

Erosion and Land Use: The Influence of Agriculture on the Epirus Region of Greece¹

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FOR half a century, students of agriculture have been concerned at the depletion of the world's agricultural resources caused by accelerated erosion on agricultural land. The evidence of soil loss is all too clear, and large areas of formerly productive farmland have been abandoned. Recently, evidence of the possibility of reclaiming eroded land has been obtained, and the picture is no longer one of unrelieved gloom. Nevertheless, in the ancient centres of agriculture, such as the Mediterranean basin, it is accepted as established that there has been a heavy decline in agricultural potential as a consequence of millennia of exploitive agriculture.

The current view of the matter has been stated by Hammond (1967) for the Epirus region of Greece.² After discussing records which point to a very large population in the past, he writes: "These figures indicate that the population of Epirus in Hellenistic times was considerably greater than it is today; for the whole population of Greek Epirus is now only some 300,000 persons. This is what we should expect. The damage to the country through devastation, deforestation, and erosion is incalculable. The small plain of Dodoni and the eastern slopes of Mount Olytsika afford a typical example. The famous forests have disappeared. The soil which has been washed down from the hillsides accumulated to a depth of 11 ft in the orchestra of the theatre. The slopes of the mountain carry only a few remnants of the great forest which once conserved the rainfall and made the roots of the mountain famous for its hundred springs. Much greater destruction has been caused on the western slopes of the mountains. The plain of Acheron is widely strewn with the boulders and shingle which have been carried down for centuries on to the level ground; the extensive swamps have been drained only partly in recent years, and the famous groves of poplar and other trees have disappeared."

The evidence is convincing, and the interpretation has been generally accepted. However, doubts were raised in my mind by Higgs's and Vita-Finzi's paper on the record of human activity in Epirus which they discovered in recent

¹ This paper was delivered at the annual conference of the B.A.H.S. at Norwich on 8 April 1968.

² N. G. L. Hammond, *Epirus*, 1967.

geological deposits.¹ They studied a series of deposits ranging from scree to silty clay, and mostly red in colour, which they called the Red Beds. In these deposits they found Palaeolithic artifacts that could be related to datable levels in cave dwellings which Higgs had excavated. They concluded that the Red Beds must have been laid down at the time when the artifacts were made, which was during the period 40000–10000 B.C. They also studied more recent deposits of brown alluvial soil, and found therein “classical” sherds, and they concluded that this alluvium was laid down between 0 and A.D. 1000. Finally, they showed that both Red Beds and alluvial soils are being cut into by rivers at the present time, so that the two deposition series are now both suffering renewed down-cutting.

The interest of these findings to me was twofold. First, they taught me—what I ought to have known—that the agriculturist, preoccupied with the fate of land from which soil has been removed, has concerned himself with only half of the erosion problem. The archaeologist, looking for relics of the past preserved by an overlay of recent deposits, is concerned with the other half. Denudation and deposition ought to be considered together and this is rarely done. The second, and more important, interest lay in the demonstration of a series of erosion sequences, going back in time to the Palaeolithic age. This is not consistent with the accepted view of erosion in the Mediterranean basin. Agriculture only began 8,000–10,000 years ago. If Higgs and Vita-Finzi are right, and erosion sequences can be dated as far back as thirty millennia before the beginning of agriculture, the causes of degradation are not the agricultural activities of man.

If current views are to be revised in the light of the archaeological findings, the mixture of evidence and deduction in accounts such as Hammond's must first be sorted out. The evidence is beyond doubt. The accumulation in the orchestra of the Dodoni theatre was demonstrated when the theatre was excavated. The mountain slopes are indeed now bare, but the springs at their base depend on geology rather than ecology. The distribution of boulder and shingle can be observed. But Higgs and Vita-Finzi have shown that the sequence of deposits derived from the erosion of these mountains goes back far beyond the origins of agriculture, and the indictment of man as the cause of these processes, which is implied in Hammond's account, is at best not proven and may be wholly unjustified.

In an attempt to determine how far man's agricultural activities have contributed to erosion in Epirus, a small agricultural party joined Higgs's archaeologists' camp at Agios Georgios on the Louros river in August 1967. The agricultural party planned to study the effect of agriculture on local soils by detailed study of a limited area that could be traversed almost entirely on foot.

¹ E. S. Higgs and C. Vita-Finzi, *Proc. Prehistoric Soc.*, 32, 1966, pp. 1–29.

Apart from what could be seen from the road during journeys between Igoumenitza on the west coast, Ioannina in the central basin, and Agios Georgios where the Louros camp was pitched, the whole of the study was carried on within the watershed of the Louros river.

The evidence of extensive erosion is clear. The valley in which Dodoni lies is small. The consequences can be seen on a vastly greater scale where the Louros and Arakthos rivers run into the gulf of Amvrakia. The town of Arta is situated on the Arakthos river where it emerges from the mountains. South of Arta lies a great fertile alluvial plain, some 15 km. in extent from Arta to the gulf. Arta was a port in the early centuries of the present era. It had disappeared from the shipping records by about A.D. 600, presumably by the silting of the harbour. The growth of the alluvium to make the present fertile plain appears to have occurred within the last two millennia. The Arakthos carries a heavy silt load, and the greater part of this extension is due to the deposit of Arakthos silt. The Louros river, which runs into the gulf of Amvrakia a few kilometres west of Arta, runs throughout its length through a limestone valley, and does not carry a substantial silt load.

One might estimate the extension of the plain of Arta by the deposits from the Arakthos river at about half a mile a century, whereas extensions due to deposits from the Louros river have been but a fraction of this amount. Evidently the major determinant of the extent of deposition is not the agriculture of the region but the nature of the terrain over which the river flows, and hence the magnitude of the silt load it carries.

Epirus is a region of 'young' mountains. It consists essentially of a series of more or less parallel limestone ridges, often with flysch deposits on their flanks. On the limestone, rainfall percolates through fissures rather than runs off, and the region is characterized by innumerable springs, and by dry torrent beds in the smaller valleys, where water only runs after heavy rain. The flysch deposits consist of shales, sandstones, and marls, and these give rise more readily to runoff. They are also less massive, and far more erodible than the limestones. The limestones are often bare, but where there is soil, it is red (*terra rosa*). On the flysch the soils are brown. The whole region is manifestly undergoing intense erosion. Slopes are steep, even precipitous. The limestone is deeply cut by ravines, and the flysch is scarred with small landslips. Erosion is inevitable, and inevitably rapid.

Agriculture is practised in the face of powerful natural erosive forces. The questions of interest are, first, whether or not the agricultural activities of man have significantly increased the rate of erosion, and, secondly, the extent to which erosion, either natural or man-accelerated, has affected the agricultural potential of the region. In terms of land use, three categories may be made, the limestone mountain slopes, the brown upland soils on flysch, and the brown

alluvial soils of the valleys and the coastal plain. Small areas of alluvial red soil in upland valleys were also studied, but they are not large enough to be significant. On the limestone, which is exceedingly pure, soil development from weathering must be very slow indeed, and there can never have been any great depth of soil. The only agricultural use of the limestones is the browse they provide for goats, sheep, and a few cattle, and the fuel that is cut for household use. There can be no doubt that man has had a devastating effect on the vegetation. Agricultural exploitation consists of browsing, chiefly by goats, and cutting for fuel. Oak trees have given place to oak scrub. This is kept down partly by the goats, and partly by the regular cutting for fuel of any stems that escape the depredations of the goats and grow out above the browsing level. Nevertheless, careful assessment of the ground cover led to the conclusion that the effect of this form of exploitation was not as serious as at first appeared. In many parts of Africa where stock are kept, the village perimeter is completely denuded of vegetation, and there is a steady improvement in the ground cover as the distance from the night kraals increases and the limit of the daily browsing range of the goat is approached. In the village areas in Epirus there is indeed little vegetation except the olive trees, but the maquis comes close to the village, and may indeed provide quite a good cover. Woods are common on the steeper and less accessible slopes, but the higher ridges do not carry as good a vegetative cover as the lower, even though the latter are within grazing range. Thus, the vegetative cover is not, as it is in overgrazed African areas, closely related to the grazing pressure, and it appears that geological and soil factors largely determine the type or the density of the plant population.

On gentle slopes and flat plateaux on the limestone, a mantle of red soil is to be found. On steep slopes the surface consists of outcrops of the massive limestone, interspersed with large areas covered with limestone rubble and occasional small patches with a thin soil mantle. In heavy rain, considerable slides of rubble can occur. There appears to be no soil, but under the surface is to be found a mixture of rubble and red earth. Road cuttings and quarry faces show that there are weathered pockets filled with rubble and red earth which are often of very considerable depth. It is in these that the trees and shrubs are rooted. At first sight, one might conclude that there had been very considerable soil losses from these slopes. However, very similar situations are to be found in flat honeycomb limestone country on islands such as Zanzibar and the Bahamas. There also, the surface is covered with rubble. There is there also a mixture of red soil and rubble below. Indeed, shifting cultivation is practised, the crops being planted in the red earth among the stones. It seems probable that in Greece, also, a completely stone-covered surface is the normal situation on the limestone slopes.

Some direct evidence of the extent of soil loss during the period of agri-

cultural exploitation can be obtained from an examination of olive trees. On all well-preserved olive trees the base of the trunk, below which the root system has developed, is readily identified. This point provides a record of the ground level at the time the tree was a seedling. The trees in Agios Georgios village are, according to local opinion, several hundred years old. The present ground level around them varies from the same as when the trees were seedlings down to 60 cm., or in some cases 1 m. lower. Even in the village therefore, where pressure on the land has been greatest, the rate of soil loss has been of the order of perhaps 20 cm. per century. On limestone slopes away from the village, occasional olives and scattered oaks provide a similar index, and a drop of 25 cm. in ground level during the life of a tree was only rarely exceeded. On flat hilltops and gentle slopes, the trees are almost always growing at the same ground level as when they were seedlings. Considering the enormous ravines that have been cut by natural forces into these limestone mountains, the rate of erosion around the olive trees cannot have been markedly increased by agriculture.

The brown upland soils on flysch deposits might be expected to show much more serious erosion losses. The flat tops and gentle upper slopes on the flysch are commonly cultivated. The lower slopes often run precipitously down to a ravine in which a torrent flows after rain. There is thus a sequence of a reasonably flat top, a rather steeper slope, and an uncultivable steep lower slope. The steeper, but still cultivable, slopes are often terraced. The cultivated lands on the brown soils do not appear to have suffered erosion to the extent of breaking the land surface and initiating gullies in cultivated fields. Agricultural use has not made them unstable. Indeed, terracing is a stabilizing practice, and erosion risks are thereby reduced. The main erosion losses from the flysch deposits arise from the cutting back of gullies and ravines undermining the beds from below. Some of the resulting slides leave substantial and conspicuous scars on the hillsides. These are natural events, rather than the consequences of agricultural use.

The most important agricultural lands are the brown alluvial deposits on the valley floors, and on the margins of the coastal lagoons. Such down-cutting as is occurring on the banks of the Louros is slight, and the cultivated valley lands, double cropped under irrigation and well cared for, are in good condition, and show no signs of erosive losses. On the lower reaches of a river, erosion products from upland areas may be destructive of agricultural land through flooding, and the choking of drainage channels. There is no evidence of this in the plain of Arta, and the grading of the alluvial fan to the sea is such that both drainage and irrigation are readily provided. Here the products of erosion have built up an extensive and highly productive plain.

It thus appears that the naturally high rate of erosion in this region has not

been significantly increased by man's agricultural activities, and that the effect of erosion on the agricultural potential of the region has been substantially favourable. Little good land has been lost and a large and productive area of new land of high natural fertility has been gained by the silting of the gulf of Amvrakia. This conclusion, quite contrary to long-accepted opinion, arises from a reappraisal of well-established evidence as much as from the collection of hitherto unknown facts. The evidence for rapid and long-continued erosion is clear and undisputed. But the assessment of the causes of erosion is another matter. From Higgs's and Vita-Finzi's discovery of Palaeolithic artifacts it is apparent that rapid erosion long preceded the beginning of agriculture. From the observation that the cultivated soils are stable and productive to this day, it is clear that erosion rates have not been markedly affected by the advent and development of agricultural practice.

The archaeologist's approach to erosion is a most fruitful tool to the agriculturist interested in the history of his art. History is recorded in deposits in a way that it can never be where denudation has taken place. Where deposition has gone on during agricultural times, there must be records to be exposed that will give a time scale to much of agricultural history that is now vague and uncertain. Consider, for example, the fortress of Kastro Orovon, standing on what must once have been an island in the gulf of Amvrakia. It is now surrounded by the alluvium of the plain of Arta. Vita-Finzi has noted the remains of a Turkish midden on the alluvium below one of the bastions. The fortress was originally Greek, and the masonry of the bastion and related structures shows a succession of Greek, Roman, Byzantine, and Turkish workmanship. The fortress has therefore had a long history of occupation. It seems likely that the disposal of rubbish would be the same regardless of the occupying power, and there is therefore a good prospect that a pit dug through the Turkish midden might reveal a datable sequence of refuse, intercalated with successive layers of the silt deposit. Thus a time scale for the deposit of the plain of Arta might be established.

My interests in the history of agriculture lie in the biological field rather than the social and economic. I am concerned with the history of soil fertility rather than land tenure, the evolution of crop plants rather than the price of grain. And the range of our knowledge and our appreciation of the changes that have gone on has been increased by contact between these interests and those of archaeology, and of Quaternary research. This is but a beginning, and there is much to be learned by a search for evidence of past events in present-day agricultural circumstances.¹

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