forest owners need in order to sell bio energy assortment?

Economy, ecology, which kind of soils you can take bio energy, its impact to biodiversity, site

index, procurement skills or some else

9 Do you plan to take bio energy assortment in future, in clear cuttings, thinning, cleanings, other activities?

Yes

Why, and when/ which cutting activity, or other

No

Why, and are there some factors which could change your attitude so you will sell in future?

and where do you get your further forestry knowledge?

Forestry papers

Webb pages

Neighbors/other forest owners

Forestry advisors

Others:

Forestry days/ evenings

11. Recycling of bioenergy wood ashes

Have you followed the discussion about wood ashes?

Yes

No

According my opinion we should have recycling of bio energy ashes?

Yes

No

Why?

Notes

12. Do you have any further comments?

Questionnaire Competence Wood Energy and Cleantech, 2011

to field operators (operators of chainsaws, harvester drivers/ forwarder drivers)

The objective of the questionnaire is not to test the knowledge of a person but rather to gather information of what they think is important from their perspective. Therefore the questions are a support for the interviewer when he/she has a dialogue with the respondent

The questions should be asked orally and be adjusted to the person that is interviewed. The nature conservation specialists could be interviewed by phone, if time is limited, while the contractors should be met in person. If a question is difficult to understand, or misunderstood, you should try to ask the question in another way. If you find new relevant questions during the interview – please, ask them!

Company: -----
Contact information: -----
Interviewed person: -----
Woman/man: -----
Contact information: -----

How often do you work with:

- a) **Harvest of residues (tops and branches)**
- b) **Harvest of stumps**
- c) **Harvest small trees, cleaning / pre commercial thinning**
- d) **Clearing/thinning in overgrown former grasslands (deciduous forests with an origin in open to semi-open grasslands)**

1. What kind of documentation do you receive for your help before you start your harvesting/driving of residues/small trees/stumps? What kind of instructions these documents contain? Do you receive these instructions in talking or written form? Does it content:
 - a. Technical instructions about how to handle your harvester/forwarder(for instance branch grapple, how to handle oils etc
 - b. About transport roads, (in which conditions roads are, rules about road damages, how to choose suitable place for residues/ small trees/ stumps for storage by roads etc
 - c. About work safety, (how to avoid dangerous moments in your work, risks for your health, alone work, fungi etc

2. Do you get specific instructions for every harvesting site about what to consider for animals and plants (including mosses, lichens, fungi, insects etc.) or do you follow general instructions?
3. What kind of basic forestry education do you have? Do you have a “green card” or some else further “green education”? Do you think that the green card – further green education - is needed and to be complemented with:

Name of basic forestry education

Name of further “Green education”

4. Do you think that the green card – further green education - should be complemented with:
 - a. More information about animals and plants (including mosses, lichens, fungi, insects etc.)
 - b. More information about cultural heritage values
 - c. More information about soil and water considerations
5. Do you need more knowledge about laws, regulations and certification rules connected to the harvest of bio energy?
6. Do you need more knowledge on how to write contracts with forest owners, what kind of information these contracts should content, and how to formulate them ?

You should discuss following topics and note what person consider according them;

Biodiversity – animals and plants (including mosses, lichens, fungi, insects etc.)

1. What is important to consider for animals and plants when harvesting residues (tops/branches)?
 - a. at the planning stage
 - b. at the harvesting stage
2. What is important to consider for animals and plants when harvesting stumps?
 - a. at the planning stage
 - b. at the harvesting stage

3. What is important to consider for animals and plants when harvesting small trees?
 - a. at the planning stage
 - b. at the harvesting stage

4. What is important to consider for animals and plants when harvesting bio energy in overgrown former grasslands?
 - a. at the planning stage
 - b. at the harvesting stage

5. Is it important which time of the year the final felling and harvest of bio energy is done for animals and plants?

6. What is the largest obstacle to be able to make better considerations for animals and plants when harvesting bio energy?

7. Is there any additional knowledge you think is needed in order to make better nature considerations for:
 - a. Harvesting planners
 - b. Field operators/ chain saw users/ forward drivers

8. Is there anything else you would like to raise that is important for the natural values when harvesting bio energy?

Cultural Heritage

1. What risks are there for the cultural heritage when harvesting bio energy?

2. How should it be ensured that cultural heritage values not are negatively affected when harvesting bio energy?
3. Could you recognize valuable cultural heritage objects when seeing them in the forest? Which in that case?
4. What is the largest obstacle to be able to make better considerations for cultural heritage when harvesting bio energy?
5. Is there any additional knowledge you think is needed in order to make better considerations for cultural heritage for:
 - a. Harvesting planners
 - b. Field operators / chain saw users, forward drivers
6. Is there anything else you would like to raise that is important for cultural heritage when harvesting bio energy?

Soil and Water

1. What risks are there for the soil and water when harvesting bioenergy?
2. How should negative effects on soil and water be kept as low as possible when harvesting bio energy?
3. What is the largest obstacle to be able to make better considerations for soil and water when harvesting bio energy?
4. Is there any additional knowledge you think is needed in order to make better considerations for soil and water for:

a. Harvesting planners

b. Field operators / chain saw users / forward drivers

5. Is there anything else you would like to raise that is important for soil and water when harvesting bio energy?

Recycling of bioenergy wood ashes

Have you followed the discussion about wood ashes?

Yes

No

According my opinion we should have recycling of bio energy ashes?

Yes

No

Why?

Do you have any further comments?



Competence Wood Energy and Cleantech, 2011

Questionnaire to Nature conservation specialists in Forest companies and Forest owner associations

The objective of the questionnaire is not to test the knowledge of a person but rather to gather information of what they think is important from their perspective. Therefore the questions are a support for the interviewer when he/she has a dialogue with the respondent

The questions should be asked orally and be adjusted to the person that is interviewed. The nature conservation specialists could be interviewed by phone, if time is limited, while the contractors should be met in person. If a question is difficult to understand, or misunderstood, you should try to ask the question in another way. If you find new relevant questions during the interview – please, ask them!

Interviewed person: -----
Woman/man: -----
Company name: -----
Contact information: -----

How large activity is the harvest of bio energy in your company?

- a) **Harvest of residues (tops and branches)**

- b) **Harvest of stumps**

- c) **Small trees, cleaning/pre commercial thinning**

- d) **Clearing/thinning in overgrown former grasslands (deciduous forests with an origin in open to semi-open grasslands)**

1. Biodiversity (BD)

- 1. What general effects could the harvest of bio energy have on BD?
 - a. Positive
 - b. Negative

- 2. What is important to consider for BD when harvesting residues (tops/branches)?
 - a. at the planning stage

 - b. at the harvesting stage

3. What is important to consider for BD when harvesting stumps?
 - a. at the planning stage
 - b. at the harvesting stage

4. What is important to consider for BD when taking small trees, in cleanings / pre Commercial things?
 - a. at the planning stage
 - b. at the harvesting stage

5. What is important to consider for BD when harvesting bio energy in overgrown former grasslands?
 - a. at the planning stage
 - b. at the harvesting stage

6. Is it important for BD which time of the year the final felling and harvest of bio energy is done? Why/why not?

7. What is the largest obstacle to be able to make better considerations for BD when harvesting bio energy?

8. Is there any additional knowledge you think is needed in order to make better considerations for BD for:
 - a. Harvesting planners

b. Harvesters/ fieldworkers/chain saw users

9. Is there anything else you would like to raise that is important for BD when harvesting bio energy?

2. Cultural Heritage (CH)

1. What risks are there for the CH when harvesting bio energy?

2. How should it be ensured that CH values not are negatively affected when harvesting bio energy?

3. Could you recognize valuable CH objects when seeing them in the forest? Which in that case?

4. What is the largest obstacle to be able to make better considerations for CH when harvesting bio energy?

5. Is there any additional knowledge you think is needed in order to make better considerations for CH for:

a. Harvesting planners

b. Harvesters / field workers / chain saw users

6. Is there anything else you would like to raise that is important for CH when harvesting bio energy?

3. Soil and Water (SAW)

1. What risks are there for the SAW when harvesting bio energy?
2. How should negative effects on SAW be kept as low as possible when harvesting bio energy?
3. What is the largest obstacle to be able to make better considerations for SAW when harvesting bio energy?
4. Is there any additional knowledge you think is needed in order to make better considerations for SAW for:
 - a. Harvesting planners
 - b. Harvesters / field workers / chain saw users
5. Is there anything else you would like to raise that is important for SAW when harvesting bio energy?

Recycling of bioenergy wood ashes

Have you followed the discussion about wood ashes?

Yes

No

According to my opinion we should have recycling of bio energy ashes?

Yes

No

Why?

Does your Company recycle bio ashes today?

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Yes

No

Do you have any further comments?
