

Irrigation network and watering system through the Lamasba document

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Abstract:

Following the Roman occupation of North Africa, their strategic objectives extended beyond acquiring fertile lands to encompass the exploitation of inland regions contiguous to the desert. This led to the displacement of local inhabitants, allowing the Romans to establish an intricate irrigation network, effectively controlling trans-territorial waters. To achieve this, they constructed water conservation reservoirs, diversion dams, and collection tanks. Subsequently, irrigation canals were developed to distribute water across fields, particularly prominent in the southeastern regions of Ouars (Algeria) bordering the Sahara.

Remnants of these Roman infrastructural feats persist across numerous provinces, exhibiting remarkable diversity. Consequently, the Roman authority enacted specific legislation granting peasants and farmers the entitlement to access water for their lands, emphasizing the public nature of these installations established under the auspices of the ruling authority. This historical legacy continues to influence land use and water rights to this day.

Keywords: Irrigation network; watering; Lamasba.

Introduction:

Water stands as an indispensable element crucial for sustaining human existence, its significance amplifying with the surge in urbanization and agricultural expansion. However, given its inherent limitation as a natural resource, there arises a pressing need to devise methodologies and legal

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frameworks for its management. This enables the sustainable exploitation of this resource and facilitates the complex task of provisioning water to cities and regions. The ancient Roman community established a series of institutions dedicated to controlling and distributing water, alongside the formulation of legal provisions and institutions specifically focused on rural communities.

I Watering texts.

Within the Roman world, ancient rural communities possessed an intricate knowledge of irrigation systems, a subject deserving comprehensive and detailed scholarly investigation due to its pivotal role in managing agricultural irrigation water. Despite this importance, literary sources and preserved documents pertaining to this aspect remain scarce.

The laws governing the management of irrigation water emerge from a collection of texts, some of which are obscure and incomplete, while others offer clearer insights. Notably, the renowned work attributed to the ancient writer Pliny the Elder (Pliny L'Ancien, *Histoire naturelle*, XVIII) discusses the oasis of Gabés in southeastern Tunisia, providing evidence of the historical use of water distribution systems during that era in Latin: «*Felici super omne miraculum riguo solo. Ternis fere milibus passuum in omnem partem. Fons abundat, largus quidem, Sed certis horarum spatiis dispensatur inter incolas*», in its meaning «*Fortunate above all due to its exceptionally fertile soil. Extending approximately three thousand paces in every direction. The spring is abundant, generously flowing, yet it is distributed among the inhabitants at specific hourly intervals*»

Although such documents are exceedingly rare worldwide, there exist incomplete and fragmented writings that shed light on watering laws and the political and administrative systems of local communities. Notable among these are the Law of Trivoli (*Inscriptiones Asiae, Provinciarum Europae Graecarum, Illyrici Latinae*, 1873), the Law of Rome (*Inscriptiones Urbis Romae Latinae*, 1876), and the Law of Promona of Dalmatia in Croatia (Cil, III, 14962- Cil, VI, 1261- Cil, X IV, 3676).

As for the text of Traconia «*Campagani Riui Larensis*» dating back to 193 AD (Cil, II, 4125=Cil, II, 14-2-1), are notably incomplete, similar in brevity to the Gabes text. Despite their brevity, these texts together offer specific and precise insights. Only two unparalleled texts from the Roman period remain the Agun Bronze Text and another text inscribed on a large stone slab known as the Lamasba document. The latter enumerates the names of all the farmers

benefiting from irrigation, along with the allocated time for each, documenting the commencement and conclusion dates of watering. This inscription stands as one of the most renowned archaeological documents related to regulating water usage for agricultural irrigation in North Africa.

1-The Agon Bronze

also known as Lex Riui Hiberiensis, constitutes the text of irrigation law in the city of Agon within the province of Syracuse, Spain. Dating between 117 AD and 138 AD, this text, discovered in 1993, 50 km west of Syracuse on the right side of the Ebro River, comprises several bronze pieces (Beltran Lloris F., 2006, pp.147-197) inscribed with paragraphs outlining the duties of judges responsible for societal functioning and irrigation system maintenance, especially in the rural regions of the Iberian Peninsula.

2-The text of Lamasba

(Fig. 1) stands as the most comprehensive and informative document discovered in the Numidian province, specifically within the Lamasba region of Ain Marouana, Algeria.

The remnants of this city lie within the Belezma plain, situated northwest of the Batna Province in a semi-arid region. The ancient name of this area has been substantiated by numerous Millenic signs scattered across the plain. Historically, this city is identified as an ancient colony of the Antoinnes, denoted by one of the Milian signs inscribing its name as "Respublica Lamasb Antoniniana" (C.I.L., 10403=22511 ; Conf. 22467). Adjacent to the northern border of this city is the village of Corneille, potentially governed by Antoninus, who likely elevated it to the status of a municipality (Gsell St., 1911, Feuille 27, n° 86).

The initial discovery of remnants related to the watering law document by Masqueray (Masqueray E., 1977, pp.35-36) during an investigative expedition approximately 4 kilometers from the Marwana mill. These findings comprised two sizable chambers alongside incomplete remnants. This document, dating back to the reign of Marcus Aurelius, contains extensive lists featuring the names of inhabitants from a small town, along with the allotted hours each individual was granted for water usage. Masqueray E. conducted a thorough examination of this document between January and March 1877, subsequently publishing its two significant sections (Table 1). Later, Gustav Willmanns republished it in the first volume of Part VIII of the Latin Code Writings, accompanied by a concise commentary (De Pachtere F.G., 1908, p373).

Gsell asserts that the document was initially discovered by Masqueray amidst the ruins, precisely 2 kilometers north of the French mill where the water distribution tables were situated. This document comprises five parts, three of which have been publicly disclosed, leaving two sections still unidentified. Masqueray personally uncovered two parts of the remaining text, a significant discovery as it complemented the previously published sections and entailed minor revisions in the work initially published in *Ephemeris Epigraphica* (Gsell St., 1893, p.p. 82-83) by Hermann Dessau.

Subsequently, Hermann Dessau, after further exploration at the site, unearthed a fragment of the preamble to the text. Dessau reissued the research findings in Part VII of *Ephemeris Epigraphica*, a periodic supplement to the Code, and in the Code itself under the guidance of Johannes Schmidt, cataloged as number 18587 (De Pachtère F.G., 1908, p.373).

The comprehensive study of the document was undertaken by De Pachtère, whose extensive analysis and article were published in 1908 (De Pachtère F.G., 1908, p.p. 373-405).

Subsequently, in 1962, Birebent contributed a summary of previous research on the document within a book focused on Roman water systems in eastern Algeria, incorporating his extensive fieldwork (Birebent J., 1962, pp. 385-406).

However, it was Brent Shaw who conducted an in-depth examination of the text, delving into its political, social, and technical dimensions. Shaw's work, titled "The irrigation and watering community" (Figure 2), published in 1982, provided further illumination on various aspects previously unexplored (Shaw B., 1982, pp. 61-103). This scrutiny uncovered explicit regulations governing the equitable distribution of water among landowners benefitting from the irrigation system

The document outlining the watering laws is inscribed on a rectangular stone slab, its composition traced back to the reign of Emperor Elagabal. The evidence supporting this claim lies in the presence of the emperor's name within the preamble of the text, allowing for the document's approximate dating between 218 AD and 222 AD. An intriguing aspect of this inscription is the disparity in letter height, with the preamble's letters measuring approximately 4 cm, while the rest of the text utilizes smaller letters at an estimated 1 cm in height (Birebent J., 1962, p. 393).

The content of the document vividly depicts a dispute regarding water distribution among the proprietors of agricultural lands in Lamasba.

Dissatisfaction prevailed among these landowners concerning the manner in which water was allocated to them. Consequently, the matter was referred to arbitration, delegated to a commission responsible for resolving this issue. Notably, one of the commissioners involved in this arbitration process was named Valentinius.

The committee's primary responsibility was to devise a fresh irrigation regulation (De Pachtere F.G., 1908, p. 374), formatted in columnar structure. The initial column listed the names of landowners, followed horizontally by their land areas, the designated irrigation hours, and the final watering schedule. This regulatory text aimed to formalize and standardize water distribution, ensuring equitable sharing based on specific criteria. De Pachtere, recognizing the significance of the text, presented it in three distinct parts (Table No. 2), which had been photographed by Weirzejski M., the Museum of Algeria's Governor at the time, before its installation in the museum (De Pachtere F.G., 1908, p. 375).

Each peasant proprietor received a designated allocation of the Claudiana water (Aqua Claudiana) (Fig. 3) for irrigating their land within a specified timeframe and on a prescribed date detailed in the text. As per Birebent, the principal aqueduct in La Masbaht connects to secondary canals, directly servicing irrigation layers and extending across the Belezma plain (Birebent J., 1962, p. 400). Additionally, Shaw posits that the term "Aqua" for aqueducts was commonly employed, particularly in Rome. Regarding Claudiana's water, this designation might have referred to a consistent water source ensuring adequate levels for each individual, possibly representing the primary canal. This underscores the necessity of having distribution channels to cater to all agricultural plots (Shaw B., 1982, p. 72).

The original content of the text consisted of a roster comprising 400 owners of agricultural land, but over time, only 93 individuals remained (Table 3) who reaped the benefits of the irrigation system through designated roles during the autumn and winter seasons, (Ronin M. 2015, p. 90). This reliance on irrigation is particularly crucial due to the scarcity of rainfall, even during the winter months. The commencement of the irrigation process typically initiated on September 25 and presumably concluded by late March, although the document itself is incomplete. This timeline suggests that agricultural activities persisted through the winter, involving the cultivation of crops like fine winter wheat, hard wheat, and even olives.

The fields belonging to the proprietors are organized into what the text refers to as "scales" (Scalae), denoted numerically as Scala I, Scala II, Scala III, and so forth. The irrigation plots are adjoined and watered from a single canal. Before the commencement of the water distribution cycle for each scale, an hour is allocated to fill the upper array canals, referred to within the text as the Matrix Riganda (Birebent J., 1962, p. 394).

Shaw meticulously reevaluated the irrigation network, determining that the scales constituted genuine units of water distribution, separated by matrices denoting the water source. In the context of the Lamasba irrigation network, a matrix refers to the primary canal line responsible for distributing water to secondary pipelines. This term for irrigation is referenced in the Imperial Constitution of 389 AD, documented within the Law of Theodosius and the Law of Justinianus (Shaw B., 1982, p. 73).

The water distribution among owners occurred through two methods: Claudiana's ascending water (QVO CLAVDIANA ASCENDIT) and Claudiana's descending water (QVO CLAVDIANA DESCENDIT). Ascending water pertains to underground pipelines signifying the gradual ascendance of groundwater for utilization by the user (Birebent J., 1962, p.p. 397-400). The text reflects a stronger allocation of descending water compared to ascending water, evident in properties whose owners possess plots of similar sizes. For instance, Ms. Steminia Aemerita owns a 400K plot of land irrigated over 6 hours with descending water, whereas Ms. Octavia Donata owns a 406K plot irrigated for 9 hours due to the utilization of ascending water. Such instances are abundantly detailed in the text.

Through Shaw's calculations concerning irrigation times for each surface, it was determined that the descending and ascending irrigation systems functioned in strict alternation. Ascending water was utilized for five consecutive days, whereas descending water was utilized for ten days (Shaw B., 1982, p. 78).

The unit of measurement denoted by the letter "K" in the text remains elusive and unspecified by scholars interpreting this document, leading to ongoing debates and uncertainties regarding its precise meaning. This unit is crucial as it serves as a decisive measure for calculating the allotted irrigation period for each plot of land. Mumsen Tudor proposed that "K" might be an abbreviation for "K(aupt)," a term associated with taxation. However, this fiscal unit emerged with the reforms of Diocletian at the end of the third century AD, nearly 80 years after the emergence of the Lamasba regulation

on watering laws, and notably, it was not utilized in North Africa (De Pachtere F.G., 1908, p. 397). Conversely, Shaw considered "K" to potentially represent an abbreviation for the word "K(audex)," signifying root (Shaw B., 1982, p. 86).

IV. CONCLUSION

Despite concerted efforts in research and study, the text of Lamasba remains somewhat ambiguous. It's worth noting that the currently known text accounts for only a quarter of the original document (Figure 4). Nevertheless, this text is regarded as pivotal and highly informative. It is perplexing that amidst the rich agricultural history, no extensive documents elucidating irrigation laws and systems adopted for land irrigation have been discovered, posing a significant gap in our understanding of rural communities and agricultural practices.

Figure N° 1. Text of the Lamasba List



Birebent J., AQUAE ROMANAE, Recherches d'hydraulique romain dans l'est algérien, Alger, 1962, pp. 385-406

Figure N° 2. The remains of Lamasba text.



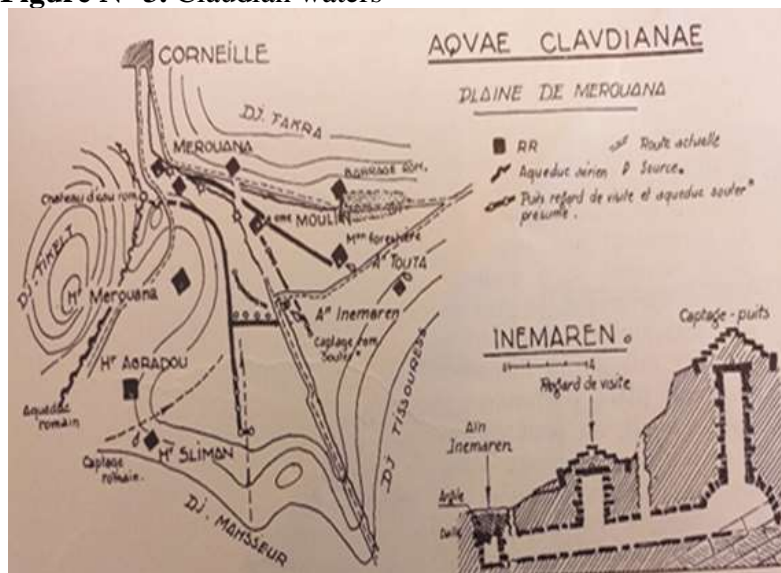
Shaw B., LAMASBA, an ancient irrigation community, *Antiquité Africaine*, T.18, 1982, pp.61-103

Table N°2. The Three Parts of the Writing

The table is divided into several sections, including 'Deuxième volume' and 'Troisième volume'. Each section contains multiple columns of data, with some columns having headers that are partially legible. The data appears to be organized in a grid-like structure, possibly representing different stages or components of a process.

De Pachtere F.G.1908, pp.375-377

Figure N° 3. Claudian waters



Birebent J., Op.Cit., 1962, p.387

Table N°3. The list of the owners

ИЗДАТЕЛЬСТВО "ВЕЩЬ" С. ПЕТЕРБУРГ, ПЕРВОЕ ПОСРЕДСТВО ЗАКАЗА И ПЕЧАТНИЦА

ИЗДАТЕЛЬСТВО "ВЕЩЬ" С. ПЕТЕРБУРГ, ПЕРВОЕ ПОСРЕДСТВО ЗАКАЗА И ПЕЧАТНИЦА

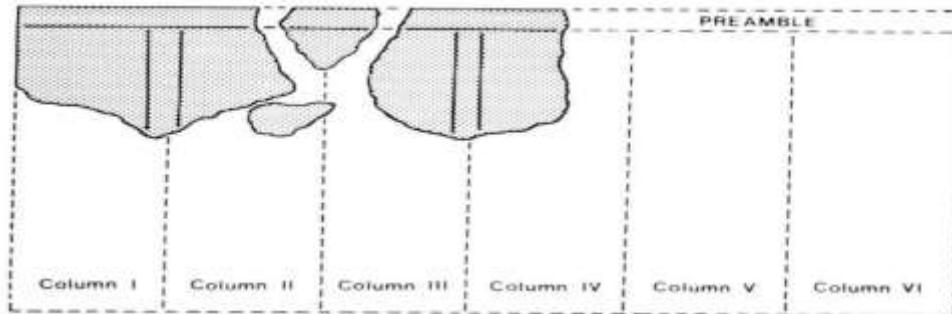
№	Имя (на русском)	Дни	Всего	Тираж	Продажа
РАЗДЕЛ I					
1	И. И. БИРЕБЕНТ	100	100	100	100
2	И. И. БИРЕБЕНТ	100	100	100	100
3	И. И. БИРЕБЕНТ	100	100	100	100
4	И. И. БИРЕБЕНТ	100	100	100	100
5	И. И. БИРЕБЕНТ	100	100	100	100
6	И. И. БИРЕБЕНТ	100	100	100	100
7	И. И. БИРЕБЕНТ	100	100	100	100
8	И. И. БИРЕБЕНТ	100	100	100	100
9	И. И. БИРЕБЕНТ	100	100	100	100
10	И. И. БИРЕБЕНТ	100	100	100	100
11	И. И. БИРЕБЕНТ	100	100	100	100
12	И. И. БИРЕБЕНТ	100	100	100	100
13	И. И. БИРЕБЕНТ	100	100	100	100
14	И. И. БИРЕБЕНТ	100	100	100	100
15	И. И. БИРЕБЕНТ	100	100	100	100
16	И. И. БИРЕБЕНТ	100	100	100	100
17	И. И. БИРЕБЕНТ	100	100	100	100
18	И. И. БИРЕБЕНТ	100	100	100	100
19	И. И. БИРЕБЕНТ	100	100	100	100
20	И. И. БИРЕБЕНТ	100	100	100	100
21	И. И. БИРЕБЕНТ	100	100	100	100
22	И. И. БИРЕБЕНТ	100	100	100	100
23	И. И. БИРЕБЕНТ	100	100	100	100
24	И. И. БИРЕБЕНТ	100	100	100	100

№	Имя (на русском)	Дни	Всего	Тираж	Продажа
РАЗДЕЛ II					
25	И. И. БИРЕБЕНТ	100	100	100	100
26	И. И. БИРЕБЕНТ	100	100	100	100
27	И. И. БИРЕБЕНТ	100	100	100	100
28	И. И. БИРЕБЕНТ	100	100	100	100
29	И. И. БИРЕБЕНТ	100	100	100	100
30	И. И. БИРЕБЕНТ	100	100	100	100
31	И. И. БИРЕБЕНТ	100	100	100	100
32	И. И. БИРЕБЕНТ	100	100	100	100
33	И. И. БИРЕБЕНТ	100	100	100	100
34	И. И. БИРЕБЕНТ	100	100	100	100
35	И. И. БИРЕБЕНТ	100	100	100	100
36	И. И. БИРЕБЕНТ	100	100	100	100
37	И. И. БИРЕБЕНТ	100	100	100	100
38	И. И. БИРЕБЕНТ	100	100	100	100
39	И. И. БИРЕБЕНТ	100	100	100	100
40	И. И. БИРЕБЕНТ	100	100	100	100
41	И. И. БИРЕБЕНТ	100	100	100	100
42	И. И. БИРЕБЕНТ	100	100	100	100
43	И. И. БИРЕБЕНТ	100	100	100	100
44	И. И. БИРЕБЕНТ	100	100	100	100
45	И. И. БИРЕБЕНТ	100	100	100	100
46	И. И. БИРЕБЕНТ	100	100	100	100
47	И. И. БИРЕБЕНТ	100	100	100	100
48	И. И. БИРЕБЕНТ	100	100	100	100
49	И. И. БИРЕБЕНТ	100	100	100	100
50	И. И. БИРЕБЕНТ	100	100	100	100
51	И. И. БИРЕБЕНТ	100	100	100	100
52	И. И. БИРЕБЕНТ	100	100	100	100
53	И. И. БИРЕБЕНТ	100	100	100	100
54	И. И. БИРЕБЕНТ	100	100	100	100
55	И. И. БИРЕБЕНТ	100	100	100	100
56	И. И. БИРЕБЕНТ	100	100	100	100
57	И. И. БИРЕБЕНТ	100	100	100	100
58	И. И. БИРЕБЕНТ	100	100	100	100
59	И. И. БИРЕБЕНТ	100	100	100	100
60	И. И. БИРЕБЕНТ	100	100	100	100

№	Имя (на русском)	Дни	Всего	Тираж	Продажа
РАЗДЕЛ III					
61	И. И. БИРЕБЕНТ	100	100	100	100
62	И. И. БИРЕБЕНТ	100	100	100	100
63	И. И. БИРЕБЕНТ	100	100	100	100
64	И. И. БИРЕБЕНТ	100	100	100	100
65	И. И. БИРЕБЕНТ	100	100	100	100
66	И. И. БИРЕБЕНТ	100	100	100	100
67	И. И. БИРЕБЕНТ	100	100	100	100
68	И. И. БИРЕБЕНТ	100	100	100	100
69	И. И. БИРЕБЕНТ	100	100	100	100
70	И. И. БИРЕБЕНТ	100	100	100	100
71	И. И. БИРЕБЕНТ	100	100	100	100
72	И. И. БИРЕБЕНТ	100	100	100	100
73	И. И. БИРЕБЕНТ	100	100	100	100
74	И. И. БИРЕБЕНТ	100	100	100	100
75	И. И. БИРЕБЕНТ	100	100	100	100
76	И. И. БИРЕБЕНТ	100	100	100	100
77	И. И. БИРЕБЕНТ	100	100	100	100
78	И. И. БИРЕБЕНТ	100	100	100	100
79	И. И. БИРЕБЕНТ	100	100	100	100
80	И. И. БИРЕБЕНТ	100	100	100	100
81	И. И. БИРЕБЕНТ	100	100	100	100
82	И. И. БИРЕБЕНТ	100	100	100	100
83	И. И. БИРЕБЕНТ	100	100	100	100
84	И. И. БИРЕБЕНТ	100	100	100	100
85	И. И. БИРЕБЕНТ	100	100	100	100
86	И. И. БИРЕБЕНТ	100	100	100	100
87	И. И. БИРЕБЕНТ	100	100	100	100
88	И. И. БИРЕБЕНТ	100	100	100	100
89	И. И. БИРЕБЕНТ	100	100	100	100
90	И. И. БИРЕБЕНТ	100	100	100	100
91	И. И. БИРЕБЕНТ	100	100	100	100
92	И. И. БИРЕБЕНТ	100	100	100	100
93	И. И. БИРЕБЕНТ	100	100	100	100
94	И. И. БИРЕБЕНТ	100	100	100	100
95	И. И. БИРЕБЕНТ	100	100	100	100
96	И. И. БИРЕБЕНТ	100	100	100	100
97	И. И. БИРЕБЕНТ	100	100	100	100
98	И. И. БИРЕБЕНТ	100	100	100	100
99	И. И. БИРЕБЕНТ	100	100	100	100
100	И. И. БИРЕБЕНТ	100	100	100	100

Birebent J., Op.Cit., p.p.403-405

Figure N° 4. A re-imagining of the Lamasba text panel



Shaw B., Op.Cit., 1982, p. 71

II. CONCLUSION

Despite concerted efforts in research and study, the text of Lamasba remains somewhat ambiguous. It's worth noting that the currently known text accounts for only a quarter of the original document (Figure 4). Nevertheless, this text is regarded as pivotal and highly informative. It is perplexing that amidst the rich agricultural history, no extensive documents elucidating irrigation laws and systems adopted for land irrigation have been discovered, posing a significant gap in our understanding of rural communities and agricultural practices.

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- Corpus Inscriptionum Latinarum, T. X IV

شبكة الري ونظام السقاية من خلال وثيقة لاماصبا.

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الملخص:

كان دور الخزانات والصحاريح والقنوات الناقلة للمياه فيما يخص الري الروماني هو تموين المدن والأرياف معا بالمياه، في حين كان دور قنوات السقاية الزراعية هو الري الفلاحي فقط. بعد احتلال الرومان لمنطقة شمال إفريقيا لم يكن هدفهم المناطق ذات الأراضي الخصبة فقط وإنما تعدى ذلك حتى الأقاليم الداخلية المحاذية للصحراء، فبدأوا باستغلالها لتعود عليهم بالفائدة، وقاموا بإخراج الأهالي من هذه المناطق لإنشاء شبكة ري قصد التحكم في المياه العابرة للإقليم وتوزيعها على الأراضي المجاورة للوديان، وأنشأوا صحاريح حفظ المياه وتوزيعها وكذا سدود التحويل وخزانات التجميع التي تنطلق منها قنوات السقي لتعمم السقاية على كل الحقول، وانتشرت أغلب هذه المنشآت في المناطق الجنوبية الشرقية للأوراس (الجزائر) المحاذية للصحراء، وما زالت إلى اليوم بقايا هذه المنشآت منتشرة في العديد من هذه الأقاليم وهي جد متنوعة.

لقد أصدرت السلطة الرومانية قوانين خاصة تمنح لكل فلاح أو مزارع حقه في سقي أراضيه باعتبار أن هذه المنشآت عمومية من بناء السلطة الحاكمة، أم هذه القوانين نص لاتيني شمل أسماء كل المزارعين المستفيدين من السقاية والوقت المخصص لكل واحد منهم مع ذكر تاريخ بدأ وإنهاء السقي، دونت هذه القوانين في لوح حجري كبير منقوش عرف بوثيقة لاماصبا، ويعتبر نص هذه النقيشة من أشهر الوثائق الأثرية المتعلقة بتنظيم استغلال المياه لسقي الأراضي الزراعية في شمال إفريقيا).

الكلمات المفتاحية: شبكة الري، قانون السقاية، لاماصبا.