Irrigation Holes in Ancient Greek Agriculture

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AGRICULTURAL STEPPED TERRACES are a characteristic feature of the modern rural landscape of the Mediterranean.[1] 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,[2] while others have denied that agricultural terraces were much used in antiquity.[3]

The author has already written on agricultural terraces.[4] 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 τειχίον), using both literary texts and inscriptions (41–44).

[1] On the types of terraces, O. Rackham and J. A. Moody, "Terraces," in B. Wells (ed.), *Agriculture in Ancient Greece* (Stockholm 1992) 123.

[2] Rackham and Moody, in *Agriculture* 129; H. Lohmann, "Agriculture and Country Life in Classical Attica," in *Agriculture* 51; S. Isager and J. E. Skydsgaard, *Ancient Greek Agriculture: An Introduction* (London/New York 1992) 81–82; A. Burford, *Land and Labor in the Greek World* (London 1993) 109, 111; S. Price and L. Nixon, "Ancient Greek Agricultural Terraces: Evidence from Texts and Archaeological Survey," *AJA* 109 (2005) 665–694.

[3] L. Foxhall, "Feeling the Earth Move: Cultivation Techniques on Steep Slopes in Classical Antiquity," in G. Shipley and J. Salmon (eds.), *Human Landscapes in Classical Antiquity: Environment and Culture* (London 1996) 45–52, 60–65, and *Olive Cultivation in Ancient Greece: Seeking the Ancient Economy* (Oxford 2007) 66–68.

[4] T. Ito, "Ancient Greek Agriculture: Concerning Agricultural Terraces," *Jochi Shigaku* (*Sophia Historical Journal*) 59 (2014) 41–57 (in Japanese).

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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 γῦρος)[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

[5] So cited by L. Foxhall, in *Agriculture* 131.

[6] *Selections on Agriculture* (Περὶ γεωργίας ἐκλογαί) compiled originally by one Cassianus Bassus in the sixth century are generally named *Geoponika*. Early editions are by Brassicanus, Basileae 1539, by Needham, Cantabrigiae 1704, and by Niclas, Lipsiae 1781, then H. Beckh, *Geoponica sive Cassiani Bassi scholastici de re rustica eclogae* (Leipzig 1895); the most recent edition is E. Lelli, *L'Agricoltura antica: I 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).

[7] T. M. Whitelaw, "Colonization and Competition in the Polis of Koressos: The Development of Settlement in North-west Keos from the Archaic to the Late Roman Periods," in L. G. Mendoni and A. Mazarakis Ainian (eds.), *Kea-Kythnos: History and Archaeology* (Athens 1998) 234.

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 ἠρέμα ἀνακεκλιμένοις … τόποις
5.4.1 τὰ πρὸς ἄρκτον νεύοντα
9.3.2 τὰ τῆς γῆς σχήματα προσκλινῆ καὶ ὑψηλά
9.3.7 τὰ προσκλινῆ καὶ ἀνάντη

'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 ἠρέμα (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 κάλλιστός ἐστιν ὁ ἐν ξηροῖς καὶ κεκλιμένοις τόποις, καὶ πρὸς ἀνατολὰς ἢ μεσημβρίαν βλέπουσι φυτευθεισῶν ἀμπέλων. τὰς δὲ δενδρίτιδας ἀμπέλους ἐν τῇ πεδιάδι καὶ κοίλῃ καὶ ὁμαλῇ, ἐπιτηδειότερον φυτεύειν. μεμνῆσθαι γὰρ πανταχοῦ, καὶ ἰδικῶς παρατηρεῖν δεῖ, ὅτι γῆ πρὸς φυτείαν χαμαιζήλοις μὲν ἀμπέλοις ἐκείνη ἐστὶν ἐπιτηδειοτέρα, ἡ ἐν τοῖς πλαγίοις καὶ ἠρέμα ἀνακεκλιμένοις καὶ ὑψηλοτέροις καὶ ξηροτέροις τόποις, αὕτη γὰρ τὸ θέρος εὐμαρέστερον ἕξει, διαπνεομένη καλῶς.
>
> 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

[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 τοῦτο γὰρ καὶ τὰ προσκλινῆ καὶ ἀνάντη σφόδρα πρὸς ἐλαίαν ἐπιτήδεια ὑπάρχειν εἰρήκαμεν, διότι δέχεται ἀεὶ εὔδιον ἄνεμον, ὡς μηδὲν διαπνεῦσαι, ἀλλὰ καθ' ἕκαστον δένδρον ὁμαλῶς διιέναι καὶ τρέφειν καὶ διεγείρειν τὴν αὔξησιν 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 = ἄμπελος δενδρῖτις (tree-trained vines) and χαμῖτις ἄμπελος (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 plantating 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-

[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 infimae Italiae 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-

[12] Barren lands consisted of σκῖρος (brushwood), ἄρρηκτος (unploughed land), and δρυμός (thicket).

[13] See *IG* XIV 645 p.172.

[14] W. Kamps, "L'emphytéose en droit grec et sa réception en droit romain," in *Recueils de la Société Jean Bodin* III *La tenure* (Brussels 1938) 76; A. Uguzzoni and F. Ghinatti, *Le tavole greche di Eraclea* (Rome 1968) 204.

[15] Tab. 1 lines 17, 21, 27, 32, 56, 87–88.

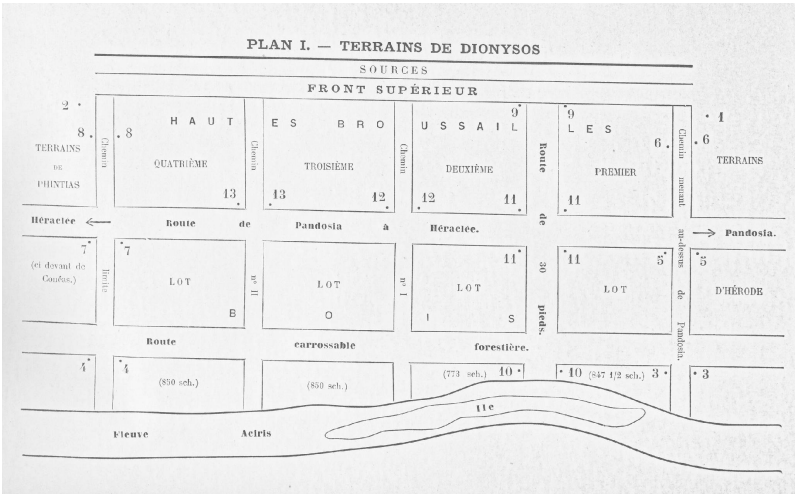
[16] Line 65.

[17] Lines 58–59, 92.

[18] Line 71.

[19] Lines 60–61, 72–73, 78–79.

ing.[20] 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.[21] A lessee had to plant vines in land over not less than 10 *schoinoi*,[22] and also had to plant more than four olive trees per *schoinos* in land suitable for olive cultivation.[23] When a lessee judged that land was unsuitable for olive cultivation, it was possible to make an objection to the state.[24]



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

[20] M. Guarducci, *Epigrafia Greca* II (Rome 1969) 278; Uguzzoni and Ghinatti, *Le tavole* 191.

[21] Lines 169–171. On this vineyard see Uguzzoni and Ghinatti, *Le tavole* 95; Kamps, in *Recueils* 80. For the units of measurement used in the inscription see Dareste/Haussoullier/Reinach pp.227–228; Uguzzoni/Ghinatti 179–84; Sartori, in *Archäologische Forschungen* 41–45 nn.113–116, 51 n.122, 53 nn.124–125.

[22] Lines 114–115.

[23] Lines 115–116.

[24] Lines 116–119.

Table 1: The lands of Dionysus

		Arable lands (*schoinoi*)			Barren lands (*schoinoi*)			Rents in barley		
Lots	Total	Temple	Encroached	Total	Temple	Encroached	Total	Temple	Encroached	Total
1	847	125	76	201	461	185	646.{5}	35 M. 1 k.	300 M.	57 M. 1 k.
4	850	81	227.5	308.5	291.5	250	541.5			278 M.
2	773	273	—	273	500	—	500	40 M.	—	40 M.
3	850	312.5	—	312.5	537.5	—	537.5	35 M.	—	35 M.
Total	3320	791.5	303.5	1095	1790	435	2225	110 M. 1 k.	300 M.	410 M. 1 k.

10 σχοῖνοι = 10692.9 m² (32.7 x 327 m)
M.= μέδιμνος = 52.50 or 52.40 litres k.= κάδδιχος = 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 *guai* (= 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.

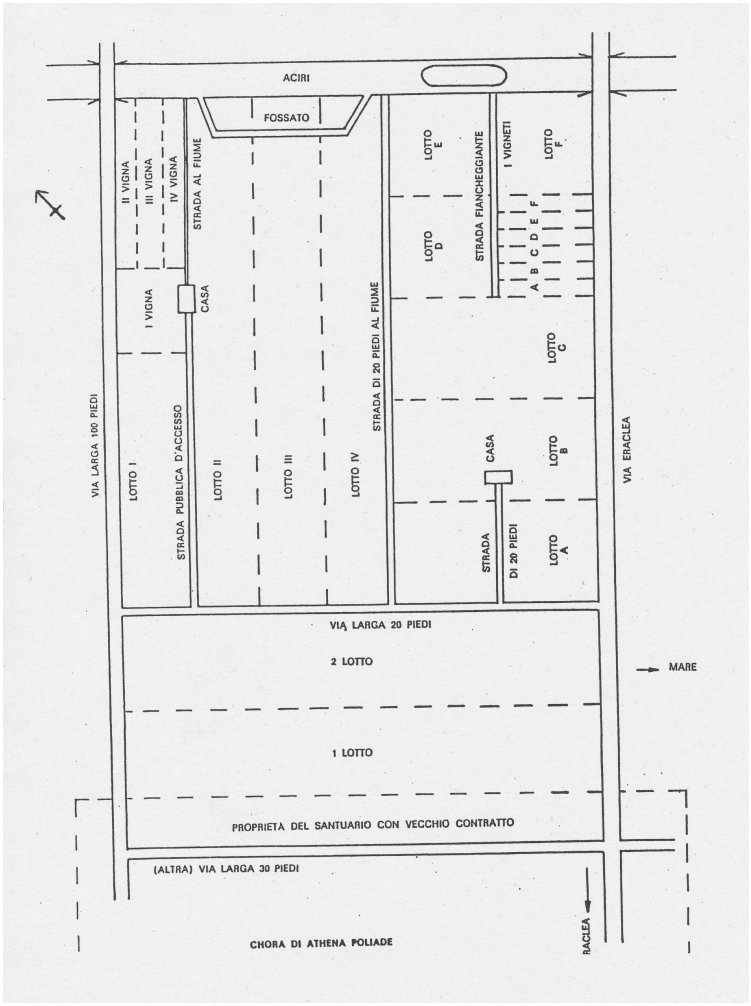
[25] Tab. 2 lines 10–19.

[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

A	1750 *schoinoi* (35 x 50 s.)			
B	Total	(γῆ) ψιλή	Vineyards	Rents (for 5 years)
1 τρίγυον	138 s. 8 o.	133 s. 26 o. 1 p.	4 s. 11 o. 3 p.	269 M. 1 ch. 2 c.
2 τρίγυον	139 s.	123 s.	16 s.	695 M.
I	59.5 s.	51 s. 7 o.	8 s. 8 o.	446 M. 4 k.
II	72 s. 8 o. 2 p.	63 s. 12 o.	8 s. 26 o. 2 p.	632 M. 1 ch.
III	74 s. 2 o.	66.5 s.	7 s. 17 o.	630 M. 2 k. 2 c.
IV	83 s. 20 o.	68 s. 13 o.	15 s. 7 o.	630 M.
A	68.5 s.	62 s.	6.5 s.	856 M. 4 k.
B	66 s.	59.5 s.	6.5 s.	458 M. 14 k. 2 c.
C	70 s.	63.5 s.	6.5 s.	306 M. 4 k.
D	54.5 s.	48 s.	6.5 s.	235 M. 15 k.
E	71 s. <1> 7 o. 2 p.	64 s.	7 s. 17 o. 2 p.	580 M. 15 k.
F	38.5 s.	30 s.	8.5 s.	
Total	935 s. 26 o.	833 s. 13 o. 1 p.	102 s. 12 o. 3 p.	5739 M. 15 k.+ α

g. = γύης (area) = 50 *schoinoi* = 53464.5 m² (32.7 x 1635 m)
o. = ὄρεγμα = 1.111 or 1.092 m p.= πούς = 0.2777 or 0.2736 m
ch. = χοῦς = 1/16 M. = 3.283 litres c. = χοῖνιξ = 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*

[30] Foxwall calls γύρωσις "trenching" in *Human Landscapes* 53–60, *Olive Cultivation* 121–124.

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

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

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

ἀμπέλους δ[ὲ]
[σκ]άψει δὶς τὸμ πρ[ῶ]το[ν μ]ηνὸς Ἀνθεστηρίῶνος, τ[ὸν]
δεύτερον σκαφη[τ]ὸν [μηνὸς] Ταυρειῶνος πρὸ εἰκάδ[ος]·
συκᾶς ἅπαξ.

(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[ὶ] σκάψει τὰς ἀμπέλους δὶς κατ[ὰ πα]σῶν τῶν ὡρῶν, the lessee "will dig round the vines twice every year (or season)" (*IG* II^2 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.

climbs up from the ground.[32] Perhaps digging and pruning were done at about the same time,[33] probably just before the arrival of spring. The technical terms for "digging (round)" are σκάπτω, σκάφος, περισκάπτω. This last is identified with γυρόω at *Gp*. 4.3.1 (γυροῦν, τουτέστι περισκάπτειν); "digging" is part of γύρωσις:

Table 4: Agricultural activities

Month	*γύρωσις*	*Reference*
October	γυρόω	*Gp*. 3.13.3
February	First σκάπτω	*Syll.*[3] 963.8–11
April	Second σκαφητός	

According to LSJ, γύρωσις is "making of a γῦρος," γυρόω is "make a γῦρος round a tree." Thus it seems that γῦρος as a technical term is a round hole, "not a trench or ditch,"[34] and that γύρωσις is the act of "digging a hole around a tree." The γῦρος is different from the hole for plants. The latter is βόθυνος/βόθρος and τράφη, not γῦρος, 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.[35] The Arcesine contract offers (27–32): τὰς τράφα[ς] ὀρύξει ἐμ μηνὶ Εἰραφιῶνι (…) τετράποδας καὶ τρίποδας, καὶ τὰ φυτὰ ἐμβαλεῖ (…) ἀμπέλους εἴκοσιν (…) συκᾶς δέκα, καθ' ἕκαστον τὸν ἐνιαυτόν, the lessee "will dig holes in the month Eiraphion[36] (…) 4-foot ones and 3-foot ones, and will put in the plants (…) planting

[32] *Op*. 570–572: τὴν φθάμενος οἴνας περιταμνέμεν· ὣς γὰρ ἄμεινον. / ἀλλ' ὁπότ' ἂν φερέοικος ἀπὸ χθονὸς ἂμ φυτὰ βαίνῃ / Πληιάδας φεύγων, τότε δὴ σκάφος οὐκέτι οἰνέων.

[33] A. N. Athanassakis, *Hesiod* (Baltimore 1993) 102–103; M. L. West, *Hesiod. Works and Days* (Oxford 1978) 302.

[34] Isager and Skydsgaard, *Ancient Greek Agriculture* 29.

[35] Xen. *Oec*. 19.3, 19.5, cf. *Gp*. 9.6.4.

[36] November/December; cf. *Gp*. 3.14–15.

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

Dimensions	*Vines*	*Figs*	*Olives*	*Reference*
Depth	4 feet	3 feet		*Syll.*[3] 963.27–32
	4 or 3 feet			*Gp.* 5.12, 2.46.1
			2.5–3 cubits	*Gp.* 9.6.4
	less than 2.5 feet			Xen. 19.3
Diameter	less than 2 feet			

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

> 2.46.2: καὶ τὸ πλέθρον δὲ τῶν παλαιῶν ἀμπέλων, ἐν τῇ εὐέργῳ, καὶ βοτάνας μὴ ἐχούσῃ, καὶ πλαγίᾳ γῇ ὑπὸ τριῶν πολλάκις ἐργάζεσθαι, ἐν δὲ τῇ σκληροτέρᾳ καὶ βοτανώδει ε′.
>
> 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: γυροῦσθαι δὲ τὸ πλέθρον ὑπὸ τεσσάρων ἐργατῶν δύνασθαι, διαβεβαιοῦνται οἱ πείρᾳ παραλαβόντες, τῆς γυρώσεως γινομένης τὸ μὲν πλάτος ἐπὶ δύο ἥμισυ πόδας, τὸ δὲ βάθος ἄχρι ποδός· τοῦτο γὰρ αὐτῆς τὸ κάλλιστον 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 δέ, τουτέστι περισκάψομεν, διετεῖς ἤδη γενομένας, εἰς βάθος δύο ποδῶν, πλάτος δὲ τριῶν. In 2.46.2

(above), old vines were the object of γύρωσις, but here it is two-year-old vines. As mentioned above, περισκάπτω has the same meaning as γυρόω; here 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 6: The hole for γύρωσις

Dimensions	*Old/mature vines*	*Two-year-old vines*
Diameter	2.5 feet	3 feet
Depth	1 feet	2 feet

It is natural that the hole for trees is deeper: otherwise, the tree would be uprooted when disturbed.[37] 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.[38] 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.[39] γύρωσις was done in October, at or just before the start of the autumn rains, the rainy season:[40] τῷ αὐτῷ μηνὶ (viz. Ὀκτωβρίῳ) γυροῦν τὰς ἀμπέλους καλόν, καὶ περὶ τὰς ῥίζας στακτήν, ἢ κόνιν, ἢ τέφραν ξηράν, ἢ οὖρον 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.

[37] Cf. Xen. *Oec.* 19.4.

[38] On filling up with earth (προσχῶσαι, *aggerari*) see *Gp.* 3.6.5 and Columella *Rust.* 11.2.46.

[39] Foxhall, in *Human Landscapes* 56, *Olive Cultivation* 122.

[40] Malainos, *Τὰ 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 δένδρεα τὰ ἥμερα τὰ ὑπάρχοντα πάντα ἐν τᾶι μερίδι ταύται περισκαψεῖ καὶ ποτισκαψεῖ καὶ περικοψεῖ τὰ δεόμενα (Tab. l.172–173). The vineyard clearly was included in the "other fruit trees" in the lot. Dareste/Haussoullier/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; περικόψει 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, περικόψει. The meanings of περισκάψει and περικόψει 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 περιτάμνω (Ion./Ep. for περιτέμνω). 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 μετοπωρινὴ (autumn) κλαδεία and ἐαρινὴ (spring) κλαδεία. The pruning referred to by Hesiod is that in spring. The term περικόπτω in the Heraclean inscription is to be equated in meaning with Hesiod's περιτάμνω. As to σκάφος, we have seen that σκάπτω in two inscriptions, σκάφος in Hesiod, and περισκάπτω in the

[41] Cf. LSJ s.v. προσσκάπτω.

[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 γῦρος" round a tree; γῦρος 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 γῦροι on those slopes, but not on very steep slopes (steeper 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 γῦροι and not terraces on sloping land in classical antiquity.

Appendix: *Odyssey* 24.220–227

οἱ μὲν ἔπειτα δόμονδε θοῶς κίον, αὐτὰρ Ὀδυσσεὺς
ἆσσον ἴεν πολυκάρπου ἀλωῆς πειρητίζων.
οὐδ' εὗρεν Δολίον, μέγαν ὄρχατον ἐσκαταβαίνων,
οὐδέ τινα δμώων οὐδ' υἱῶν· ἀλλ' ἄρα τοί γε
αἱμασιὰς λέξοντες ἀλωῆς ἔμμεναι ἕρκος
ᾤχοντ', αὐτὰρ ὁ τοῖσι γέρων ὁδὸν ἡγεμόνευε.
τὸν δ' οἷον πατέρ' εὗρεν ἐϋκτιμένῃ ἐν ἀλωῇ,
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 αἱμασιά is translated as "*wall* of dry stone" and αἱμασιάς τε λέγειν as "to lay *walls*"; ἕρκος is "fence, enclosure"; ἀλωή 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, αἱμασιά seems to

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, λιστρεύοντα φυτόν. λιστρεύω is hapax, from λίστρον (*Od.* 22.455, hapax), a tool for levelling or digging: spade, shovel. Thus it is clear that λιστρεύω 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 φυτὸν ἀμφελάχαινε (*Od.* 24.242, hapax). λαχαίνω is to "dig," so ἀμφιλαχαίνω is "dig round."[43] Thus, it seems that λιστρεύω corresponds to σκάπτω and ἀμφιλαχαίνω to περισκάπτω.[44]

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[43] W. Richter, *Die Landwirtschaft im homerischen Zeitalter*, *Archaeologia Homerica* II H (Göttingen 1968) 126; J. Russo, M. Fernández-Galiano, and A. Heubeck, *A Commentary on Homer's Odyssey* III (Oxford 1992) 386.

[44] I am grateful to the editor of *GRBS* for helping me to improve an earlier draft of this paper, and to anonymous readers for their valuable comments. Remaining deficiencies are my responsibility alone.