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AGRARIAN ECOLOGY IN THE GREEK ISLANDS: TIME STRESS, SCALE AND RISK

(PLATE I)

A botanical study of crop processing was undertaken on the semi-arid, southern Aegean islands of Karpathos and Amorgos.[1] The present article provides details of the crop processing activities, and some contextual information concerning the wider agricultural economy. Attention is drawn to three aspects of this wider economy (time stress, scale and risk) which are of particular significance for understanding both recent 'traditional' and ancient farming practice in the region. Amorgos is discussed in greater detail as the period of fieldwork was longer.

The study areas

On Karpathos, the area chosen was the northern part of the island, around the isolated village of Olimbos. Olimbos itself is a nucleated village lying on the slopes of a steep ridge which provides concealment from the sea and the pirates who once, so local legend insists, posed a serious threat. Immediately below the village are vegetable/pulse gardens, some irrigated. Fields are scattered widely, but arable farming is concentrated in the alluvial valley of Avlona, an hour's walk to the north. Here a cluster of field houses is used as a temporary base during the peak periods of agricultural work. Each field house has its stone threshing floor and a store for the hay and chaff used as animal fodder during the winter.

Our two week visit in June 1980 coincided with the reaping and processing of barley (*Hordeum vulgare*, το κριθάρι). The wheat (το σιτάρι, a 'maslin' mixture of bread and macaroni wheat, *Triticum aestivum* and *T. durum*) was just ripening and the pulses had for the most part already been harvested, threshed and cleaned for storage. Pulses included broad bean (*Vicia faba faba*, το κουκκί), field bean (*V. faba minor*), lentil (*Lens esculenta*, η φακή), pea (*Pisum sativum*, το γλυκίδι), *Lathyrus clymenum* (or *L. articulatus*, ο αρακάς),[2] *L. ochrus* (η σπρικά, also η ξετρίχια), grass pea (*L. sativus*, το λαθούρι), common vetch (*Vicia sativa*, ο βίκος) and bitter vetch (*V. ervilia*, το ρόβι). All these crops were said to be autumn sown, 'around November, depending on the rain'. In addition, chick pea (*Cicer arietinum*, το ρεβίθι) and *Phaseolus/Vigna sp.* (το φασόλι) were being grown as summer garden crops, along with tomatoes etc., while a single row of globe artichokes bounded some of the cereal fields.

Grass pea, common vetch and bitter vetch were grown as animal feed, the remaining pulses and wheat for human consumption. One informant described human consumption of barley as a thing of the past, but others implied that barley was still eaten by both man and livestock. While most of the species listed are widely known as crops, both in the Aegean and elsewhere, *L. clymenum* and *L. ochrus* are rather more unusual. *L. clymenum*, recorded as an occasional fodder

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[1] G. Jones, 'Interpretation of archaeological plant remains: ethnographic models from Greece' in W. van Zeist and W. A. Casparie (eds), *Plants and ancient man* (Rotterdam 1984) 43–61; *Journal of Archaeological Science* xiv (1987) 311–23.

[2] *Cf.* A. Sarpaki and G. Jones, 'Ancient and modern cultivation of *Lathyrus clymenum* L. in the Greek islands' (forthcoming).

crop,[3] is also grown for human consumption on the Cycladic islands of Thira and Anafi.[4] *L. ochrus*, also an occasional fodder crop,[5] is grown for human consumption on Euboia (as το λαθούρι),[6] and its cultivation is also reported from Patmos in the Dodecanese.[7]

In Olimbos farming was very much in decline and the mainstay of the local economy was remittances from emigrés in mainland Greece, Australia and the USA (in the past many men had worked abroad as itinerant stone masons). Agriculture was largely in the hands of middle aged and elderly women. The higher, poorer terraces were widely abandoned and there were other indications that the scale of cultivation was significantly reduced: for example, in southern Karpathos, June is known as 'theristis' (ο θεριστής—reaper) and July as 'alonistis' (ο αλωνιστής—thresher),[8] but in Olimbos in 1980 the whole cycle was proceeding far more rapidly. With the exception of petrol-driven corn-grinders, which had led to the abandonment of all but one of the windmills perched on the ridge over the village, farming was apparently completely unmechanised.

The second area chosen for study was the community of Arkesini in southern Amorgos. Arkesini itself is again a nucleated village, on the edge of a land-locked basin, but the principal focus of investigation was the outlying group of dispersed hamlets on the gently rolling Kolofana plain. Local tradition has it that these hamlets were formed '100 years ago': with the suppression of piracy and redistribution of monastic land by the modern Greek state, some farmers moved out of Arkesini to take up residence in their field houses or 'stavloi' (οι σταύλοι). In Amorgos, the dissolution of the major monastic estates is assigned to the period 1870–1915, while the last reported pirate raid was in 1835.[9]

After the dissolution, partible inheritance, as elsewhere in Greece,[10] led to fragmentation of land holdings, but especially since World War II some farmers have been able to extend or consolidate their holdings by purchases from emigrating relatives. Emigration also radically altered the balance between available land and available labour, although latterly mechanisation has to some degree balanced this change. In spite of emigration and the abandonment of the highest terraces, southern Amorgos is still farmed on a large scale compared with the infertile north of Karpathos. The far-flung fields are connected by cobbled mule tracks, said to have been built in recent decades by communal labour—three days per year from all 15–60-year-olds.

Villagers report that farming used to be dominated by subsistence production of wheat and barley and by cash cropping of tobacco. The cereals were grown in alternation with bare (i.e. ploughed) fallow (perhaps unploughed on some of the terraces), while tobacco was planted in place of fallow on some of the better fields. In the 1930s tobacco was abandoned (because of competition from Macedonian tobacco)[11] and government agronomists initiated the replacement of fallow with pulse fodder crops to improve the productivity of livestock and so provide a cash income from cheese and from kids and calves sold for meat. This was essentially the system which prevailed in 1981.

Our visit covered six weeks in June and early July and coincided with the threshing and winnowing of pulses and the harvest and processing of cereals. The pulse crops were lentil (η φακή), pea (το κατσούνι), broad bean (το κουκκί), chick pea (το ρεβίθι) and black-eyed bean (*Vigna unguiculata*, το φασόλι), grown as human food, and grass pea (το λαθούρι) and common vetch (ο βίκος), grown for animal feed. Bitter vetch (το ρόβι) was a regular contaminant of grass pea and had been grown as a fodder crop some years previously. The cereal crops included wheat (again a mixture of bread wheat—ο γκριλιάς—and macaroni wheat—η μαυραγάνη), grown for human consumption, and oat (*Avena sativa*, η βρώμη) and barley (*H. vulgare*) grown as

[3] G. Usher, *A dictionary of plants used by man* (London 1974).

[4] Sarpaki and Jones (n. 2).

[5] O. Polunin, *Flowers of Europe* (London 1969) 197.

[6] Authors' field notes (1987).

[7] C. C. Townsend and E. Guest (eds), *Flora of Iraq, iii: Leguminales* (Baghdad 1974) 554.

[8] E. Melas, pers. comm. (1980).

[9] S. Sutton, *Migrant regional associations: an Athenian example and its implications* (Ph.D. dissertation, University of North Carolina 1978) 86, 62.

[10] K. Thompson, *Farm fragmentation in Greece: the problem and its setting* (Athens 1963).

[11] Sutton (n. 9).

fodder. By far the most common crop, however, was 'migadhi' (το μιγάδι), a wheat/barley maslin grown principally for the making of bread.

Ideally, sowing started in November with broad bean, common vetch and grass pea. Barley and 'migadhi' were sown through November and December, followed by wheat and lentils during January and February. The fields were said to be ploughed at right angles to the direction followed in the previous year and were mostly dressed with artificial fertiliser—nitrate and phosphate on cereals, phosphate only on pulses for human consumption. Animal dung was highly valued but scarce: one farmer, with a few work animals and a few goats, expected to manure 1–2 str. (0·1–0·2 ha.: the 'stremma'/το στρέμμα = 1000 m^2) each year in September, selecting the poorest of his level fields (i.e. avoiding terraces). Cereals and pulses were usually grown in rotation (50 out of 71 fields sampled) and, as elsewhere in the Mediterranean, the abandonment of alternate year bare fallowing had not been accompanied by the introduction of irrigation. Every few years, however, fields were bare fallowed to control weeds and some of these fields were planted in the spring of the fallow year with unirrigated summer crops (τα καλοκαιρινά), including chick pea, black-eyed bean, tomato, cucumber, sesame, onion, watermelon etc. Ideally fields selected for summer crops were ploughed in autumn, then three times in March–early May. The first of the spring ploughings (το νιάτο) was relatively shallow, the second (το δίβολο) was deeper and at right angles to the first, while the third (το τρίβολο) accompanied sowing.[12]

Processing of winter cereals and pulses

All the winter cereals and pulses were processed in a broadly similar way, regardless of whether they were intended for animal or human consumption.[13] The processing of summer crops was not observed, but on Amorgos the small chick pea and black-eyed bean crops were harvested pod by pod and so will have posed quite different processing problems from their winter counterparts.

Harvesting (το θέρισμα)

Cereals were usually reaped with a sickle (το δρεπάνι).[14] On Amorgos, the crop was cut quite low so that most of the straw was harvested. On Karpathos, the crop was reaped at mid-height (just low enough to harvest the lower ears), leaving much of the straw in the fields, but in the past crops were cut lower and the shortest barley was uprooted. Pulses were harvested by uprooting using a blunt sickle or, in some cases on Amorgos, were cut with a scythe (η δραπάνα). Either way, a large amount of stalk and leaf was collected with the seed pods.

While harvesting, a varying degree of care was taken to leave weeds behind in the field. On Amorgos, large robust weeds with obvious colouring, such as *Rumex pulcher*, were often left (see Appendix for local common names). Conservative farmers preferred the sickle to the reaping machine (and uprooting to the scythe) because of the opportunities for such selective harvesting. On Karpathos, farmers even tried to leave behind such inobvious weeds as darnel (*Lolium temulentum*). This was made easier by their practice of reaping cereals high and is also much more practical on poor, stony ground, where the crop is sparse, than on fertile soil. On Amorgos, the

[12] *Cf.* H. A. Forbes, *Expedition* xix (1976) 5–11.

[13] For a comprehensive account of crop processing in Turkey, see G. Hillman, 'Reconstructing crop husbandry practices from charred remains of crops' in R. J. Mercer (ed.) *Farming practice in British prehistory* (Edinburgh 1981) 123–62; 'Interpretation of archaeological plant remains: the application of ethnographic models from Turkey' in van Zeist and Casparie (n. 1) 1–41; *Bulletin on Sumerian Agriculture* i (1984) 114–52; *Bulletin on Sumerian Agriculture* ii (1985) 1–31; also G. Lerche, *Tools and Tillage* i 1 (1968) 33–49; H. Rasmussen, *Tools and Tillage* i 2 (1969) 93–104; A. Steensberg, *Tools and Tillage* i 4 (1971) 241–56.

[14] Benaki Museum, Παραδοσιακές καλλιέργιες (Athens 1978) 27 Plate 19.

cleaning out of darnel seeds took place in the later stages of crop processing and failure to do this effectively was said to have occasioned severe illness in the past.

After reaping, cereals were tied in bundles and pulses piled in heaps and both were left in the field to dry for a few days, before they were transported by donkey or mule to the threshing floors. The crops were piled up round the edge of the floor to await threshing, sometimes guarded by dogs.

Threshing (το αλώνισμα)

Bundles of harvested cereals or pulses were strewn on the stone threshing floor (το αλώνι) and left to dry further.[15] Threshing, to release the seed, was usually accomplished by trampling under the hooves of a team of animals (various combinations of oxen, cows, donkeys and mules).[16] The team (not anchored to a central pole, as in some other areas) was driven around the circular floor by a person wielding in one hand a stick and in the other a tin can for catching the animals' droppings. A threshing sledge (Karpathos—το βολόσυρο), embedded with stone or metal blades, was only rarely in use. On Karpathos, the reason given was that the female workforce lacked the ability to make sledges. On Amorgos, threshing sledges were said to chop the straw more finely than was ideal for animal fodder.

Threshing characteristically took place in the heat of the day when the harvested crops were at their driest and so most likely to break up. On a good, hot day a full threshing floor might be completed in a few hours, while in cool, cloudy conditions it might take several days. Sometimes, as the crop was trampled down, more sheaves or bundles were added to the partly threshed crop. Small quantities of pulses were sometimes threshed by hand, using a long stick (unjointed flail).

Winnowing (Amorgos—το λύχνισμα, Karpathos—το ξαχέρισμα)

The next stage in the process was the separation of the chaff and straw (leaf, stem and pod in the case of pulses) from the grain by winnowing. The threshed crop was tossed into the air with a winnowing fork (το διχάλι), light chaff and straw were carried aside by the breeze, while the grain, heavier chaff and straw fragments fell straight downwards.[17] This process could take anything from a few hours to several days depending on the strength and quality (i.e. persistence and direction) of the breeze. In the later stages of winnowing, when the pile being winnowed was more grain than chaff, a shovel was used in place of a fork.

Ideally, winnowing was carried out in a gentle steady breeze so that the light fraction of the crop (Amorgos—η πάσπαλη) was carried only a few feet. (Sometimes a rag was tied to a stick to monitor the strength and direction of the breeze.) Branches of bushes, e.g. juniper, were often placed on the lee side of the threshing floor to trap fragments of chaff and straw and when winnowing was complete the resultant straw and chaff pile was often covered by branches to prevent it blowing away. As a result, juniper berries sometimes turned up in the winnowing by-product.

Small crops could be winnowed without tools—simply being lifted by the handful and allowed to fall. If the crop was large, one end of the pile might be winnowed first, the light chaff and straw accumulating on top of the remaining unwinnowed crop. This would then be raked aside before winnowing proceeded to the crop below. If the crop was very large then a part of it only might be threshed first and partly winnowed (Amorgos—το παραλύχνισμα) in order to reduce the volume on the threshing floor. More of the crop was then piled onto the floor, on top of the partly winnowed fraction, and a second threshing followed.

[15] Benaki Museum (n. 14) 31 Plate 27.

[16] D. R. Theokharis, *Neolithic Greece* (Athens 1973) Plate 158.

[17] Benaki Museum (n. 14) 36 Plate 36.

Second Threshing

On Amorgos, this followed the first winnowing and was carried out under two circumstances only: first, when the crop was too large to be accommodated in a single threshing (in practice, only true of cereals) and, secondly, when the crop was rich in barley. In the first instance, more crop was added and threshing continued with the same purpose as before. In the second case, the purpose of the second threshing (το στρούμβισμα, *cf.* English 'hummeling') was to break off the barley awns (το άγανο, *cf.* Karpathos—ο τσούνακας) which are very rough and can cause irritation if allowed to get into flour for human consumption. Indeed, at least some farmers on Karpathos did not use barley chaff as fodder for this reason, though on Amorgos this was not seen as a problem.

Second Winnowing

Winnowing was now carried to completion (as was the first winnowing when no second threshing was involved). In the final stages, fragments of straw were raked off the top of the grain pile, usually with a thyme bush (which sometimes introduced thyme flowers into the crop). If the crop was large, the final stages of winnowing were often accomplished piecemeal (PLATE I). The windward side of the pile was winnowed first and, when that was as clean as possible, the next section was tackled and so on. As each section approached completion, it was worked over to the fully winnowed pile of grain. Sometimes on Amorgos, an incompletely winnowed fraction—the 'aposoria' (τα αποσώρια)—was left between the grain and chaff piles at the end of winnowing. It contained a higher proportion of weed seeds and heavy straw fragments than the grain pile and, in the case of maslin, a higher proportion of barley. It was often fed directly to domestic animals and sometimes comprised a substantial proportion (up to one fifth) of the total grain.

Coarse Sieving

A coarse sieve (Amorgos—το δρεμόνι, Karpathos—το ρεμόνι; mesh size approx. 6–10 mm) was used which allowed grain to pass through while retaining large straw fragments, weed heads, unthreshed ears and pods etc. Coarse sieving was a recurrent operation during and after (but never before) winnowing. Grain cleaning on the threshing floor was usually carried out by two and often three or four people at a time, so that one or two might winnow, another use a thyme-bush rake and one or two be involved in coarse sieving. Coarse sieving was often not performed on fodder crops and might also be omitted if winnowing was very thorough. Conversely, on a still day, coarse sieving might partially replace winnowing, but only for small quantities of crop.

The coarse sieve was used as follows:

(i) Between the piles of grain and light chaff and straw, which accumulated during winnowing at opposite ends of the threshing floor, was an ever-diminishing pile of grain and heavier straw fragments. This was often sieved to speed up the process of winnowing.

(ii) Rakings from the top of the grain pile were often sieved as they contained significant amounts of grain; alternatively they might be kept as 'aposoria'.

(iii) The fully winnowed grain was usually sieved, the grain being poured slowly and from a height so that any dust was 'winnowed' away.

The sieve could be rested on an upright fork propped in the grain pile.[18] On Amorgos, the fraction retained by the coarse sieve (τα κόνταλα, *cf.* English 'cavings') might be amalgamated with the straw and chaff pile, but was usually fed directly to domestic animals. (Sometimes,

[18] Benaki Museum (n. 14) 38 Plate 43.

'aposoria'—the incompletely winnowed fraction—were sieved, the contaminated grain being fed to chickens and the cavings to larger animals.) On Karpathos, the coarse sieve by-product was often rethreshed, usually on a small scale with a stick, and then winnowed.

The completion of winnowing and coarse sieving for each crop was often marked on Amorgos by a brief ceremony. First, the shape of a cross was drawn in the grain pile. Then four winnowing forks and shovels were set in the sides of the grain pile, in the form of a cross, and a simple cross made from a broken stick was placed in the top of the pile. Once the grain had been thus 'blessed', it was measured using a *c.* 18 litre olive tin housed in a niche in the wall of the threshing floor. One tin was reckoned to contain half a 'kilo' of grain (το κοιλό was a unit of volume thought equivalent, on average, to 32–33 kg of wheat, lentil, pea, grass pea or common vetch, 25–26 kg of hulled barley, 22 kg of broad bean, chick pea or black-eyed bean, and 21 kg of oat). The measured grain and the chaff were then bagged up and taken into store. On Amorgos commercial sacks and fertiliser bags were used for transport, but on Karpathos chaff was carried in decorated sacks woven from goat hair (each 70 × 135 cm sack was said to require the clippings from 7–10 goats). Finally, the threshing floor was swept before the next crop was threshed and the sweepings sometimes fed to chickens.

Fine Sieving

A fine sieve (Amorgos—το γυροκόσκινο, Karpathos—ο αρολός; mesh size approx. 2–2·5 mm), which retained the grain but allowed small weed seeds etc. to pass through, was also used for grain cleaning. Fine sieving tended to occur piecemeal throughout the year[19] and was associated with food preparation and the cleaning of seed corn. Fodder crops were not usually fine sieved.

As the crop was sieved with a circular motion, light components such as straw, pods and weevil-infested seeds collected on top and could be scooped off. Such scoopings (*cf.* English 'chob') were often mixed with the residue from the bottom of the sieve and, on Amorgos, fed to chickens. Fine sieving could be very thorough, leaving the minimum of cleaning to the final stage.

Hand Sorting

On Amorgos at least, weed seeds, straw nodes, pod fragments etc. not already removed were picked out by hand (το πάστρεμμα). This cleaning, which was often very thorough, was applied to crops destined for human consumption and immediately preceded grinding into flour or cooking. The hand-pickings were again used as chicken feed. On Karpathos, sieved grain was also apparently washed and barley subjected to roasting (το φρίξιμο) and beating to remove the stubs of barley awns.

Food Preparation

After milling of cereals, a flour sieve (η τριχιά; mesh size 1 mm) was used to clean out bran, barley hulls and, on Amorgos, barley awn stubs. Bread was eaten both fresh (said traditionally to have been baked every eight days or so) and in the form of a hard, twice-baked 'rusk' (το παξιμάδι) which keeps for several months.[20] Of the pulses grown for human consumption, pea, *L. ochrus* and *L. clymenum* were eaten as 'fava' (η φάβα), that is split in a hand-mill. On Karpathos the loose testas or 'skins' were said to be winnowed away. *L. ochrus* and *L. clymenum* were also eaten green, and on Amorgos fresh chick peas were a great delicacy in July—a foretaste of the luxuries of later summer, when tomatoes, grapes and prickly pears came available. Fodder crops

[19] Benaki Museum (n. 14) 44 Plate 51.

[20] G. D. R. Sanders, *ABSA* lxxix (1984) 259.

might also be milled: on Amorgos, for example, barley fed to cattle was ground, though not that fed to sheep, goats, donkeys or chickens.

Time stress: the labour requirements of farming

The sheer drudgery of the activities described above may be highlighted by considering their absolute labour requirements. On Amorgos, harvesting was reckoned to take about 1·5 man days/str. for cereals reaped with a sickle, 1 man day/str. for uprooted pulses and 0·3 man days/str. for pulses mown with a scythe. On Karpathos, cereals were cut higher than on Amorgos and took 1–3 man days/str., the higher figure reflecting the number of elderly women in the labour force. The faster rate was expected of hired labour and probably reflects, *inter alia*, a lesser degree of care in leaving weeds behind in the field. Barley, being shorter, took about half as long again as wheat and uprooting of the shortest cereals and of pulses was said to be slower still. In addition, farmers on Amorgos reckoned to need 7–10 donkey loads/str. to carry away the harvest from a good field—a time consuming task for the more distant fields.

The time spent on threshing and winnowing is less easily quantified as it is so dependent on weather conditions and on the amount of human and animal labour which can be mustered to take advantage of favourable conditions. Moreover, the time spent in winnowing could be reduced by reserving some of the crop as 'aposoria'. This decision depended on the weediness of the crop and the ease with which it could be cleaned (given prevailing weather and available labour), as well as the competing claims of human and animal consumers. Overall, the labour required in crop processing is of the same order of magnitude as in reaping, and sometimes crops are left on the threshing floor for days pending suitable weather.

Ploughing with a pair of oxen was estimated on both islands to be rather faster than reaping—*ca.* 0·5–1·0 man days/str. for winter crops—but was again more subject to unfavourable weather conditions and offered fewer opportunities to make full use of a household's human labour force.

Such estimates of labour time mean little unless account is taken of the *scale* of agricultural production. Sanders suggests (on the basis of average yields in the Cyclades in 1916) a *subsistence* requirement of 7·5 str. in cultivation per head.[21] An elderly farmer on Amorgos, brought up between the two World Wars, suggested a rather higher minimum of 12 str. of 'migadhi' per head. Assuming cultivation of 7·5–12 str. per head, harvesting (at 1–3 man days/str.) would take 7·5–36 man days/*head*. The time available for harvest, therefore, covering some 30 days around the month of June, is far from generous for the many families with several members too young, too old or too busy to participate in reaping. The same is true of the subsequent crop processing—a point underlined by the existence of verbs signifying the completion of individual threshing and winnowing tasks ('πολώνεψες/'πολύχνισες; have you threshed/winnowed?).

Only 4–12 days ploughing are implied per head (*excluding* fodder crops and fallow fields). For large families with a single plough team, however, the four month winter ploughing season (November–February) would only be generous in favourable weather conditions.

Thus with traditional technology, farmers in the Greek islands operate under considerable 'time stress'[22]—particularly at harvest time. In practice, the extent to which farmers are under time stress may have been seriously underestimated here, for reasons which are discussed in the following two sections.

Scale: the role of livestock in arable farming

A striking feature of the entire processing sequence on Amorgos is the extent to which it is integrally bound up with the keeping of livestock—and in particular of work animals. On

[21] Sanders (n. 20) 253.

[22] R. Torrence, 'Time budgeting and hunter-gatherer technology' in G. Bailey (ed.) *Hunter-gatherer economy in prehistory* (Cambridge 1983) 14.

Karpathos, by contrast, where agriculture was very much in decline, work animals were relatively unimportant and this too manifests itself in the way crops are processed, in the way processing residues are used and in the labour costs of processing.

On Amorgos, the relevance of livestock to crop processing methods is most easily seen in their contribution to threshing. On Karpathos, where the areas harvested were relatively modest and animals available for threshing were relatively scarce, it was commonplace to see crops being threshed by hand. Donkeys and mules also play an important role in carrying reapers to the fields and then harvested crops to the threshing floors, while together with oxen they spend much of the winter and spring in ploughing.

The steeper and rockier parts of both islands support extensive natural pasture, but this is sparse and seasonal. For example, natural pasture makes up 75% of the 2000 ha. territory of Arkesini and is grazed during winter (from December if the rains start early). Fallow fields provide grazing from January/February until they are ploughed up in spring, stubble fields from June until the first rains in October. Harvested pulse fields are preferred, but cereal stubble is also valued if cows and donkeys first consume the coarse material and make weeds and fallen grains available to goats and sheep.[23] Although the months of August and September, when stubble grazing is running out, are considered the leanest season, during much of the year natural pasture is more or less insufficient in quantity or quality both for cattle, goats and sheep being fattened or milked for the market and for oxen, donkeys and mules which are least free to graze at the times when they are working hardest. As a result, natural pasture is supplemented with considerable quantities of sown pasture and stall fodder.

Common vetch, grass pea and (on Amorgos) oat were sown specifically as fodder crops, barley partly so. On Amorgos, the two pulses were partly grazed *in situ* in March and April, by breeding cows, milking goats and fattening calves, and partly allowed to ripen for their seed, which was also fed to working animals. Oat and barley were grown for their seed, which was fed to the same livestock. In addition, the winnowed straw and chaff of nearly all the cereals and pulses (except perhaps barley on Karpathos) were stored as winter fodder. The unthreshed pods and cereal ears collected by coarse sieving were treated rather differently in the two study areas. On Amorgos they were fed to the nearest donkey as a 'snack', while on Karpathos they were sometimes threshed again. This contrast may again reflect the small size of the harvest and relative unimportance of work animals on Karpathos, compared to Amorgos. On Amorgos, chob, fine sievings and some 'aposoria' were fed to poultry. On Karpathos, considerable quantities of 'hay' were also stored up, both 'wild vetch' and oat cut during April and the tangle of late maturing weeds pulled up from the stubble fields after the harvest.

The need to stall feed livestock greatly increases the difficulty of crop processing in four ways. Firstly, by planting fodder crops in place of the traditional fallow, the farmers of Amorgos have effectively doubled the size of the task facing them. Such crops are threshed and winnowed, even though both grain and straw/chaff are to be fed to livestock, because different animals need the two components in different proportions at different times. Secondly, although livestock was allowed to graze the stubble fields, most cereal and pulse straw was collected for stall feeding. Crops were deliberately cut low, therefore, and harvesting was even more backbreaking than on Karpathos, where crops were reaped at mid-height.

Thirdly, the great bulk harvested on Amorgos enormously increased the volume of crop to be transported from the fields to the threshing floors and then into store. One farmer on Amorgos estimated that, to feed two oxen, a calf and two donkeys over winter, he needed 25 donkey loads of threshed and winnowed chaff (the produce of 15 str. in a good year). To be secure against late rains and the retarded development of natural pasture, he would need twice as much. Given the dispersed nature of land holdings, the harvested crops often had to be carried substantial distances and in the case of pulses, which tend to shatter and shed their seed in the heat of the day, this could only be done in the early morning or evening. After transport, the

[23] R. H. V. Bell, *Scientific American* ccxxv (1971) 86–93.

proportion of straw in the crop to be dried, threshed and winnowed further delayed processing for storage. Fourthly, the need to keep chaff and straw for fodder forced farmers to winnow in a gentle breeze and so slowed the processing down yet further: indeed those with a large backlog would even attempt to winnow in conditions of almost dead calm. In a strong wind, winnowing was suspended.

The crucial point to recall is that these extra burdens are being incurred at a time of year when farmers are already operating under acute time stress. Once crops have ripened, farmers are rightly anxious to get the grain and chaff safely in store, for crops growing or stooked in the fields or stacked on the threshing floor are vulnerable to sudden storms, theft or raiding by livestock. A striking feature of the southern Amorgos landscape is the widely dispersed distribution of threshing floors—a pattern which is enhanced by the freedom with which farmers are allowed the use of each other's threshing facilities. In effect, by threshing and winnowing close to the field, farmers can transport the vital grain into store as rapidly as possible and deal with the bulkier chaff and straw afterwards. Similarly, on Karpathos, farmers store chaff in their field houses at Avlona and transport it back to Olimbos piecemeal during the winter as it is needed.

Today on Karpathos and Amorgos, nucleated settlement, dispersed land holdings and scarce human labour (to varying degrees on the two islands) enforce an *extensive* pattern of land use, which would not be practicable without the services of traction and pack animals. Farmers are thus locked into the system of crop processing and usage described, in which the muscle power and dietary requirements of work animals are paramount. If settlement were less nucleated, however, land holdings more consolidated or labour more abundant, then a less extensive pattern of land use would ensue. Less cultivation of marginal land and less production for market or to pay taxes etc. would have the same effect.

Below a certain threshold, the extent and distance of land in cultivation would be insufficient to warrant the considerable capital expense of keeping pack animals, and the same is arguably true for plough animals. On Karpathos, some of the small gardens around Olimbos were tilled by hand and elsewhere in the Mediterranean small-holders have been known to replace work animals entirely by human labour.[24] Small scale cultivation also tends to be characterised by more intensive husbandry in other respects—for example, the irrigation of some gardens on Karpathos has already been mentioned. On Amorgos, the 'gardens' with summer crops are widely dispersed (even though the benefits of proximity to home are recognised), because their location is determined primarily by the needs of individual fields for a bare fallow. Like the remaining fields, therefore, they are tilled by plough, but they are more intensively hoed and weeded. Moreover, in contrast to the broadcasting typical of the more extensive winter crops,[25] sowing tends to be by dibbling—a strategy which is less wasteful of seed corn and facilitates weeding and so on. With smaller scale cultivation, staple cereals might likewise benefit from more intensive husbandry and indeed on Amorgos, prior to the loss of labour through mass rural emigration earlier this century, even extensively cultivated cereals were weeded and the edges of fields were dug over to kill weeds missed by the plough.

Similar considerations of scale also suggest that cereal/pulse rotation may have been practised long before its introduction by agronomists in the 1930s. In the recent past, pulses have been grown for human consumption on only a modest scale (compared with cereals) and, on Karpathos, they are somewhat preferred for cultivation in the infield gardens. An important consideration here may be the relatively labour intensive nature of pulse cultivation—for example, on Amorgos some of the winter pulses grown for human consumption, unlike other field crops, are weeded even today. Thus the 1930s agronomists may have succeeded not because they revealed the benefits of cereal/pulse rotation to soil fertility, but because they provided an incentive (the rearing of livestock as a 'cash crop') for the extensive cultivation of pulse crops at a

[24] E.g. G. Delille, *Agricoltura e demografia nel regno di Napoli nei secoli xviii e xix* (Naples 1977) 127–9.

[25] *Cf.* F. Sigaut, *L'agriculture et le feu* Cahiers des Études Rurales i (Paris 1975).

relatively low cost in labour (for example, fodder pulses need less weeding than peas or lentils). It has already been observed that the recent development of continual cropping on Amorgos was not accompanied by irrigation, casting doubt on the popular argument that the traditional practice of bare fallowing was primarily a water conservation measure.[26] Bare fallowing should be seen instead as an extensive method of weed control (and perhaps nitrogen replenishment)[27] in circumstances where the large scale of cultivation or the low premium placed on pulse fodder crops militates against cereal/pulse rotation.

Thus agriculture in the islands embraces both an extensive 'field' component and an intensive 'garden' component and their relative importance is integrally related to recent patterns of residence and land tenure.

Risk: flexibility in agricultural practice

A further striking feature of farming in the islands is the complexity and flexibility of farmers' day to day decision making. Even a few days' delay in harvesting ripe crops can lead to severe losses from birds and on both islands farmers question passers-by closely to monitor the state of ripeness of their more distant fields. Crops awaiting processing for storage are also at risk, however, and compete with the unharvested crops for the farmer's attention. Pulses must be reaped and transported when the sun is low, while threshing has to take place in the heat of the day, but different tasks often take place some distance apart—and of course it is important to take advantage of a good winnowing breeze when it springs up. To complicate the matter, the labour supply varies: a wife must occasionally attend to domestic duties; a teenage daughter can only help with tasks near the home, to which she is tied by her primary responsibility of looking after the milk goats; a grown son returning from town for the weekend makes a major inroad on the task of threshing. Moreover, the farmer may well have to balance his own interests against a responsibility to help elderly relatives, or he may wish to earn cash by working for another farmer unable or unwilling to endure arduous manual labour.

In addition to such day to day adjustments to their schedule, farmers face year to year variation in their circumstances and their responses to this permeate every aspect of agricultural practice. Most obviously, perhaps, weather conditions vary and, in the semi-arid climate of the islands, even modest variations in rainfall can be disastrous. It is essential, therefore, to take the fullest possible advantage of the modest winter rainfall and on Amorgos this is reflected in a local saying stressing the benefits of early sowing: 'το πρώιμον το ευλόγησεν ο Θεός, και το έψιμον ο καλός καιρός' ('the early [sown crop] is blessed by God, the late by good weather'). On the other hand, sowing must not start before the winter rains are properly under way and, constrained by limitations of labour and of days suitable for ploughing and sowing, farmers are forced to plant some crops late. The success or failure of these crops, in particular, is dependent on uncertain spring rainfall and the invariable response of the Amorgiot farmer to questions about his economic prospects is 'άμα βρέξει ο Μαρταπρίλης . . .'. ('if it rains in March–April . . .'). Because early sown crops are so much more reliable, it was customary on Amorgos to begin ploughing on the lower and more productive fields and then to proceed to the more marginal terraces (τα πεζούλια). The higher terraces were sometimes not worth reaping at all in dry years (and have been widely abandoned, on both Karpathos and Amorgos, with the post-war decline in rural population).

The broken terrain of the islands can also be an advantage and, on Karpathos at least, the dispersal of fields was reckoned to cushion the individual farmer somewhat against the dangers of an unreliable rainfall (and the indirectly related labour crises during ploughing/sowing and

[26] P. Halstead, *JHS* cvii (1987) 77–87.

[27] *Cf.* W. J. Staple, 'Significance of fallow as a management technique in continental and winter-rainfall climates', in *Plant-water relationships in arid and semi-arid conditions xv* (Paris 1960) 205–14; R. J. French, *South Australian Journal of Agriculture* lxvii (1963) 42–8, 76–9.

reaping/threshing etc.). Evidently, the dispersal of fields also provides growing crops with a partial defence against insects: on Amorgos, for example, *Bruchus* spp. were widespread pests of pulses (pea and grass pea being particularly vulnerable, followed by lentil and then common vetch), but the severity of infestation of each crop varied greatly from field to field.

Problems of variable weather can also be mitigated to a degree by planting a range of crops, requiring water and human labour at different times. On both islands, the diversity of crops was impressive, including a range of annual cereals and pulses as well as perennials such as olive, vine and fig. Of particular interest on Karpathos is the cultivation of no fewer than nine winter sown pulses. On Amorgos, a slightly narrower range of crops was grown, but farmers were conscious of the particular soil preferences of each. For example, the red 'firoyi' (φιρόγη) soil (formed on limestone)[28] was easier to work when wet and less susceptible to drought than the grey 'psaroyi' (ψαρόγη) soil (formed on shales/schists and graywrackes) and was preferred for wheat. Wheat might be sown on 'psaroyi', however, when a farmer's 'firoyi' plots had to be devoted to pulses. Also wheat tended to be sown, where possible, immediately after bare fallow or on fields which had been generously manured. Common vetch and grass pea could be grown on weedier plots and poorer soils than peas or lentils. Farmers also took great interest in the performance of individual fields and usually knew the recent 'case history' (yields, sequence of crops, date of last fallow etc.) of their own fields in some detail. Thus although cereal/pulse rotation was quite unambiguously the norm, the decision as to what should be sown (and when) on any individual field was subject to a host of considerations and some farmers very much emphasised this flexibility and underplayed the existence of a norm.

A further element of strategic diversity is the sowing of mixed crops. It is unclear whether bread and macaroni wheat were sown together deliberately to reduce the likelihood of complete failure, though farmers on Amorgos at least were perfectly aware that the wheat crop was mixed. The sowing of wheat/barley and common vetch/grass pea(/pea) maslins on Amorgos, however, was quite explicitly perceived as a way of 'hedging bets'. Wheat and barley made up widely varying proportions of 'migadhi' seed corn, depending on the quality of the field and the availability of seed, but their relative contribution to the harvest also depended on the growing conditions in a given year. Plentiful rain during the growing season tended to favour the more highly valued wheat. The pulse maslin represents a compromise between the preference of livestock for grass pea and the greater productivity and resistance to infestation in the field by *Bruchus* spp. of common vetch.

The great flexibility of the wheat/barley maslin becomes even more apparent during processing. In good years, the crop tended to be both abundant and relatively rich in wheat and the grain was separated with a special (4–5 mm mesh) sieve into wheat- and barley-rich fractions, the former being used for bread or sold for cash, the latter for fodder. In bad years, bread would be made largely from barley and the livestock would not be fed grain. In the recent past in Greece, human consumption of 'animal fodder' in bad years can be widely documented. In Karpathos, for example, bitter vetch was eaten as a famine food during World War II, after first being ground and soaked to remove toxins. The Amorgos maslin allows human consumption of fodder at minimal social cost, however, because all wheat and barley crops are to some degree mixed: one poor individual buying 'barley' (the term used by the farmer who grew the crop) for his own consumption was able, on the strength of a slight admixture of wheat, to classify his purchase as the more acceptable 'migadhi'.

Since years of poor grain harvest often also yield a poor harvest of straw, and follow a dry winter or spring with reduced grass growth, it is apparent that the victims of this example of human flexibility are domestic livestock. Indeed it might be argued that one of the most valuable functions of domestic livestock on Amorgos is to provide a rationale for the regular overproduction necessary for farmers to have a chance of breaking even in poor years.

The sowing of a range of crops and a policy of overproduction are only a partial defence

[28] *Geological map of Greece, 1:50,000. Amorgos-Donoussa sheet* (Athens 1985).

against shortage. The severest weather conditions may affect all crops, while sudden losses of labour through illness, injury etc. may make underproduction inevitable. For this reason, it is commonplace to keep enough food in store to meet the requirements of both the current and the following year:[29] at the time of the 1981 harvest on southern Amorgos, farmers still had much of the previous year's crop in store.

Apart from the possibility of dramatic losses through theft or fire (on Amorgos, food, fodder and seed grain alike were stored in the house), stored grain is also liable to weevil attack. On Amorgos, wheat seemed more vulnerable than the hulled barley to attack by *Sitophilus* spp. in storage. *Bruchus* spp. infested growing pulses, but the extent of damage only became apparent during storage, once all the pests had emerged. One farmer described the traditional practice of pit burial or 'lakkiasma' (το λάκκιασμα) as offering protection against insect pests. After processing, grain was placed in a straw/chaff-lined pit (2 m in diameter and 1 m deep) in the fields and covered with soil. Burial for the period of '40 days' caused some grain to sprout, but killed pests in the crop (presumably by starving them of oxygen).[30] Thereafter the grain was dug up and transferred to long-term storage in the house in chests of wood (τα μπάρια) or stone (τα ριά), each said to hold 100 'kilo'. 'Lakkiasma' may have limited damage by *Bruchus* spp. and other field pests, but will not have provided any protection against *Sitophilus* spp. populations established in the storage chests. Even with this precaution, therefore, storage has its limitations and, once the target of two years' supply was reached, farmers would sell surplus grain—in effect converting it to the more flexible and (usually) more durable medium of money.[31]

When stores ran out, a range of further responses is remembered from the recent past. On Karpathos, it is said that help was initially sought from relatives, in the form of loans of food. Alternatively, farmers in need might work for their richer neighbours, helping to build a barn or assisting in tasks such as reaping and ploughing, in return for grain. Exchanges between farmers and shepherds are also recalled. Only as a last resort would farmers seek to buy grain on the market, working in Athens or Rhodes to earn the necessary cash. On Amorgos, needy farmers have in living memory sometimes bought grain from other farmers: from neighbours in Kolofana, when slight differences between individuals in choice of sowing time have made the difference between success and failure, and from other villages in the southern part of the island, when failure has been more widespread. The money for these purchases presumably came from sales both of surplus grain and of 'cash crops'—tobacco or, latterly, cheese and meat. In more desperate situations, farmers start selling off their fields (and even their children),[32] so offering more fortunate farmers the opportunity to convert money to the more stable and profitable form of land. The last resort of the failed farmer is to abandon the land altogether and recent emigration has been particularly prevalent among poor farmers with too little land to be economically viable. Those who have stayed behind, expanding their holdings by buying land from emigrés, have tended to be farmers of moderate wealth.[33]

Discussion

This partial account of traditional farming on two Greek islands is of interest in its own right as a record of disappearing local customs and language. The farmers of Amorgos and Karpathos also offer some far wider insights into Mediterranean agrarian ecology, present and past.[34]

[29] H. A. Forbes, *Strategies and soils: technology, production and environment in the peninsula of Methana, Greece* (Ph.D. dissertation, University of Pennsylvania 1982).

[30] P. C. Buckland, *Journal of Stored Products Research* xvii (1981) 1–12; P. J. Reynolds, *Proceedings of the Prehistoric Society* xl (1974) 118–31.

[31] *Cf.* H. A. Forbes, 'Of grandfathers and grand theories: the hierarchised ordering of responses to hazard in a Greek rural community' in P. Halstead and J. O'Shea (eds) *Bad year economics: cultural responses to risk and uncertainty* (Cambridge 1989) 87–97.

[32] M. Jameson, 'Famine in the Greek world' in P. D. A. Garnsey and C. R. Whittaker (eds) *Trade and famine in classical antiquity* (Cambridge Philological Society Supplementary Volume viii [1983]) 6–16.

[33] Sutton (n. 9).

[34] For interesting parallels, see especially Forbes (n. 12); *Annals of the New York Academy of Sciences* cclxviii (1976) 236–50; 1982 (n. 29); Hillman 1981 (n. 13); 1984 *bis* (n. 13); 1985 (n. 13).

First, the highly seasonal nature of agricultural activity and the uncertainty of the weather conditions required for some tasks conspire to place farmers under serious time stress at certain critical times. This is particularly true of the early summer period of harvesting and processing staple cereal and pulse crops and, perhaps to a lesser extent, of the winter ploughing season.[35] This problem of seasonal time stress is often concealed in modern surveys of rural (under-)employment in the Mediterranean[36] or in estimates of the labour requirements of farming in antiquity.[37]

Secondly, this study highlights both the vital role of work animals in ploughing, threshing and transporting produce and the remarkable extent to which their maintenance conditions the methods and labour requirements of arable farming. Not only would traditional extensive agriculture be impossible without work animals, but work animals would not be worth maintaining without extensive agriculture. For certain periods of the past, quite different social and demographic conditions have prevailed,[38] demanding a form of land use far less extensive than today, in terms not only of quantity—the area cultivated—but also of quality—the methods of husbandry employed. The gardens of modern Karpathos and Amorgos may often be a more appropriate model for ancient cultivation than are the present-day fields—and indeed a recent archaeobotanical study found that cereal crops at bronze age Assiros Toumba (Macedonia) were associated with more 'garden' weeds than were modern cereal fields on Amorgos.[39] Moreover, the techniques of intensive horticulture are so different from those of extensive agriculture that great caution should be exercised in extrapolating recent labour and production norms back into the distant past.[40]

Thirdly, the reluctance of many farmers to offer such norms reflects the essential variability of the conditions with which they must cope. Indications of future weather patterns, in both the immediate and more distant future, are eagerly sought in atmospheric conditions, the behaviour of birds and so on, and a similar concern in antiquity is implied by Hesiod's linking of his calendar of agricultural tasks to such natural phenomena in the *Works and Days*. In response, farmers constantly adjust their practices, juggle with scarce time and labour and reschedule competing priorities in order to complete the most urgent or essential tasks. Such flexibility, well illustrated on Amorgos by the frequent tactical decision to retain 'aposoria' during crop processing, is a vital element in the armoury of the Mediterranean farmer.

Fourthly, the impact of variation in production targets, land, labour or weather is heightened by time stress which may leave little scope for postponing a task, when labour is scarce, or for sowing a larger area, when stores are low. Island farmers use an impressive array of ploys to dampen the effects of variability, taking progressively more drastic measures to avoid the risks of failed harvests, food shortage and finally hunger.

Some aspects of the response to agricultural risk in the islands are particularly worthy of note. The growing of a range of different crops is a widely documented practice,[41] but the discovery of *L. clymenum* and *L. ochrus* cultivation on Karpathos suggests that the extent of crop diversification may have been significantly underestimated in the literature on recent Mediterranean agriculture. The confusing, recent nomenclature for pulses in the islands also suggests potential problems for the investigation of crop diversity in ancient, written sources.[42]

[35] See also S. Aschenbrenner, 'A contemporary community' in W. A. McDonald and G. R. Rapp (eds) *The Minnesota Messenia expedition* (Minneapolis 1972) 47–63.

[36] E.g. M. Wagstaff and S. Augustson, 'Traditional land use' in C. Renfrew and M. Wagstaff (eds) *An island polity: the archaeology of exploitation in Melos* (Cambridge 1982) 106–33.

[37] E.g. K. D. White, *Antiquity* xxxix (1965) 102–7.

[38] E.g. D. R. Keller and D. W. Rupp (eds) *Archaeological survey in the Mediterranean area* (British Archaeological Reports Int. Series clv [Oxford 1983]); P. D. A. Garnsey, *Proceedings of Cambridge Philological Society* ccv (1979)1–25; K. Vergopoulos, Το αγροτικό ζήτημα στην Ελλάδα. Κοινωνική ενσωμάτωση της γεωργίας[2] (Athens 1975).

[39] G. Jones, 'Phytosociology and the archaeological recognition of crop husbandry' in *Festschrift* for *W. van Zeist* (*Review of Palaeobotany and Palynology*, special volume).

[40] Halstead (n. 26).

[41] E.g. Forbes 1976 (n. 34).

[42] *Cf.* N. Jasny, *The wheats of classical antiquity* (Baltimore 1944); P. Faure, 'Les legumineuses de la Crete minoenne' in Πεπραγμένα του Ε' διεθνούς Κρητολογικού συνεδρίου τόμος Α (Heraklion 1985).

For example, the pea has a local name on both Karpathos (το γλυκίδι) and Amorgos (το κατσούνι), while one of its common mainland names (ο αρακάς) is applied in the islands to the rare *L. clymenum*. Also, a variety of pulses may be referred to as 'fava', because they are 'split' and eaten in a gruel, while the term 'fasoli' covers pulse crops of two separate genera (*Phaseolus* and *Vigna*).

A precautionary policy of overproduction and of storing more than one year's supply of food is also documented elsewhere in Greece[43] and indeed the production of such a 'normal surplus' is arguably a minimum requirement of farming in a highly seasonal environment.[44] Recent risk-buffering behaviour thus suggests a simple solution to the thorny problem of how emerging elite minorities in the islands in the later prehistoric and early historic periods commanded the resources which they needed to support themselves. Rather than stimulating *de novo* the necessary overproduction,[45] they may simply have commandeered existing 'normal surplus'.[46]

The integration of crop production with animal husbandry (particularly flexible in the case of the Amorgos wheat/barley maslin) is also of interest. In years of surfeit 'human food' may be directed to livestock, while 'animal fodder' may be requisitioned for human consumption in times of scarcity.[47] The cultural distinction between food and fodder is thus observed somewhat loosely (which incidentally poses problems for both archaeological and literary recognition of ancient fodder crops). This flexibility is invaluable as a buffer against risk: in good years livestock provides an incentive for overproduction and in bad years overproduction reduces the risk of shortage. Such use of livestock as a 'safety-valve' for arable-based economies, both on a household and on a regional scale, has been suggested for prehistoric and early historic Greece[48] and is likely to have been widespread in other parts of the Mediterranean too.

On Amorgos much of the animal produce which results from the feeding of grain to livestock is sold for cash, which may in turn be converted back to staple foodstuffs in time of need. Some surplus grain is converted directly to money and some wheat is grown specifically for this purpose, commanding a higher price as a cash crop than the more reliable (and so more abundant) barley. Given the unreliable rainfall of the islands, a substantial net 'surplus' is likely to be off-loaded on the market in good years. It is highly questionable, therefore, whether sporadic historical records of exports from the islands in individual years can be used as evidence of changing agricultural goals[49]—let alone as a measure of *average* potential 'production beyond subsistence' in antiquity.[50] On the contrary, most records of a 'grain trade' in both recent and ancient times in the Mediterranean probably reflect *short-term* conditions of surfeit and shortage.[51] Clearly a subject deserving further investigation is the extent to which more specialized cash crops (e.g. tobacco in early twentieth century Amorgos, olive oil in archaic and classical Athens) have been raised with a view either to exchange for grain or to securing money as a medium of long-term storage.

[43] Forbes (n. 29).

[44] W. Allan, *The african husbandman* (Edinburgh 1965).

[45] C. Gamble, 'Surplus and self-sufficiency in the Cycladic subsistence economy' in J. L. Davis and J. F. Cherry (eds) *Papers in Cycladic prehistory* University of California, Institute of Archaeology Monograph xiv (Los Angeles 1979) 122–34; 'Leadership and "surplus" production', in C. Renfrew and S. Shennan (eds) *Ranking, resource and exchange* (Cambridge 1982) 100–5; C. Renfrew, 'Polity and power' in Renfrew and Wagstaff (n. 36) 264–90.

[46] *Cf.* P. Halstead, 'The economy has a normal surplus: economic stability and social change among early farming communities of Thessaly, Greece', in Halstead and O'Shea (n. 31) 68–80.

[47] *Cf.* also M. D. Grmek, *Les maladies a l'aube de la civilisation occidentale* (Paris 1983) 324–5.

[48] P. Halstead, 'From determinism to uncertainty: social storage and the rise of the Minoan palace' in A. Sheridan and G. Bailey (eds) *Economic archaeology* (British Archaeological Reports International Series xcvi [Oxford 1981]) 187–213; *ABSA* lxxxii (1987) 71–83; J. F. Cherry, 'Pastoralism and the role of animals in the pre- and proto-historic economies of the Aegean' in C. R. Whittaker (ed.) *Pastoral economies in classical antiquity* (Cambridge Philological Society Supplementary Volume xiv [1988]) 6–34; S. Hodkinson, 'Animal husbandry in the Greek polis', in Whittaker (*op. cit.*) 35–74.

[49] Wagstaff and Augustson (n. 36).

[50] Renfrew (n. 45).

[51] E.g. P. D. A. Garnsey, T. W. Gallant and D. Rathbone, *JRS* lxxiv (1984) 30–44.

A final point of interest concerns the long-term consequences of risk-related transactions in labour and land. Successful farmers convert surplus grain to the increasingly durable forms of cash then land, while needy farmers dispose of labour, cash and finally land to make good shortfalls of grain. In the short term, such transactions ensure the economic survival of many households, but in the long term they may undermine their viability and in recent centuries have often paved the way for increasingly sharp inequalities of wealth.[52] Similar processes must have been a frequent vehicle for social change in antiquity.[53]

Even without the use of money or alienation of land, successful farmers may acquire rights to the labour of others,[54] by releasing surplus grain in years of dearth, and may reinforce their position by acting as intermediaries in the disposal of surplus in years of plenty.[55] In this way, in the risky agricultural environment of the Mediterranean, the few have repeatedly commandeered the 'normal surplus' of the many.

APPENDIX

Common Names of Weeds of Cereal and Pulse Crops (Amorgos)

*Common name**	*Latin name*	*Common name**	*Latin name*
το αγριάσταχο	*Hordeum murinum* ssp. *leporinum* (Link)	ο κολίτσανος	*Galium aparine* L.
		το κόπανο	*Rumex pulcher* L.
η αγριοπερικοκλάδα	*Convolvulus altheoides* L. & *C. arvensis* L.	ο μαζάς	*Phalaris coerulescens* Desf.
		η μαντελίδα	*Chrysanthemum coronarium* L. & *C. segetum* L.
ο αΐλαμος	*Avena sterilis* L.		
ο ασπροβολβός	*Ornithogalum narbonense* L.	η μολόχα	*Malva sylvestris* L.
το βαρελάκι	*Medicago turbinata* (L.) All.	η ξυλόγυρα	*Lolium perenne* L. & *L. rigidum* Gaudin
η βελονίδα	*Scandix pecten-veneris* L.		
ο βολβός	*Muscari comosum* (L.) Miller	η παπαρούνα	*Papaver rhoeas* L.
		ο πεντάλευρος	*Plantago lagopus* L.
η γύρα	*Lolium temulentum* L.	η πικροραδίκα	*Cichorium intybus* L.
η δρούβα	*Hirschfeldia incana* (L.) Lagreze-Fossat & *Sinapis arvensis* L.	η ρασινίδα	*Anchusa azurea* Miller
		ο (τσαλα)πετεινός	*Gladiolus italicus* Miller
		η φιραλονίδα	*Reseda lutea* L.
ο κόλιανδρος	*Bifora testiculata* (L.) Roth		

* Some common names may also be applied to other species of similar appearance to those listed.

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[52] E.g. Vergopoulos (n. 38).

[53] *Cf.* M. M. Austin and P. Vidal-Naquet, *Economic and social history of ancient Greece* (London 1977) 58–72.

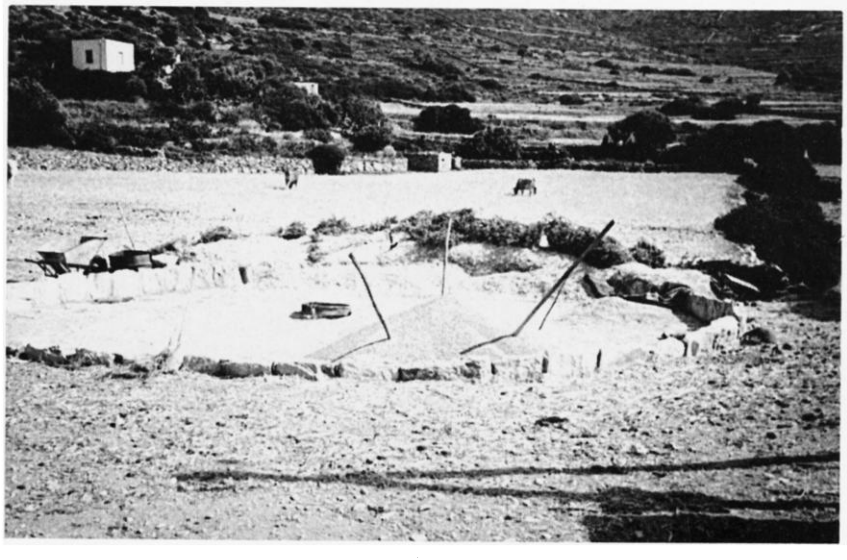
[54] E.g. A. I. Richards, *Land, labour and diet in Northern Rhodesia* (Oxford 1939).

[55] P. Garnsey and I. Morris, 'Risk and the polis: the evolution of institutionalised responses to food supply problems in the ancient Greek state' in Halstead and O'Shea (n. 31) 98–105; Halstead (n. 46).

A large crop is cleaned in several stages:

(*a*) In the middle of the threshing floor, part of a cereal crop is being winnowed with virtually no breeze (note the limp rag tied to a stick in the foreground) and coarse sieved. To the right is a pile of cleaned grain and to the left is threshed but unwinnowed crop. Behind the threshing floor, the light winnowings from an earlier crop have been weighted down with branches to await storage as animal fodder.

(*b*) As cleaning of the grain in the middle of the floor nears completion, a thyme bush is used as a rake. The two piles of cleaned grain will soon be amalgamated.



(*c*) The crop has been fully winnowed and coarse sieved. The light winnowings have been left at the rear of the floor, there is a pile of 'aposoria' (also for animal fodder) to the right and the cleaned and 'blessed' grain is in the foreground.