

## The Real-World Impact of Woodcutting in Old School RuneScape

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### Abstract

This paper looks at the process of achieving a maximum woodcutting level (99) within the game Old School RuneScape (OSRS) and looks at the potential effects if these actions occurred in real life. An assumption made is that only teak trees are cut, as this is the most prevalent type of tree cut within the game while levelling up. The value obtained is 153,082 teak logs per player. Then the conversion between logs obtained in the game to real-life trees is calculated to be 8 logs for each real-life tree. Using real-world values from teak farms, it is found that 172,224 m<sup>2</sup> of space and 19,136 teak trees are needed for one player to achieve level 99. The potential consequences of these actions are discussed in the case that every single account with level 99 woodcutting within OSRS completed a similar process in real life. The potential result is that 14.7% of the world's teak farms would need to be cut and the carbon storage of these trees can be compared to the addition of 1,009,200 cars over 10 years, approximately 3.2% of the total cars in the UK.

### Background

Old School RuneScape (OSRS) is a multiplayer online role-playing game released in 2013 [1]. There are around 100,000 concurrent players in 2019 [2]. One of the core gameplay mechanics is the player's ability to train various skills leading to experience gain, levelling up, and unlocking new content [3]. Within the game, the skill of woodcutting involves the use of an axe to cut different trees to obtain their respective logs. By progressing in woodcutting level, the player sequentially unlocks different types of trees which subsequently give more experience [4]. In the real world, the act of clear-cutting trees within forests destroys potential habitats within ecosystems, degrades nutrient levels within the soil, and increases risk of landslides and floods [5]. This paper attempts to calculate the total number of trees that would be needed in real life so that all players who have level 99 woodcutting in OSRS could complete this achievement. Then, a subsequent estimate of the potential real-world impacts is made.

### Results

The amount of experience needed to achieve the maximum level in any skill in OSRS is 13,034,431 [6]. The experience needed to attain subsequent levels grows exponentially. At level 1, a player can only cut down normal trees. These give normal logs, awarding

25 experience points (exp) per log [4]. Players must reach level 15 to unlock the next type of tree, which requires 2,411 exp. Thus, the total number of logs required can be calculated:

$$\frac{2,411 \exp}{25 \exp \log^{-1}} = 96.44 \text{ logs of wood.} \quad (1)$$

Since a fraction of a log is impossible to attain in-game, 97 logs must be attained. The game mechanics specific to this type of tree mean that a player attains one normal log before the tree is "depleted". Like all types of trees within OSRS, it must then re-grow before it can be cut again. Thus, the real-life equivalent would necessitate 97 trees to be cut down. While the game does not specify the genus of this tree, this information is irrelevant based on a future assumption.

At levels 15, 30 and 35, an OSRS player can chop oak trees, willow trees, and teak trees respectively, attaining the associated log. All trees other than the regular tree that was cut through levels 1 to 15 follow a different game mechanic relating to the "depletion" of the tree. Through the action of chopping a tree, the player gains a log in their inventory, with each log providing differing amounts of experience. After a log is gained by the player, there is a 1 in 8 chance that the tree will be "depleted" and require time to grow

again [7]. Following a similar calculation as before, the number of logs that need to be chopped to reach each milestone can be calculated, shown in Table 1.

Level range	Log type	Exp log <sup>-1</sup>	Exp needed	No. of logs.
1-15	Normal	25	2,411	97
15-30	Oak	37.5	10,938	292
30-35	Willow	67.5	9,031	134
35-99	Teak	85	13,012,011	153,082

Table 1 – Calculations to find the necessary number of logs that need to be cut to advance to the next type of tree [4]

Because of this different game mechanic for depletion, we must consider a way to equate the number of logs attained by a player to the number of trees in real life. To do this, a probability function is first made to find the probability of obtaining exactly  $n$  logs from a tree,  $P(n \text{ logs})$ .

$$P(n \text{ logs}) = \left(\frac{7}{8}\right)^{n-1} \times \left(\frac{1}{8}\right). \quad (2)$$

In equation 2 the first term is the probability of obtaining  $n - 1$  logs without depletion and the second term is the probability that the  $n^{\text{th}}$  log cut depletes the tree [8]. Equation 2 can be used to create an expected value function  $E[N]$  for a discrete probability distribution.

$$E[N] = \sum_{n=1}^{\infty} \left[ n \left(\frac{7}{8}\right)^{n-1} \times \left(\frac{1}{8}\right) \right]. \quad (3)$$

Evaluation of equation 3 results in a ratio of 8 logs per tree being found [8].

From Table 1, this means that in order to go from level 1 to 99, the equivalent number of trees cut down in real life would be approximately 97 normal, 37 oak, 17 willow, and 19,136 teak trees. This paper assumes that only teak trees are chopped past level 35 since this is the most time-efficient way of gaining experience out of all the types of trees within OSRS. Since the quantity of all other trees is much smaller compared to the number of teak trees, this paper will investigate the environmental effects of cutting only teak trees.

Within teak tree plantations, a single tree usually occupies an area of 9 m<sup>2</sup> in order to allow for optimal growth [9]. Trees are usually harvested after 10 years [10]. As such, the area of teak trees cut in real life by a single player on a plantation to achieve level 99

woodcutting is 172,224 m<sup>2</sup>. As of 20<sup>th</sup> February 2019, there are 37,159 players with level 99 woodcutting in OSRS [11]. Thus, the total amount of teak trees needed to be cut in real life would be:

$$37,159 \times 19,136 = 711,074,624 \text{ teak trees. (4)}$$

Multiplying this total number by the area occupied by a single tree (9 m<sup>2</sup>), this number of teak trees would cover an area of 6,399,671,616 m<sup>2</sup>, or 639,967 hectares. In 2012, plantations of teak trees around the world were estimated to cover 4.35 million hectares [12]. As such, the total amount of trees needed for 37,159 players to achieve level 99 woodcutting is approximately 14.7% of the total area covered by teak tree plantations in 2012.

The amount of carbon dioxide removed per hectare of plantation teak tree is approximately 72.54 tons for teak trees with a 10-year lifespan [9]. By multiplying this value with the area of teak trees needed to be chopped to get level 99 woodcutting (639,967 hectares), this gives a value of 46,423,206 tons of carbon emissions stored.

### Discussion

Based on the assumptions made, it is calculated that 711,074,624 teak trees would need to be cut in real life for 37,159 players to reach level 99 woodcutting is OSRS, which would have stored a total of 46,423,206 tons of carbon over the trees' lifetime. A typical car produces 46 tons of carbon dioxide over a 10-year lifetime [13]. Assuming all the carbon that was stored in teak trees is then re-released into the atmosphere, this would be the equivalent of adding 1,009,200 passenger vehicles onto roads for 10 years, or 3.2% of the total amount of the cars registered in the UK in 2018 [14]. These actions would surely contribute to the current issues of global warming.

### Conclusion

The number of teak trees that would need to be cut in real life to reach the highest level (99) in the skill of woodcutting was calculated for a single player to be 19,136. Then using a value for the total number of players with level 99, the total area of teak trees harvested was calculated to be 639,967 hectares, or 14.7% of the world's entire teak tree plantation population. Further studies may consider creating a more accurate model, as many OSRS accounts that possess level 99 woodcutting have more than the 13,034,431 exp necessary, since the maximum experience is capped at 200,000,000.

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