



IMPROVING MONITORING OF IRRIGATED LAND IN JONDOR DISTRICT

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Abstract. Objective: to establish a scientific basis for improving monitoring of irrigated land in Jondor District by linking land-accounting data with soil and remote-sensing observations. **Methods:** the national land inventory as of 1 January 2026, a local study, and international literature were compared, and area ratios were recalculated. **Results:** irrigated land totals 34,590 ha (6.69% of the district area); irrigated arable land (25,970 ha) represents 75.08% of the irrigated total. The remaining 8,620 ha includes other irrigated land types and is not an indicator of degradation. **Conclusion:** reliable monitoring requires consistent accounting boundaries, locally applicable indicators, and independent accuracy assessment; a single-date inventory cannot establish a salinity trend.

Keywords: Jondor; land accounting; irrigated land; soil salinity; environmental monitoring; validation; uncertainty.

1. Introduction. Land monitoring includes observing soil condition and its change over time in addition to recording area. Land accounts report area by category, but a category alone does not measure salinity, fertility, or degradation.



The main accounting indicators for Jondor District are given in the national land-report data compilation [1].

Monitoring of irrigated land relies on three kinds of data: cadastral and accounting records, soil analyses, and remote-sensing imagery. If their spatial coverage, date, or units differ, comparison may lead to incorrect conclusions. At the local level, the current state of land accounting on irrigated land in the Dalmun massif has been analysed [2]. Internationally, the land degradation neutrality (LDN) approach is based on changes in land cover, land productivity, and soil organic carbon stocks [3, 4]; it has been applied to remote monitoring of irrigated areas in four other regions of Uzbekistan [4].

Three questions therefore need answers before a monitoring system is designed: which land population is observed; whether the chosen indicator measures the intended process; and whether the observed change differs from measurement error. The aim of this study is to interpret the district land inventory scientifically and to define priorities for ameliorative monitoring. The objectives were (i) to determine the coverage and shares of irrigated land in the inventory, (ii) to justify criteria that separate accounting indicators from environmental indicators, and (iii) to propose a practical procedure for linking observations to parcels and assessing accuracy.

2. Materials and methods. The study is a secondary analysis of existing sources. The principal data were the land-inventory indicators for Jondor District as of 1 January 2026 — total land area, all irrigated land, irrigated arable land, and irrigated perennial plantations [1]. The 2024 irrigated arable area of the Dalmun massif was taken from a local study [2]. International work on remote assessment of salinity [5], organisation of repeated measurements [6, 7], and map-accuracy assessment [8, 9] was used to formulate evaluation criteria.

The analysis had three steps. First, the date, coverage, units, and totals of the indicators were checked; the inventory rows partly overlap and were



therefore not summed. Second, area shares were recalculated: the share of all irrigated land in the district area (U), the share of arable land in the irrigated total (S), and their difference. Third, the requirements found in the sources were grouped under four criteria: K1 — consistency of accounting coverage; K2 — validity of the indicator for the intended process; K3 — comparability of repeated measurements; K4 — quantification of error.

No new field measurements, satellite classification, or laboratory analyses were performed. Because the inventory refers to a single date, temporal change and salinity prevalence were not assessed. The requirements proposed here are untested recommendations developed for Jondor.

3. Results. Accounting coverage and shares. Table 1 presents the district land inventory and the shares calculated from it.

Table 1. Land inventory of Jondor District and calculated shares, 1 January 2026 [1]

Indicator	Area, ha	Share of district, %	Share of irrigated total, %
Total land area	517,195	100.00	—
All irrigated land	34,590	6.69	100.00
Irrigated arable land	25,970	5.02	75.08
Irrigated perennial plantations	2,550	0.49	7.37
Difference (all irrigated – arable)*	8,620	1.67	24.92

Note. The rows partly overlap and cannot be summed to obtain total area.

*Calculated value; not a separate category of the inventory.



The share of all irrigated land in the district area was calculated as:

$$U = \frac{34,590}{517,195} \times 100\% = 6.69\%. \quad (1)$$

The share of irrigated arable land in the irrigated total:

$$S = \frac{25,970}{34,590} \times 100\% = 75.08\%. \quad (2)$$

Irrigated arable land represents 5.02% of the district area and perennial plantations 0.49%. The 8,620 ha (24.92%) between all irrigated land and arable land includes other irrigated land types [1]; because the inventory rows partly overlap, its composition cannot be fully separated from the available data. There is no basis for interpreting this difference as unused or degraded land.

The 2024 irrigated arable area of the Dalmun massif, 1,415.26 ha [2], refers to a different coverage and a different year than the district figure. Its ratio to the district arable area, about 5.4%, indicates scale only; neither temporal change nor an average condition for the district can be derived from it.

Literature synthesis. The requirements drawn from the sources are summarised against criteria K1–K4 in Table 2.

Table 2. Monitoring requirements and their criteria

Monitoring component	Required distinction	Criterion
Accounting baseline [1, 2]	Irrigated arable land versus all irrigated land	K1
Degradation indicators [3, 4]	Land designation versus ecological condition	K2
Remote-sensing interpretation [5]	Spectral anomaly versus confirmed salinity	K2
Repeated soil measurement [6, 7]	Same points, depths, season, and analytical method	K3



Monitoring component	Required distinction	Criterion
Map and model validation [8–10]	Mapped area versus sample-based area estimate; model applicability domain	K4

4. Discussion.

The results reveal two kinds of uncertainty. The first concerns coverage: because irrigated arable land makes up three quarters of all irrigated land, a salinity survey of arable fields cannot be extended to all 34,590 ha, and an assessment of all irrigated land does not accurately describe arable fields. The second concerns interpretation: a land category is an administrative designation, not a measurement of soil condition. The LDN approach relies on changes in land cover, productivity, and organic carbon [3]; the results of Kust et al. support indicator selection but do not establish the extent of degradation in Jondor [4].

A low vegetation index or a bright soil surface in imagery does not confirm salinity on its own: moisture, vegetation cover, and salt characteristics affect the spectral response [5]. An anomaly should therefore guide the choice of field-investigation sites, while a salinity conclusion rests on laboratory or calibrated measurement evidence. Methods for interpreting soil electrical conductivity as a salinity indicator are described in an FAO manual [7], and a geostatistical approach to repeated electromagnetic induction (EMI) surveys has been considered for salinity monitoring in Uzbekistan [6]. A change can be distinguished from measurement error only when repeated observations use the same points, depths, comparable seasons, and the same analytical method. Likewise, prediction accuracy cannot automatically be extended to conditions not represented in the training data [10].

The proposed monitoring procedure (Figure 1) rests on three conditions. First, parcel identifiers and their versions are linked in a single database with land type, crop, irrigation status, and observation date; administrative



reclassification is recorded separately from physical change. Second, remote-sensing observations are matched to crop development stages. Third, map accuracy is assessed with independent reference observations: area counted from a map may be biased by classification error, so class area is estimated from a probability-based stratified sample [8, 9].

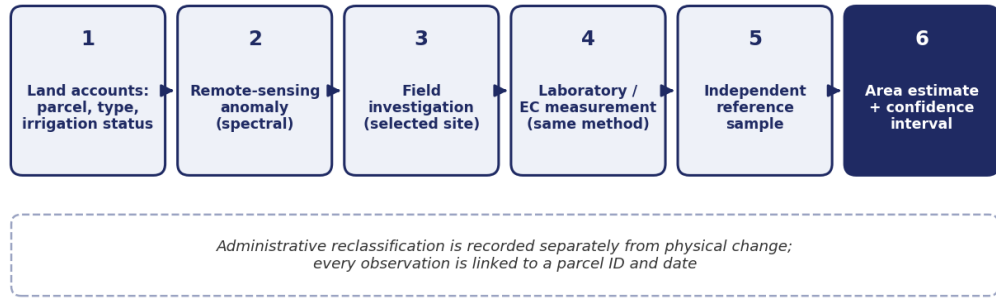


Figure 1. Proposed monitoring sequence for Jondor (author's scheme)

The area proportion and area of class k , its standard error, and the 95% confidence interval are estimated as [8]:

$$p_k = \sum_h W_h \cdot \frac{n_{hk}}{n_h}, \quad A_k = A_{tot} \cdot p_k \quad (3)$$

$$SE(p_k) = \sqrt{\sum_h W_h^2 \cdot \frac{\frac{n_{hk}(1 - \frac{n_{hk}}{n_h})}{n_h - 1}}, \quad A_k \pm 1.96 \cdot A_{tot} \cdot SE(p_k) \quad (4)$$

where $W_h = A_h / A_{tot}$ is the area weight of stratum h (a map class); n_h is the number of sample units in stratum h ; n_{hk} is the number of those assigned to class k by the reference classification; and A_{tot} is the area of the observed territory. A change in mapped area is thus interpreted as degradation only after classification error has been considered.

Limitations: because the inventory refers to a single date, salinity prevalence and the degradation trend were not assessed; parcel-level data are needed to establish the composition of the 8,620 ha difference; and the proposed requirements should be tested in subsequent field studies.



5. Conclusions. In Jondor, all irrigated land totals 34,590 ha and represents 6.69% of the district area; irrigated arable land is 25,970 ha, or 75.08% of the irrigated total. These shares describe land composition, not salinity or degradation. Reliable monitoring requires consistent accounting boundaries, locally applicable indicators, and independent accuracy assessment together. Repeated parcel-linked observations allow a scientifically grounded assessment, whereas the existing single-date inventory cannot establish salinity dynamics.

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