Interreg Alpine Space project - **NEWFOR**

Project number 2-3-2-FR

NEW technologies for a better mountain **FOR**est timber mobilization

Priority axis 2 - Accessibility and Connectivity

Workpackage: Costs & Benefits evaluation

»WoodChainManager« online tool for the visualization of production processes and cost estimates

http://www.newfor.net/fr/woodchainmanager-the-online-application-to-visualize-and-to-summarize-costs-of-the-forestry-wood-supply-chain/

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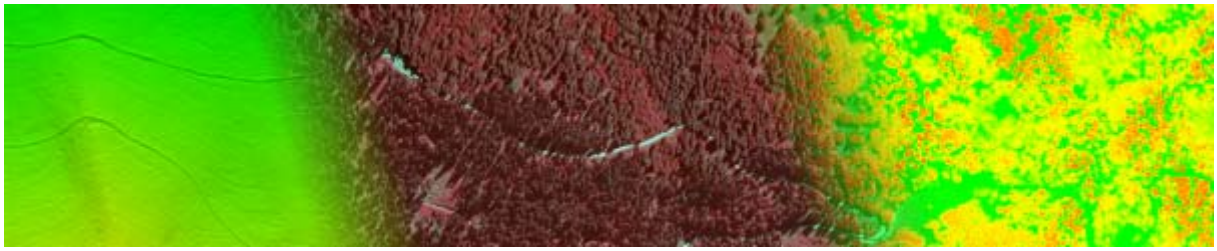
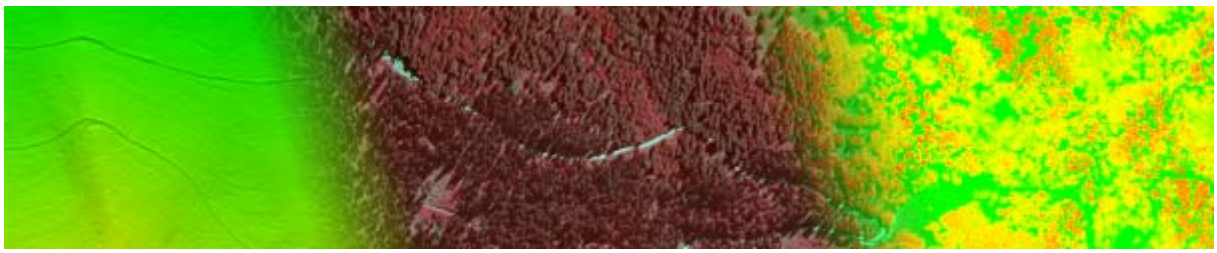
Final version 30/november/2014



The consortium of the project Interreg Alpine Space NEWFOR



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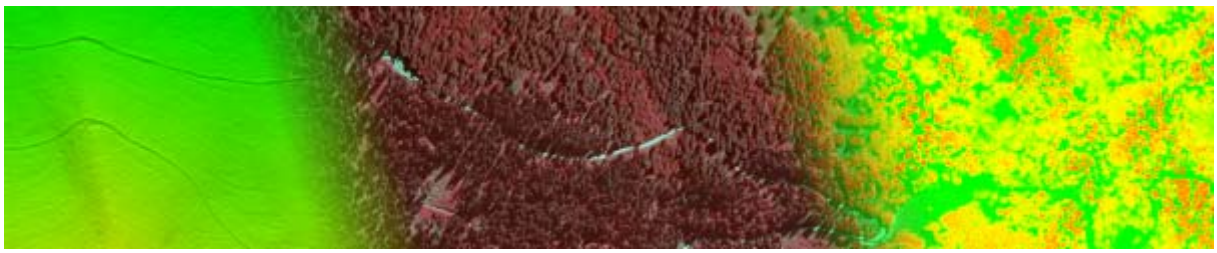
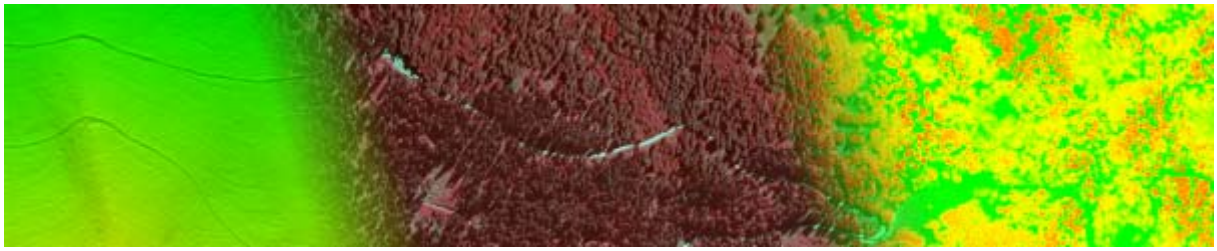


1 ABSTRACT

For a preliminary estimate of costs, an online tool for the visualization of production chains with accompanying calculations made in the business process (production, service) has been developed by the Slovenian Forestry Institute within the framework of »NewFor« (http://www.newfor.net/) international project.



2 A SYNTHETIC OVERVIEWOF THE INTERREG ALPINE SPACE PROJECT NEWFOR

2.1 THE CONTEXT

The role play by mountain forests is extremely varied. Their contributions to the stability and overall development of life and economic factors in mountainous regions are highly significant. Due mainly to topographic conditions, managing mountain forests is significantly more cost intensive than in plain ones. A good knowledge of forest biomass location, characteristics, mobilization conditions and connectivity to wood industry is a prerequisite for the development of a sustainable timber supply chain in mountain territories. This knowledge is currently insufficient to provide at reasonable costs, the required guarantees on the wood supply and on its sustainability. Improving an efficient and robust evaluation of the forest growing stocks (volume and quality) and its accessibility are the efficient measures to mobilise sustainably more wood from mountain forests. As building forest roads and other infrastructures are often complex and expensive, the availability of financial resources is a key challenge. This could be achieved by providing technology and financial support. With such knowledge and tools it will be then possible to develop an active and sustainable cultivation of mountain forests and an efficient European mountain forest management policy.

2.2 OBJECTIVES OF THE PROJECT

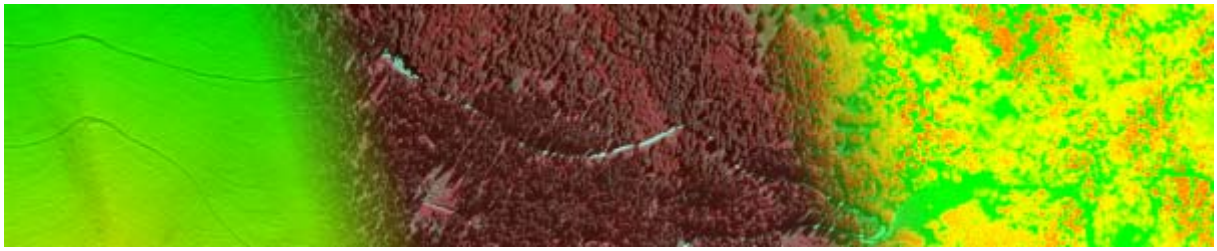
According to this context and based on the use of new technologies (LiDAR: light detection and ranging, Unmanned Aerial Vehicle,...) for forest and topography characterization, the project NEWFOR has been dedicated to enhance and develop tools and adapted policies for decision making in the field of a sustainable and adaptive mountain forest resources management facing the sustainability of mountain forest ecosystems services.

So, the main goal of the project NEWFOR is the improvement of accessibility to the forest for an economically effective wood harvesting and transport related to a sustainable forest management and wood industry in Changing Climate. The 14 partners involved in the project's consortium, have broken down this main goal into five thematic workpackages (wp):

- Forest resources and LiDAR

  Recent developments in LiDAR technology, combined to other available data sources (aerial photographs, aerial photo series by UAVs, …), are now allowing a precise and fine mountain forest resource quantification, qualification and mapping. Integrating this technology will provide an innovative response to the challenges of a precise and robust knowledge on the available growing stocks. The actions of this wp had for objective to test and develop tools for the use by foresters of data coming from this new technology.

- Forest accessibility



After the identification of forest resources, the second step of an efficient forest management is to evaluate the accessibility to these resources. In mountain area the slope is the main constraint to a technical and economically efficient exploitation. This wp demonstrated how to use topographic LiDAR data coupled with geographic information systems (GIS) for an optimal planning of the opening-up of forests according to the current accessibility of forest resources.

- Forest and industry connectivity

Since the forest resources and its accessibility are characterized, then the question of the actors of the wood supply chain is how to feed the wood market from the forest to the wood users? In other terms, the question is: what is the real connectivity between the wood at the road side (inside the forest) and the wood at the mill's timber yard? The objective of this wp was to answer to this question.

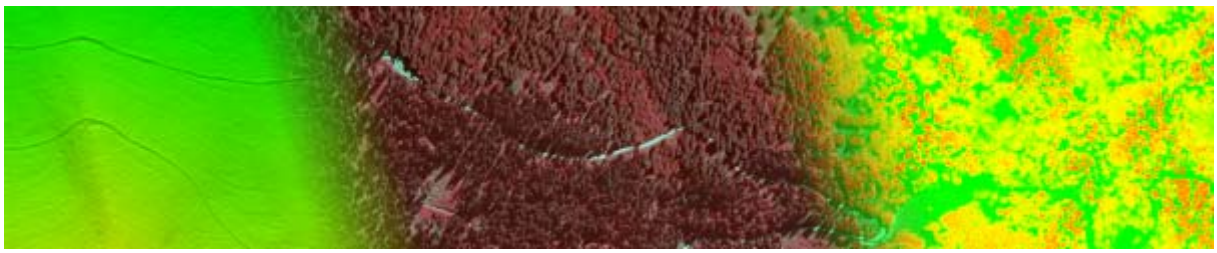
- Costs and benefits evaluation

NEWFOR aims to develop helping decision tools dedicated to defining strategies for sustainable mountain wood supply chain. To fulfil this objective the 3 first workpackages (see above) have been building up with the objective of developing tools for identifying forest resources, their accessibility and connectivity to the wood market. In order to achieve the demarche, and to choose the optimal strategy, it's necessary to evaluate, from the economical aspect, the costs and benefits of each possible strategies. This was the objective of this wp.

- Logistical planning strategy

There is a need to frequently adjust the planning of forest management to new economical evidence as well as to unforeseeable developments. Such an adaptive management needs to balance ecological, social and economic factors. The main objective of this wp was to provide forest managers and decision makers with reliable information for the evaluation of technical and economical conditions for their decision-making on timber supply chain logistical planning and land use strategies.

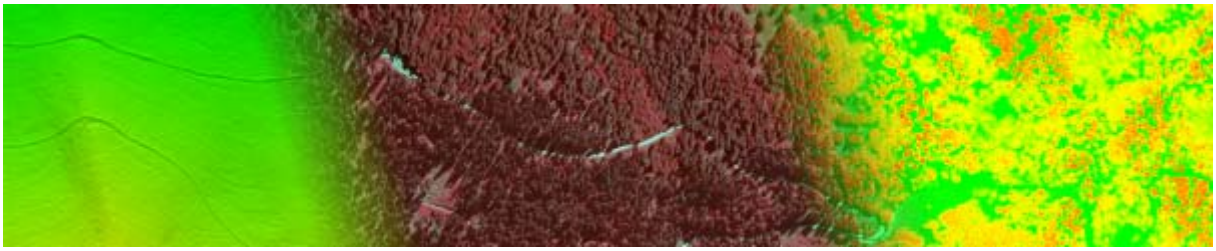
This project has been, co-funded by the European Regional Development Funds, and achieved under the third call of the European Territorial Cooperation Alpine Space Programme 2007-2013.



3 PRESENTATION AND USE OF THE TOOL WCM

3.1 GENERAL OVERVIEW

For a preliminary estimate of costs, an online tool for the visualization of production chains with accompanying calculations made in the business process (production, service) has been developed by the Slovenian Forestry Institute within the framework of »NewFor« (http://www.newfor.net/) international project. The very first forms of production chain visualization are found in literature from the early 1970s and can partially be associated with the time when machine cutting began to be practised in the forests. The visual approach in description of technological systems is no novelty in Slovenia either, although it has so far been used more or less for research purposes only, i.e. as a tool for easier understanding of differences between technological systems. The basic tool for description of technological models is the matrix, which visualizes cutting and haulage from the standing tree in the forest stand to the forest products at the final user. Changes in the processing of trees (e.g. standing trees, trunkwood and logging residues, roundwood (assortments), woodchips) are thus arranged on the ordinate axis. On the abscissa, on the other hand, the course of hauling or transport from the standing tree via different categories of forest roads to the warehouse on the forest (truck) road and finally warehouse at the final user (biomass logistics centre, sawmill, boiler room …) is defined. The intersections in the matrix indicate the places where certain process or the state in conversion of forestry-wood assortment is modified (e.g. limbing or final cross cutting can be carried out in the stand on the skid-road or even on forest road). This online tool has been named »WoodChainManager« and is freely accessible by all users at http://wcm.gozdis.si/. The user independently determines which processes or operations will be implemented or included in the forest production chain (cutting, limbing/ bucking, cross-cut, making of woodchips, haulage/transport) and the location where they are to be carried out (forest stand, skid trail, skid road…). Hereinafter, the online tool automatically offers the user a range of technologies with which he can implement the selected operations at selected localities. In the operations that envisage shifts along thoroughfares (hauling or transport) as well, he also selects the locality where transport is to end. Algorithm of the online tool uses logical controls that enable the user to select unreal production chains or lead him to the selection of a logical and real combination of machines. Here the user can choose between several different machines and their appertaining additional equipment, such as various types and versions of adaptive machines for tractors (winches, forestry trailers…) and additional equipment for tractors (safety cabin, chains …).



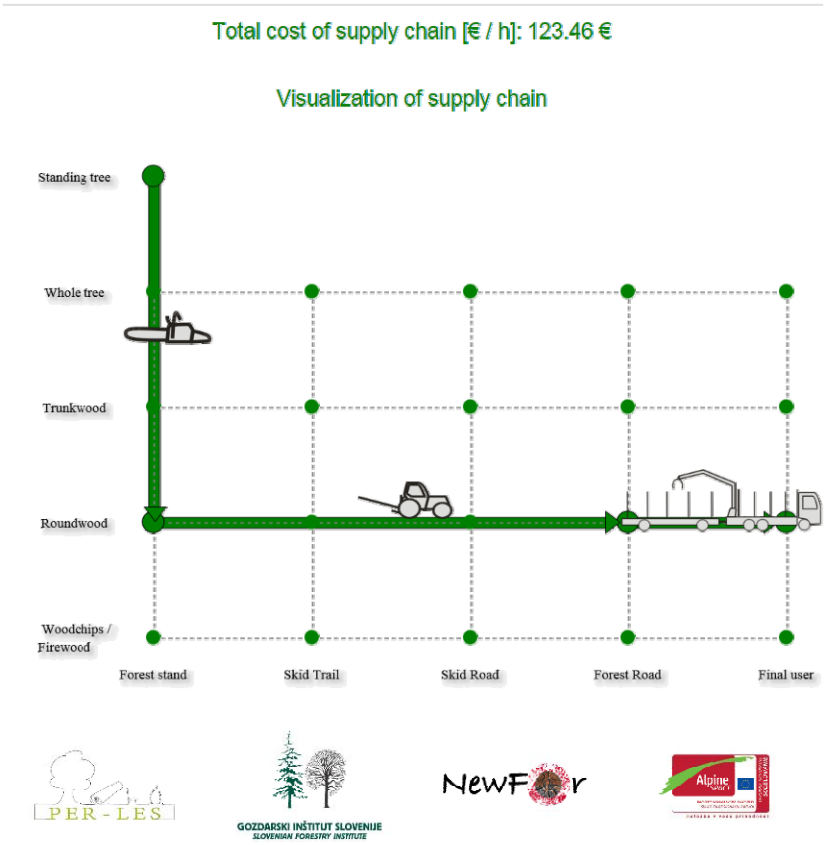
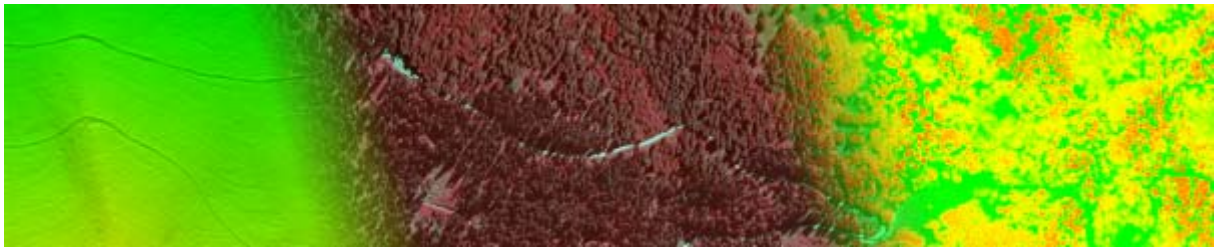


Figure 1: Visualization of forestry-wood chain using the online tool

3.2 HOW TO USE THE WCM TOOL

In the first phase of the online tool's development for visualization of forestry-wood production chains, the tool with calculations of mechanization costs was additionally equipped. We focused on the simple cost calculation method, which at the same time reflects the state of actual costs in the forestry production chain. The online tool offers the user a range of standard parameters or cost items. The more demanding users, however, have the opportunity of changing the offered average values with their own data (e.g. engine power, annual use, purchase value…).



Parametri strojev

Stroj	Traktor - štirikolesni pogon (75-94 kW)	Traktor - štirikoles
Moč motorja	85.00	kW 85
Nabavna vrednost	41,700.00	€ 41.700
Amortizacijska doba	12.00	Year 12
Amortizacijska doba	10,000.00	Hours 10.000
Letna raba	500.00	Hours 500
Vrsta goriva	1.00	1
Faktor vzdrževanja*100	0.80	% 0,8
Fiksni stroški v €/leto	5,977.00	€/Year 5.977
Fiksni stroški v €/uro	11.95	€/Hour 11,95
Variabilni stroški goriva in maziva	17.12	€/Hour 17,12
Variabilni stroški vzdrževanja v €/h	3.34	€/Hour 3,34
Stroški skupaj v €/h	32.41	€/Hour 32,41

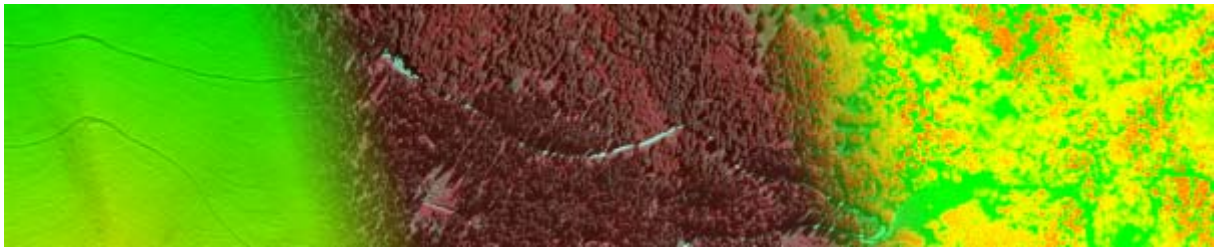
Shranite parametre

Figure 2 : Calculation of costs for the selected technology enables a simple input of one's own parameters (e.g. purchase value, annual use…).

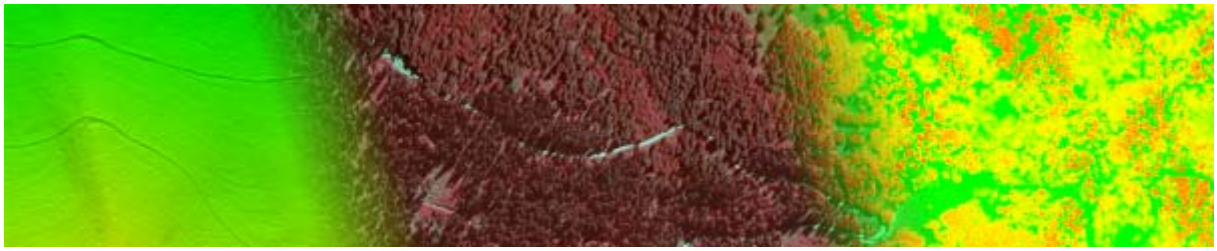
3.2.1 AN EXAMPLE OF USE

For a better understanding of the online tool's functioning, individual steps from the entry in the tool to the successfully created production chain are presented hereinafter. (①) – the number in parenthesis indicates commands (mouse click). Each step in the instructions is furnished with serial numbers of commands. Commands are followed by turns; they cannot be skipped and are recommended not to be repeated in order to implement them successfully (if the command (①) has already been executed, it is not to be repeated). With each step, the sequence begins again.

① Picture of the palm equipped with number indicates the place on the picture where confirmation of command is envisaged (click) in the WoodChainManager online tool.

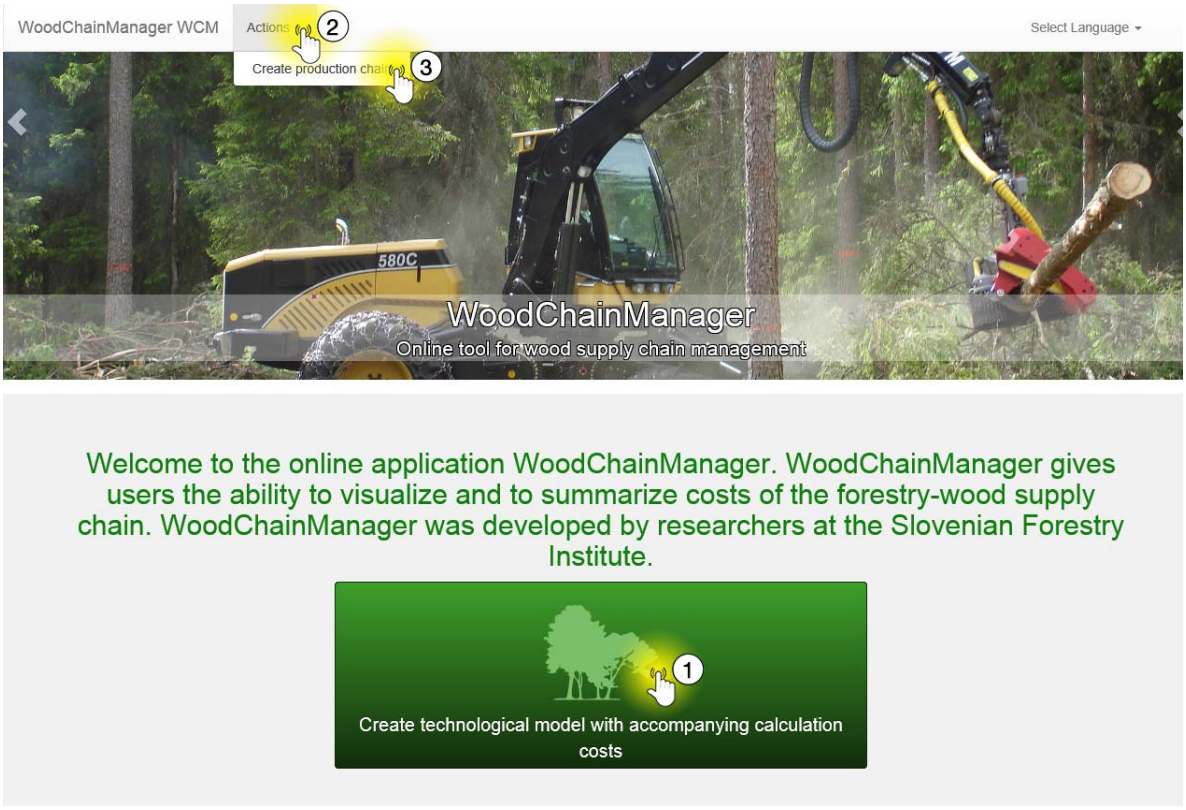


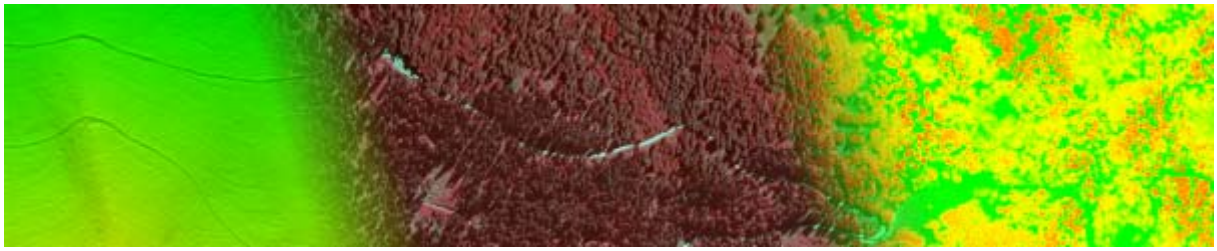
Example:
Example of the WoodChainManager online tool's use is presented in one of the most classical types of forest production, i.e. combination of standard cutting with chainsaw and hauling with tractor. The production chain begins in forest stand, when wood cutter fells a tree, delimbs it and cuts the stem top off. This is followed by hauling of roundwood with tractor and use of winch along the skid-road to the forest road. This technological model involves the system of stemwood hauling according to the so-called full-length method, given that tractor driver saws the trunkwood with chainsaw (after disconnecting the cables and prior to wood levelling) into assortments only in the timber yard at forest road. Transport of assortments from forest road to the final user is envisaged with forest transport composition.
To simplify it all, the text is divided into separate forest production phases:
Phase 1: Cutting and trimming with chainsaw in forest stand
Phase 2: Hauling with tractor to forest road
Phase 3: Sawing (bucking) and making of assortments on forest road
Phase 4: Transport of assortments to end user with forest transport composition



3.2.2 STEP 1

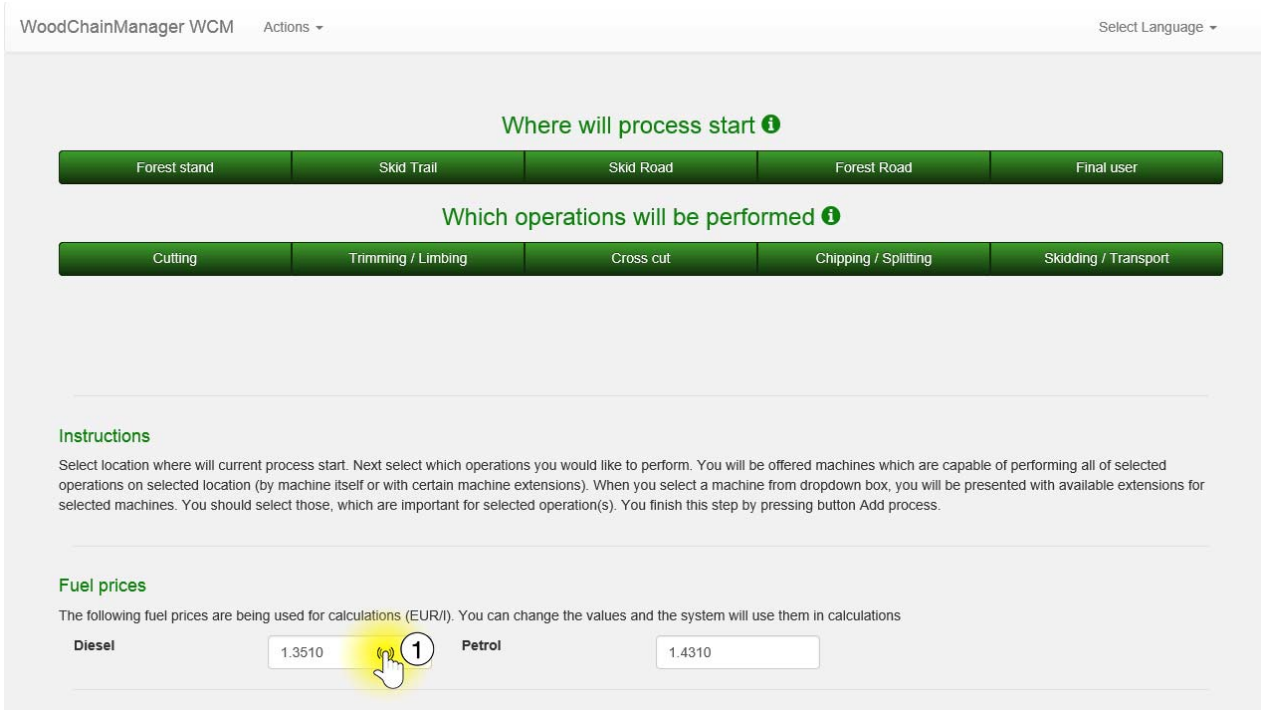
By clicking on the box »Create technological model with accompanying calculation costs« (①) on the entry page, the process of production chain preparation is started. This can also be done by using the drop-down menu »Actions« (②), where the box »Create production chain« (③) is found.

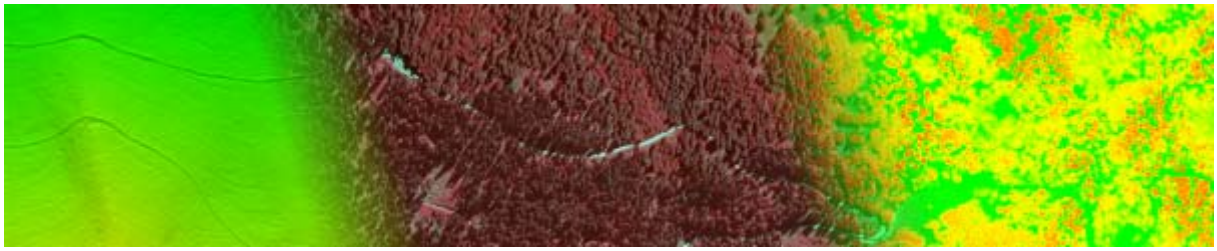




3.2.3 STEP 2

During step 2, the price of fuel is initially stipulated by clicking on the box »Petrol« or »Diesel« (①) and new value entered. Fuel prices are, otherwise, automatically updated each Tuesday.

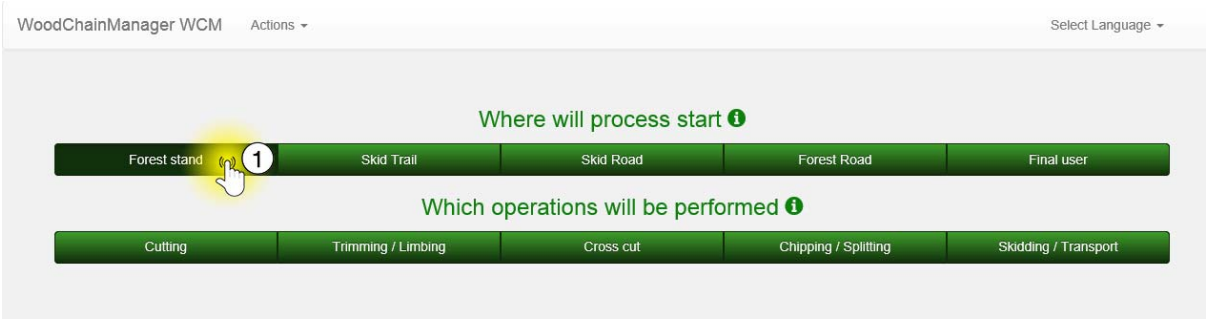


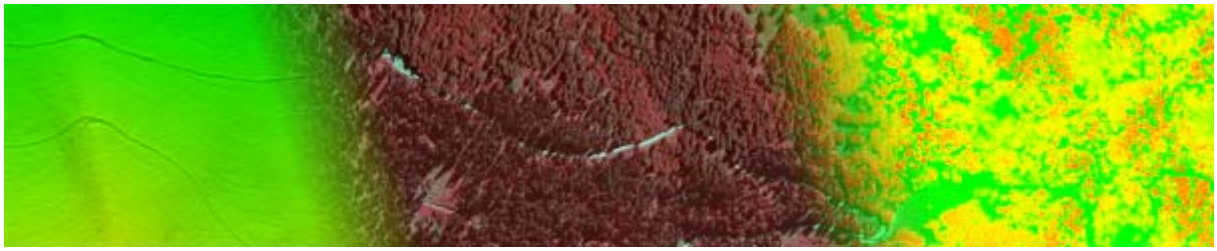


3.2.4 STEP 3

During step 3, the location where production chain is to start is stipulated. This is done by clicking on one of the locations offered in advance (forest stand, skid trail, skid road, forest road or final user) (①).

Example: In the chosen example, production begins in forest stand, which is why the selected location turns to a darker colour when clicking on the box »Forest stand« (①).

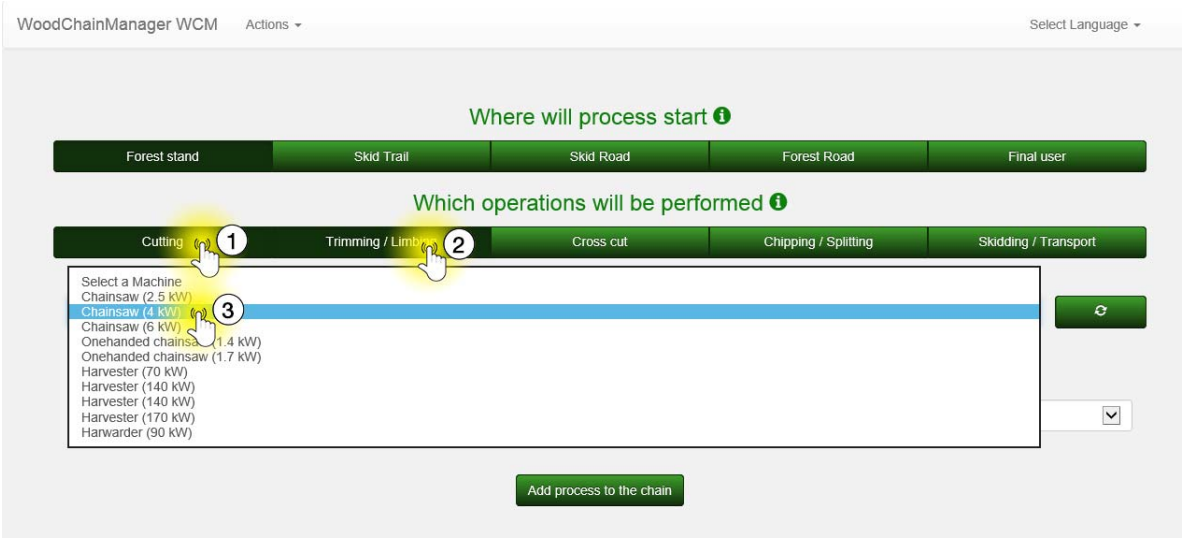


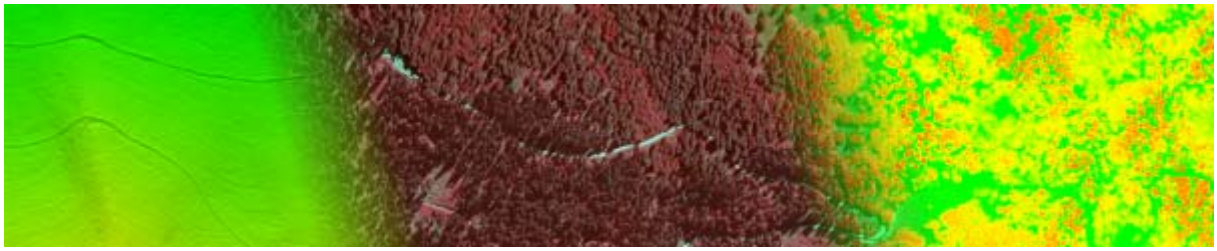


3.2.5 STEP 4

During step 4, we have to choose among the processes we wish to implement on selected location, stipulated during the preceding step. We can choose among five processes stipulated in advance, i.e. cutting, trimming , cross cutting (sawing through), making of chips or firewood and hauling or transport. Hereinafter, the online tool automatically offers us the range of technologies that can carry out the selected processes on selected location. If the process »Skidding / Transport« is chosen, the online tool automatically offers us the selection of locations, where the process of hauling or transport is to end.

Example: In the selected example, wood cutter fells and delimbs a tree. This is why both "Cutting" (1) and "Trimming / Limbing" (2) are selected with a click. A few seconds later the programme offers us a selection of technologies, amongst which the appropriate is chosen (chainsaw in the selected example) (3).

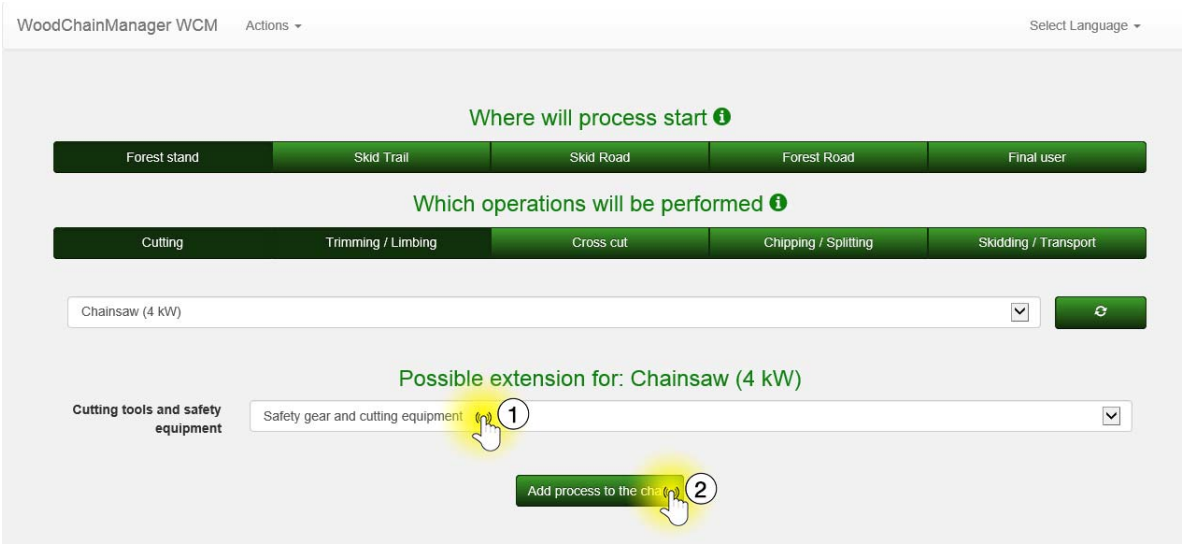


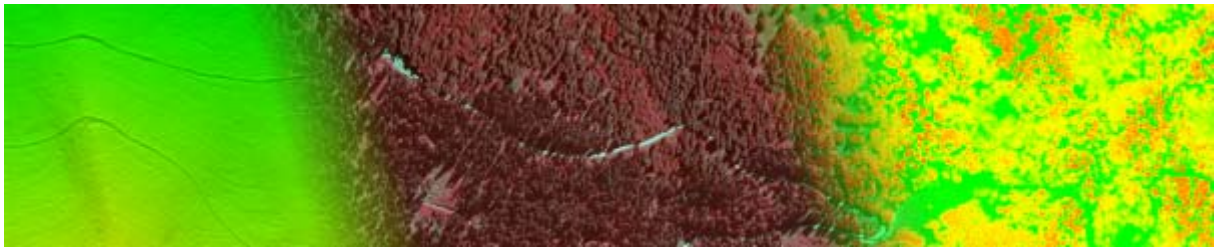


3.2.6 STEP 5

If accessories or upgrades exist for the technology selected during step 4, we can choose among possible accessories during step 5 (①). The selected technology and processes are included in production chain with click on the box »Add process to the chain« (②).

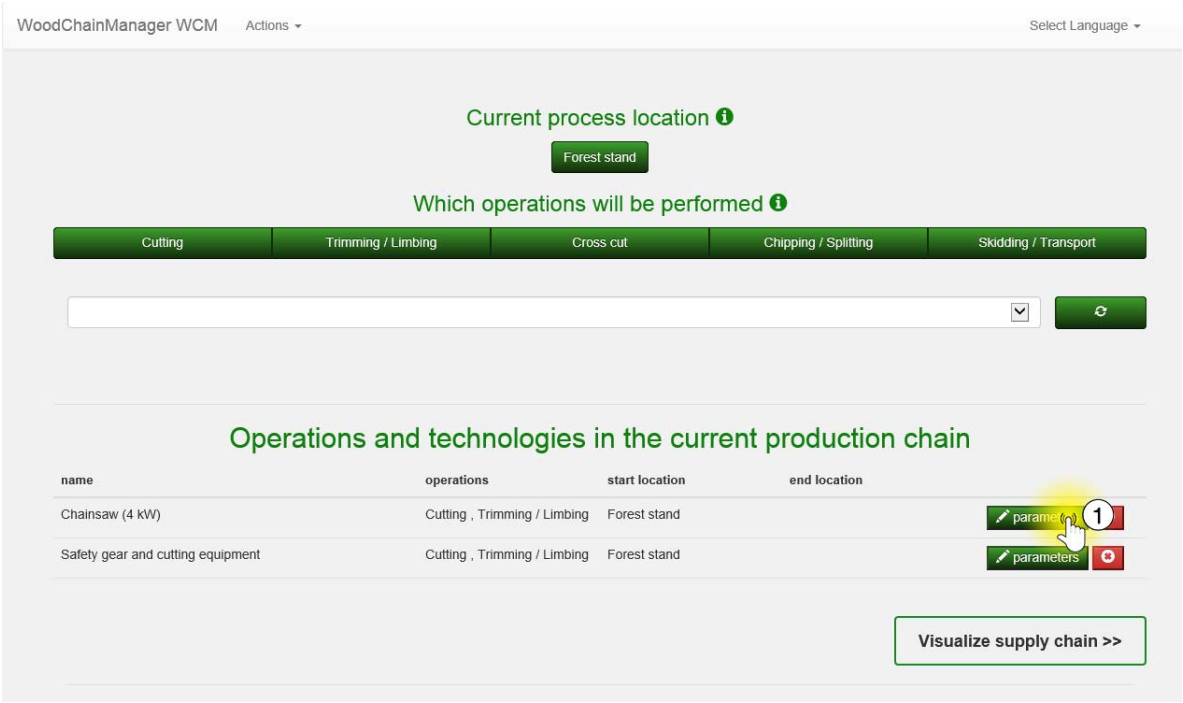
Example: In the chosen example, we can also select the accessory »Safety dear and cutting equipment« (①) and end with a click on the box »Add process to the chain« (②).



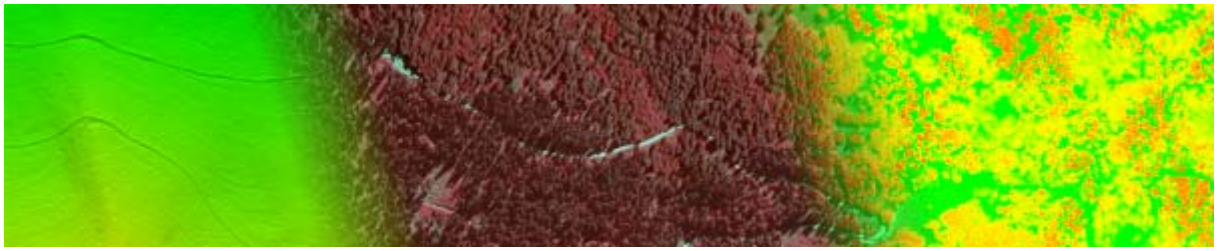


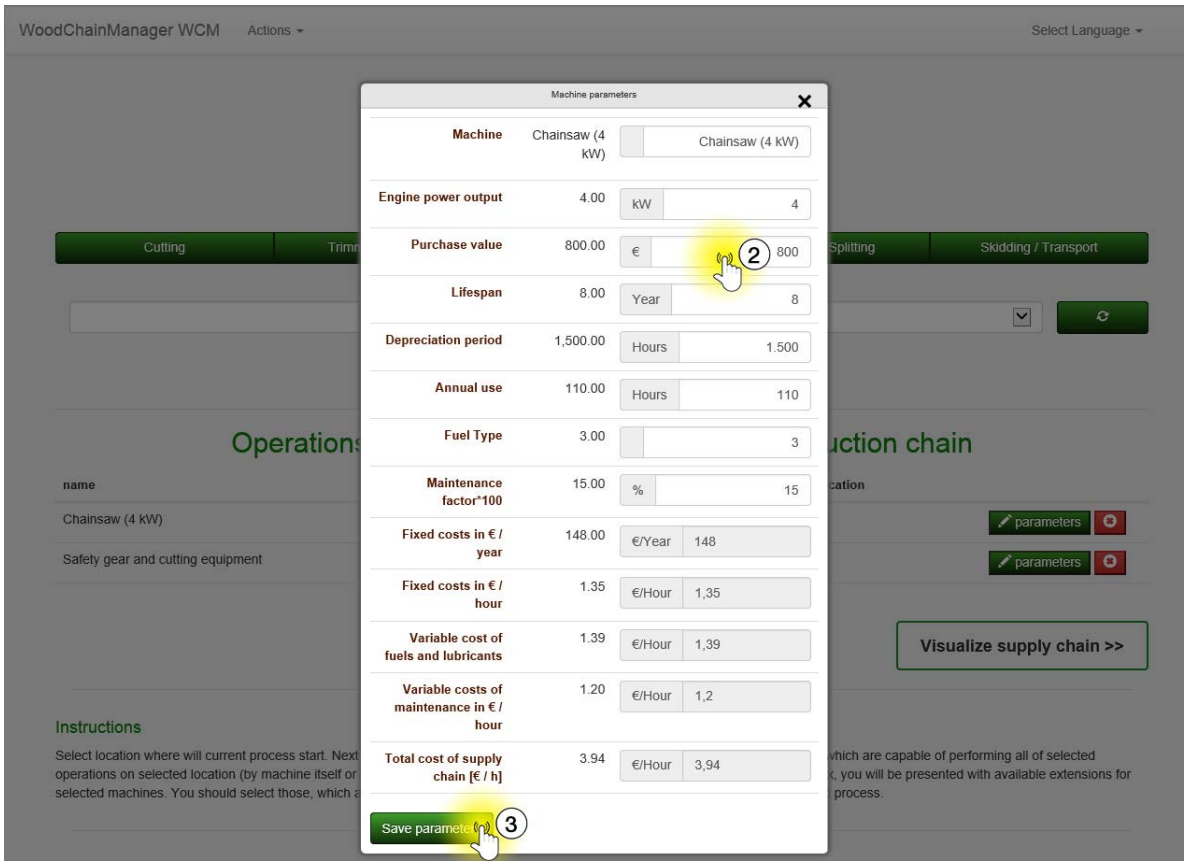
3.2.7 STEP 6

As soon as the user successfully concludes the entry of the first process (technology) into production chain, he gets control over the selected technologies and information on operation with location.



The online calculation tool utilizes parameters (data) stipulated in advance for all available technologies. The user can view the input data with a click on the »parameters« box (①). With a click on the box of individual parameter (②), the user can change certain data or enters the data that concern his technology (e.g. purchase value) or his conditions of work (e.g. annual use). The grey coloured boxed represent the already calculated parameters (or factors), which therefore cannot be changed. The user confirms the change in parameters with a click on the »Save parameters« box« (③).

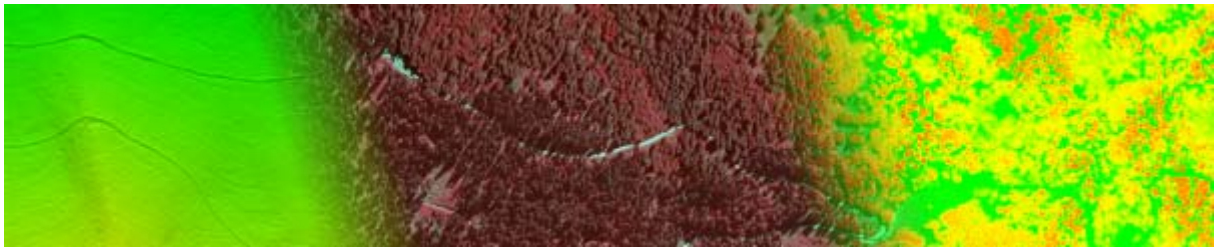


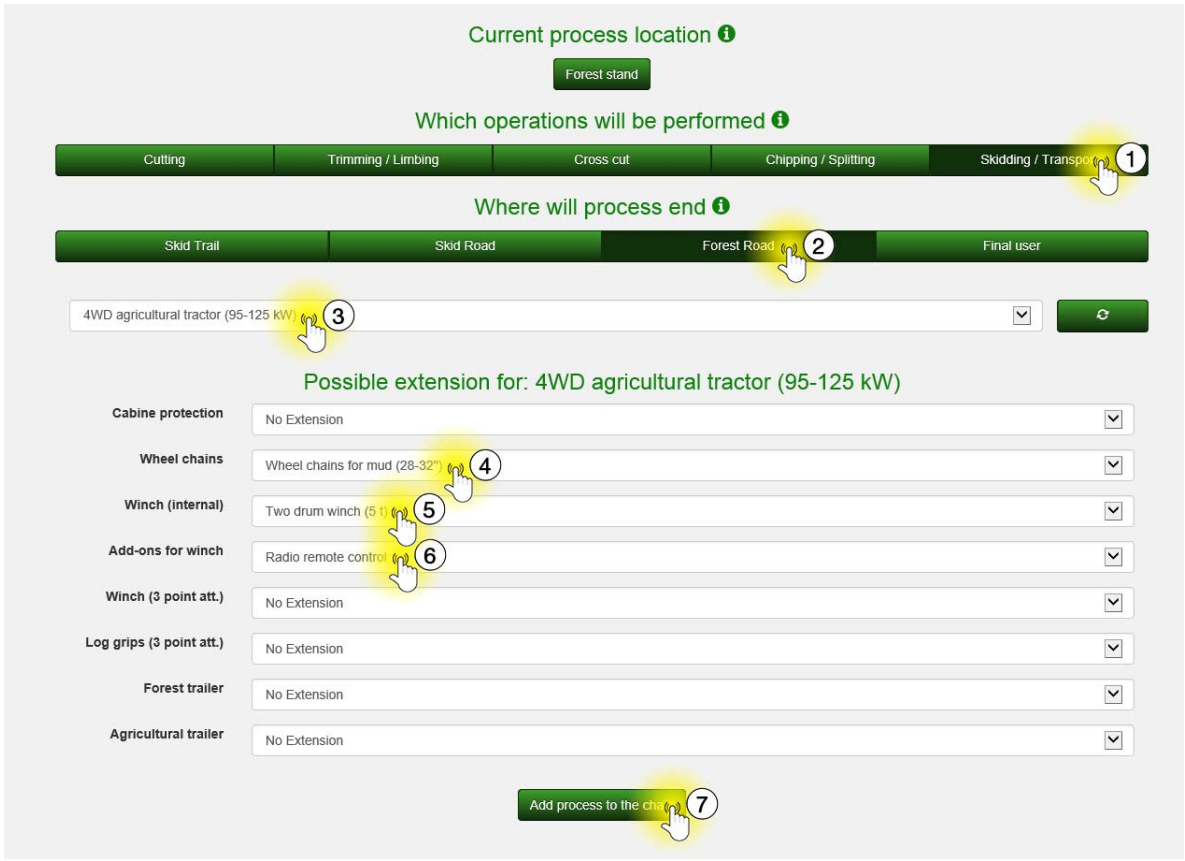


3.2.8 STEP 7

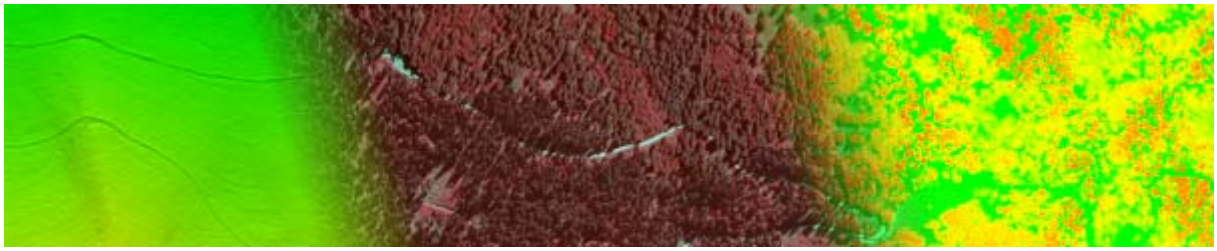
Hereinafter, steps 4, 5 and 6 are repeated, until all processes or envisaged technologies for the selected production chain are entered. Step 3 does not need to be repeated, considering that the WoodChainManager online tool already knows the place of the current process on the basis of preliminary steps, which means that it does not need to be stipulated once more and cannot be changed at the same time as well.

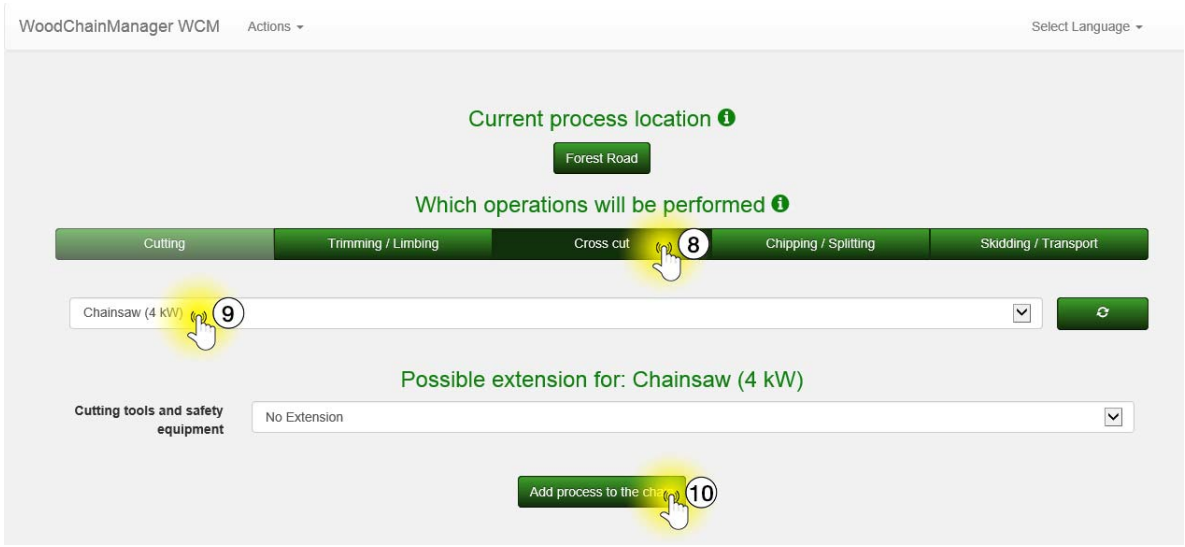
Example: Production chain is continued within the selected example with tractor haulage to the truck (forest) road, and as the online tool already knows the place of current process from preliminary steps, this does not need to be stipulated any longer. The process »Skidding / Transport« (①) is selected, then »Forest road« (②) stipulated as location where the process is to be terminated, and a suitable technology (e.g. 4WD Agricultural tractor…) selected from the range of technologies (③). After choosing the technology, suitable accessories are selected as well. In the event of tractor hauling, numerous upgrades are possible (e.g. forestry wheel chains (④),built-in winch (5t) (⑤) and radio control (⑥)). It is therefore necessary to consider what we shall add, given that every accessory brings additional costs to the production chain. With a click on the box »Add process to the chain« (⑦) we conclude the matter and



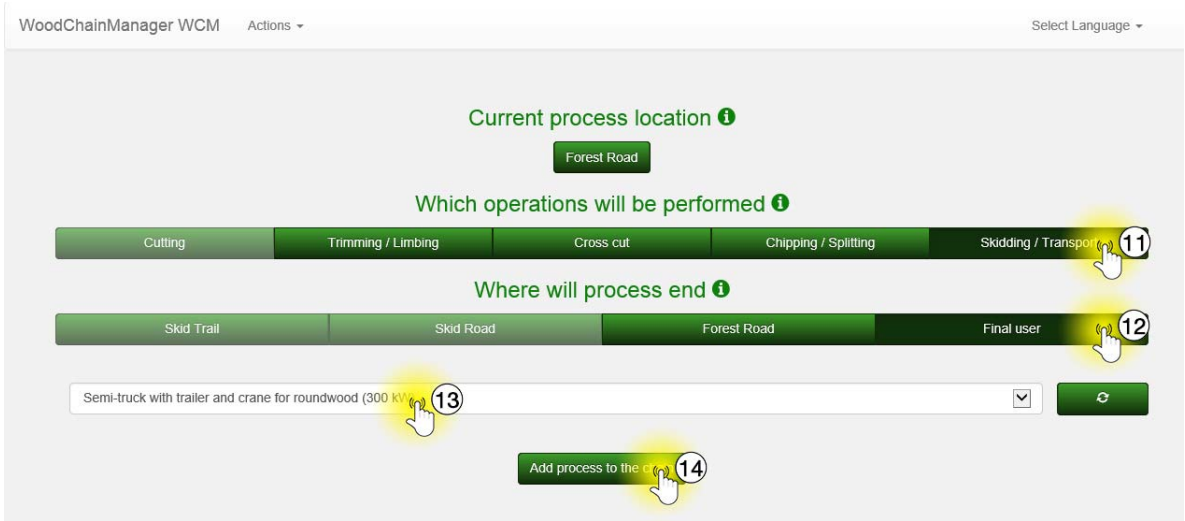


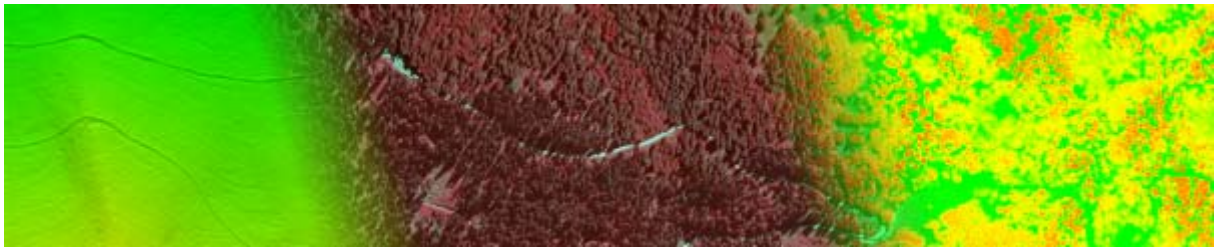
Example: In the selected production chain, transverse cutting of stemwood is envisaged on the truck road as well, which is the reason why we select the mentioned process (»Bucking/transverse cutting (8) and chainsaw (9) or technology with which the selected process is to be implemented. With a click on the box »Add process to the chain« (10) we conclude the matter and hereinafter examine the parameters as described in step 6.





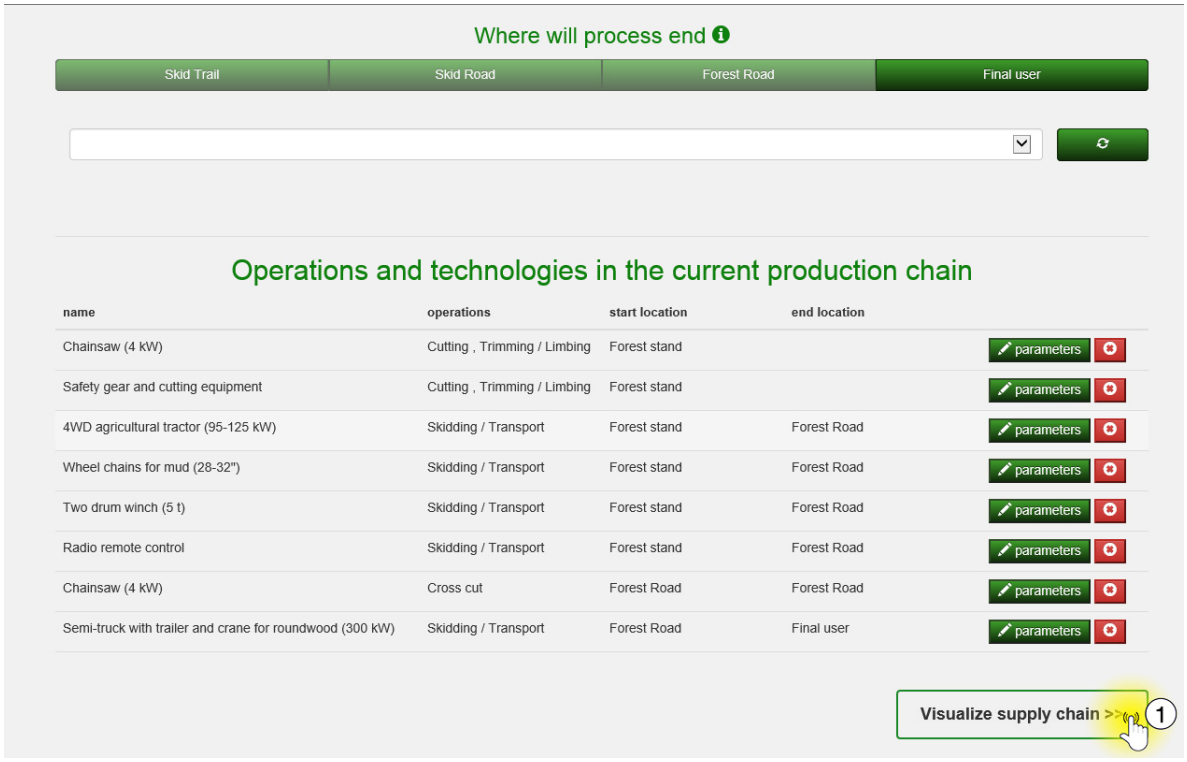
As the selected production chain ends with transport of assortments to the final user with forestry transport composition, the above mentioned process (»Skidding / Transport«) (11) is selected, as well as the location where this process is terminated (»Final user«) (12) and technology with which we wish to implement the selected process (e.g.. »Semi-truck for roundwood with crane and trailer«) (13). With a click on the box »Add process to the chain« (14) we conclude the matter and hereinafter examine the parameters as described in step 6.

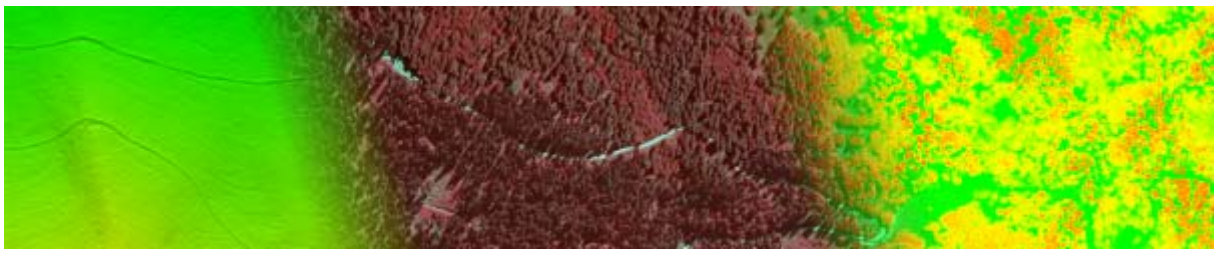




3.2.9 STEP 8

In the last step we are left only with conclusion or, in the first place, a review of all selected machines / technologies in the production chain. If all operations and technologies envisaged in the selected production chain are stated in the list of processes (see under »Operations and technologies in the current production chain«), there follows only a confirmation, together with a graphic display of production (»Visualize supply chain« (1)).

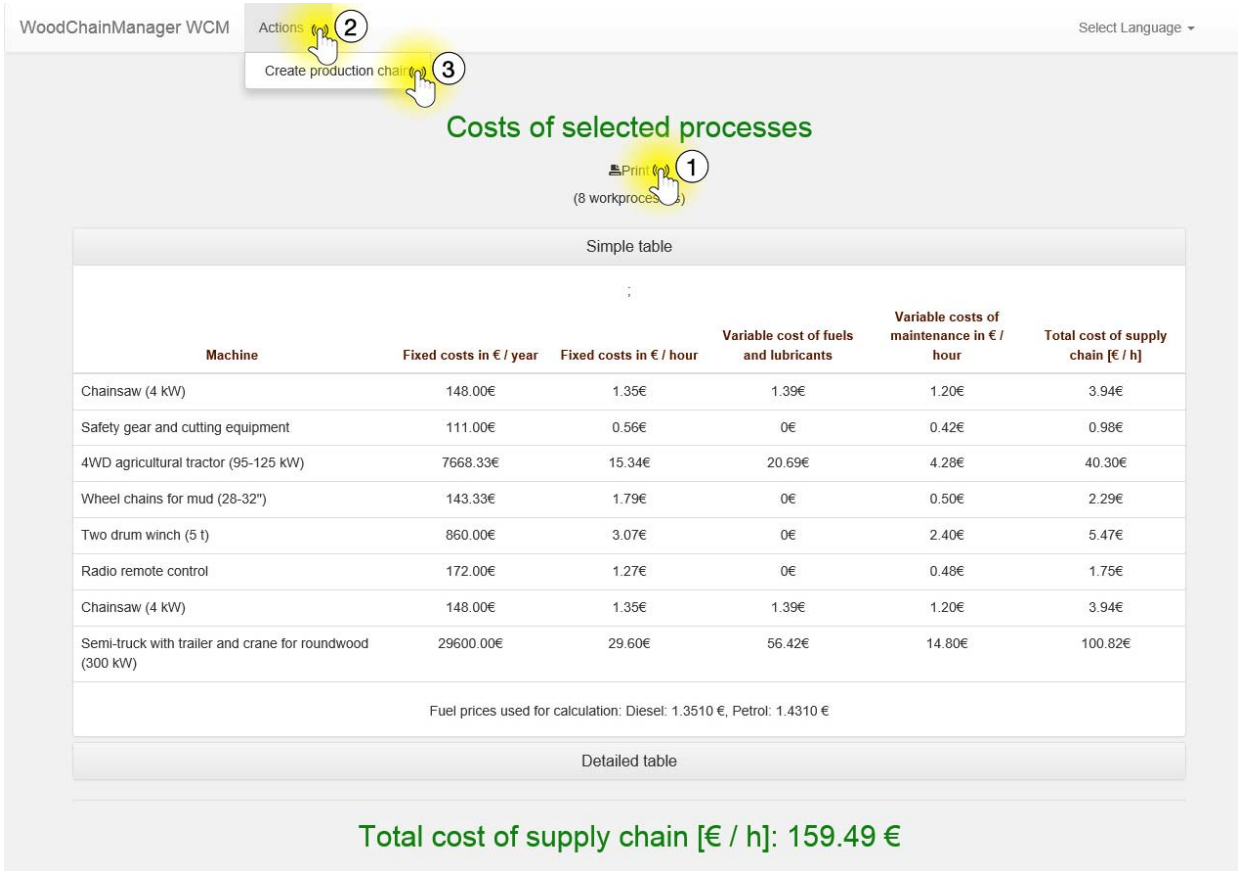




3.2.10 STEP 9 – VISUALISATION OF PRODUCTION CHAIN WITH ACCOMPANYING CALCULATIONS

After a successful selection of all operations and technologies, the online tool offers the user a report that includes:

- Costs of mechanization in the selected production chain (with a possibility of simplified and detailed display) and total costs of the selected production chain;



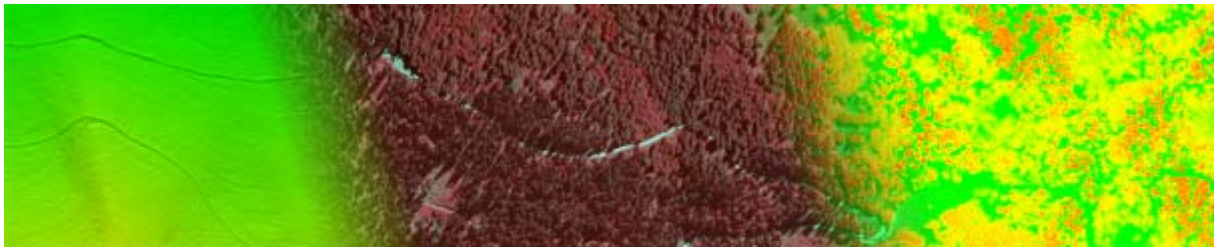
Simple table

Machine	Fixed costs in € / year	Fixed costs in € / hour	Variable cost of fuels and lubricants	Variable costs of maintenance in € / hour	Total cost of supply chain [€ / h]
Chainsaw (4 kW)	148.00€	1.35€	1.39€	1.20€	3.94€
Safety gear and cutting equipment	111.00€	0.56€	0€	0.42€	0.98€
4WD agricultural tractor (95-125 kW)	7668.33€	15.34€	20.69€	4.28€	40.30€
Wheel chains for mud (28-32")	143.33€	1.79€	0€	0.50€	2.29€
Two drum winch (5 t)	860.00€	3.07€	0€	2.40€	5.47€
Radio remote control	172.00€	1.27€	0€	0.48€	1.75€
Chainsaw (4 kW)	148.00€	1.35€	1.39€	1.20€	3.94€
Semi-truck with trailer and crane for roundwood (300 kW)	29600.00€	29.60€	56.42€	14.80€	100.82€

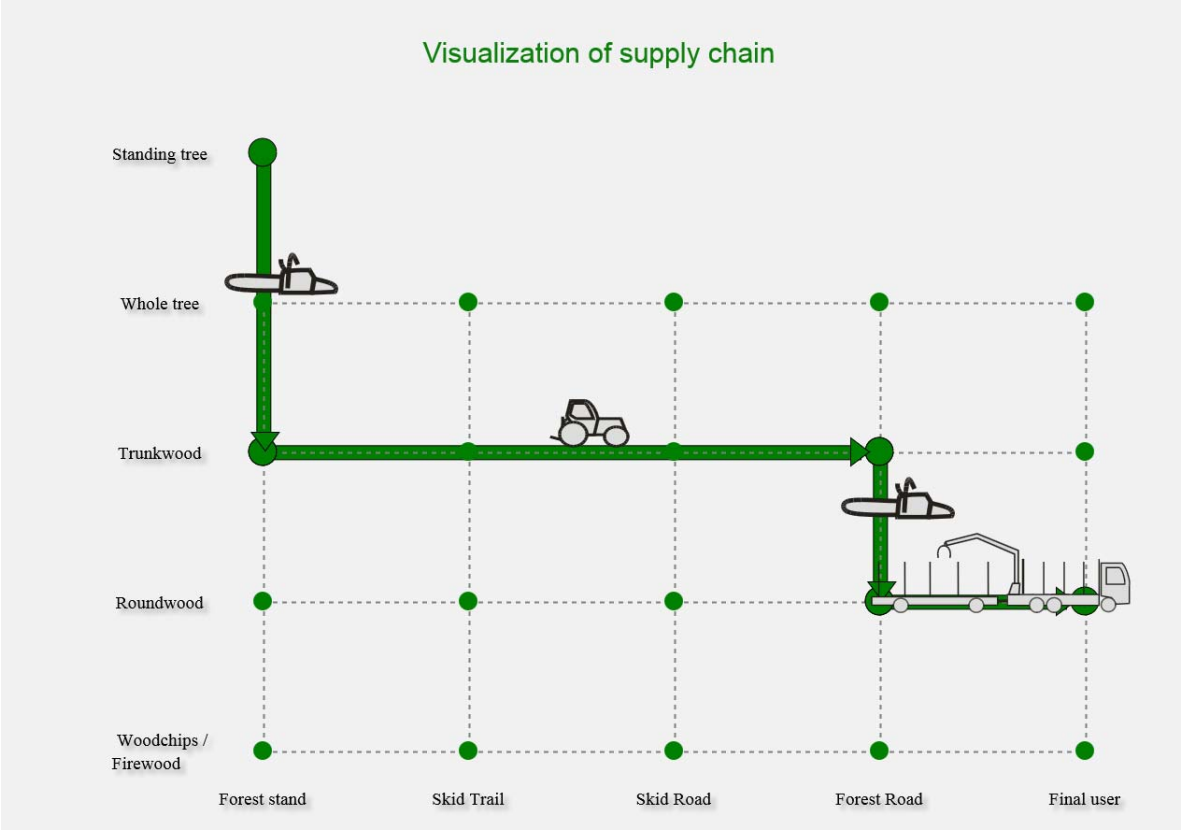
Fuel prices used for calculation: Diesel: 1.3510 €, Petrol: 1.4310 €

Detailed table

Total cost of supply chain [€ / h]: 159.49 €

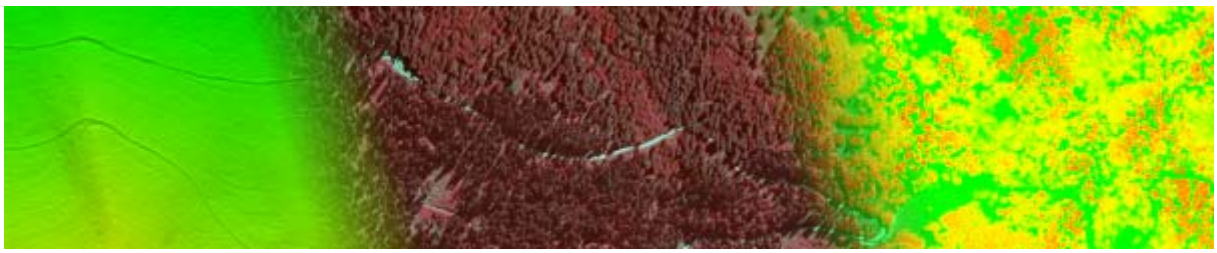


- and a sketch of forestry-wood production chain.



The user has the option of printing the prepared report by pressing »Print« (①) or saving it in electronic form. On the basis of several prepared reports, the user has a good control over different production chains. To prepare a new technological model or chain, click on the box "Actions" (②) in the upper left corner and on the box "Create production chain" (③) and start composing a new chain (we are at step 2).

Calculation of total costs per hour and visualization of selected forestry production chain renders the user a solid preliminary estimate of costs. Further development of the online tool depends on its financing, but in any event it would be reasonable to carry on with its development and upgrading the tool with additional economic and environmental components that play an important role in forest production – apart from attempting to enable a direct mutual comparison of various forestry-wood chains and thus to bring the tool even closer to the user's requirements. We wish to upgrade cost calculation in such a way that calculation of costs per production unit (e.g. €/m3) will be enabled as well. Within the environmental component framework, we are aiming at developing a decision-making tool, aimed at assessing the adequacy of selected technologies in forestry-wood chain in view of the given terrain and weather conditions. This decision-making tool can also serve as a device in the implementation planning or preparation of work.



With the use of this decision-making tool we indeed do not achieve a direct production rationalization, but present the environmental aspect of production chains in the woods. The decision-making tool is in the first place intended for preparation of work, although it is also useful in the implementation of operations in changing working conditions (e.g. dampness at worksite or machine failure, due to which substitution mechanization is to be selected or additional / unforeseen machine used to fill the capacities).

For a preliminary estimate of costs, an online tool for the visualization of production chains with accompanying calculations made in the business process (production, service) has been developed by the Slovenian Forestry Institute within the framework of »NewFor« (http://www.newfor.net/) international project. The very first forms of production chain visualization are found in literature from the early 1970s and can partially be associated with the time when machine cutting began to be practised in the forests. The visual approach in description of technological systems