Cost Efficient Harvesting Methods Under Wet Soil Conditions in North Eastern Germany

Hans-Ulrich Dietz*, Ute Seeling
Kuratorium für Waldarbeit und Forsttechnik e.V.
Spremberger Strasse 1, D – 64823 Gross-Umstadt
info@kwf-online.de

Abstract:
Since the early years of the 21st century complete stands of ash (Fraxinus excelsior and Fraxinus angustifolia) in all age and dimension classes are affected by the dieback disease – probably caused by a fungi infection.
The objective of the presented paper is to evaluate cost efficient and safe harvesting methods to harvest dying of dead ash trees under wet site conditions.
The paper is reporting about an ongoing project.
So far the four harvesting methods and systems had been selected within the project:
1)Motor-manual felling and skidding supported by horse
2)Motor-manual felling supported by tractor winch
3)Motor-manual felling and skidding by wire crane system
4)Mechanized felling and processing by tracked harvester.
The four systems had been tested under practical conditions with regard to the efficiency and safety, and the data collection is completed. In the next step the data will be analysed.

Keywords: *Fraxinus excelsior / angustifolia*, harvesting ash stands, wet site conditions, dieback disease

1 Introduction

The presented case study of cost efficient harvesting methods under wet soil conditions in North Eastern Germany is part of a joint research project funded by the German Federal Ministry of Food, Agriculture and Consumer Protection (FKZ.: 22010910) concerning forestry and timber strategies for dealing with the Ash dieback occurring in Germany since early years of the 21st century. Affected are *Fraxinus excelsior* and *Fraxinus angustifolia* in all ages caused by a fungal pathogen which infects green leaves in early summer, penetrates through the petioles and causes diffuse staining wood and bark necroses. After several years of massive infestation complete ash stands in all age classes and tree dimensions die. The ash dieback from a biological and a silvicultural point of view and for reasons of biodiversity is a growing problem especially since currently no antidote is known. At the same time defoliation of ash trees growing on glacial drift soils in North Eastern Germany is accompanied by physical instability and economical loss. T reduce the economic losses the dying or dead ash trees shall be harvested and sold on the wood market. Partly they have an excellent quality, but cost efficient and safe harvesting as well as appropriate harvesting technologies and equipment to harvest under wet site conditions are demanded.

The harvesting in these dying stands is realised as clear-cutting.

2 North eastern Germany - fundamentals

German Federal Land Mecklenburg-Vorpommern in North Eastern Germany has about 515.000 hectares of forest area where of 15.500 hectares are stocked with ash. Nearly half of this area (45%) is actually affected by the ash dieback. Table 1 shows the predicted merchantable timber volumes on the affected stands.

The structure of age and stock volume shows a various range of expected timber assortments. So far the cultivation of ash was almost exclusively focused on the production of large, high added value timber. For the now harvested small dimension timber assortments, there are no high-quality utilization facilities yet. The affected ash stands occur frequently on wet-sensitive sites which are not or rarely passable and therefore require specialized forest operation systems.

Table 1: Timber volume of ash stands, affected by the dieback disease

Assortment	Premature stands, 3.600 ha Age 50- 80 years			Mature stands, 2.400 ha Age > 80 years			Total stands 6.000 ha
	[%]	Volume [m^3/ha]	Total timber volume [m^3]	[%]	Volume [m^3/ha]	Total timber volume [m^3]	Total timber volume [m^3]
Timber	10	22	79.200	20	62	148.800	228.000
Pulpwood	85	187	673.200	65	202	483.600	1.156.800
Chipper wood	5	11	39.600	15	47	111.600	151.200
SUM	100	220	792.000	100	310	744.000	1.536.000

3 Forest operation systems – Case studies

Within the project it was planned to select four harvesting methods and to evaluate them according their suitability for the harvesting in dying ash stands.

The technical capabilities of timber harvesting have rapidly been developed over the past few decades. A variety of methods and technologies is available nowadays. The application relates to the specific situations of timber harvesting, which are described by the type of the harvesting operation, the timber dimension and assortments as well as the site conditions. The usability of a harvesting method specifies the probability that a harvesting operation is appropriate to the given conditions (Fig.1).

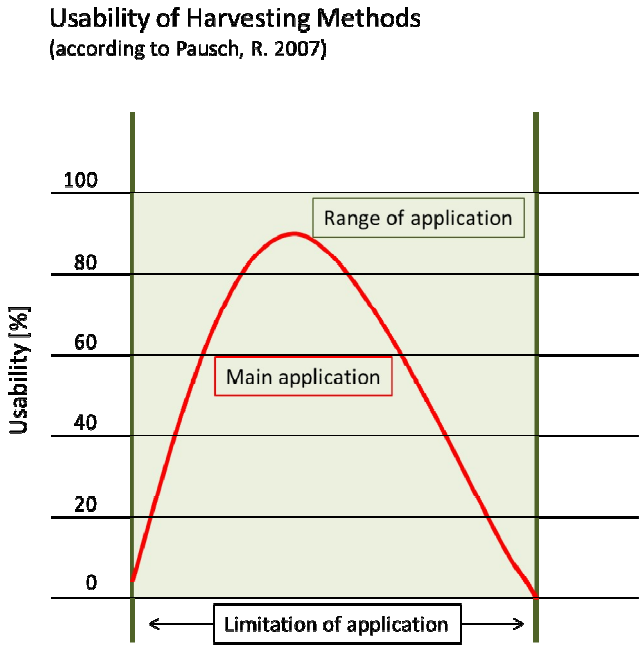

Figure 1: Usability of a harvesting methods

Criteria for determination of the usability of harvesting methods are:

⇒ Technical feasibility
⇒ Occupational safety and health
⇒ Work planning and organization
⇒ Silviculture
⇒ Nature conservation and ecology (soil protection)
⇒ Timber utilization
⇒ Economy

According to these criteria different forest operation systems and harvesting methods were identified within the case study, discussed and practically tested. Special focus was put on harvesting methods where local or at least regional forest entrepreneurs may be involved with existing or available technical equipment.

For the description of the harvesting methods the KWF generally uses the presentation form of ERLER, J. and WEIß, M. (2003). The so-called "functiogram" uses a consistent presentation which allows making a simple way to understand the most basic processes, implementation options and conditions of harvesting methods. In the horizontal level the conversion of the product from standing tree to graded logs is described, whereas in the vertical level the location of the process from stand to forest road is illustrated.

The selected four harvesting methods to be evaluated in dying ash stands are explained in functiograms (ERLER and WEIß, 2003).

3.1 Motor-manual felling and skidding supported by horse (Fig. 2)

At a given distance of skid trails of approximately 40m the trees are felled and processed manually in the stand. The graded logs are transported by horse to the skid trail and finally transported to road side by forwarder. It is a two stage process in premature ash stands (20-35 cm dbh) Motor manual clearing of the trees is only possible with a lower degree of stand damage for reasons of occupational health and safety.

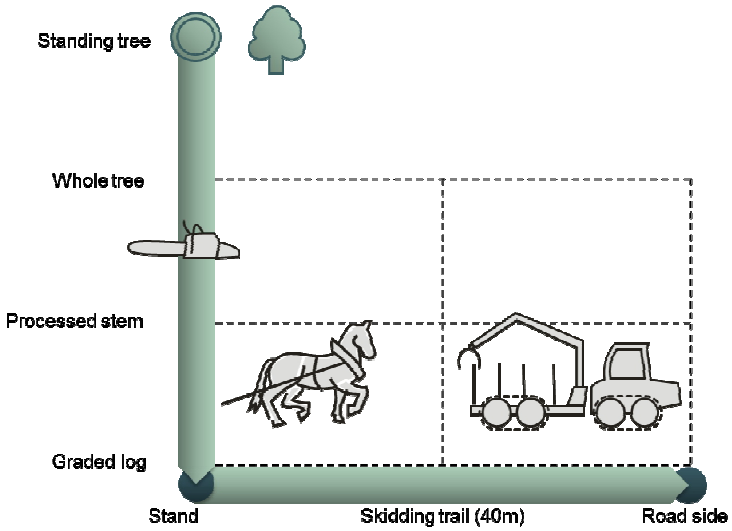

Figure 2: Functiogram of the motormanual felling and horse skidding

The productive efficiency of this harvesting method is determined by the following factors:

⇒ Weather, stock and soil conditions
⇒ Work planning and organization
⇒ Single tree volume, skidding distance, number of log assortments

⇒ Weight, tractive power, health condition of the horses
⇒ Training and work experience of horse and forest workers

3.2 Motor-manual felling supported by tractor winch (Fig. 3)

At a distance of skid trails of 40m or more the trees are motor-manually felled supported by tractor winch. The whole tree will be transported by winch to the skid trail, processed and finally transported to road side by forwarder. Occupational health and safety aspects on instable ash stands are prior to productive efficiency in using this harvesting method.

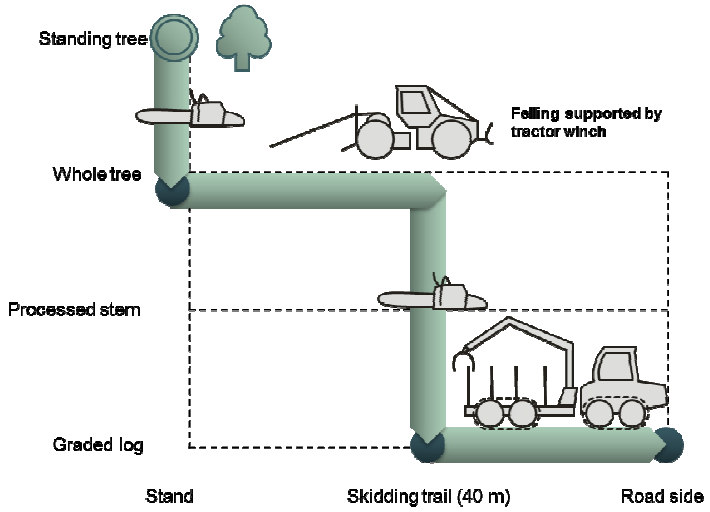

Figure 3: Functiogram of the motor-manual felling supported by tractor winch

3.3 Motor-manual felling and skidding by wire crane system (Fig. 4)

On flat, wet sites that are not passable by heavy machines skidding by wire crane may be used. Normally mobile wire crane units are used; crane, winch and drive unit are mounted on a carrier vehicle. The wire crane alternatively may be mounted directly on an excavator boom (yarder), eliminating the costly anchoring of the mast. After cutting and fixing the cable line the wire crane system will be positioned and anchored if necessary. Subsequently whole trees or processed stems are transported to the road side and finally converted to graded logs. In Figure 3, the classical method is illustrated.

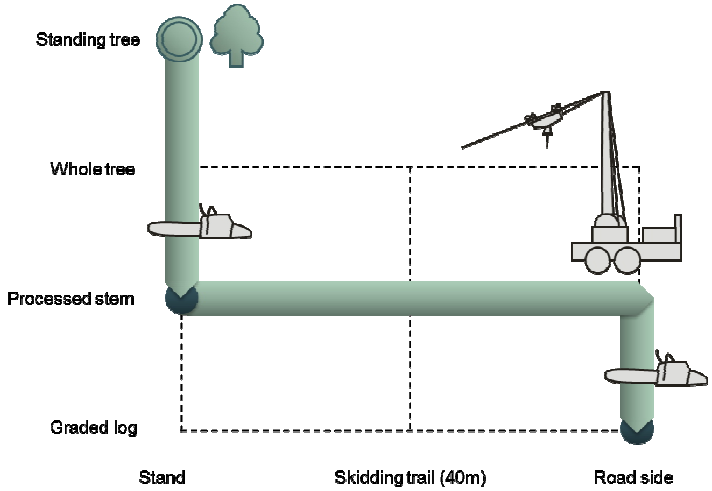

Figure 4: Functiogram of the motor-manual felling and skidding by wire crane system

3.4 Mechanized felling and processing by tracked harvester

On adequate soil bearing conditions the prior harvesting method will be fully mechanized forest operation systems, particularly for reasons of ergonomics and workplace safety. On soils with lower bearing capacity track wheeled harvesters or excavators shall be used. If the distance between skid is around 40m, however, a motor-manual felling of the trees outside the crane area is inevitable. Prerequisite is the layout of approximately 4m wide strip roads. Felling and processing of hardwood by harvester can be used only for predominantly straight growing trees. Coarse and knotty timber causes considerable difficulties. The harvester is moving on the strip road and processing the trees within the crane zone. The trees outside the crane zone have to be felled motor-manually in a second process (note occupational health and safety regulations). For those trees which are normally felled towards the strip road the processing by harvesters is less productive. The graded logs are stored along the skid trail and transported to the forest road by forwarder.

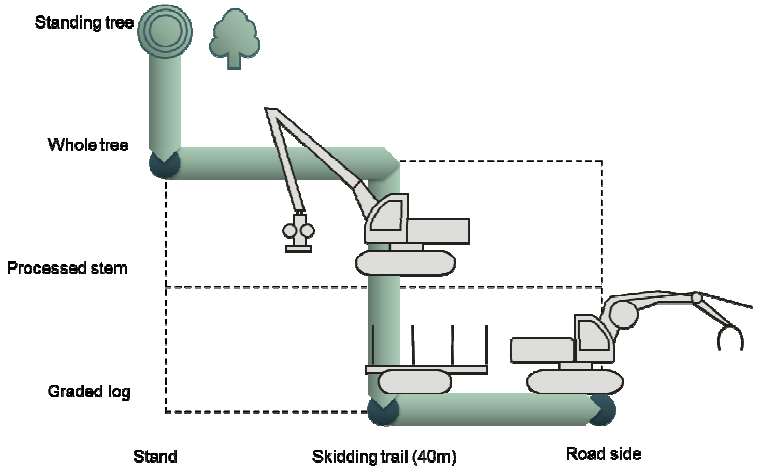

Figure 5: Functiogram of the mechanized felling and processing by tracked harvester

4 Preliminary results

The whole range of the presented forest operation systems and harvesting methods has been practically tested. Focus so far has been put on the technical feasibility.

The collected data will be analysed in the next step.

A preliminary conclusion is that the described harvesting methods are operational and efficient. Practical operation reveals that the state of health and stability of the infected ashes is lower than predicted. Aspects of occupational health and safety therefore have to be taken into account with a higher priority. Harvesting methods without motor-manual felling of the trees have to be improved and implemented.

5 References

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