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IRRIGATION INFRASTRUCTURE AND ITS USE IN BRĂILA AND GALAȚI COUNTIES: A REVIEW

Alexandra Violeta LAZIA[1] (ORCID: 0009-0005-3076-716X); Maria Magdalena TUREK-RAHOVEANU[1,2] (ORCID: 0000-0001-5238-5641)

[1] "Dunărea de Jos" University of Galați, Faculty of Engineering and Agronomy of Brăila, Romania

[2] "Lunca" Research and Consultancy Centre for Agronomy and Environment, Brăila, Romania

Corresponding author: alexandra.lazia@ugal.ro

Abstract. *Irrigation infrastructure contributes to agricultural adaptation to water scarcity; however, the existence of areas equipped for irrigation does not demonstrate that irrigation services have been contracted or that water has been delivered and applied to farmland. This synthesis review examines how irrigation infrastructure and its use are described in Brăila and Galați counties, Romania, drawing on scientific studies, institutional information, and a descriptive comparison of the 2024 administrative records of the National Agency for Land Improvements (ANIF). The literature synthesis distinguishes infrastructure availability, service contracting, actual water delivery, and agronomic use, while considering network conditions, energy and operating costs, water-user organization, and monitoring methods. For the administrative comparison, contracting rates and uncontracted areas are calculated from branch-level totals; explicitly named individual irrigation schemes with legible values are analyzed separately from administrative subtotals and independent holdings. The Brăila branch reports 367,895 ha equipped and 294,765.94 ha contracted (80.12%), compared with 145,200 ha and 96,809.96 ha (66.67%) in Galați. Considerable variation is also observed across the individual schemes included in the comparison. Among the selected records with legible values, the three largest schemes account for 58.64% of the contracted area in Brăila and 94.11% in Galați; the subgroups differ in size, so these shares are not directly comparable as measures of operational performance. The study shows that contracting indicators provide a useful administrative description but cannot measure the area actually irrigated, water volumes, service continuity, or irrigation efficiency. The contribution of this study lies in an integrated interpretation of published evidence and transparently calculated administrative indicators, which may inform more consistent territorial monitoring. The analysis is limited to the records available for 2024 and does not establish causal relationships.*

Keywords: *irrigation infrastructure; irrigation use; contracted area; water management; Brăila; Galați.*

INTRODUCTION

In agricultural regions repeatedly exposed to drought, irrigation infrastructure is a strategic resource. However, its ability to support agricultural production depends on successive stages: the physical existence of the scheme, equipment functionality, access to services, water delivery, and application at plot level. The literature cautions that assessments based on a single indicator may conflate infrastructure availability with operational performance (AHMAD et al., 2024; WARD, 2022).

Distinguishing the area equipped for irrigation, the contracted area, and the area actually irrigated is particularly important in Romania. In administrative statistics, the contracted area reflects a service agreement covering a declared area; it does not describe irrigation frequency, pumped volumes, or water application uniformity. National studies of areas equipped for irrigation and areas actually irrigated emphasize that these categories should not be treated as equivalent (BĂLAN, 2024).

Existing Romanian research has examined access to irrigation and water-user organization in Brăila (TUDOR AND CHITEA, 2012), differences between areas equipped and actually irrigated (BĂLAN, 2024), and irrigation patterns detected by remote sensing in Galați

(FLOREA et al., 2026). These perspectives address different dimensions of irrigation. A scheme-level comparison based on the contracting structure reported by the same administrative source can reveal information not apparent from branch totals; nevertheless, it cannot explain the reasons behind contracting decisions.

This synthesis review addresses the extent to which available scientific evidence and administrative indicators can jointly clarify the distinction between irrigation infrastructure and its use within the ANIF Brăila and Galați branches. Its objectives are to: (i) synthesize approaches to interpreting infrastructure, service access, water delivery, and actual irrigation; (ii) compare equipped and contracted areas at branch and individual-scheme levels for 2024; and (iii) identify complementary observations needed to assess operational use. The 2024 comparison is an illustrative administrative component of the review, rather than an assessment of irrigation trends over time.

MATERIALS AND METHODS

A cross-sectional documentary study was conducted for the 2024 reporting year using the ANIF "Irrigation Campaign" table, available at https://www.anif.ro/irigatii/ (accessed 22 October 2026). The aggregation unit was the territorial branch, while the lower-level unit of analysis was the individually named irrigation scheme. Subtotals for administrative units (U.A.) and the aggregated "independent holdings" category were not counted as individual schemes. Schemes with the same name reported by both branches were retained separately because branch coverage does not necessarily coincide with county boundaries.

For each individual scheme with a positive, legible equipped area (Ea) and a legible contracted area (Ca), the contracting rate was calculated as RC (%) = 100 × Ca/Ea, and the absolute uncontracted difference as D (ha) = Ea − Ca. The scheme's share of the contracted area was calculated as PC (%) = 100 × Ca/ΣCa, with denominators determined separately for each analyzable branch subgroup. The CR3 indicator was the sum of the shares of the three schemes with the largest contracted areas. CR3 is therefore especially sensitive when only four individual schemes are available; it is not a direct measure of infrastructure efficiency. Branch-level rates were calculated from the published branch totals rather than from unweighted averages of scheme-level rates.

Data quality verification protocol. For Ianca–Surdila Greci, the ANIF record indicates 26,759 ha equipped, but the contracted area appears as "19.04,71", an ambiguous numerical value. This record was excluded from the primary scheme-level statistics pending source clarification; the published branch totals were retained. Subtracting the sum of the 13 legible Brăila schemes (275,675.23 ha) from the branch's total contracted area (294,765.94 ha) yields 19,090.71 ha. The corresponding difference for the equipped area is 26,759 ha. No imputed values were entered in Tables 2–3 or in the figures. The effect of this potential reconciliation on the findings should be assessed once the source has been confirmed.

The study is a thematically oriented narrative synthesis, not a systematic literature review or meta-analysis. Publications were selected for their relevance to irrigation indicators, water- and energy-use performance, service access and water-user organization, plot-level monitoring, and remote sensing. Findings are compared according to what each source actually measures: infrastructure, contracting, water delivery, or plot-level irrigation. The ANIF calculations provide a local application of this distinction. This approach does not claim exhaustive coverage of the literature and does not support causal inference.

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RESULTS AND DISCUSSION

1. Territorial comparison at the aggregate level

Table 1

Administrative indicators for the territorial branches (2024)

Indicator	Brăila	Galați
Equipped area (ha)	367,895	145,200
Contracted area (ha)	294,765.94	96,809.96
Contracting rate (%)	80.12	66.67
Ea − Ca (ha)	73,129.06	48,390.04

Source: ANIF (2024); authors' calculations. The uncontracted area is not equivalent to the area actually left unirrigated.

The Brăila branch reports an equipped area approximately 2.53 times that of Galați, while its contracting rate is 13.45 percentage points higher (Table 1). The rate describes the recorded extent of contractual coverage, not the proportion of land on which water was actually applied. Thus, the comparison between branches identifies an administrative difference; it does not demonstrate differences in hydraulic or economic performance.

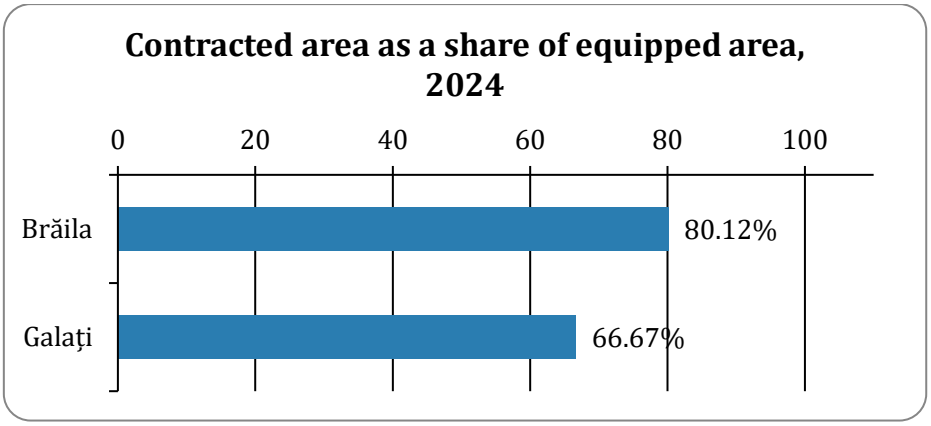


Figure 1. Contracting rates calculated from ANIF branch totals, 2024. Source: ANIF; authors' calculations.

2. Heterogeneity across irrigation schemes

Table 2

Explicitly named individual schemes with legible data and calculated rates (2024)

Branch	Irrigation scheme	Ea (ha)	Ca (ha)	RC (%)	D (ha)
Brăila	Terasa Brăilei	67,435	50,708.07	75.20	16,726.93
Brăila	Lunca Râu Buzău	6,453	1,962.78	30.42	4,490.22
Brăila	Latinu–Vădeni	13,097	6,879.42	52.53	6,217.58
Brăila	Noianu–Chișcani	1,780	0.00	0.00	1,780.00
Brăila	Brăila–Dunăre–Siret	3,625	3,625.00	100.00	0.00
Brăila	Nămoloasa–Măxineni	29,928	26,465.96	88.43	3,462.04
Brăila	Ciorăști–Măicănești	10,434	9,935.11	95.22	498.89
Brăila	Terasa Viziru	32,656	32,388.50	99.18	267.50

Branch	Irrigation scheme	Ea (ha)	Ca (ha)	RC (%)	D (ha)
Brăila	Călmățui–Gropeni–Chișcani	15,608	12,026.18	77.05	3,581.82
Brăila	Grădiștea–Făurei–Jirlău	14,605	3,118.84	21.35	11,486.16
Brăila	Bazinul râului Călmățui	23,426	17,604.28	75.15	5,821.72
Brăila	Ialomița–Călmățui	57,429	47,523.59	82.75	9,905.41
Brăila	I.M.B.	64,660	63,437.50	98.11	1,222.50
Galați	Brateșul de Sus	5,180	5,156.51	99.55	23.49
Galați	Câmpia Covurlui	107,106	63,770.21	59.54	43,335.79
Galați	Terasa Nicorești	16,589	13,042.92	78.62	3,546.08
Galați	Năməloasa–Măxineni	5,637	5,634.02	99.95	2.98

Source: ANIF (2024); authors' calculations. The 13 schemes shown for Brăila and four for Galați exclude ambiguous values and aggregated categories.

In Brăila, the contracting rates of the included schemes range from 0% (Noianu–Chișcani) to 100% (Brăila–Dunăre–Siret), with substantial differences between them. In Galați, the four named schemes have rates ranging from 59.54% (Câmpia Covurlui) to 99.95% (Năməloasa–Măxineni). Absolute differences add scale to this interpretation: Câmpia Covurlui records a difference of 43,335.79 ha, compared with 3,546.08 ha for Terasa Nicorești. In Brăila, the difference is 16,726.93 ha for Terasa Brăilei and 1,780 ha for Noianu–Chișcani. None of these differences, on its own, establishes the cause of non-contracting.

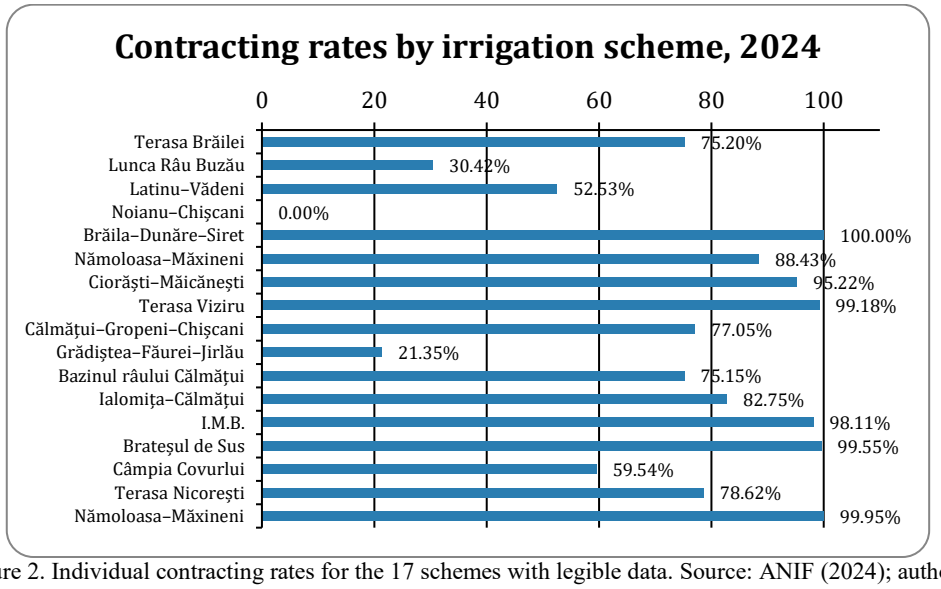


Figure 2. Individual contracting rates for the 17 schemes with legible data. Source: ANIF (2024); authors' calculations.

3. Distribution and concentration of contracted areas

Table 3

Contributions of the three largest schemes in each analyzable subgroup (2024)

Branch	Irrigation scheme	Share of subgroup Ca (%)
Brăila	I.M.B.	23.01
Brăila	Terasa Brăilei	18.39
Brăila	Ialomița–Călmățui	17.24
Galați	Câmpia Covurlui	72.79
Galați	Terasa Nicorești	14.89
Galați	Nămoloasa–Măxineni	6.43

Subgroup denominators: 275,675.23 ha for 13 Brăila schemes and 87,603.66 ha for four Galați schemes. The corresponding CR3 values are 58.64% and 94.11%, respectively. Source: ANIF; authors' calculations.

The three largest schemes in Brăila account for 58.64% of the contracted area in the included subgroup, compared with 94.11% in Galați. Within the Galați subgroup, Câmpia Covurlui alone accounts for 72.79%, although its own contracting rate is only 59.54%. Scheme size thus affects concentration and branch-level interpretation: nearly complete contracting in smaller schemes may contribute relatively little to the total contracted area. Because the Galați subgroup comprises only four schemes, comparing its top-three share with that of Brăila is not neutral with respect to subgroup size. These percentages describe the characteristics of different administrative structures, not a ranking of system performance.

Reconciliation of the totals also warrants attention. The four named Galați schemes total 87,603.66 ha contracted, whereas the published branch total is 96,809.96 ha. The difference of 9,206.30 ha corresponds to the "independent holdings" category, which must be retained separately rather than treated as a fifth individual scheme. In Brăila, the residual value of 19,090.71 ha is consistent with the ambiguous Ianca–Surdila Greci record, but still requires validation before being included as an observed value.

4. Synthesis of evidence on infrastructure use and limitations of the 2024 comparison

Assessing irrigation use requires distinguishing four aspects. First, the equipped area records the territorial extent associated with irrigation infrastructure but does not certify that all its components are operational. Second, the contracted area reflects administrative access to irrigation services; it does not indicate how often or how much water is applied. Third, delivery depends on actual flow rate, pressure, continuity, pumping, and energy requirements. Fourth, plot-level use concerns water applied to crops, the number of irrigation events, and the extent of land actually irrigated. Research on performance indicators (AHMAD et al., 2024) and assessments of water and energy balances in collective systems (LOUREIRO et al., 2024) examine variables that cannot be inferred solely from equipped or contracted hectares.

The literature also identifies factors that may influence the conversion of infrastructure access into actual irrigation, including operating costs, collective organization, and the conditions under which irrigation services are provided (TUDOR and CHITEA, 2012; IANCU and STROE, 2025; MONTEIRO et al., 2024). These studies provide interpretative context, not verified explanations for the differences reported between Brăila and Galați in 2024. Remote-sensing studies and irrigation monitoring technologies provide complementary evidence (CARTHY et al., 2024; BWAMBALE et al., 2022; BOUNAJRA et al., 2024). In particular, FLOREA et al. (2026) examine satellite-based irrigation identification in Galați. Nevertheless, administrative contracting, satellite classification, and measurement of delivered water volumes remain distinct

indicators and should be compared only after harmonizing definitions, reference dates, and scheme boundaries.

The findings are subject to three limitations. First, the administrative comparison covers only the 2024 reporting year and therefore cannot demonstrate a multi-year trend. Second, the contracted-area value for Ianca–Surdila Greci is ambiguously formatted in the public table and has not been silently corrected; the primary scheme-level calculations exclude it. Third, the number of selected individual schemes differs between the two branches, and these schemes do not encompass all reporting categories. Consequently, concentration shares describe the selected subgroups and do not quantify technical performance, water-saving potential, or actual agricultural irrigation.

Taken together, the literature and the ANIF comparison support a staged interpretation of use: (1) equipped capacity as potential coverage; (2) contracting as administrative access; (3) delivery as measured operation; and (4) irrigation events and land actually irrigated as agronomic use. This staged framework is conceptual, not a validated composite index. It helps specify the missing observations that should be collected before contracting differences are interpreted as differences in actual use.

CONCLUSIONS

The comparative assessment of ANIF data for 2024 identified contracting rates of 80.12% for the Brăila branch and 66.67% for the Galați branch, a difference of 13.45 percentage points. These values describe contractual coverage relative to the equipped area, not actual irrigation or service efficiency.

The scheme-level analysis reveals substantial variation concealed by aggregate branch indicators. The absolute difference between areas complements the percentages by indicating the scale associated with each individual rate. The concentration analysis also shows that the three largest schemes account for 58.64% of the contracted area among the 13 legible Brăila records and 94.11% among the four Galați records. The unequal subgroup sizes limit the direct comparability of the two CR3 values.

The original contribution consists of an integrated synthesis and a clearly delimited, reproducible comparison that distinguishes infrastructure availability, contracting, delivery, and actual plot-level use. The finding that the size and composition of irrigation schemes substantially affect the interpretation of branch-level averages supports the need for more detailed administrative monitoring. A broader assessment would require harmonized multi-year records at scheme level, maps of scheme boundaries, delivered water volumes, service continuity, energy information, and observations of areas actually irrigated. The findings can identify monitoring priorities but cannot establish why individual schemes have different contracting rates.

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