Irrigation Holes in Ancient Greek Agriculture

Tadashi Ito

Agricultural stepped terraces are a characteristic feature of the modern rural landscape of the Mediterranean. Nevertheless, it is unclear how extensively the ancient rural landscape was terraced. Some scholars have believed that the past landscape was very like the modern one, in other words, that the terrace systems can be traced back to classical antiquity, while others have denied that agricultural terraces were much used in antiquity.

The author has already written on agricultural terraces. In that paper he considered the question whether agricultural terraces can be projected back into classical antiquity. First, the article looked carefully at ancient terminology (αἱμασιά and τεῖχιον), using both literary texts and inscriptions (41–44).


Second, it investigated the evidence from archaeological fieldwork (44–49). Through these examinations the author concluded that claims to have discovered ancient terracing systems in Greece are doubtful, and that there are no ancient written references to terrace walls (49–51). In this paper the author considers irrigation holes (i.e. the γύρος)\(^5\) on sloping land, using the *Geoponika*\(^6\) compiled in the tenth century by the emperor Constantine VII, and demonstrates that there were holes, not terraces, on sloping land in antiquity.

1. First, let us consider the lie of the land. Whitelaw in a notable article has attempted to correlate the location of agricultural sites with the angle of slope on Keos: \(^7\)

There is a clear relationship between site location and slope angle ... The key distinctions are between slopes less than about 10° which could have been cultivated without terracing, slopes between about 10° and 15° which might have been cultivated without terracing, but which would probably have been subject to severe soil erosion, and slopes steeper than about 15°, which could not have been cultivated without agricultural terraces ... Within the survey area overall, some 780 ha. (42%) have slopes lower than 15°, while within the catchments of the sites, 420 ha. (79%) are lower than 15°.

If so, on Keos most of the small farmstead sites in the classical

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\(^5\) So cited by L. Foxhall, in *Agriculture* 131.

\(^6\) *Selections on Agriculture* (Περὶ γεωργίας ἐκλογαῖ) compiled originally by one Cassianus Bassus in the sixth century are generally named *Geoponika*. Early editions are by Brascianus, Basileae 1539, by Needham, Cantabrigiae 1704, and by Niclas, Lipsiae 1781, then H. Beckh, *Geponica sive Cassiani Bassi scholastici de re rustica eclogae* (Leipzig 1895); the most recent edition is E. Lelli, *L’Agricultura antica: L’*Geoponica di Cassiano Basso* 1–2 (Perugia 2010). Translation and commentary: T. Owen, *Γεωπονικά: Agricultural Pursuits* (London 1805); E. Malainos, *Τὰ Γεωπονικά* (Athens 1930); A. Dalby, *Geoponika: Farm Work* (Devon 2011).

period were situated on slopes of less than 15°, which might have been cultivated without terracing. It seems to me that ancient farmers preferred to avoid slopes that needed extensive terracing.\(^8\)

Second, let us consider how sloping land is expressed in the Geoponika:

- 2.3.1 ἐν τοῖς ἀνακεκλιμένοις τόποις
- 5.2.13 ἐν ξηροῖς καὶ κεκλιμένοις τόποις
- 5.2.14 ἐν τοῖς πλαγίοις καὶ ἡρέμα ἀνακεκλιμένοις … τόποις
- 5.4.1 τὰ πρὸς ἄρκτον νεύοντα
- 9.3.2 τὰ τῆς γῆς σχήματα προσκλινὴ καὶ υψηλά
- 9.3.7 τὰ προσκλινῆ καὶ ἐνάντη

'Sloping' is expressed by ἀνακεκλιμένος, κεκλιμένος, νεύων, πλάγιος, and προσκλινής. Three of these are participles, two are adjectives, and three modify τόπος (place). It is probable that the τόπος modified by these words is sloping land between about 10° and 15°, and that the τόπος further characterized by ἡρέμα (gentle) is sloping land of less than about 10°.

Third, let us consider the agricultural use of sloping land. What kind of cultivation is sloping land suitable for? There are two important places concerning this in the Gp.:\(^9\)

- 5.2.13–14: οἶνος δὲ κάλλιστος ἦστιν ὁ ἐν ξηροῖς καὶ κεκλιμένοις τόποις, καὶ πρὸς ἄνατολάς ἢ μεσημβρίαν βλέπουσι φυτευθείσων ἄμπελοιν. τάς δὲ δενδρίτιδας ἄμπελους ἐν τῇ πεδιάδι καὶ κούλη καὶ ὑψαλή, ἐπιπετειεύσεσθαι φυτεύειν. μεσινήθαι γὰρ πανταιχοῦ, καὶ ἱδίκως παρατηρεῖν δεῖ, ὅτι γῇ πρὸς φυτεύαν χαμαζήλοις μὲν ἄμπελοις ἐκείνη ἦστιν ἐπιπετειεύσεσθαι, ἢ ἐν τοῖς πλαγίοις καὶ ἡρέμα ἀνακεκλιμένοις καὶ υψηλότεροις καὶ ξηροτέροις τόποις, αὕτη γὰρ τὸ θέρος εὔμαρστερον ἔξει, διαπνεομένη καλὸς.

The finest wine is that made from vines grown on dry and sloping terrain facing east and south. It is better to plant tree-trained vines in plains, valleys and level terrain. In every case the rule must be remembered and observed that the more suitable

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\(^8\) Cf. Foxhall, in *Human Landscapes* 64.
\(^9\) Dalby’s translation, with amendments italicized.
Terrains for planting ground-trained vines are sloping lands, gentle slopes, relatively high and relatively dry sites, which will have a milder and well-aired summer.

9.3.7: διὰ τούτο γὰρ καὶ τὰ προσκλινὴ καὶ ἀνάντη σφόδρα πρὸς ἐλαίαν ἐπιτίθεται ὑπάρχειν εἰρήκομεν, διότι δέχεται οἱ εὔδους ἄνεμον, ὡς μηδὲν διαπνεύσαι, ἀλλὰ καθ’ ἐκαστὸν δένδρον ὀμαλοῖς διέναι καὶ τρέφειν καὶ διεγείρειν τὴν αὐξήσιν τοῦ φυτοῦ.

This, then, is why we said that sloping and uphill sites are very suitable to olives; they welcome gentle winds, which do not go to waste but penetrate each tree alike, nourishing them and awakening the growth of the plant.

Two kinds of vines appear in the Gp.: ἀναδενδράς = ἀμπέλος δενδρίτες (tree-trained vines) and χαμίτις ἀμπέλος (ground-trained vines).10 On the one hand tree-trained vines were planted in plains, hollow and even terrain; on the other hand the more suitable terrains for planting ground-trained vines were sloping lands and gentle slopes, relatively high and dry sites, which make summer heat milder, and where fresh air blows. The mild air contributes to the thriving of all plants, and particularly to that of olives; warm and dry air is adapted to olives. A contribution to the suitableness of the air is made by the sloping and elevated configuration of the land. Olive trees in such locations make the best oil, while olives in the plains produce thick oil. Sloping and high sites are very adapted to olives, because they always receive temperate winds. Thus we conclude that sloping lands are suitable for vines and olives.

2. Next we consider the landscape of the lands of Dionysus and Athena Polias as attested in the Heraclean bronze Tabulae.11 The temple lands having been encroached on by private par-

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10 On tree-trained vines see Gp. 3.1.1, 3.6.3, 5.20.2; Dem.53.15; Aesop Fab. 15 Perry; on ground-trained vines, Gp. 3.1.5.

11 Kaibel, IG XIV 645; Dareste/Haussoullier/Reinach, Recueil des inscriptions juridiques grecques 12; Arangio-Ruiz/Olivieri, Inscriptiones Graecae Siciliae et infiniae Italicæ ad ius pertinentes 1; F. Sartori, in Archäologische Forschungen in Lukanien II (Röm.Mitt. Ergänzungsh. 11 [1967]) 37–76.
ties, the commissioners restored them to Dionysus and Athena Polias; two commissions were appointed to define and mark their boundaries, survey them, and divide them into lots. Tabula I contains the report of the commission dealing with the lands of Dionysus, Tabula II contains their report on the lands of Athena Polias.

A. On the lands of Dionysus

What was the landscape of the lands of Dionysus as revealed by Tab. I? There were barren lands and arable lands. The extent of barren land\(^{12}\) (line 19) is 2225 schoinoi, of arable land (36–37) 1095. It is notable that the percentage of thicket and forest, the barren land, was quite high compared with the percentage of arable land, approximately 2 to 1.

As to the geography (see Plan 1): located on the slope of the south side of the valley formed by the Akiris river which flows west to east, the lands face north,\(^{13}\) and are disadvantageous to cultivation.\(^{14}\) There is a spring at the top.\(^{15}\) There are wooded hills near no. 6 and no. 8,\(^{16}\) a trench and marshlands overgrown with papyri near no. 2,\(^{17}\) and a cheese press near no. 8.\(^{18}\) Downward near nos. 3, 4, and 10 oak forest and swamp spread along the Akiris.\(^^{19}\) When we take into consideration these situations together, it is possible to say that the conditions of the land were quite bad, and that this area was unsuitable for cultivation, and in fact was suitable entirely for stock breed-

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\(^{12}\) Barren lands consisted of σκῆρος (brushwood), ἄρρηκτος (unploughed land), and δρυμός (thicket).

\(^{13}\) See IG XIV 645 p.172.


\(^{15}\) Tab. 1 lines 17, 21, 27, 32, 56, 87–88.

\(^{16}\) Line 65.

\(^{17}\) Lines 58–59, 92.

\(^{18}\) Line 71.

\(^{19}\) Lines 60–61, 72–73, 78–79.
The lands that had been encroached on by private parties were restored to Dionysus, divided into four lots, and lent out to four persons (see Table 1). The fourth lot had 2.4 hectares of vineyard. A lessee had to plant vines in land over not less than 10 schoinoi, and also had to plant more than four olive trees per schoinos in land suitable for olive cultivation. When a lessee judged that land was unsuitable for olive cultivation, it was possible to make an objection to the state.

Plan 1: Land of Dionysus (after Dareste et al. 222)

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22 Lines 114–115.
24 Lines 116–119.
Table 1: The lands of Dionysus

<table>
<thead>
<tr>
<th>Lots</th>
<th>Arable lands (schoinoi)</th>
<th>Barren lands (schoinoi)</th>
<th>Rents in barley</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temple</td>
<td>Encroached</td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>847</td>
<td>125</td>
<td>76</td>
</tr>
<tr>
<td>4</td>
<td>850</td>
<td>81</td>
<td>227.5</td>
</tr>
<tr>
<td>2</td>
<td>773</td>
<td>273</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>850</td>
<td>312.5</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>3320</td>
<td>791.5</td>
<td>303.5</td>
</tr>
</tbody>
</table>

1 σχοινος = 10692.9 m² (32.7 x 327 m)
M. = μεδιμος = 52.50 or 52.40 litres
k. = κάδειχος = 1/24 M. = 2.189 litres

B. On the lands of Athena Polias

The land consists of two districts. One district (A in Table 2) is the land that has not been encroached on and is not comprehended in the new contract. There is a stream where cattle drink. The extent of this district is 35 γαί (= 1750 schoinoi).25 The other district (B) is the lands that had been encroached on, were restored to Athena Polias by the commissioners, divided into 12 lots, and lent out to 12 persons. This district is located in the plain,26 is very good land suitable for cultivation,27 does not include barren lands, is mostly arable,28 and has vineyards of more than 102 schoinoi.29

On the one hand the lands of Dionysus are sloping, so the type of vine is ground-trained, and on the other hand the lands of Athena Polias are in plains, and so planted with tree-trained vines.

25 Tab. 2 lines 10–19.
26 Line 7.
27 Uguzzoni/Ghinatti, Le tavole 177.
28 Tab. 1 line 175, Tab. 2 line 33. Cf. LSJ s. v. ψιλός.
29 Cf. Kamps, in Recueils 76.
Plan 2: Land of Athena Polias (after Uguzzoni/Ghinatti 176)
Table 2: The lands of Athena Polias

<table>
<thead>
<tr>
<th></th>
<th>1750 schoinai (35 x 50 s.)</th>
<th>(γή) ψηλή</th>
<th>Vineyards</th>
<th>Rents (for 5 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Total</td>
<td>138 s. 8 o.</td>
<td>4 s. 11 o. 3 p.</td>
<td>269 M. 1 ch. 2 c.</td>
</tr>
<tr>
<td>1 τρίγυον</td>
<td>139 s.</td>
<td>123 s.</td>
<td>16 s.</td>
<td>695 M.</td>
</tr>
<tr>
<td>I</td>
<td>59.5 s.</td>
<td>51 s. 7 o.</td>
<td>8 s. 8 o.</td>
<td>446 M. 4 k.</td>
</tr>
<tr>
<td>II</td>
<td>72 s. 8 o. 2 p.</td>
<td>63 s. 12 o.</td>
<td>8 s. 26 o. 2 p.</td>
<td>632 M. 1 ch.</td>
</tr>
<tr>
<td>III</td>
<td>74 s. 2 o.</td>
<td>66.5 s.</td>
<td>7 s. 17 o.</td>
<td>630 M. 2 k. 2 c.</td>
</tr>
<tr>
<td>IV</td>
<td>83 s. 20 o.</td>
<td>68 s. 13 o.</td>
<td>15 s. 7 o.</td>
<td>630 M.</td>
</tr>
<tr>
<td>A</td>
<td>68.5 s.</td>
<td>62 s.</td>
<td>6.5 s.</td>
<td>856 M. 4 k.</td>
</tr>
<tr>
<td>B</td>
<td>66 s.</td>
<td>59.5 s.</td>
<td>6.5 s.</td>
<td>458 M. 14 k. 2 c.</td>
</tr>
<tr>
<td>C</td>
<td>70 s.</td>
<td>63.5 s.</td>
<td>6.5 s.</td>
<td>306 M. 4 k.</td>
</tr>
<tr>
<td>D</td>
<td>54.5 s.</td>
<td>48 s.</td>
<td>6.5 s.</td>
<td>235 M. 15 k.</td>
</tr>
<tr>
<td>E</td>
<td>71 s. &lt;1&gt; 7 o. 2 p.</td>
<td>64 s.</td>
<td>7 s. 17 o. 2 p.</td>
<td>580 M. 15 k.</td>
</tr>
<tr>
<td>F</td>
<td>38.5 s.</td>
<td>30 s.</td>
<td>8.5 s.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>935 s. 26 o.</td>
<td>833 s. 13 o. 1 p.</td>
<td>102 s. 12 o. 3 p.</td>
<td>5739 M. 15 k. + α</td>
</tr>
</tbody>
</table>

g. = γύνς (area) = 50 schoinai = 53464.5 m² (32.7 x 1635 m)
o. = ὀργά = 1.111 or 1.092 m  p. = πούς = 0.2777 or 0.2736 m
ch. = χοῖνος = 1/16 M. = 3.283 litres  c. = χοῖνος = 1/48 M. = 1.09 litres

3. It is clear that slopes between about 10° and 15° might have been cultivated without terracing, but would probably have been subject to severe soil erosion. If terrace farming was not done widely in ancient Greece, did any effective farming for it exist—through which soil erosion is reduced, water stays in the same place longer, and thus penetrates to deeper levels and is less likely to be lost through evaporation? We can see it in the Geoponika: it is the technique called γύρωσις.³⁰

The repeated digging of fallow land was effective for weeding and reducing moisture loss through capillary action. In the same way, it was an important operation for arboriculture—olives, figs, and especially vines. It is evident from the Geoponika

and inscriptions that the soil around each tree was dug several times a year. According to the Geoponika (4.3.1), mature vines were dug twice, and we can see from Geoponika 3 that the soil around vines was dug at several particular times a year.

Table 3: Agricultural activities: dates and terminology

<table>
<thead>
<tr>
<th>Plant</th>
<th>Months / Terms</th>
<th>Geoponika</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vines</td>
<td>March / περισκάπτω</td>
<td>3.3.6</td>
</tr>
<tr>
<td></td>
<td>May / σκάπτω = σκάφος</td>
<td>3.5.4</td>
</tr>
<tr>
<td></td>
<td>July / σκάπτω</td>
<td>3.10.1</td>
</tr>
<tr>
<td></td>
<td>October, after harvest / σκάπτω</td>
<td>3.13.7</td>
</tr>
<tr>
<td>Young vines</td>
<td>First(?), December / περισκάπτω</td>
<td>3.15.4</td>
</tr>
<tr>
<td></td>
<td>Second, April / σκάφος</td>
<td>3.4.5</td>
</tr>
<tr>
<td>Cleft-grafted vines</td>
<td>June / περισκάπτω</td>
<td>3.6.1</td>
</tr>
<tr>
<td>Mature vines</td>
<td>December / περισκάπτω</td>
<td>3.15.4</td>
</tr>
<tr>
<td>Unripe vines</td>
<td>August / περισκάπτω</td>
<td>3.11.1</td>
</tr>
</tbody>
</table>

An inscribed contract of the fourth century B.C. from Arceine on Amorgos includes these details:31


(the lessee) will dig round the vines twice, the first digging in Anthesterion (February), the second before the twentieth of Taureion (April); and round the fig trees once.

A decree of an Athenian phratry of the end of the fourth century stipulates: κα[λ] ἀμπέλους δις κατ[ά] πα[σ]σῶν τῶν ὄρων, the lessee “will dig round the vines twice every year (or season)” (IG II² 1241.20–21). Moreover, Hesiod recommends pruning vines before the swallow arrives, and advises not to dig round the vines after the house-carrier (the snail)

31 Syll.3 963.8–11 = Rhodes/Osborne 59.

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climbs up from the ground.\textsuperscript{32} Perhaps digging and pruning were done at about the same time,\textsuperscript{33} probably just before the arrival of spring. The technical terms for “digging (round)” are σκάπτω, σκάφος, περισκάπτω. This last is identified with γυρώ at \textit{Gp}. 4.3.1 (γυρών, τοποστε περισκάπτειν); “digging” is part of γύρωσις:

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
Month & γύρωσις & Reference \\
\hline
October & γυρών & \textit{Gp}. 3.13.3 \\
February & First σκάπτω & \textit{Syl}.\textsuperscript{3} 963.8–11 \\
April & Second σκαφητός & \\
\hline
\end{tabular}
\end{table}

According to LSJ, γύρωσις is “making of a γύρος,” γυρών is “make a γύρος round a tree.” Thus it seems that γύρος as a technical term is a round hole, “not a trench or ditch,”\textsuperscript{34} and that γύρωσις is the act of “digging a hole round a tree.” The γύρος is different from the hole for plants. The latter is βόθυνος/βόθρος and τράφη, not γύρος, and “to dig a hole” for plants is ὀρύσσω. Xenophon says that the hole for plants is less than 2.5 feet deep and less than 2 wide, and that the hole for olive-trees is deeper than that for vines.\textsuperscript{35} The Arcesine contract offers (27–32): τὰς τράφα[ζ] ὀρύξει ἐμ \\
ποιησάντες τὼν ἐνίαυτων, the lessee “will dig holes in the month Eiraphion\textsuperscript{36} (…) 4-foot ones and 3-foot ones, and will put in the plants (…) planting

\textsuperscript{32} Op. 570–572: τὴν φθάμενος οίνας περιτακμηρίσσετεν ὃς γὰρ ἀμενον. / ἀλλ': ὡς τοῦτο ἔρεν ἄρ θεοὺς ἐμ μενον. / Πλησία σελίς, τῶς δὲ σκάφος οὐκέτι οἶνον.
\textsuperscript{34} Isager and Skydsgaard, \textit{Ancient Greek Agriculture} 29.
each year twenty vines (...) and ten fig trees.” The holes for vines and fig trees were in depth 4 feet and 3 feet respectively. These depths are also recommended for vine-plants in Gp. 5.12.1, 5.

Table 5: Holes for plants

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Vines</th>
<th>Figs</th>
<th>Olives</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>4 feet</td>
<td>3 feet</td>
<td></td>
<td>Syll. 3 963.27–32</td>
</tr>
<tr>
<td></td>
<td>4 or 3 feet</td>
<td></td>
<td></td>
<td>Gp. 5.12, 2.46.1</td>
</tr>
<tr>
<td></td>
<td>2.5–3 cubits</td>
<td></td>
<td></td>
<td>Gp. 9.6.4</td>
</tr>
<tr>
<td>less than 2.5 feet</td>
<td></td>
<td></td>
<td></td>
<td>Xen. 19.3</td>
</tr>
<tr>
<td>Diameter</td>
<td>less than 2 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The *Geoponika* supplies important evidence for the use of γύρωσις on sloping lands:

2.46.2: καὶ τὸ πλέθρον δὲ τῶν παλαιῶν ἀμπέλων, ἐν τῇ εὐέργῃ, καὶ βοτάνας μὴ ἐχούσῃ, καὶ πλαγία γῆ ὑπὸ τριῶν πολλάκις ἐργάζεσθαι, ἐν δὲ τῇ σκληρότερᾳ καὶ βοτανόδει εὗ.'

A plethron of old vines, in easily worked ground, with no weeds, even on sloping land, is often worked by three people, or if more difficult and weedy by five.

2.46.4: γυρώσθαι δὲ τὸ πλέθρον ὑπὸ τεσσάρων ἐργατῶν δύνασθαι, διαβεβαιώνται οἱ πείρα παραλαβόντες, τῆς γυρώσεως γενομένης τὸ μὲν πλάτος ἐπὶ δύο ἴμησι πόδας, τὸ δὲ βάθος ἄχρι ποδὸς τοῦτο γὰρ αὐτῆς τὸ κάλλιστὸν εἶναι μέτρον παρατετήρηται.

Four men can hole a plethron, so the experts assure us, if the width of the hole is two and a half feet, the depth one foot; this is prescribed as the best measure.

There is no reference to terrace farming here; terrace walling is never mentioned as a measure for sloping lands. This means that γύρωσις, not terrace farming, was general on sloping land.

Moreover, the chapter entitled Περὶ γυρώσεως (Gp. 5.20) begins: γυρώσομεν δὲ, τούτεστι περισκάψομεν, διετείς ἦδη γενομένας, εἰς βάθος δύο ποδῶν, πλάτος δὲ τριῶν. In 2.46.2
old vines were the object of γύρωσις, but here it is two-year-old vines. As mentioned above, περισκάπτω has the same meaning as γυροῦ; here it is meant “digging a γῦρος round a vine,” not simply “digging round,” and the dimensions of the γῦρος are two feet deep and three wide. The dimensions differed depending on the degree of maturity of the vines.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Old/mature vines</th>
<th>Two-year-old vines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>2.5 feet</td>
<td>3 feet</td>
</tr>
<tr>
<td>Depth</td>
<td>1 feet</td>
<td>2 feet</td>
</tr>
</tbody>
</table>

It is natural that the hole for trees is deeper: otherwise, the tree would be uprooted when disturbed. According to Gp. 5.26.1, in such waterless places as Libya and Anatolia they do not replace the soil immediately after digging holes all around vines, γυρώσαντες τὰς ἀμπέλους, but leave the holes (τοὺς γυρούς) during a whole winter. The γῦρος probably was a basin-like round hole. The soil was banked around the outer edges of the hole to hold water and to allow rain to penetrate to the roots. γύρωσις was done in October, at or just before the start of the autumn rains, the rainy season: τῷ αὐτῷ μηνὶ (viz. Ὁκτωβρίῳ) γυροῦν τὰς ἀμπέλους καλὸν, καὶ περὶ τὰς ρίζας στακτῆν, ἢ κόνιν, ἢ τέφραν ξηράν, ἢ οὐρὸν ἀνθρώπειον παλαιόν, ἢ τρύγα οἴνου, ἢ ἄχυρα περιτιθέναι (Gp. 3.13.3). At this time vines were manured; lixivium, or dust, or dry ashes, or old human urine, or the lees of wine, or chaff were put about the roots. The title of Gp. 5.26 is Πῶς δεῖ ἐν τῷ καιρῷ τῆς γυρώσεως κοπρίζειν. We can see from Gp. 5.26.3 that mature vines are manured in the hole (πρὸς τῷ γυρῷ) with the dung of oxen or sheep or swine, or of other cattle.

38 On filling up with earth (προσχώσατε, aggerari) see Gp. 3.6.5 and Columella Rust. 11.2.46.
39 Foxhall, in Human Landscapes 56, Olive Cultivation 122.
40 Malainos, Tà Γεωπονικά 71, specifies 14 October to 13 November.
To return to the Heraclean inscription: the fourth lot had 2.4 hectares of vineyard. The lessee had to plant vines in lands of not less than 10 schoinoi, and at least four olive trees per schoinos in lands suitable for olive cultivation. He was ordered to dig round, pile up earth around,\(^{41}\) and prune olives, figs, and indeed all fruit trees that were in this lot: τὰς δὲ ἐλαίας καὶ τὰς συκίας καὶ τὰ ἄλλα δένδρα τὰ ἡμερὰ τὰ υπάρχοντα πάντα ἐν τοῖς μερίδι ταύτα περισκαψεῖ καὶ ποτισκαψεῖ καὶ περικόπτει τὰ δέομεν (Tab. 1.172–173). The vineyard clearly was included in the “other fruit trees” in the lot. Dareste/ Haussoulier/Reinach (211) translate: “Quant aux oliviers, figuiers et autres arbres fruitiers qui se trouvent dans ce lot, le preneur y creusera les rigoles et les cuvettes nécessaires et pratiquera les ébranchages qu’il faudra.” Arangio-Ruiz/Olivieri (30) interpret the terms: “περισκάψει = effodiet circumcirca; προσσκάψει = accumulabit terram fodiendo, confirmabit terrae acervis; περικόπτει circumcidet.” Sartori translates:\(^{42}\) “Quanto agli olivi e ai fichi e a tutti gli altri alberi da frutto che esistono in questo lotto, scaverà attorno le buche e i rincalzi di terra e praticherà le necessarie potature.”

Three terms are crucial: περισκάψει, προσσκάψει, περικόπτει. The meanings of περισκάψει and περικόπτει are clear. As discussed above, the operations of digging and pruning are done at about the same time. The words used by Hesiod (570 ff.) for “dig round” and “prune” are σκάφος and περιτάµω (Ion./Ep. for περιτέµω). The word for pruning vines in Gp. 2.46.5 is κλαδεύω. According to Gp. 3.14, the operation of pruning vines was practiced two times a year: ἡ μετοχαρινή (autumn) κλαδεία and ἐαρινή (spring) κλαδεία. The pruning referred to by Hesiod is that in spring. The term περικόπτει in the Heraclean inscription is to be equated in meaning with Hesiod’s περιτάµω. As to σκάφος, we have seen that σκάψει in two inscriptions, σκάφος in Hesiod, and περισκάψει in the

\(^{41}\) Cf. LSJ s.v. προσσκάπτει.

\(^{42}\) Archäologische Forschungen 49; cf. Uguzzoni/Ghinatti, Le tavole 71.
Heraclean inscription are synonymous: they have the same meaning as περισκάπτω in the Geoponika. Finally, προσσκάπτω: what kind of operation was this? As mentioned earlier, γυρόω is “make a γὺρος” round a tree; γὺρος is a basin-like round hole; and soil was banked around the outer edges of the hole. It is likely that προσσκάπτω means the same as γυρόω. These three operations were very important for viticulture.

Conclusion

To sum up, it seems that slopes between about 10° and 15° might have been cultivated without terracing, but would probably have been subject to severe soil erosion. However, erosion was reduced by γυρόω on those slopes, but not on very steep slopes (steepener than about 15°). And γύρωσις also had the effect of slowing runoff. It is likely that γύρωσις was normal on sloping land, rather than terracing. In short, we can conclude from these considerations that there were γύροι and not terraces on sloping land in classical antiquity.

APPENDIX: Odyssey 24.220–227

οἱ μὲν ἔπειτα δόμονδε θοὸς κίων, αὐτὰρ Ὀδυσσεῦς ἄσον ἐν τοιαύτα ἔργα ἐπιτήδευσαν. οὐδὲ εὑρὲν Δολίον, μεγαν ὄρχητον ἐσκαταβαίνον, οὐδὲ τινα δμώον οὐδ’ υἱὸν’ ἄλλ’ ἄρα τοῖς αἰμασιάς λέξοντες ἀλωῆς ἐμεναὶ ἔρκος ὑσεν’, αὐτάρ’ ὁ τοῖς γέρων ὄδον ἤγεμόνευε. τὸν δ’ οἰον πατέρ’ εὑρὲν ἐὐκτιμένη ἐν ἀλωῆς, λιστρεύοντα φυτόν’

They thereafter went quickly to the house; but Odysseus drew near to the fruitful vineyard in his quest. Now he did not find Dolius as he went down into the great orchard, nor any of his slaves or of his sons, but as it chanced they had gone to gather stones for the vineyard wall, and the old man was their leader. But he found his father alone in the well-ordered vineyard, digging about a plant. (transl. Murray, Loeb 1919)

In LSJ αἷμασια is translated as “wall of dry stone” and αἷμασιάς τε λέγειν as “to lay walls”; ἔρκος is “fence, enclosure”; ἀλωῆ is “garden, orchard, vineyard, etc.”—particularly vineyard, because the vineyard of Alcinoos (Od. 7.122) and the vineyard represented in the shield of Achilleus (Il. 18.561) are so called. In this case, αἷμασια seems to

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indicate a stone wall (= fence, enclosure) round the vineyard of Laertes. And also the great orchard of Alcinoos (7.113) and the vineyard on the shield of Achilleus (18.564) are each enclosed by a ἕρκος. We cannot see the extent of the vineyard of Laertes, but he has promised to give Odysseus fifty rows of vines (24.341–342). Odysseus found his father alone in the well-made vineyard, λιστρέυοντα φυτόν. λιστρέυω is hapax, from λίστρον (Od. 22.455, hapax), a tool for levelling or digging: spade, shovel. Thus it is clear that λιστρέυω means “dig.” φυτόν, in the lexica, is understood as “plant” in a broad sense. Nevertheless, we learn from several sources (Hes. Op. 570 ff.; Syll.3 963.27 ff.; Xen. Oec. 19.2 and 12) that φυτόν is typically a vine in a narrow sense. λιστρεύοντα φυτόν probably means the same as φυτόν ἀμφιλαχαίνω (Od. 24.242, hapax). λαχαίνω is to “dig,” so ἀμφιλαχαίνω is “dig round.” Thus, it seems that λιστρέυω corresponds to σκάπτω and ἀμφιλαχαίνω to περισκάπτω.44

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