Weights and Measures Units in Petra Papyri

Mohammed Al-Nasarat[a],*

[a]Department of History, Al-Hussein bin Talal University, Ma’an, Jordan.  
*Corresponding author.

Received 18 February 2018; accepted 22 April 2018  
Published online 26 May 2018

Abstract
Petra papyri is one of the most important discoveries in the history of ancient Jordan, and provide evidence that there were specified metrological units in Petra during the Byzantine period. The use of these weights and measurements was common in ancient Petra during the Byzantine period. So, this study will try to discuss various weight and measure units and measures of capacity dry and liquid that were practiced by the people in Petra and the modern equivalents of these weights and measures, although today it is difficult to define exactly how much certain these historic units measured, as compared to modern equivalents.

Most of these measures were widely used and known by the eastern people even though they had variations in values. It seems that the people in Petra borrowed the measures technique from the Romans. This study will depend on the papyri of Petra and sources of the measures such as Epiphanius of Salamis.

Key words: Weight; Measure; Petra papyri; Petra; Metrological units; Roman measures

INTRODUCTION
As has been known, the documentary sources, particularly the papyri, are considered the main source for studying the history of Petra during the Byzantine period. The Petra papyri were discovered in 1993 at Petra church (Figure 1) opened an entirely new avenue of research on Byzantine Petra, and reveal very clearly picture for studying the
economic life and management of tax system by the end of the fifth century and beginning of the sixth century AD, at least at Petra (Figure 2).

Units and Measures: Papyri texts provide us with a considerable kinds of weights and measures, these are as follows:

1. MEASURES OF AREA

The units of measures land mentioned in the Petra papyri are Roman *iugera.*¹ The Petra papyri are the first source to attest land specified as “*iugera of the patrimonium*" (πατριμωνίου ιογέρα) (Frösén et al., 2002). The tax expected by the taxpayer is calculated based on units such as *iugum* (Jones, 1964). Literally, in the Petra papyri, the farmers use Semitic land measures such as: the *koriatia* (kor), *sattiaia* (se′ah) and *kabiaia* (kab) (Invs. 13 and 14; Fiema, 2005; Koenen, 1996, p.86; Frösén et al., 2002, p.77). St. Epiphanius (AD 315-403)² mentions that these are measures of the ground area which can be sown by these tools (Dean, 1935).

The first measure in Petra papyri is *iugera* or *iugerum,* the land measure (Frösén et al., 2002, p.103). It is a Roman area unit, meaning “yoke of oxen” (Pliny: 18:9; Dean, 1935). This unit used in determining imperial taxes (Dean, 1935). Later, the term came to mean the area that a yoke of oxen could plow (Caldwell, 2001). Pliny gives a *iugum* as 40 *iugera* or 30 if the soil is difficult (Jones, 1990). The Syro - Law book defines the *iugum* as 20 *iugera* of arable first- class land, in terms of vines; the *iugum* equals 5 *iugera* (Jones, 1990). Epiphanius, at the end of the fourth century AD defined the *iugum* as 13 *iugera* (Caldwell, 2001). This measure was used before Diocletian, but was defined in his reign, and was made statutory (Caldwell, 2001)³. Jones describes the *iugum* as a tax unit, and as a unit used in the measurement of land (Jones, 1990). It is worth noting that the *iugum* is not mentioned in the Egyptian papyri, although, it is known from the Theodosian Code that the *iugum or iugatio* was used for property holdings in Egypt (Caldwell, 2002). As well as in Nessana papyri (Stroumsa, 2008, p.42). In the Petra papyri, the land taxes were paid based on *iuga* that were calculated by considering the size and type of land (Caldwell, 2003).

Most of the fields mentioned in the Petra papyri are under Petra’s communal tax authority rather than the imperial fiscus (Fiema, 2002, p.226). The amount of assessed tax was determined by the total area of land registered for Petra (Ibid.). In general, land around Petra was measured in Roman *iugera* (Nasarat et al., 2012, p.112), and it is clear from

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¹ The standard Roman *iugero* of about 2523 square meters was used. All the land in Petra is measured in Roman *iugera.* (Koenen, 1996, p.186).
² An Eastern Church Father, born in Eleutheropolis in Judae, Epiphanius was a monk from his earliest youth. For more information about his life, see (Shaw, 1936).
³ Some scholars argue that the *iugum* represents an accountancy unit not a land unit of measurement. (See Goffart, 1974).
the papyri that taxation was based on a fixed fiscal unit calculated according to the type, amount and quality of the land. Therefore, different types of land would be taxed at different rates, so all land cannot be lumped together under one measurement. The Petra papyri show that tax collectors from Petra and Augustopolis used the system of taxation based on the registration and classification of land prescribed by the Byzantine state. The accounts of tax liability were kept in records for the cities of Petra and Augustopolis (Caldwell, 2001, p.76). Koenen says that the needed amount of seed makes sense when local conditions did not allow farmers to sow the entire area regularly. This easily occurs in desert agriculture when the amount of rain or other water changes from one year to the next or when rocks and migrating stones and sand render part of the area infertile. (Koenen, 1996, pp.177-188)

The oldest and one of the most important documents of the Petra archive is inv.10, dated to AD 527/537 mentioned a division of property among three brothers named Bassos, Epiphanios, and Sabinos. Three brothers divided about 130 iugera between them, containing vineyards and sown land (Caldwell & Gägos, 2014). This means that the people of Petra during the sixth century AD used not only Roman land measures but also Semitic land measures. These measures are also used in the Nessana papyri, from the archive of Babatha4 (Yadine et al., 2002).

Koenen says that “three brothers may have had the choice of using their traditional local measures” (Koenen, 1996, p.187). In general, in the ancient Near East the system of measuring area was based upon the quantity of seeds sown in it (Koenen, 1996, p.187; al-Salameen, 2007, p.22). In Babylonia and Assyria the Land was measured by the area a team of oxen could plow in a day, “land was also measured according to the quantity of grain necessary to sow it” (Bible Encyclopedia, “Weights & Measures”).

Using iugera by the people of Petra shows the Roman influence on the community of Petra, especially after AD 106, when the Nabataean kingdom was transformed into Provincia Arabia.

2. MEASURES OF CAPACITY

Some measures were primarily used for units of dry-goods, others for liquids, but it has not been definitively proven that this distinction was valid throughout the whole system. It is difficult for us to give the exact information when we can merge the liquid and dry measures into one system of measure.

2.1 Dry

(a) The first dray and capacity measure mentioned in Petra papyri is se’ah, or saton “cátov” in Greek (Dean, 1935; Yadine et al., 2002, p.69), and the plural form sata (Schmidt, 2014). This measure is attested in the Nabataean in the plural form sanya as follows “the portion of our lord, the leasing (tax) for a year, as well, in its amount of ten Se’ah” (al-Salameen, 2007, p.23). The se’ah a measure of flour or grain (Bible Encyclopedia, “Weights & Measures”). It was sometimes used to determine both liquid and dry measures. Se’ah is the most common word for measure of volume in Bible lands (Hastings, 2004a, p.820). The area of sowing a se’ah is 625m² (Frösén et al., 2002). The word se’ah is attested in Aramaic and Hebrew texts “סן” (Gen. 18:6; 1 Sam. 25:18; 1 Kings 18:32; al-Salameen, 2007, p.24). This measure is mentioned in the Elephantine papyri5 from the fifth century BC (Encyclopedia Judaica: “Weights & Measures”). This is a traditional local measure used in Petra instead of the standard Roman area measures (Koenen, 1996, p.186).

The same measure se’ah was used in Mesopotamian measures (Encyclopedia Judaica: “Weights & Measures”). Its capacity has been a matter of some discussion (Yadine et al., 2002, p.69). Although one se’ah equals 1 and quarter modii (μόδιος) (Dean, 1935). The se’ah was 1/30 of a kor (Frösén et al., 2002), or 12.148 litres (Bible Encyclopedia, “Weights & Measures”). Se’ah also equaled 50 xestes (Stone and Ervine, 2000). Josephus says that a Se’ah is equal to one and one-half Italian modii (Josephus, Antiq: ix.iv.5).This measure was used during the Islamic period (Strange, 2010).

(b) The second liquid or dry measure used in the Papyri is Kor. This word is attested in Mesopotamian measures (Encyclopedia Judaica: “Weights & Measures”); Schmidt, 2014), and used simultaneously in Hebrew texts the word is kor, xestes “סן” (Ezek. 45:14), and in Greek “κόρος” (kóros) (Schmidt, 2014). In the dictionary of the bible the cor contained 41 Graeco-Roman modii (Hastings,

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4 The Babatha archive contains documents of a Jewish woman who lived in the village of Maoza situated in the southern shore of the Dead Sea (Cotton, 1993).

5 The Elephantine Papyri consist of 175 documents from Egypt. For more information. (See Porten, 1996).

6 Both a dry and a liquid measure, equal to 1/6 of the chief unit, Arabic, mudy (Figure 3) (Welborn, 1935). Also equal to 8.49 liters, a modius was used in Palestine during the Hellenistic and Roman period (Encyclopedia of the Bible, “Weights and Measures”). Retrieved from https://www.biblegateway.com/resources/encyclopedia-of-the-bible/Weights-Measures

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Figure 3
Bronze Modius Measure (4th Century AD) With Inscription Acknowledging Imperial Regulation of Weights and Measures
Source: http://en.wikipedia.org/wiki/Ancient_Roman_units_of_measurement

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Canadian Social Science, 14(5), 1-5

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2004b, p.904). Epiphanius point out that this measure has thirty modii and that the word kor means a heap which a camel loads. One koriaia equaled one iugum (Dean, 1935; Frösén et al., 2002, p.77). The Kor is 30 modii (Welborn, 1935). One cor would sow 23,200 m² (Rathbone, 1991, p.242). The origin of the word is kūra, taken from the Hebrew language (Dean, 1935). The kor was mostly used for weighting grain, barley, oil, and flour (Dean, 1935; al-Salameen, 2007, p.24). One kor of barley is equal to one shekel of silver (Welch, 1999), and equaled five iugera (Frösén et al., 2002), and 880 xestes (Stone and Ervine, 2000). A koriaia in Petra papyri was the area which could be sown with a kor (Frösén et al., 2002, p.77).

(c) kāb or Kabb is a dry measure (Hastings, 2004b, p.910) mentioned in the Petra papyri (inv.14; Frösén et al., 2002), and Nessana papyri (Kraemer, 2015, p.79) used in weight grain (Schmidt, 2014) and corn (Strange, 2010). The capacity measure kāb appears in the second century Greek documents from the Judaean desert (Frösén et al., 2002, p.77). A Kāb was 1/6 of a se‘ah, or 1/80 of a kor (Frösén et al., 2002). This measure derived from the Hebrew word "בַק" (Dean, 1935). A kāb equals one-fourth of a modius (Kings II 6:25; Dean, 1935). Kāb is also attested in Greek as Kabos (kabhó̂c) (Frösén et al, 2002). Kraemer states that the kāb a grain measure containing 4 sextarii (Kraemer, 2015, p.79).

2.2 Liquid

One of the important and widespread measures appearing in the Petra papyri is xestes, used as a liquid measure, for oil and wine, in inv.4 (Frösén et al., 2002, p.77). Xestes (ξεστης), a Greek measure (Smith and Anthon, 1843), was used for both liquid and dry measure (Tarbell, 1891), and called the measure of a wine-vat (Stone and Ervine, 2000). It corresponds to the Roman sextarius (Jones, 1976, p.52). As 1/16 of the basic Roman modius, the sextarius held about 0.539 liters (Jones, 1976). Epiphanius says that a xestes has great variation and was used widely (Dean, 1935; Frösén et al., 2002). Epiphanius was aware of the changeable values of xestes, stating that “its standard is variously fixed among many peoples” (Mayerson, 1999). A Xestes was used for weight corn and wine (Kelly, 1821), as well as for weight oil in Alexandrian and Southern Palestine (Mayerson, 1999).

CONCLUSION

It’s clear that the Petra papyri provided good details about the economic life of the Nabataean during the late byzantine period. The information extracted from the papyri reveals that the community in Petra was open to other communities. Due to the scarcity of the information, papyri are our chief source of information for the commercial daily life in Byzantine Petra.

The system of weights and measures in the Petra was based on those of Roman and Mesopotamia. Most of these measures were widely used by the ancient Near Eastern neighboring societies. In the Petra, dry things, such as Wheat, Barley, and Flower were measured according to their capacity.

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