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# 1

## Food Storage, Containers, Empire

TWO THOUSAND years ago, the residents of the city of Rome drank so much wine that a year's worth would have overflowed the Pantheon.<sup>1</sup> But almost none of that wine came from Rome, a metropolis too large and densely occupied to produce its own food and drink.<sup>2</sup> Instead, Rome's residents depended on a large-scale food supply system that not only served the city but also sustained the empire's expanding territory and population. This was an enormous feat. Without climate-controlled airplanes or trucks, moving and protecting so much food was a challenge. Adding to this, consumers expected a constant supply of wine, yet the grape harvest and wine production occurred once a year starting in the autumn season and could be a lengthy activity if the vintner wished to age the wine. Having enough wine available for a large population year-round required not only high production but also effective and plentiful storage.

Under the Roman Empire, food storage technology and infrastructure reached new heights. Massive warehouses (*horrea*) lined rivers and coasts and punctuated the ancient capital and numerous other urban and military settlements. The productive power of vineyards, farms, and villas was expanded by large wine cellars filled with *dolia* (singular *dolium*), enormous ceramic pots the scale of which was almost never found again after the Roman period (Figure 1.1; Plate 1).

### Studying Dolia and Tracing Their Development

Dolia claim the title for being by far the largest vessels in antiquity. Capable of holding anywhere from hundreds to as much as three thousand liters, dolia were massive jars often taller than a person. They primarily held wine, though they occasionally stored other foods, such as oil, grain, and fish sauce; olive oil storage is discussed intermittently in this book because dolia were only occasionally used to hold olive oil in central Italy, due to the low yields and consumption of olive oil compared with wine, other storage jar options for oil, and production trends of the area. Thousands of *dolia defossa*, dolia buried to their shoulders to keep their contents cool, can still be found in ancient houses, farms, warehouses, and port facilities in special storerooms known as *cellae* (Figure 1.2; Plate 2);

1. Frier 1983, 257n3.

2. Morley 1996.

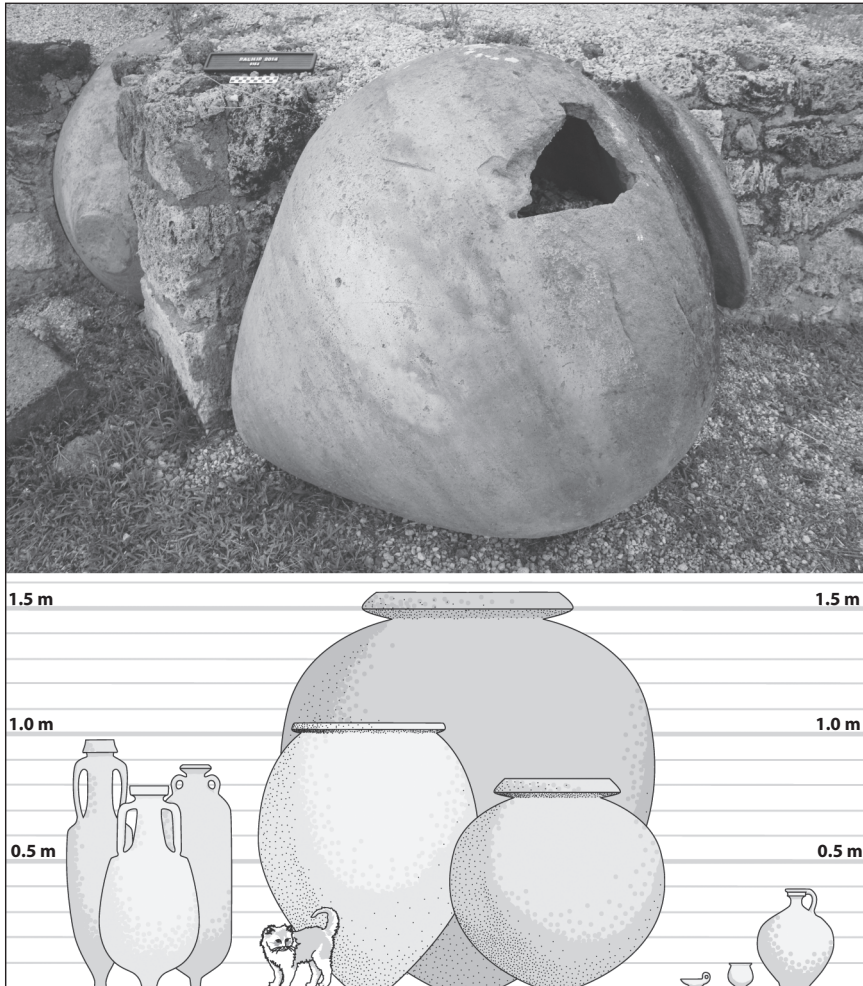


FIGURE 1.1. (Top) Dolium lying on its side (I.22 no. 5), Pompeii. Courtesy of the Ministry of Culture—Archaeological Park of Pompeii. Reproduction or duplication by any means is forbidden. (Bottom) Dolia compared with amphorae (large bulk transport jars, left-hand side) and other pottery (right-hand side). Illustration by Gina Tibbott.

some were even cemented into the hulls of ships.<sup>3</sup> Because they were such widely used storage vessels, dolia can be found throughout the Roman world, and multiple complete sets can still be found in situ, thus providing direct evidence for how people in antiquity stored wine and olive oil.

Despite their large numbers and preservation in the archaeological record, dolia remain understudied. One of the greatest challenges for a comprehensive study of dolia is that there has not even been a general scholarly consensus on what a dolium is. The term *dolium*

3. Marlier and Sibella 2008; Gianfrotta and Hesnard 1987; Carrato and Cibecchini 2020; Heslin 2011.





FIGURE 1.2. *Dolia defossa* (top) in Caseggiato dei Doli (I.4.5), Ostia, by Jamie Heath, 2009; and (bottom) in Villa Regina, Boscoreale. Courtesy of the Ministry of Culture—Archaeological Park of Pompeii. Reproduction or duplication by any means is forbidden.

is casually employed to describe any giant jar that is not easily identified, and *dolia* are often conflated with other big vessels, but it is crucial to begin with distinguishing *dolia* as vessels distinctive from generic large storage jars of an earlier tradition. Storage jars, known as *pithoi* (singular *pithos*), were instrumental for conserving food in the Mediterranean for centuries (Figure 1.3).<sup>4</sup> Capable of holding several hundred liters, *pithoi* were large terracotta jars used to store a variety of foods such as cereals, legumes, wine, and olive

4. For Etruscan *pithoi*, see Perkins 2021; Ridgway 2010. For Greek *pithoi*, see Christakis 2005, 2008; Giannopoulou 2010.



FIGURE 1.3. (L) Iron Age Cretan pithos from Knossos, by Jastrow, 2005. (R) Seventh-century BCE Etruscan pithos, Brooklyn Museum, Gift of Robin F. Beningson, 88.202.6.

oil. Their thick terracotta walls kept their contents cool and dry and protected them from extreme and fluctuating temperatures and humidity, as well as moisture and pests. Typically cylindrical or piriform, pithoi featured wide rims for easy access to their contents. They were usually placed on the ground or only partly submerged to stabilize the jars. Often decorated with geometric or figural moldings and incisions (especially during the early Iron Age), occasionally even endowed with ornamental but nonfunctional handles (pithoi were much too heavy and bulky to lift by these tiny handles), pithoi also had high symbolic value. Associated with surplus, food, and even life, pithoi were status objects for households, communities, and even the deceased who were buried or deposited in the vessels;<sup>5</sup> their decoration and placement further enhanced their visibility. The pithos' general utility was crucial for a wide range of consumers from individual households to communities to palatial and aristocratic complexes. In fact, scholars of the Aegean Bronze Age have identified pithoi as instrumental in the palace's ability to collect, store, and redistribute agricultural surplus, the foundation of the palace's power.<sup>6</sup> Pithoi also directly contributed to the increased wealth in central Italy. Phil Perkins' recent synthesis of Etruscan pithoi, for example, persuasively shows that pithoi enabled large-scale economic growth

5. E.g., Knappett 2020; Knappett et al. 2010; Zeitlin 1997; Steiner 2013; Sissa 1990; Dubois 1988.

6. E.g., Christakis 2005, 2008; Pullen 2010, 2011; Halstead 2011; Nakassis et al. 2011; Privitera 2014.

and urbanism across Etruria during the seventh to fifth centuries BCE by increasing agricultural productivity and towns' and cities' abilities to feed their residents.<sup>7</sup>

Although Mediterranean settlements had a long history of using large ceramic jars to store food, *dolia* were different. Identifying the moment when potters developed *dolia* as jars distinctive from *pithoi* and other storage jars, however, is impossible given how sparse the evidence is.<sup>8</sup> There was probably not one particular moment or place this happened, but a gradual process as potters learned new skills and demand increased. Discerning the difference between *dolia* and *pithoi* can also be difficult since Latin authors often used the term *dolia* and Greek authors *pithoi* interchangeably because these terms overlapped conceptually as the largest type of pottery, though they had their differences. In antiquity, the term *dolium* also designated a specific ceramic storage vessel for wine that diverged from other jars;<sup>9</sup> although *dolia* varied in size, ancient writers and archaeological evidence show that they were large, capable of holding on average approximately 550–750 liters.<sup>10</sup> *Pithos* was used early on in the Greek speaking world to describe a similar type of large ceramic storage container; a *pithos*, however, was a general food storage container, and not associated with any particular content. On the other hand, *dolium* came much later, appearing for the first time in a text in Plautus' *Pseudolus* and Cato's *De Agri Cultura*.<sup>11</sup> Cato's discussion of managing a farm included extensive lists of equipment, chief among which was the *dolium* for wine and oil cellars.<sup>12</sup> In Plautus' *Pseudolus*, on the other hand, the enslaved protagonist Pseudolus said, "we are loading words into a perforated *dolium*" (l. 369: *in pertusum ingerimus dicta dolium*), using the saying "to load something into a perforated *dolium*" (*ingerere aliquid in pertusum dolium*) to mean to waste one's effort or to labor in vain. By the early second century BCE, then, the *dolia* were well known enough in the cultural imagination and day-to-day vocabulary that one could speak about them proverbially. Varro also tells us that, before *dolium*, there existed an ancient word, *calpar*, a vessel associated with wine; *calpar* came from the Greek word *kalpis*, which was a term for a specific wine vessel and also meant "new wine," because the vessel's primary function was to hold sacrificial wine.<sup>13</sup> About a century later, Pliny the Elder echoes this idea, claiming that "*dolia* [were] invented for wine" (*NH* 35.56: *doliis ad vina excogitatis*). A *dolium* was therefore designed for a primary purpose: to hold wine.

Archaeological evidence also suggests that the *dolium* had a particular design and became established by the late third or early second century BCE. While *pithoi* and similar vessels had a more cylindrical shape, *dolia* were strawberry-shaped or spherical, without any decoration whatsoever, to facilitate wine fermentation. Thanks to their thick ceramic walls and their placement, partly buried in the ground (*dolia defossa*), they kept wine cool.

7. Perkins 2021.

8. Perkins 2021, Carrato 2017, and Salido Domínguez 2017 take the same stance.

9. K.D. White 1975, 145ff. *Iul. Dig.* 50.16.206 classifies *dolia* as wine containers.

10. Diocletian's *Price Edict* 15.97: a *dolium* holding 1,000 *sextarii* (550 liters); *Vitr. Arch.* 6.6.3: one *culleus* (ox-hide container, ca. 518 liters); *Columella Rust.* 12.18.7: *sesquicullearis* (one and a half ox-hide containers, ca. 750 liters); *Palladius* 10.11: two hundred *congi* (ca. 650 liters).

11. Some scholars have hypothesized that a fragment of Ennius (*Fest.* 278) includes *pertusum dolium*.

12. See Terrenato 2012 for pitfalls of using Cato's *De Agri Cultura* as a historical source for villaculture.

13. *TLL* entries on *dolium* and its synonym *calpar*; Varro *fr. Non.* p. 547.

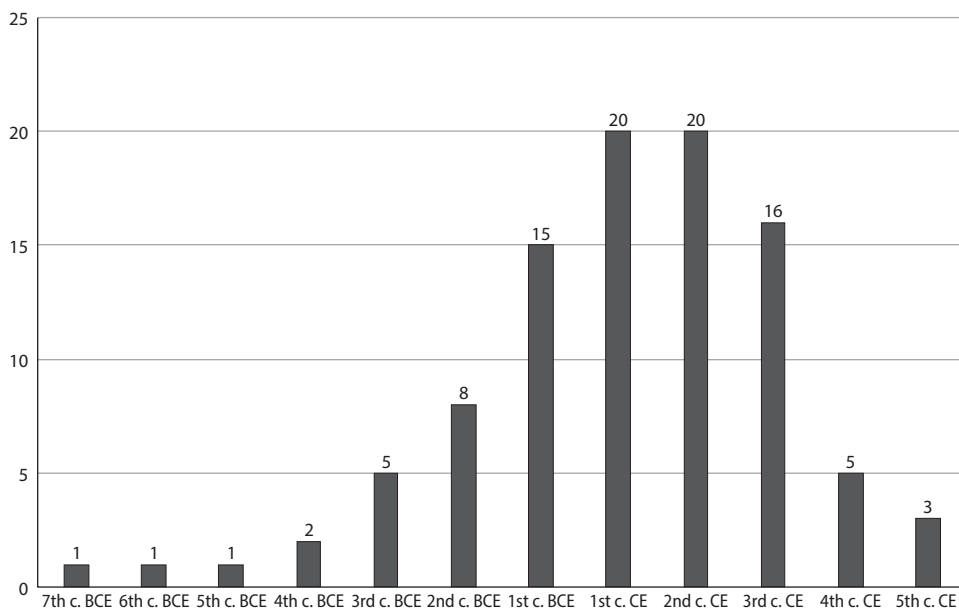


FIGURE 1.4. Dolium production sites in Tuscany, Latium, and Campania.

The earliest securely identified dolia come from contexts dated to the middle Republican period.<sup>14</sup> The production of dolia, at least in Latium, Tuscany, and Campania, is not well attested until the third century BCE or later, before which only a handful of dolium production sites were tenuously identified (Figure 1.4).<sup>15</sup> Elite villas with dolia, which Chapter 3 will discuss in greater detail, do not appear in significant numbers until the second century BCE.<sup>16</sup> According to both textual and archaeological evidence, then, dolia were a distinct kind of vessel with a specific design and purpose, and they were first developed by specialized potters around the third century BCE for the expanding Italian wine industry.

Dolia were unlike other types of pottery. With their cumbersome size and shape, they were not considered *portable* material culture and were moved only when necessary: from production facility to place of use, and then again if their owners sold the property where they were installed.<sup>17</sup> (Moving a large dolium called for the help of several people.)<sup>18</sup> Although they were considered a class of pottery, they were often produced alongside brick and tile products, as well as other heavy terracotta objects, in the same workshops that

14. Nicoletta 2007; Bergamini 2007. Possible rim fragments from the late fourth/early third century BCE from the Auditorium Villa in Rome (Carandini et al. 2006) and from the mid-third century BCE found at Ostia (Olcese and Coletti 2016, 455–456).

15. Olcese 2012; Bergamini 2007; Tol and Borgers 2016.

16. The single dolium from the Iron Age has not been confirmed; the original publication (Piccarreta 1977, #8–14) included no photographs or drawings; see also Attema and van Leusen 2004, 88.

17. E.g., dolia of the villa of N. Popidi Narcissi Maioris (De Spagnolis 2002, esp. 273–274); Pompeii I.22 (Cheung and Tibbott 2020); Villa Magna (Fentress et al. 2017); Apul. *Met.* 9.5–7.

18. Eight men are required to move a single *qvevri* (Georgian wine vessel similar to dolia) (Slatcher 2017).



supplied the building industry of Rome, known from stamped bricks and tiles as *opus doliare* workshops.<sup>19</sup> The law classified them as fixed architectural elements of a property and the defining feature of a wine cellar.<sup>20</sup> Considered both ceramic containers and architectural elements, dolia bring together various aspects of society normally studied separately: pottery, agriculture, wine, trade, construction and architecture, and craft production.

Dolia were highly valued, useful, and, when well made, incredibly robust. As a result, they were often used for at least several decades, sometimes bearing evidence of not only their use but also repairs to extend their lives.<sup>21</sup> Although dolia are rarely considered participants in the ancient Mediterranean economy, this book shows that dolia can be informative in multiple ways and at multiple scales and argues that they expanded the Roman wine trade. While double-handled ceramic transport jars known as amphorae have been studied to trace and quantify the scale and expansion of Roman trade, dolia and the potential insights they offer on the wine trade have been overlooked.<sup>22</sup> When dolia are studied, they are usually used only to identify the function of a room and perhaps underpin estimates of the scale of wine and olive oil production.<sup>23</sup> The emergence and growing numbers of dolia throughout central Italy and the Mediterranean reflected and supported a changing scale of the economy and of the wine industry in particular, becoming features in both moral and economic arguments.<sup>24</sup> Dolia can also feed into a different narrative, however, each vessel with a story of its own to tell. To the trained eye, the physical condition of the vessel reads like a history of its interactions, shedding light also on the people who came into contact with it (Figure 1.5). Following the “life” of a dolium can uncover the different skills, resources, and labor invested in it, as well as how the vessel’s value or purpose changed over time.<sup>25</sup>

Let us briefly look at one hypothetical example. Sometime in the first century CE, a specialist potter manufactured a dolium; a stamp found on the dolium tells us that the potter worked in a workshop in Campania that also supplied bricks, tiles, and amphorae to other sites in the region. The potter formed the dolium through coil building over the course of several weeks. After a lengthy period of air drying to remove moisture from its thick walls, the workshop’s kiln operators fired the vessel with a batch of other heavy terracotta objects; temperature changes had to be gradual, and the process took several days (and overnight shifts) from loading, firing, and cooling to unloading the kiln. The pot’s production was challenging, time consuming, and prone to failure, but it fetched a high profit. A customer from Pompeii ordered the vessel and arranged its transport with two contract drivers who packed the big jar carefully with straw onto a large mule-drawn cart.

19. For ceramic fabric, see Orton and Hughes 1993. On the similarity between the fabrics of bricks, tiles, and dolia, see Lazzeretti and Pallecchi 2005.

20. Ulp. *Dig.* 33.6.3.

21. Dolium-like vessels today, such as Portuguese *tinajas* and Georgian *quevri*, are used for at least several decades, some even for over a century.

22. See Komar 2021 for recent discussion of amphorae and economy. On dolia, see Brenni 1985; Carrato 2017; Salido Domínguez 2017; Carrato and Cibecchini 2020.

23. E.g., De Caro 1994, 63–69, on the Villa Regina at Boscoreale; De Simone 2017.

24. Van Oyen 2015a; 2020b, esp. 50–53.

25. For the life history of dolia, see Peña 2007b, 324–325; also 213–227, 35, 46–47, 194–196. See also Skibo 1992; Schiffer 1972, 1996; Dobres 1999; Dobres and Hoffman 1999.

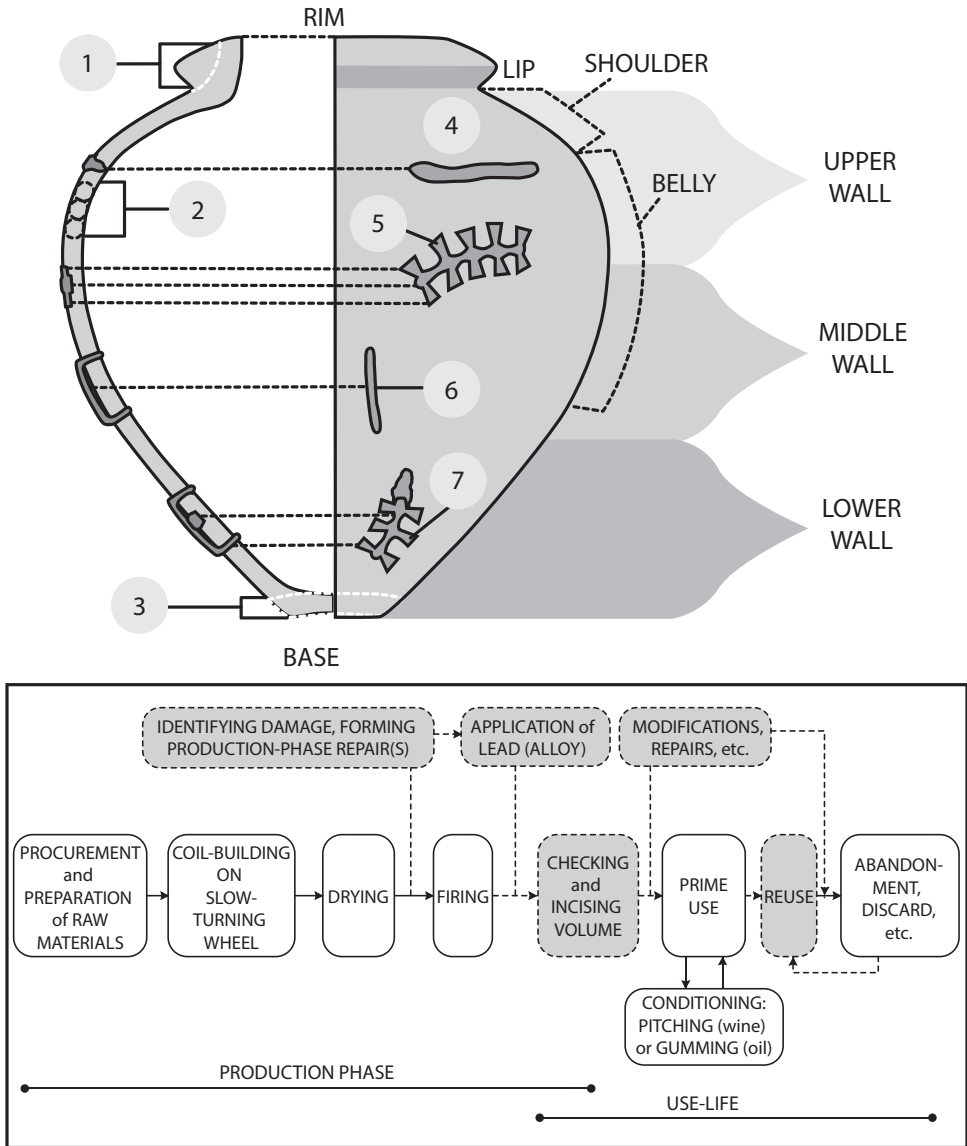


FIGURE 1.5. (Top) Production and repair of dolia; (1)–(3) show evidence of producing dolia (coil building); (4)–(7) show evidence of dolium repair: (4) lead fills, (5) double dovetail tenons, (6) staples, and (7) hybrid repairs. (Bottom) Dolium “life cycle”; shaded boxes represent optional stages. Illustrated by Gina Tibbott.

They navigated the cart from the workshop to its destination, a bar in Pompeii, and unloaded the dolium from the wagon. Later, they dug a hole, placing the jar halfway in up to its shoulder to stabilize it. Every few days, workers from the countryside dumped wine they brought in a large ox-hide container into the dolium; because it was partly buried in the ground, the dolium kept the wine cool, and workers regularly ladled out wine for customers. The workers also kept nuts, lentils, beans, vegetables, and eggs warm in other storage jars cemented in the counter, serving the local clientele. One day, cracks formed on our dolium

around the rim and shoulder. Luckily, the workers found a pottery mender, who was able to scale up her technique and materials to mend the large jar. After drilling holes on either side of the crack, she formed lead clamps to bridge the crack. The repair was mostly successful, though the workers had to be careful not to fill the dolium too full, just up to where the crack started, and lined it with pine resin regularly to keep it from leaking. A couple of years later, a powerful earthquake shook the town, damaging many houses and other buildings. Our jar's crack grew, and the jar lost most of its wine. The workers were able to find the pottery mender again, but this time she not only gave a higher quote because it would be a more challenging job but also could not guarantee the repairs would work. The owner decided to cut his losses and found a neighbor willing to pay a few denarii to take the dolium off his hands. The neighbor ran a perfume workshop out of a flower garden just down the street. He had already salvaged a few severely cracked wine dolia from other properties for dirt cheap. He buried our dolium in the garden to store rainwater next to another broken jar that he had sawn in half and mounted on four low pillars as a house for the garden's canine guardian.<sup>26</sup> Not long afterward, Mount Vesuvius erupted and covered the entire town of Pompeii. Our dolium would not be discovered until almost two thousand years later.

The cracks, discoloration, repairs, and stamp on the dolium tell us about the jar's trajectory: from how a local potter skillfully manufactured it to the care in its transportation and installation, how useful it was for retail, and how people found ways to mend and reuse the dolium when it broke. This is the story of just one dolium out of many. Studying multiple dolia together, we can learn more about this type of storage technology and systematic patterns of how people invested in and profited from this type of vessel. With a large, diverse dataset, we can trace regional differences and chronological developments in how dolia were made and used. Dolia in west-central Italy and beyond over the course of approximately four hundred years were products of a developing ceramic craft, which specialist potters established and continuously refined. Using and maintaining dolia also required particular procedures, knowledge, and resources. Dolia were an expensive type of hardware. For those who could afford them, they became a tool integral to systems of trade that enabled economic strategies previously unattainable. This book therefore considers dolia a type of storage container *technology*—that is, a type of tool or instrument and the skills by which people in antiquity produced and used it.<sup>27</sup> As a type of supersized storage container and technology, dolia not only emerged during a period of intensifying large-scale and long-distance trade across expanding imperial territory but also propelled it.

## Urban Growth and the Food Supply

Technology does not develop or exist in a vacuum. People develop technological innovations to solve problems or streamline a process, and the success of these technologies and innovations depends on how well integrated they are in their cultural context.<sup>28</sup> Technologies reflect

26. For identification of the jar as a doghouse, see Jashemski 1979a.

27. Bain's (1937, 860) classic definition of technology: "includes all tools, machines, utensils, weapons, instruments, housing, clothing, communication and transporting devices and the skills by which we produce and use them. Social institutions and their so-called non-material concomitants such as values, morals, manners, wishes, hopes, fears and attitudes are directly and indirectly dependent upon technology and are mediated by it."

28. Schatzberg 2018; Rogers 2003.

their times, and *dolia* were no different.<sup>29</sup> *Dolia* were designed, refined, and implemented to expand production, storage, and trade across the Mediterranean basin.

The emergence of Rome's sweeping territorial empire during the final two centuries BCE fundamentally transformed the Mediterranean region.<sup>30</sup> The population within Italy itself experienced major demographic shifts, with many from the countryside and abroad streaming into the city of Rome.<sup>31</sup> By the first century BCE, Rome became the largest metropolis in the Mediterranean world, with a population of one million.<sup>32</sup> The dramatic growth of the city and the attendant demands for resources reverberated throughout Italy and stimulated developments in both agricultural production and urbanization. Changing patterns of land use and ownership, the increasingly uneven distribution of wealth, large influxes of enslaved people, and the growing use of enslaved labor in agriculture disrupted and even displaced many free peasants, who poured into the city of Rome for work.<sup>33</sup> As the population of the city of Rome grew, so did demands for a reliable food supply.<sup>34</sup> The hinterland and adjacent territories of Rome were areas where these demands had the greatest impact on agricultural and horticultural transformations in the landscape. This new settlement pattern required a sophisticated regime for the production, storage, and distribution of agricultural products to feed the city, often requiring the state to facilitate and maintain this new system.

Ensuring a supply of food was always paramount for the Roman state, and numerous attempts were made to provide and guarantee grain for the urban populace.<sup>35</sup> The state offered several incentives to those willing to transport grain to Rome, such as tax exemptions, social privileges, and even citizenship.<sup>36</sup> Moreover, institutional developments and technological advances during this period enabled large-scale and long-distance merchant shipments at major ports in the Mediterranean, especially along the west-central coast of Italy.<sup>37</sup> In fact, from the outset of Rome's expansion, the coast of Italy was of prime strategic importance for Rome, and the establishment of Roman colonies at Cosa to the north and Paestum to the south in 273 BCE, as well as the general oversight of the Tiber River, safeguarded this vital region.<sup>38</sup> Between the two colonies, a series of ports dotting the coast

29. E.g., Finley 1965, 1973; Greene 2000; A.I. Wilson 2002; Taylor 2010.

30. For climate history during Rome's expansion, see Bernard et al. 2023.

31. Hopkins 1980; Hin 2013; Morley 1996; Witcher 2005; Scheidel 2004, 2005.

32. Scheidel 2007, 2001; Morley 2013, 1996; Parkin 1992; Hopkins 1978; Hermansen 1978; Storey 1997. For summary, see Morley 2013, 1996, which estimates a population between 850,000 and 1,000,000.

33. Studies include Morley 1996 on developments in agriculture in Rome and its hinterland; Purcell 1994 on the *plebs urbana*; and Witcher 2005 for demographic changes in Rome's immediate hinterland.

34. Morley 1996; Hopkins 1980, 1978.

35. Rickman 1980; Erdkamp 2005; Sirks 1991; Garnsey and Morris 1989; Garnsey 1998, 1999; Mattingly and Aldrete 2000; Vitelli 1980; Geraci 2018; Holleran 2019.

36. On the role of the state in lowering transaction costs, increasing agricultural productivity, and protecting farmers and landholders, see Kehoe 2013.

37. See D. Robinson et al. 2020. A.I. Wilson 2011 attributes the high frequency of long-distance commercial shipping to institutional developments, the eradication of piracy, the use of a single currency, reduced transaction costs, a greater integration of markets, and the consolidation of the Mediterranean Sea under one political entity.

38. Vell. Pat. 1.14; Livy *Epi. Per.* 14.

served Rome's military and economic interests, permitting vast quantities of goods to enter the city. Roman conquests enabled the extraction of grain from acquired territories such as Egypt, Sicily, and North Africa, allowing some farmers and landowners in Italy to turn to large-scale wine production.

Viticulture was potentially profitable, but also highly risky.<sup>39</sup> Wine featured in all aspects of daily life in ancient Rome, from casual dining to lavish banquets to religious festivals, and many considered it a staple food. With many different types of vintages and varying grades of quality, the price of wine could fluctuate wildly, but unlike for cereals, the state made no attempt to regulate it. Yet viticulture could also lead to financial ruin. Ancient writers discussed examples of vineyards increasing in value exorbitantly, or coming to a crash and emptying an investor's coffers. Pliny the Elder recounts a story about a man who acquired a neglected vineyard for a low price to revive it in ten years and sell it at four times more than the original price.<sup>40</sup> Stories of flipping vineyards or losing an investment weave across discussions of wine production, cautioning the reader that financial ruin could await a negligent or unlucky farmer. Cultivating grapes and producing wine was an expensive activity fraught with potential failures from as early in the process as establishing a vineyard to the storage and sale of wine. Setting up a vineyard required time, patience, and money: newly planted vines do not begin to produce fruit until at least three years after their planting, during which farmers would sink labor and equipment into the vineyard without making any profit. Their cultivation also drew on specialized skills and knowledge as they required proper support and pruning, topics popular among agronomists who codified best practices for viticulture in their agricultural manuals for maximum yields.<sup>41</sup> The labor regime for wine production was also uneven, necessitating vast amounts of labor focalized during the harvest season, which required the landowner to hire seasonal farmhands to harvest and process grapes quickly. But the most disappointing failure was when wine, after processing and aging, spoiled in storage, dashing a vintner's hopes of reaping a fortune.

The key to Rome's wide-reaching, massive food supply was storage. The storage of agricultural surplus was the building block of every society.<sup>42</sup> Communities and households in antiquity processed and stored their foods to access these items of sustenance throughout the year. Scholars working across different areas and time periods have identified a range of storage infrastructure from silos and pits to storage bins and jars to specially built storerooms. Communities practiced large-scale storage of agricultural surplus to buffer against periodic

39. On the development, profitability, and risks of viticulture in Italy, see Purcell 1985.

40. Plin. *NH* 14.48ff. Shaw 2019, 535.

41. On types of supports for vines, see Varro *Rust.* 1.8; Columella *Rust.* 1.4–6; Cato *Agr.* 1.7. In the early history of viticulture in Egypt, Greek landowners who leased their agricultural properties to local Egyptians still took care of viticulture themselves. *P.Ross.Georg.* 2.19; *P.Oxy.* 47.3354; Rowlandson 1996, 231–236; Kloppenborg 2006, 516–521, 528–534; Langelotti 2020, 188–193; Vandorpe and Clarysse 1997; Rowlandson 1999, 139ff.

42. For studies in the Roman world, see Erdkamp 2005; Morley 1996; Garnsey 1988; Bowman and Wilson 2013; Rickman 1980; Virlouvet 1995; Van Oyen 2020b. In the Greek world, see Foxhall 1993; Foxhall and Forbes 1982; Garnsey and Morris 1989; Halstead and Frederick 2000; Riley 1999; R. Palmer 2001; van Andel and Runnels 1987; Alcock et al. 1994; Halstead 1987, 1989; Halstead and O'Shea 1982, 1989; Wells 1992; Barret and Halstead 2004; Howe 2008. See J.C. Scott 2017; Chankowski et al. 2018; Forbes and Foxhall 1995. For the Andes and Greece, see Hastorf and Foxhall 2017.



variations in food availability, an issue particularly problematic in the Mediterranean.<sup>43</sup> Astrid Van Oyen has recently shown that storage as a practice is both universal and historical: storage is a practice all societies engage in, but it varies across time and space and shapes history.<sup>44</sup> As a result, modern scholars have been fascinated with the large storehouses featured in many ancient Mediterranean settlements. Storehouses, especially granaries, are some of the most conspicuous and distinctive buildings in Roman settlements. Often large with two or more floors, thick walls, and multiple single rooms, sometimes around a large central courtyard, these structures dominated the landscape and imposed a sense of controlled surplus.<sup>45</sup> Security, organization, and supervised access were shared concerns across different sites, regions, and stored foods. For grain, the raised floors of the horrea promoted ventilation and the thick walls helped keep temperatures cool and stable. Storing wine and olive oil, however, entailed additional requirements. Critical to their storage was proper packaging (and containers) in order to hold, protect, identify, and transport them.<sup>46</sup> Storage, in other words, lies between production and consumption—where most scholarly attention has been focused. Yet it was nonetheless essential, and its infrastructure often required specialized expertise, particular modes of organizing labor, and, most importantly, proper containers.<sup>47</sup> Wine and oil cellars (*cellae vinariae* and *cellae oleariae*) were architecturally and functionally distinct from other types of storerooms thanks to the containers within: the dolia.

## An Empire Full of Containers

In a world without refrigeration, the containers in which food was stored and transported were the superstars of a large food supply system. Containers are not only capable of holding something for transport and storage; they can also package and “brand” goods.<sup>48</sup> People in the ancient Mediterranean used various types of containers to protect, store, and distribute different foods. The importance of these containers in antiquity can hardly be overestimated. They transported olive oil and wine over long distances. More importantly, though, each container protected its contents, ensuring that the product’s quality would be preserved throughout its journey.<sup>49</sup> But two important points must be clarified immediately. First, not all containers are created equal.<sup>50</sup> Different types of containers had their own properties that

43. On variation in food supply in the Mediterranean, see Garnsey 1988; Bintliff 1997; Halstead and O’Shea 1989; Horden and Purcell 2000, ch. 6. Responses to food scarcity included diversification of agricultural products and production, storage, and redistribution of surplus. For agriculture and political economy, see Earle 2002; M.E. Smith 2004; Foxhall 1995; D’Altroy and Earle 1985; LeVine 1992.

44. Van Oyen 2020b, 1–18. See also Bevan 2020.

45. Rickman 1971; Van Oyen 2020b, 2015a. On the efficiency of horrea, see Pagliaro et al. 2014, 2016.

46. Cheung 2020; Curtis 2015, 2016.

47. E.g., Dietler 2010b; Kehoe 2007; Jongman 2007; Morley 2007.

48. On containers and packaging, see Klose 2015, 323–341. On container types, see Knappett 2020, 130–166; Hunter-Anderson 1977; papers in Shryock and Smail 2018a, esp. Shryock and Smail 2018b; Bevan 2018; Robb 2018.

49. See Bevan 2014 for a *longue durée* study of containers in the Mediterranean basin; see McCormick 2012 for amphorae and barrels. Shipping containers today transformed production and consumerism; see George 2013; Levinson 2006; Klose 2015; Shryock and Smail 2018a.

50. Cf. Twede’s work on packaging, the history of packaging, and packaging performance: Twede 2002a, 2002b, 2005a, 2009; Twede and Harte 2011; Twede et al. 2000a, 2000b.

made them advantageous or ineffective for certain products, modes of transportation, or steps in the supply chain. It would not make sense, for example, to package a commodity normally sold in bulk in fragile containers—for example, shipping grain in glass bottles. Some containers were more effective for storage—that is, maintaining ideal conditions to stop or delay the deterioration of their contents. Second, containers only functioned as people expected if they were made well and were handled properly before, during, and after each usage. If a jar had a production defect, it had to be either repaired or replaced to ensure its contents would be protected. Moreover, the choice of container was influenced not only by accessibility and costs of materials but also by cultural preferences and workforces and industries in the area or the ability to import them. People might even expect to receive certain types of containers with their products.

Containers were some of the most essential objects and actors in an intricate system of storage and packaging that made food available year-round and in far-flung destinations, one of the most remarkable traits of the Roman Empire. They are the products of the traditions and behaviors of storage and packaging, and reflect some of the deepest cultural mentalities and preferences. In the United States, for example, milk is packaged in paper cartons, plastic jugs (often with a single handle), or glass bottles, whereas in Canada milk is sold in bulk in large plastic bags. The availability of certain containers in antiquity too depended not only on natural resources but also on cultural preferences, social expectations, labor, and economic conditions. Agricultural workers expected specific types of equipment and containers to process and package their goods. Wine was supposed to have a particular taste and texture, and it was expected to be stored, packaged, presented, and labeled a certain way. Lastly, containers were so widely used for all types of distribution and consumption—just think of how many bags, cartons, bottles, and cans are picked up when buying groceries—that their production and distribution could make people rich. (Case in point: the Uihlein family, owners of ULINE, a company that produces packaging and shipping materials, is worth over \$4 billion.)<sup>51</sup>

Studying containers and their biographies, itineraries, or trajectories helps us recognize the vast array of craftspeople, skills, manpower, and organization of labor required for making and using these containers; the social and cultural meanings ascribed to them; and their role in shaping labor, the economy, and agricultural practices.<sup>52</sup> At the peak of the Roman Empire, the *dolium* reigned supreme. The heavyweight ceramic storage vessel was uniquely placed among different containers, fulfilling special roles that no other container did in antiquity and becoming a concept that symbolized abundance and wealth. In order to understand what exactly that role was, and what the potential payoff is from studying it, it will be useful to review briefly the process of making wine and olive oil, and the other types of containers that operated in the same system.

Sometime in early autumn, droves of farmhands, usually contract laborers, freed ripe grapes from the vine, placing them into baskets (*fisci*).<sup>53</sup> It was an urgent time. As soon as

51. Saul and Hakim 2018. In 2020, ULINE generated almost \$6 billion in revenue.

52. For the (changing) value of objects, see Appadurai 1986; Kopytoff 1986. For benefits of the term “trajectory,” see Van Oyen and Pitts 2017b, 13ff.: object biographies are useful for studying single objects; trajectories give objects a role to play. See also Joyce and Gillespie 2015a, 2015b; Hodder 2012; Bennett 2009.

53. On contract vineyard work, see Kloppenborg 2006. On tenancy in Byzantine Egypt, see Hickey 2012.

grapes reached the peak of ripeness, they were at their sweetest but also most vulnerable state. Workers had to move quickly and harvest the grapes, while taking care not to bruise them or puncture their skins; after gathering the grapes, workers would then tread them in vats or press them, often in a bag or sack (*saccus*), and the freshly pressed juice (*mustum*, “must”) would be collected in open vats (Figure 1.6).<sup>54</sup> After the initial fermentation period, which lasted a few days, vintners could move wine from vats into dolia and seal the dolia. After at least thirty days of fermentation, the wine was separated from its sediments (lees).<sup>55</sup> From fermentation until the wine was packaged for sale, winemakers could employ different sorts of treatments to protect the wine’s quality and alter its taste, and they could even reserve some to age into a more expensive vintage. To sell and distribute wine, workers transferred the wine from the dolium into other containers, such as amphorae, which were often used to export products, especially overseas, or an ox-hide container known as a *culleus*, which could then be carted to its final destination, where the wine could be decanted into other vessels, or to a bottling facility where wine could be poured into amphorae and shipped overseas.<sup>56</sup> Variations to this schema were possible, but these were the typical stages and containers in the fermentation, storage, and packaging of wine.

Olives too were harvested and pressed in the fall, though a significant crop generally developed only every two years due to the olive’s biennial cycle.<sup>57</sup> Olives also required processing. Anyone who has ever tasted an olive off the tree knows it has to be treated before it is edible. The olive is a bitter fruit that requires brining or other preparations before it can be consumed. In antiquity, the process for pressing olives for olive oil was similar to that for making wine and, in fact, they required much of the same equipment, though the processing of wine and olives usually did not share equipment at elite production facilities to avoid contamination.<sup>58</sup> Olives were generally harvested in late autumn, though there was a wider window of time than that for grapes: harvesting less ripe olives at the earlier end of the spectrum would yield smaller amounts of high-quality oil, whereas harvesting ripe olives later would increase quantities of lower-quality oil.<sup>59</sup> After collecting and cleaning olives, workers used a stone olive mill (*trapetum*) to crush the olives, after which they placed the pulp, flesh, and fragmented seeds into baskets for pressing, usually with a lever or screw press.<sup>60</sup> After pressing, workers separated the oil from the bitter, aqueous part of the olive

54. This is a simplified account of wine production. Three batches of wine could be produced: (i) from treading, (ii) from the first pressing, and (iii) from pressing the skins, known as *lor(e)a*, which would be given to enslaved workers for rations. For discussion, see Curtis 2001, 375ff.; Thurmond 2006. For overview of equipment, see K.D. White 1975; Hilgers 1969.

55. Cato *Agr.* 25: wine should ferment for at least thirty days. For variations and transformative qualities of wine, see Thurmond 2017; Dodd 2022; Van Oyen 2020b, 50–53.

56. Villa B of Oplontis is a unique example of a bottling facility; M.L. Thomas 2015, 2016. For wine and amphorae production in regional networks, cf. Peña and McCallum 2009a, 2009b.

57. See Waliszewski 2014 for how Romans might have tinkered with olive groves to get annual yields.

58. See Rossiter 1981; Curtis 2001; Marzano 2013a. On distinguishing between facilities, see Brun 1993. Peasant farms probably did not have separate equipment; see Vaccaro et al. 2013, 140–142.

59. Plin. *NH* 18.320: olives are harvested and oil produced after the vintage. Thurmond 2006, ch. 2. Rowan 2019a.

60. For different types of presses used in the Roman world, cf. Curtis 2001, 381ff.; Lewit 2020.

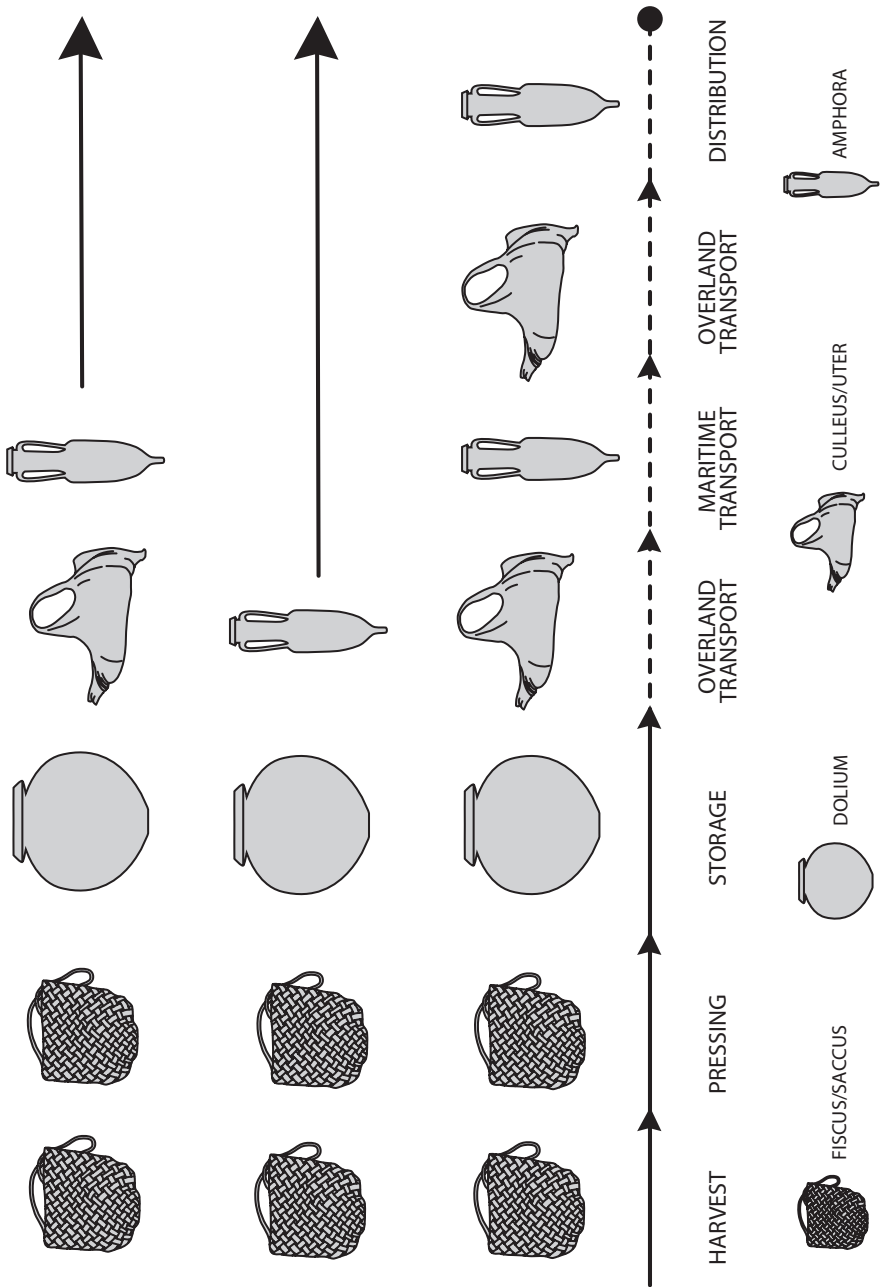


FIGURE 1.6. Supply chain, and containers, of wine, by Gina Tibbott.

(*amurca*).<sup>61</sup> Depending on the scale of production, they placed the oil in a dolium or smaller jars to settle for a few months, and later transferred the oil to another container for distribution.<sup>62</sup>

Although wine and olive oil production had their own procedures, timelines, and concerns, both required the storage conditions that a dolium offered. Foods in general deteriorate from exposure to light, oxygen, and high temperatures, so they need protection from heat, air, and light, as well as pests. In general, the various stages of the supply chain for wine or oil relied on different containers, but dolia often held wine and olive oil for long (sometimes the longest) periods of time and during the most formative stage of the process.<sup>63</sup> It is thus no surprise that farmers and merchants invested in and installed thousands of these supersized jars across the ancient Mediterranean.

## Organization of Chapters

The dolium-based storage technology was in full force in central Italy during a period of imperial expansion, circa 200 BCE–200 CE, when Rome was becoming the largest and most populated city and when the Mediterranean was increasingly unified economically and politically.<sup>64</sup> In seeking to better understand this unification, a fuller picture of the investments, skills, labor, and people involved can emerge by tracing the development of dolia not only as objects but as an industry and a type of technology in their own right. This book evaluates the economic and social realities of Roman imperialism for the individuals living in the shadow of the epicenter of a Mediterranean-wide empire through the lens of dolia. Situated at the intersection of pottery, craft production, agriculture, and the construction industry, dolia bring to light interactions and relationships between elites and subelites alike among seemingly disparate activities. By studying the nuts and bolts of this commerce, the book opens a new window on a whole series of uncharted interactions in the ancient world. The following chapters show how the expansive, highly profitable wine trade so distinctively characteristic of the Roman period was only able to emerge and grow thanks to the dolium storage technology. Dolia enabled the large-scale production, storage, and distribution of wine to supply the ancient capital, and their increasing use offered new opportunities for wealth. In other words, the dolium storage technology was simultaneously a manifestation, product, and instrument of Roman economic expansion.

Because of the uneven nature of the evidence, and in order to explore the importance of dolia from several distinct angles, this book is organized thematically, rather than chronologically or regionally, and primarily follows the life cycle of (1) the dolium, dolium technology, and dolium industries—from development, through use and maintenance, to demise—and, in discussing the use of dolia, (2) the supply chain of wine, from its production to its storage, transport, and retail. Chapter 2 starts from the beginning of the dolium's story and traces the dolium industry. The chapter explores how potters developed and refined a challenging craft for a new, specialized storage technology. Although dolium

61. See Curtis 2001, 394, for techniques of oil separation.

62. Smaller jars—e.g., *labra* and *seriae*—stored olive oil; cf. K.D. White 1975. Varro *Rust.* 3.2.8: *serias olearias*.

63. Many olive oil production sites did not have dolia (see Chapters 3 and 5).

64. Bevan 2014, 392. Morley 1996 discusses broad agricultural developments to supply Rome.



producers used the same technique to make the vessels, the scale of production differed drastically between regions and among workshops. Dolium production was a challenging, long-term process that required at least several weeks and substantial upfront costs, which most could not afford. Over time, investors in multiple large-scale opus doliare (heavy terracotta and ceramic products; the term *opus doliare* is based on attestations on brick stamps) workshops in the Tiber River Valley successfully and profitably included dolium production in their repertoire of mass-produced bricks and tiles, becoming attractive “one-stop shops.” Dolium production became a lucrative industry, garnering not only financial gain for workshop owners but also status, power, and control over resources essential to viticulture and being a good farmer.

The next part of the book (Chapters 3–6) reviews the various uses of dolia for wine and olive oil, from their production to their transport and sale. Chapter 3 looks at how farmers in central Italy used dolia for viticulture, sometimes amassing capacious wine cellars to produce for a market. Although dolia were designed for and used in viticulture, they were practical as multiuse vessels too, commonly implemented in large-scale olive oil production. All farms needed storage equipment and facilities, but dolia appeared in great numbers on estates, especially large ones, supporting and enabling profitable viticulture and olive oil production for sale on the market, and often for export too. Dolia became so instrumental in expanding an estate’s ability to produce and store wine that they came to represent good farming and abundance, and some villas even celebrated viticulture and storage by embellishing their wine cellars and dolia.

The next two chapters expand the geographical lens to look at how communities adopted dolia beyond Italy in a highly connected Mediterranean world. The massive capacities of dolia became attractive for an unexpected purpose: bulk transport. Markets farther afield offered potentially huge profits, luring merchants to undertake more long-distance trade. Bringing goods to more-distant destinations, however, called for containers that could not only hold large amounts but also protect their contents on potentially long journeys. Chapter 4 takes stock of the different containers for the local and long-distance trade in wine (and olive oil) during the Roman period. Although traders had traditionally packaged wine, olive oil, and other foods in amphorae for centuries, some traders forged a new and highly specialized form of bulk shipping. Synthesizing recent discoveries in underwater archaeology, this chapter sheds light on innovations in the dolium industry as a group of entrepreneurs merged dolium construction with shipbuilding to create a new vessel to deliver tons of wine more efficiently to markets in the western Mediterranean. Thanks to the ships’ unique design, traders could quickly dump massive quantities of wine into dolia built directly into tanker ships and sail to both maritime and fluvial ports where lucrative markets were based within a narrow “open” sailing season.

Chapter 5 shows that, in an increasingly connected economy, lucrative opportunities in the wine and olive oil markets took off and fostered different knock-on effects. Landowners in the northwestern Mediterranean, where dolium ships visited, also invested in dolia as local villas developed and diversified their agricultural portfolio to include wine and olive oil. Over time, producers in Gaul and Iberia supersized their own production and storage capabilities, tapping into the dolium-based infrastructure, as they expanded their operations and delivered huge amounts of wine and olive oil to the capital’s doorstep. As a result, expansive villas specializing in wine and olive oil production spread across Gaul

and Iberia, often surpassing Italian villas in scale. In addition to markets in the northwest Mediterranean, Rome was a destination and consumer of those wines as demand and infrastructure for a more robust food supply system grew.

Although dolia were originally used for food production and storage on farms and villas, their effectiveness as storage containers opened new possibilities for urban retailers, traders, and consumers, especially around the imperial capital. The next part of the book shifts its gaze back to urban infrastructure in west-central Italy. Chapter 6 examines how different urban communities in central Italy used these vessels to support urban populations near the capital. Thanks to their design, dolia could be installed to maximize food storage in densely populated areas. Their labor-intensive use and maintenance, however, also meant that their adoption was not always successful, compatible, or long-lived. In places where dolia became worthwhile investments, these vessels were built into shops, bars, and warehouses and occasionally featured in dining establishments where additional services could be provided. Dolia helped bridge town and country, and their role in urban storage fostered the rise of urbanism and increasing specialization in the urban economy. In Ostia and Rome, wine warehouses were especially massive and specialized structures, and probably ventures only the very wealthy and powerful could afford to bankroll. Those who had the financial and social capital to set up *cellae vinariae* not only controlled wine supplies; they also wielded considerable negotiating power, influence, and prestige.

The next part of the book casts light on the maintenance, repair, and longevity of these valuable vessels. Chapter 7 explores how dolium owners protected their investments and how the dolium industry became increasingly specialized as different parties developed dolium repair techniques. Dolia were listed among essential farm equipment and were expensive, yet they were susceptible to damage and prone to break. Many dolium users chose to have their costly vessels repaired to prolong their use rather than just throw them away. Mending dolia, however, posed new challenges. Although they are ceramic, they were much bulkier and heavier than other types of pottery, and traditional pottery repair materials and methods often failed to stabilize and hold together these hefty pots. Craftspeople experimented with and devised new techniques, finding ways to make stronger repairs. Traditionally, nonspecialist craftspeople fixed dolia when they became damaged in use. As the dolium industry developed, however, dolium repair in some areas became more specialized within the workshop itself, drawing on techniques from the architectural industry. Regional discrepancies in dolium repairs reveal different resources and organizations of labor available for urban food storage. In the area around the capital, where demand and specialization were higher, *opus doliare* workshops directed significant skill and labor into preemptively reinforcing their products. Owners of profitable urban warehouses not only procured well-made and reinforced dolia from *opus doliare* workshops; they also hired designated workforces to maintain and routinely provide upkeep for their costly investments. The various, and often specialized, repair techniques and workforces simultaneously extended the reliability and longevity of dolia, as well as the success and stability of the dolium industry, but involved substantial resources and new skills.

Despite diligent maintenance and repairs, dolia inevitably broke or fell out of use. Chapter 8 surveys different ways dolium owners might have tried to recuperate their investments, as well as why and how some eventually discarded them. Because dolia were so large and unwieldy, people found creative ways to reuse and jettison the vessels. The

chapter then notes widespread abandonment of the technology too, as farmers and merchants shifted their priorities when they faced new opportunities. For some urban communities, using *dolia* and their specialized system no longer seemed worthwhile, and they stopped moving and storing wine in large *dolia*. The *dolium*-based system enjoyed success for several centuries, but merchants and vintners began to abandon the technology across the board. The chapter considers broader changes to the industry and to storage and packaging as some farmers and merchants switched to a radically new container technology that would be in place for almost two millennia, a more generalized system that revolved around the barrel. Their growing use to deliver wine to the capital was not a simple or straightforward replacement of *dolia* but sheds light on the pitfalls of the specialized storage system that had sprung up around the *dolium* as well as new economic strategies wine traders were pursuing to supply Rome and other communities across the empire. Chapter 9 zooms out to consider the broader implications of a *dolium*-based container system for investors, workshops, and personnel before discussing container systems and the enduring legacy of *dolia*.

## The Data

Much of the book focuses on west-central Italy, the area around the capital, and is informed by published material and further augmented by unpublished material from four sites that provide a detailed view of *dolium* industries in that area from the second century BCE to the second century CE (Figure 1.7): Cosa (second century BCE to second century CE, though most of the material is from the final two centuries BCE), Pompeii (third quarter of the first century CE), Ostia, and Rome, the capital itself (second century CE). The towns and cities are well-known archaeological sites of central Italy that have been relatively well published. The *dolia*, however, have not been studied in depth, and this study, the first to document the *dolia* in great detail, thus integrates their analysis within a richer, contextually informed discussion. The data on these *dolia*—their dimensions, stamps, markings, and repairs, among other types of evidence—have been compiled in Appendix 1 (A1), and more detailed descriptions of individual *dolia* are included in Appendix 2 (A2). (The Guide to the Appendixes will provide more information on the assembly and organization of the data.) Overall, the data show that the trajectories in both the development of *dolia* and their industries diverged between the sites, highlighting the multiple ways *dolia* could be adopted in a range of urban areas: the towns of Cosa and Pompeii occupied a place in agriculturally rich hinterlands known as wine exporters, whereas the densely occupied cities of Ostia and Rome relied on foods produced elsewhere.<sup>65</sup>

The first case study settlement is the town of Cosa, a port colony founded in 273 BCE in southern Tuscany with a thriving wine industry that dominated the western Mediterranean from the mid- to late Republic.<sup>66</sup> Perched on a hill about 110 meters above sea level and just approximately 150 km northwest of Rome, Cosa overlooked both the Tyrrhenian Sea and a hinterland speckled with multiple villas engaged in lucrative activities. Hundreds

65. Erdkamp 2001.

66. F.E. Brown 1951, 1980.



FIGURE 1.7. Map of Italy with case study sites marked, by Gina Tibbott.

of wine amphorae originating from Cosa have been found in large concentrations in areas as distant as southern Gaul, testifying to its large-scale wine enterprise. Many of these amphorae bore stamps linked to the prominent Sestius family, offering an opportunity to explore the developing relationships between industries for wine, agricultural production, and pottery in this region. From the end of the Republic through the imperial period, Cosa increasingly imported, rather than exported, wine.<sup>67</sup> Cosa and its

67. Will 1987.

hinterland, the *ager Cosanus*, have been the focus of many archaeological projects and studies, and excavations of the town over the years have explored the forum, several temples, some houses, and now the bath complex. Among the many artifacts recovered from excavations of the town were nearly fifty dolium fragments;<sup>68</sup> though they are low in quantity, often from reuse or discard contexts (only a few are from primary use contexts), and not well preserved, these dolium fragments are among the earliest datable dolia from an urban site. The majority of dolia and dolium-related objects were discovered in the early excavations sponsored by the American Academy in Rome and formed part of a publication on the utilitarian pottery finds, but only diagnostic fragments (sherds with features such as rim and base) were published.<sup>69</sup> The current Cosa excavations of the bath complex discovered other dolium fragments, which were reused as fill, that inform this study.<sup>70</sup> In general, most of the diagnostic dolium fragments date from the early second to late first century BCE, and some fragments, primarily body sherds, were reused in second-century CE contexts. With materials spanning from the early to later history of the town, the Cosan evidence highlights the wax and wane of dolium use in an agriculturally productive colony.

The second case study site, Pompeii, offers a detailed view of storage during the first century CE, a period notable for global trade and a “consumer revolution.”<sup>71</sup> Pompeii, an urban settlement in Campania, was founded sometime in the seventh or sixth century BCE and was granted colonial status in 80 BCE after Sulla’s conquest. Ancient authors noted that Pompeii was particularly fertile thanks to its rich volcanic soil and was hence known as a region that produced plentiful fruits and well-known wine.<sup>72</sup> Archaeological evidence, including architectural and archaeobotanical remains, confirms that Pompeii itself was a productive agricultural town, with farmhouses and villas clustered densely not only outside the town but even within the town walls.<sup>73</sup> Due to the eruption of Vesuvius in 79 CE, Pompeii offers a unique opportunity to study Roman agricultural production and its integration within an urban fabric. The southeastern sector (Regio I and Regio II), notably the town’s verdant sector, along with several “villas” outside the town walls such as the Villa of the Mysteries and Villa Regina of Boscoreale, illuminates the storage and packaging behaviors of Pompeii and its *ager*.<sup>74</sup> Most of the dolia are well preserved and have been left in situ since the eruption of Mt. Vesuvius in 79 CE, but some were moved from the town and surrounding areas to the storerooms on-site. Pompeian dolia were typically found in shops and in planted areas, such as gardens, vineyards, and groves for

68. Some dolia were published (Dyson 1976), but many remain unstudied.

69. Nondiagnostic fragments such as body sherds were often discarded; catalog cards in the Cosa Archive at the American Academy in Rome indicate dolia were discarded over the years.

70. R.T. Scott et al. 2015; De Giorgi 2018.

71. Wallace-Hadrill 2008 places Italy’s “consumer revolution” to a time when the population began to recover from civil war and demands for consumer goods spurred production in Italy.

72. Plin. *NH* 14.35, 14.38; Flor. *Epitome* 1.16. Vesuvian wine was shipped overseas. M.L. Thomas (2015) and Peña and McCallum (2009a, 2009b) have posited that a wine packaging facility was located on the coast near wine production centers.

73. For discussion and evidence of cultivation in Pompeii, see Jashemski 1979b, 1993.

74. See Nappo 1997 for growth and reorganization of Pompeii’s southeastern sector: housing developments in the late third/early second century BCE, then agricultural production in the first century CE.



the storage, fermentation, or processing of agricultural products. Approximately one hundred dolia and dolium fragments, and another hundred of a cylindrical storage jar, mostly found where they were used in antiquity, reveal how integral and specialized dolium storage was for an agricultural town's food production and retail in the first century CE.

The urban populace of Rome constitutes, of course, the major beneficiary of these long-distance movements, and the city's infrastructure constantly evolved to store masses of commodities flowing into the city.<sup>75</sup> The third case study focuses on the area of the imperial capital and examines both Ostia and the city of Rome. As one of the capital's most crucial ports, Ostia shows how the "local" territory was affected by Rome's own growth from the late first to the beginning of the third century.<sup>76</sup> Ancient authors credited the foundation of Ostia, situated twenty-five kilometers southwest of Rome, to Ancus Marcius, the fourth king of Rome, in the late seventh century BCE.<sup>77</sup> For most, if not all, of its occupation, Ostia was a naturally strategic harbor for Rome, and as the city and empire of Rome grew, so did Ostia.<sup>78</sup> Ostia underwent several major renovations during the early second century CE, when various parts of the settlement were expanded or rebuilt. Among the enhancements in the harbor district were several warehouses containing dolia defossa to hold wine. Ostia had over two hundred dolia installed, but they have only been briefly mentioned in publications.<sup>79</sup> The roughly 125 dolia across three storerooms still accessible today provide valuable insights into the development of the dolium craft and the large-scale enterprise for storing wine to supply the capital. The city of Rome, a densely populated metropolis, was also equipped with a plethora of warehouses, including wine and oil cellars with dolia, though we mostly know of them through inscriptions rather than physical remains. The continuous occupation of the city has meant that only a small portion of the ancient city has been excavated, but several well-preserved dolia have been recovered, approximately twenty of which were documented for this study. In antiquity, the numerous cellae vinariae of the capital were surely filled with many dolia, three dozen of which are now scattered in various museums or set up as décor in gardens, parks, and even the US embassy to the Italian Republic. Most of the dolia were moved from their ancient contexts to museums early on and now lack provenance, though they likely came from several wine warehouses built in the second century CE. Because Rome and Ostia were serviced by the same workshops, their dolia were mostly found in the same types of contexts, and the uneven sets of evidence from the two cities inform each other, they are discussed as a single case study in the following chapters.

A close examination of dolia brings to light the ingenuity, cross-craft fertilizations, collaborations, and social and economic constraints of largely invisible craftspeople whose remarkable products stored and transported wine across a Mediterranean-wide empire. But this is not just a book on pottery, and not a traditional ceramics study. This book does not present a comprehensive typology of dolia (and it would probably be impossible to

75. Rickman 1971, 1980, 2002; Virloeuve 1995, 2011; Van Oyen 2020b.

76. Ostia was not continuously inhabited and built over and helps understand Rome's urban layout.

77. Livy 1.33.9; Enn. *Ann.* 2, fr. 22; Cic. *Rep.* 2.5, 2.33; Dion. Hal. *Ant. Rom.* 3.44.4; Isid. *Orig.* 15.1.56; Plin. *NH* 3.56, 31.89; Meiggs 1973, 16–17.

78. Meiggs 1973, 1–10, 16–50, 479–482.

79. Peña 2007b is a notable exception.

produce one given how much these hand-built vessels varied from one another), nor does it catalog or delve into thick descriptions of all individual unpublished dolia (though there is more information on select examples in Appendix 2).<sup>80</sup> Almost none of the dolia themselves are newly or recently excavated specimens. With the exception of a dozen or so fragments at Cosa, the other dolia and dolium fragments have long been excavated. New discoveries, and more scientific analyses, will augment our understanding and interpretations of the dolia, but small sets of data, no matter how high resolution, limit comparisons across sites and time. Instead, this study interrogates large sets of previously excavated material by asking new questions from old artifacts. By looking at seemingly mundane materials closely, we can tease out how a new food storage technology promoted investments, labor, trade, and even urban infrastructure.

Although wine was only part of the ancient economy, the wine trade was a characteristic feature of ancient Rome; with its colossal scale, immense variety, and extensive reach, the Roman wine trade was unique in the history of the Mediterranean. This study builds on previous work on the Roman food supply but provides a fresh perspective from the bottom up, one that focuses on what I argue to be the “keystone” container of the Roman wine trade: the dolium.<sup>81</sup> Various containers made possible the range of economic activities and storage and movement of goods, at the center of which was the dolium. The following chapters highlight the role that the dolium storage technology played in the wine trade, especially in supplying the capital. But this was not a direct route. Dolia shuffled resources, and hence possibilities for profit and wealth. As the common thread running through wine production, storage, and distribution (both wholesale and retail), dolia could expand a farm’s ability to produce wine, reduce bottlenecks in the shipping process, and hold wine until merchants could sell it for higher prices. In becoming the backbone of the Roman Empire’s complex, large-scale, long-distance, and highly profitable wine trade, dolia also opened new channels for economic opportunities and strategies. Some people became rich(er) investing in dolium production, producing more wines, operating shops or restaurants, shipping wines, or all the above. There were those who also found new, ancillary work that supported the dolium-based infrastructure. This was not just about money, though. Financial gain was certainly an incentive that drove people to have a hand in the food supply. Stories of Romans making a fortune on hoarding and price gouging wheat (and surely other foods) run rampant in ancient sources. But having a direct hand in the food supply—whether through agricultural production or distribution—also guaranteed access to valuable, and often coveted, resources, clinching one’s power and influence over supplies, and even other people.

80. Carrato (2017, 2020) produces a typology based on dolia in Gaul, Iberia, and Italy.

81. On the “material turn” and need to incorporate material culture into (economic) history, see Bowes 2021c; Van Oyen and Pitts 2017a.

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