

Income Effects of Harvesting

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Abstract:

Germany shows a heterogeneous composition of soils and sites. There are dry and resilient as well as humid and sensitive sites. In the last years we observed an increasing degradation of sensitive soils caused by poorly adapted harvesting methods (standard methods). In most instances those standard methods represent the cheapest alternative among other technically suitable processes.

In some heavy cases of degradation it was necessary to put grit into the skid trail to preserve the technical trafficability. The research project "Income effects of harvesting" uses a cross-period balance of incomes and expenses. It demonstrates in an economic way that careful harvesting methods are advantageous because they avoid the technical degradation of the skid road.

Basis of this evaluation is the question which potential harvesting methods are possible and workable depending on soil and site respectively. For this decision it is necessary to consult a panel of experts. These experts have special knowledge about harvesting methods and damages which can appear by using the standard methods. For them it is possible to assess the common practice and the rehabilitation of the damaged skid trails.

In the majority of cases the process costs of careful methods are higher than those of standard methods. Therefore, the second step of the study will be to calculate the costs and the productivities on the basis of existing data.

The contribution margin and the operating results can be calculated with the aid of costs, revenues (equal in all scenarios and therefore insignificant) and capital holding values. The balance sheet helps to find a conclusion, which harvesting method will be the better one under certain conditions. The results should conduce soil protection by using economic evidence.

Keywords: forest value, harvesting costs, trafficability, degradation

1 Introduction

1.1 Problem

The destruction of forest floor by larger and heavier machines with wheels and tracks moves more and more in the critique of society. Not only the harvesting and the machines themselves interfere the forest visitor, more than that the clearly visible tracks on the ground. The public puts the regularity and sustainability of this behavior into question.

The federal states of the Germany govern the driving on forest floors by guidelines. They set the distances between the skid trails and harvesting procedures determined by location in different ways. In some cases, the forester has the opportunity to limit his acts. He chooses a bigger distance between the skid trails than required by the guideline. Generally, the harvesting methods on skid trails with bigger distances are more expensive than standard methods in 20m intervals. There remains the question of the added value.

1.2 Target

The study will examine the question of the influence of harvesting methods on forest values. First, the effects of the method and the skid trail spacing must be determined. The issue of skid trail rehabilitation needs to be answered, too.

The research should help to optimize the modern forest management and the selection of the best harvesting method taking into account of sites. This article describes the methodological approach, which is based on theoretical considerations and basic ideas. The author developed a model, which serves as the basis of the research.

2 Material and methods

2.1 Considerations and ideas

Machines drive on the forest floor with wheels or tracks. This requires skid trails, because plane trailing is not convenient with the rules of sustainability and the legal requirements of a proper forest management. The certification systems require permanent skid trails, too.

In an optimal case, the skid trails run in parallel and with equal intervals. They have a width of about 4m (Erler 2005). The intervals are determined by the harvesting method and the used machines. To reach every tree in the mechanized process, the distance from the centerline of each skid trail to the next should not be greater than 20m. This is due to the usual cranes of forest machines that have a range about 10m. Different distances up to 60m to be found in practice (Erler and Hauptvogel 2004). Forest owners and forest managers forgo this narrow interval in favor of a wider distance (Faber 2008). There must be reasons which may be found in monetary and ecological terms. Three different intervals are distinguished for this study: 20m, 40m and 60m.

2.2 Effects of wheeling on skid trails

Soil protection

By interdiction the plane wheeling on forest soils, we protect a complex habitat as well as our economic base. The claim of protection and security is regulated by law. Certification systems demand this, too. The states of Germany implement this by guidelines.

Area loss

Still a part of the biologically-active forest land area gets lost permanently by the installation of skid trails (Erler 2005). How large this proportion is, is dependent on the chosen distance between the skid trails. The area loss is about 20% (at a distance of 20m), about 10% (at a distance of 10m), or approximately 7% (at a distance of 60m). The quantifying of this area loss causes some difficulties. Much of the scientific studies found no growth losses by reducing the production area (Jaeger 2012). This means that the forest value remains unchanged by the functional separation. Whether the wheeling of the skid trail leads to a restriction of another, subsequent use is another question that needs further theoretical considerations.

Restriction of silvicultural freedom

The system of skid trails restricted the forest manager in his decisions. 100% of the area is no longer available. In addition, trees in the direct nearness of the skid trails are not selectable during a positive selection, because the predisposition to harvest damages is too high. That means he has to get the same number of trees on a smaller area, with the result that the optimal tree spacing cannot be guaranteed, the trees are too close, or he has to reduce the number of elite trees.

The loss of area and the restriction of the silvicultural freedom increase with decreasing skid trail intervals. The harvesting method has only an indirect influence on it. Because both value influences cannot be measured, theoretical derivation will serve for qualification.

Degradation of the skid trail

Sometimes it comes to a soil translocation (viscous soil flowing) in addition to the compaction of soil by wheeling skid trails. The machine itself buries deeper and deeper in the ground and the wheels lose more and more traction. In the worst case no further movement is possible, because the machine sit on the floor

pan or the slip is nearly 100%, so the wheels rotate without a movement of the machine. In these cases, one speaks of the loss of technical trafficability. A staggered driving is conceivable, but this leads to biological degradation of soil and is not compatible with the various laws, requirements and economic goals.

Therefore, four different scenarios are possible for the simplified representation of reality:

- ⇒ The forests are managed carefully that the skid trail is not technically degraded and the method causes no additional costs. Therefore, it is referred to as the best method. The method can be used again and again; the technical drivability is maintained long term.
- ⇒ In another case, another method is used, which degrades the skid trail technically. A machine cannot drive on the trail at the next harvest.

The skid trail is technically degraded. Solutions must be found to drive again with machines.

- ⇒ To ensure the next wheeling, it is necessary to rehabilitate the skid trail. Consequently, the cost of rehabilitation has to be added to those of harvesting. In a follow-wheeling the cheapest method can be applied, because the risk of degradation does not exist. Nevertheless, regular maintenance costs will accrue for the skid trail.
- ⇒ In the next harvest, a method will be used, which is independent of the damaged skid trails. Rehabilitation is not necessary.

A visual degradation of the skid trail is possible, too. The visible damages disturb the forest visitors. The technical trafficability is not necessarily put into question. In this case, "cosmetic" measures are necessary to bring more social acceptance of timber harvest. The costs of this must be accounted for in the calculation.

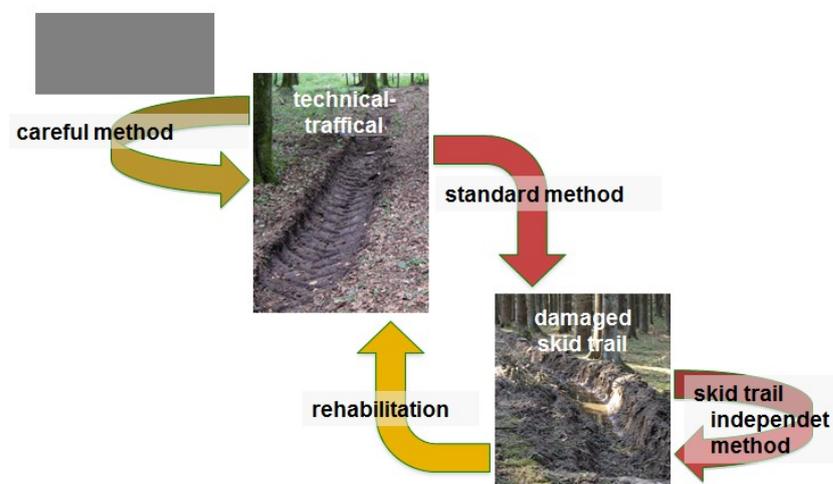


Figure 1: Four scenarios

The described problems do not play a special role on dry sites. However, on wetter sites it comes to heavy impairments to the skid trails, till the loss of technical trafficability.

3 Results

3.1 Economic model for mapping a harvesting operation

To evaluate the scenarios and various process alternatives, the following model was made:

Each forest has a value V . Economics describe the value with the capital holding. This is the sum of the discounted expecting cash flows from everlasting forest management.

A harvesting operation changes the forest. Silviculture can be understood as an investment in the forest. Consequently, there is a forest value before the measure V_{before} , and a value later V_{after} . First, the forest value is lowered by the removal of the timber. The tree growth closes this gap and the forest value increases. The "value gap" is not affected by the harvest method and is equal between the created scenarios. For this reason, it is set to zero to simplify the model.

Now, only with these two values we construct an economic balance sheet. V_b will be written on the expense side, V_a on the income side. Like any other investment, timber harvesting consumes resources and costs money. The harvesting costs will be written on the expense site of our balance sheet. The generated revenues are considered as income.

	income	expenses
befor:	value (t)	
harvesting:	sum of income	sum of expenses (disk.)
after:		value (t+1)
result:	profit in the period	

Figure 2: Balance sheet

3.2 Idealized model calculation

Now, the above scenarios serve as examples.

- ⇒ Scenario 1 - There is a careful harvest method with the costs C_{harv1} . No rehabilitation is required ($C_{\text{reha1}}=0$), so that the method is not changed. The forest value is conserved: $V_b=V_a$ (A decrease in revenue from the harvesting of wood is not taken into account as described above)
- ⇒ Scenario 2 - Imagine an intact forest with the value V_b1 . If an careless method is used, the skid trail is technically demoted. If the costs of this harvest method are lower than those of scenario 1, $C_{\text{harv1}} > C_{\text{reha2}}$, the net proceeds of this scenario are larger. First it seems appropriate from a business perspective. But as a result, the skid trails cannot be cruised. For a next harvest, the above alternatives are available (scenario 3 or 4).
- ⇒ Scenario 3 - The rehabilitation of degraded skid trails costs money, C_{reha} . If the sum of the periodic costs $C_{\text{harv2}} + C_{\text{reha}}$ is greater than the costs of the careful method C_{harv1} , future gains will be less. The manager has provided more expenses to achieve the same revenue. The future income streams sink and therefore the forest value sinks, too.
- ⇒ Scenario 4 - By using a skid trail-independent method the harvesting costs will increase ($C_{\text{harv3}} > C_{\text{harv1}}$). The forest value will sink accordingly.

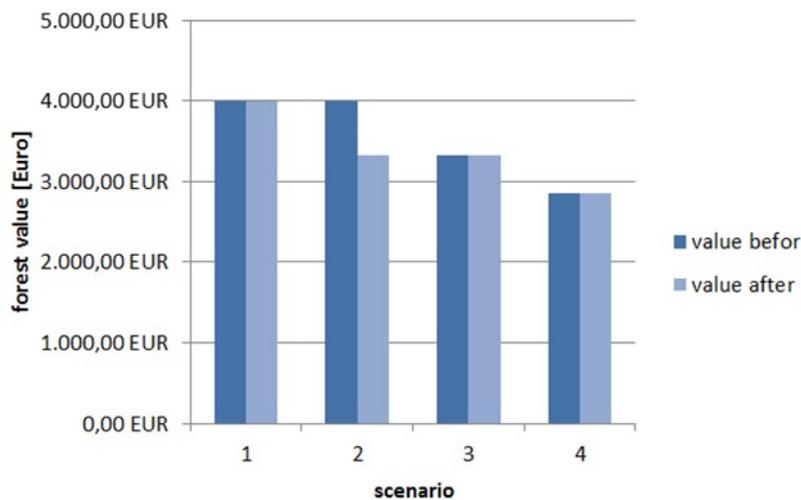


Figure 3: Forest values of the scenarios – an example

As it was shown by these simple examples, it is very important to include not only the harvesting costs into consideration. Rehabilitation costs and cost of the skid trail system have to take into account.

The probability of degradation of the skid trail does not only depend on the harvest method. Especially the soil plays a major role. The distance between the skid trails and the kind of machines have an influence, too.

4 Discussion

For the evaluation of various disposable timber harvesting methods some information are required. First, the functionality of the process has to be checked. Second, data on the rehabilitation are needed. There are questions like "What happens during a rehabilitation? Where is it necessary (in respect to the ground and the harvest procedure)? How much does it cost?". All information regarding the functionality and the rehabilitation will be collected by group discussions. The members of these groups are forest experts of the Saxon Public Forest Enterprise. The necessary cost and value calculations are based on these information.

The soil loss and the adverse effect on the silviculture will be incorporated theoretically into the model. They have a direct impact on the forest and its value.

5 Conclusion

The work should contribute significantly to the choice of the optimal harvesting process. The effects of mechanized harvesting are dependent on two dimensions. First, the soil moisture determines largely the probability of loss of technical trafficability and the need of additional costs.

On the other hand, the skid trail spacing has a significant influence on the change in forest value, while it affects the production area, the loss of silvicultural freedom and the degradation of the skid trail. Currently, the group discussion is to be prepared. It will serve to aggregate the experts opinions and provide the basis for the calculations of forest values.

These calculations are intended to represent the influence by harvesting method and skid trail spacing on the forest value. Site-specific recommendations can be made based on the results.

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