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Some Notes on the Effect of the Forest on Water Availability – A German Experiment.

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DURING a study tour of Northern Germany last May I had an opportunity of inspecting a rather unique rainfall experiment. It was concerned mainly with the effect of the forest on water conservation in a catchment area. Due to clear fellings by the occuption forces after the last war a situation developed, (normally contrary to all the dictates of German silviculturists) in which an entire valley was completely denuded of timber.

Alongside lay a forested valley of similar proportions, the crop consisting of pure Norway spruce, most of which was in a mature condition, only 3% of the ground area not being under tree canopy. The height above sea-level varied from 450 m. (1,480 ft.) at the valley bottom to 700 m. (2,300 ft.) at the highest point in the ridge separating the two valleys. The Spruce at this height was 80 ft. high × 8-11 in. B.H.Q.G. at 120 years of age. The original time envisaged was ten years but now after seven years the experiment was nearing completion due to scattered Spruce regeneration and the upsurge of the indigenous vegetation in non-forested valley which naturally would tend to invalidate the results.

This experiment was worked on a comparative basis—square metre of forest versus square metre of bare land. The forested valley was 86 ha. (212 acres) in extent, the bare one being 73 ha. (180 acres), slope and height above sea-level being essentially the same. The total rainfall in both valleys was measured by rain gauges, readings for relative humidity and maximum and minimum temperatures were also taken. The water is dispersed in the following ways :

(i) Surface water flows into streams.
(ii) Water absorbed by ground reappears in wells which eventually flow into streams.
(iii) Water is evaporated off the ground, vegetation and trees.
(iv) Water is absorbed by trees and other vegetation in the process of growth.

This dispersal is measured by the following methods :

(i) Sluices were built where the streams left the experimental area, the rate of flow being measured in two ways :

(a) By a V-shaped iron gate over which the water had to flow. The rate of flow being simply measured by the point the water level reaches in the V.

(b) By inserting a container of known volume under the water spout at the V notch and measuring by stop-watch the length of time taken to fill it.

Either of these methods gave the water flow in litres per minute.

(ii) Well water output is measured by the same V-notch system the well being built up and covered in to avoid entry of water from other sources.

(iii) The water evaporated off the forested area is accounted for by knowing the total rainfall in a given time, and subtracting from it that which reaches the ground in the same time interval. The rain which percolates through the canopy is collected in a special trough (1 sq. m.) from which number of ccs. per ha. per minute can be calculated. The amount of ground vegetation in the forested area is negligible. The run-off down the tree trunk is intercepted by a small rubber chute encircling the bole of the tree; this is transposed to the ha. basis and a time factor introduced by multiplying the run-off on an average stem in a given time by the number of stems per ha. This accounts for the percentage of rainwater which reaches the ground, the rest being held in the crown and subsequently evaporated. This was done for mature tree, pole stems, thicket and pre-thicket stages, with the following results :

36% of total rainfall held in crown by mature trees.
28% „ „ „ „ „ „ „ pole stage.
21% „ „ „ „ „ „ „ thicket stage.
11% „ „ „ „ „ „ „ pre-thicket stage.

In non-forested area ground and vegetation evaporation and vegetation water usage is calculated by subtracting stream and well output from total rainfall.

(iv) What is assimilated and transpired by the trees in the process of growth is calculated by subtracting the volume accounted for by the other measurable dispersal methods from the known total rainfall.

Very little information was got by checking water run-off on slopes. Readings from the various instruments were taken at regular intervals and graphed against their appropriate factors.

The results so far indicate the following facts :

(1) The flood point in wells occurs several days after the flood point in streams showing the length of time water takes to seep through the soil.

(2) In erosion test it was found that erosion is more severe in a given time in the non-forested valley than in the forested valley but on the whole the amount of erosion was approximately equal. The forest, however, effects the deposition of gravel, more gravel being deposited above sluice-gates (where water speed is decreased) in bare valley.

(3) The flood point appears earlier in non-forested valley and is of greater volume per minute than in forested valley where water output graph shows a much more even flow with more subdued peak periods.

(4) In March snow water does not flood to the same extent in forested valley but in April forest area output exceeds bare area output due to melting by rain of snow still in the forest. In 1953, for example, water output from July to October was higher and more sustained from bare area than from forest area. In 1958 the lines of the graph almost run together as the grass and Vaccinium growing in cleared area then used as much water as the forest in the Summer.

The overall result is that the proportion of rainfall reaching the streams is heavier in the non-forested area. Therefore the forest uses more water. To conclude, if one required as large a volume of water as possible from a catchment area the best method is to keep the ground denuded of all vegetation.

Cover Photograph

The Cover photograph shows a mixed crop of Monterey cypress (*Cupressus macrocarpa*) and European larch, planted in 1927 in Camolin forest, Co. Wexford.

The following figures were obtained from a plot measured in the summer of 1957 :

Mean height	Cypress	65	feet.
,, ,, ...	Larch	63	feet.
Mean B.H.Q.G.	Cypress	10	inches.
,, ,, ...	Larch	6	inches.
Stems per acre	Cypress	200.	
,, ,, ,, ...	Larch	60.	
Volume per acre	Cypress	3,480	H. feet O.B.
,, ,, ,, ...	Larch	470	H. feet O.B.

The photograph is printed by kind permission of the Department of Lands, Forestry Division, Dublin.