PLANET
CHANGE

Salmon and rainforest

Teachers manual

Planet change is the short name of an EU Erasmus+ project aimed at VET teachers and their students. With small activities, the idea is to create awareness about sustainability and acquire 21st century skills. All this is done in a technical context, mostly from space technology.

www.planetchange.eu

Contents:

1. General information

Duration: 2 x 45 minutes

Target group: 16-20 y.o.

European qualifications framework level: 3-4

Materials: Computer with internet connection

Software: Google Earth Pro. Students will use *Google Earth Pro* to complete the first part of the activity. The software must be installed in the computers. The instructions are described in the task. This application is easy to use, and the activity explains step by step how to proceed.

Teacher preparation: study background information, materials listed with the activity

Topic

Themes: Agriculture, climate change

Keywords: sustainability, deforestation, food production, data collection, data analysis, earth observations, 21st century skills

Activity

Goals

The objective of this activity is to study fish farming as a possible factor contributing to the deforestation in Amazonia. Students will go through different sources to explore this correlation. They will analyse the origin of the food used for fish farming and make calculations of the forest area needed for salmon production. Finally, they will search for more sustainable ways for this important sector.

Learning Objectives

The student will get better knowledge and training about

1. The importance of using space:
    a. How to use satellite images to monitor the anthropogenic impact
    b. How to use satellite images to follow deforestation

2. How aquaculture is affecting deforestation and reasons behind

3. Comparison with the impact on deforestation of other food industry like poultry, pigs and sheeps.

4. Make calculations to relate production, resources, and impact on the environment.

5. How to make the salmon industry more environmentally friendly.

6. Training of 21st Century skills including:
    a. Media literacy: find and gather relevant information
    b. Critical thinking
    c. Collaboration
    d. Communication

7. How the abilities learned in the school can help to a future career in the space sector.

Summary

In this task, students learn to use satellites images to monitor the deforestation in the Amazon rainforest and dig into the reasons behind it. They will explore how deforestation may be related to the actions of the countries in which we live, driven by the national industry and even from local activities that we may think use clean strategies. Students will focus on fish farming, in particular the case of salmon farming in Norway, and analyse the impact on deforestation of other food industry in Europe like poultry, pigs and sheep. Based on the analysis and calculations, students will search for alternatives to drive this important economic sector in a sustainable way.

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2. Introduction

Deforestation in Nova Xavantina, Mato Grosso state, Brazil. Photograph: Amanda Perobelli/Reuters

Deforestation and climate change:

Deforestation in several areas of our planet and particularly in the Amazon rainforest is a well-known dramatic process that continues. Cutting trees for using the land for other purposes is having devastating effects and producing an important impact on climate.

The rainforest is not only home to an incredible diversity of species, but it also has a critical cooling effect on the planet because its trees channel heat high into the atmosphere. In addition, forests absorb and store carbon dioxide (CO_2) from the atmosphere, which is released back into the atmosphere when trees are cut and burned. The Amazon rainforest alone absorbs one-fourth of the CO_2 absorbed by all land on Earth. CO_2 is one of the most important greenhouse gasses and the main contributor to global warming. This is due to its increase in the atmosphere because of human actions. We need more than ever forests to counteract this, and deforestation is making the situation by far more dramatic. The amount of CO_2 absorbed today in the Amazon rainforest is 30% less than it was in the 1990s because of deforestation. If deforestation continues at current rhythm, the Amazon region could become drier and drier, unable to support healthy habitats or croplands, and with almost no capacity to absorb CO_2.

Satellites for monitoring deforestation:

Monitoring the evolution of deforestation and other anthropogenic changes is now easier with the use of satellites. Satellites provides images for monitoring the global planet. Access to this information was, reserved just a few years ago to experts, but now it is quite open and easy to access through several online platforms, making the evaluation of these facts reachable to the society. Satellites are continually taking images and producing a huge library of

information. Therefore, one can evaluate changes happening during the last years and even decades. An easy platform to access to satellite images and compare pictures taking in different epochs is *Google Earth Pro*.

Deforestation: why?

Several citizens are aware that deforestation is an important problem. Deforestation and their consequences are very present in news and media, but it seems to be something beyond their actions. Something happening in distant countries, driven by bad people with many interests, independent of our actions and where we cannot do much. This activity digs into this point.

To give light, the first step is to understand the reasons behind it. Important questions are what drives cutting the rainforest? What is the new use of land, the industry behind and the final consumers? The answers will provide a better perspective and tools to answer other important questions like: who are the responsible?

A major motive for deforestation is cattle ranching. Several countries have created a consumer demand for beef, so clearing land for cattle ranching can be profitable—even if it's illegal. Other important reason that makes difficult to protect forest resources is the increase of demand for cropland for food such as soybeans.

Soy has several uses, also in aquaculture. The use of soy in diets provides a feed solution for aquaculture and is the most used protein source in aquaculture feeds worldwide. Soy has a high protein density, is highly digestible for most cultured fish and shrimp species, can replace high-cost animal proteins, and yields rapid fish growth. Several sources mention the use of soy in aquaculture as great and sustainable solution. Therefore, this is a good example to go deeper, to evaluate, to understand how sustainable it is from different perspectives, considering specially where the soybeans grow.

3. Part 1 Satellites eyes help from space

Preparations: Google Earth Pro tutorial

This activity uses Google Earth Pro. Note that it must be the "pro" version. You can download and install it from the following address: https://www.google.com/intl/no/earth/versions/#earth-pro
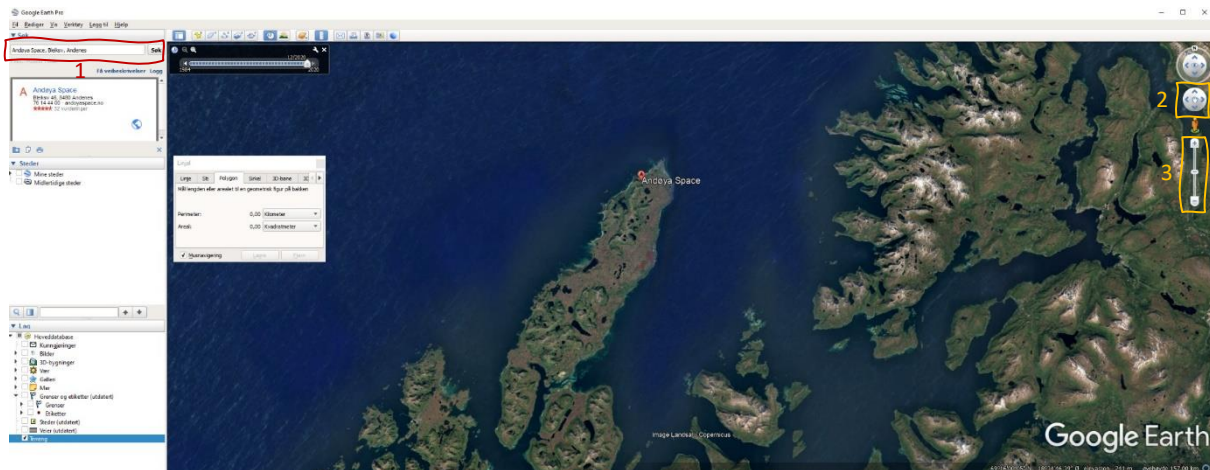

Google Earth Pro interface is intuitive. There are several features, but we will use it in a simple way. In the image above you can see the Google Earth Pro user interface and below a description of the main tools we are going to use in this task.

- ○ Find a place by writing its name in the search field – 1 (locate numbers in the image above)
- ○ Move around the area by dragging the mouse while holding down the left button. Alternatively, you can use the move tool - 2
- ○ Zoom in/out by using the mouse wheel. Alternatively, you can use the zoom tool - 3
- ○ Access to older satellite images by clicking in the historical images tool 🕐 . A small window will appear. Each vertical line indicates a previous image. Drag the pointer to the different positions to see the historical images.

- ○ You can measure distances and areas using the measure tool 📏 . Click to activate it. To measure a distance, select the *line* tab and click with the right button in the initial and final point. You can also measure the areal and perimeter of an area by using the *polygon* tab
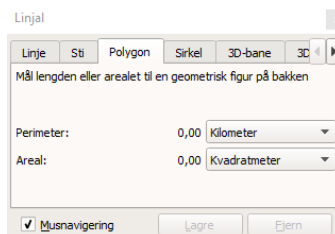
To explore more in detail *Google Earth Pro* check the tutorial: https://youtu.be/3lGl1VZjtg4

https://www.planetchange.eu

Activity 1

This activity focus on exploring the anthropogenic impact from space using *Google Earth Pro*.

i. Open *Google Earth Pro*. This is a great tool for exploring the Earth using satellite images. The "Pro" version includes a collection of historic satellites images giving the opportunity to explore changes in an area due natural or anthropogenic cause. We will proceed exploring changes in predefined places.

   a. Download the file "PlacesGoogleEarth.zip". It contains a few Google Earth files (kmz). Unpack the zip file.

   b. In the main menu, select *File-Open*. Navigate to the folder where you placed the files and select "*Aral Sea.kmz*". Google Earth will fly to the area. Keep on place in the area displayed without moving around and open the historical image tool

   c. Explore the changes in the area by selecting the most recent images vs older images. Take note of the changes you see.

   d. Use the measure tool to have an idea about the scale of the changes. You can measure for example changes in the distance of a feature from edge to edge with the *line* tab, or perimeters and areal with the *polygon* tab. Write some interesting findings.

   e. Now we concentrate in changes in the Amazonia rainforest. Repeat the procedure for the other files "*Rondonia.kmz*" and "*Nova Xavantina.kmz*".

   f. Search in internet the possible reasons behind the changes in places like Rondonia, Madagascar and Aral Sea. Take notes of your findings

ii. **Work in groups** of 3 students. Discuss the following questions. Focus on what do you think, what do you expect, without searching online for answers. Designate one person of the group to take notes about your answers.

   a. What do you think are the main reasons driving the deforestation of the rainforest?

   b. What do you think are the countries most responsible for the deforestation of the Amazon rainforest? Can you explain why?

   c. How much do you think your country is contributing and why?

4. Part 2 Amazon rainforest deforestation

"The first step to humility is the recognition of one's own imperfections." – John Milton 1644

Assumptions: For simplicity we assume that the fish industry gets all their protein from soya. This can in fact be checked later in the task.

Aquaculture in Kvinnherad, Norway. Photo: Peter Andersen

Activity 2

Proceed with an overview of the next sources. These are crucial for identifying critical information/data for to complete the task:

- o "Feed Conversion Ratio" (FCR) or "fôrfaktor" in Norwegian, is the amount of feed, usually measured in kg, needed to produce a unit of output, such as a kilogram of fish. A lower FCR indicates that less feed is needed to produce the same amount of fish and is therefore more efficient. To know more about FCR check the next link. This report from 2020 is in Norwegian but includes a summary in English (page 2) with relevant information:

  https://nofima.brage.unit.no/nofima-xmlui/bitstream/handle/11250/2977260/Korrigert%20Rapport%202%202022%20Ressurs%202020.pdf?sequence=6&isAllowed=y

- You can also check the volume of fish produced in Norwegian fish farming in the previous link.

- Yield is another important factor to consider. This link from FAO (Food and Agriculture Organization of the United Nations) gives information about the amount of soya produced per square meter of plantation, typically in the unit kg/m^2:

  https://www.fao.org/land-water/databases-and-software/crop-information/soybean/en/

- From this final link you can search where is the soy is produced:

  https://wwfeu.awsassets.panda.org/downloads/2021_106_european_soy_supply_wnf_2201_final.pdf

i. Search in internet for areas where the soy is produced on Amazon. For example, you can use google and search for "soybean deforestation". Clue: you have visited already one area in the previous section. Use *Google Earth Pr*o, go to the places you have found, and use the timeline to check rainforest deforestation. Report your findings.

Activity 3

This is the main section. Use the previous sources to find the information/data for answering the following questions.

i. What is the total consumption of fish feed in Norway?

ii. How much area is needed to produce 1 kg of soya protein?

iii. What is the area (m^2) of soya plantation needed to produce Norwegian Atlantic salmon demand of soya protein? Illustrate this area this using Goggle Earth Pro

iv. What is the cost of making 1 kg of salmon in NOK

v. What is the cost of making 1 kg of salmon in m^2 of soya plantation?

vi. Compare the impact on deforestation of the salmon factory with other food industry that use soya. Use as example the cases of poultry, pigs and sheep. Use the result of the previous point and the rations of the FCR to calculate how many m^2 of soya plantation it is needed to produce 1 kg of the different cases analysed. Check the following source: https://www.skretting.com/en/transparency--trust/faqs/how-much-feed-is-needed-to-grow-a-farmed-fish/

5. Reflection and nest steps

Work in groups. Use the same groups as in the Part 1. Discuss the following questions. Designate one person of the group to take notes of your discussion and final conclusions.

i.   Compare your findings with your expectations (part 1, activity 1.ii). Write the new conclusions based on what you have learned.

ii. Analyse with your colleagues what can we do to improve this situation, how to keep the salmon aquaculture as an active industry but making it more sustainable and environmentally friendly, e.g., alternative protein sources, alternative areas, change our diet etc. Write a small report with your recommendations.

A possible future in the space sector

Work in groups. Use the same groups as in the previous sections. Discuss the following questions. Designate one person of the group to take notes of your discussion and final conclusions.

The skills learned in several VET schools are valuable for using space to make the food industry more environmentally friendly. We need satellites and all the infrastructure around for designing, building, launching, operating, analysing data, and making it available for the users. Based on this we can make decisions and improve our food industry in a more sustainable way.

Example: The Norwegian VET school system has 10 different paths. Some of them provides skills valuable for completing these projects. For example, the education program "building and construction" provide good skills to work in the development and specially maintenance of space ports and other infrastructures needed for satellites. The education program "electrical engineer and computer technology" is adequate to work with the maintenance of networks, electrical components, computers systems and software needed in these infrastructures, and in some cases for the satellites themselves. For this activity, the education program "agriculture, fishing and forestry" is valuable, since it combines skills related to forestry and fisheries that help in concreting what is the best satellite information needed and how to make the process more environmentally friendly.

i.   Identify and discuss about how different VET schools in your country can help to the space sector for improving the food industry.

ii. Discuss the skills learned at your VET schools that are valuable to work in the space industry.