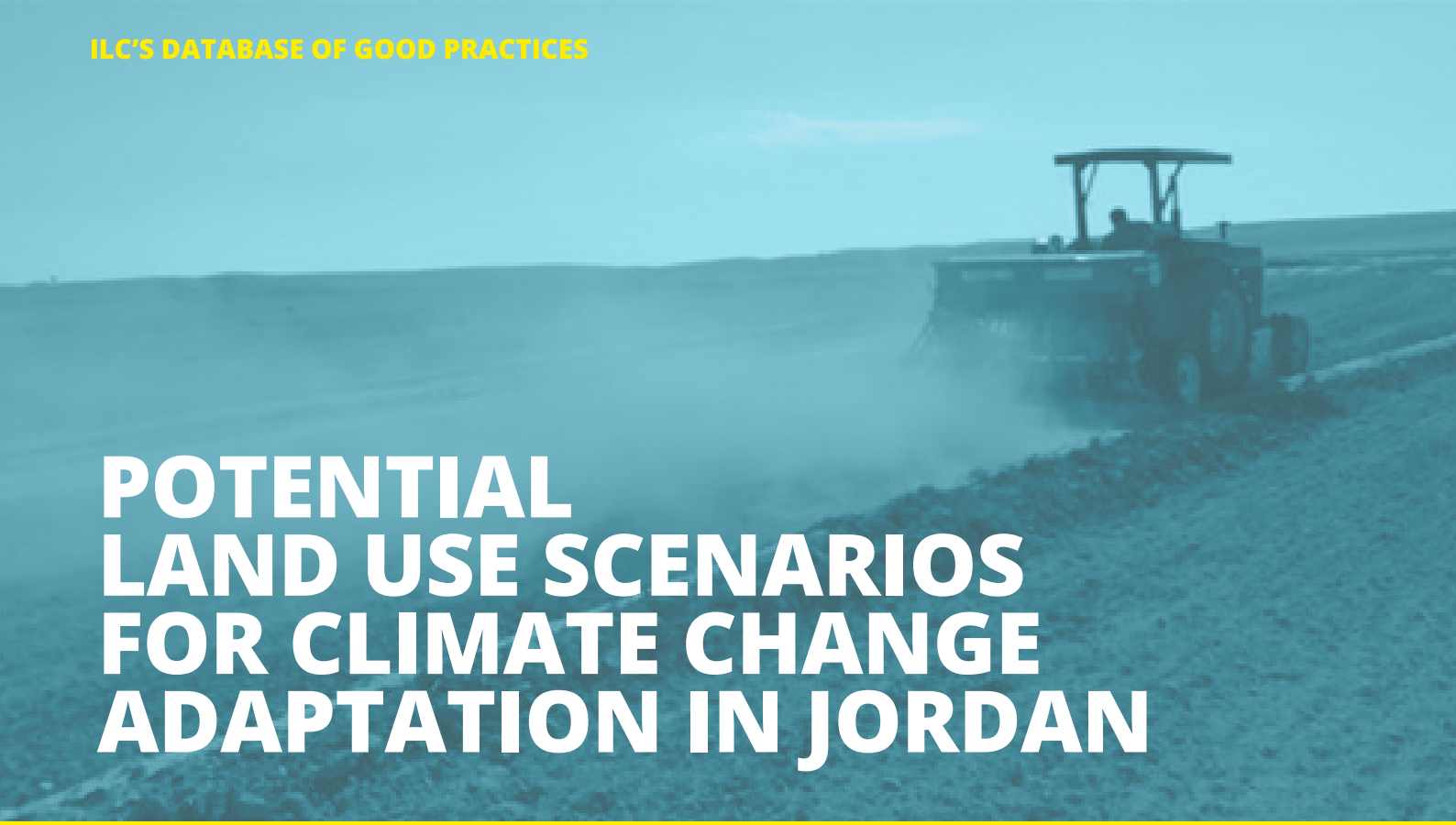


# POTENTIAL LAND USE SCENARIOS FOR CLIMATE CHANGE ADAPTATION IN JORDAN

LEARN, SHARE AND BE INSPIRED!

*Country:* **JORDAN** | *Principal Organisation:* **National Agricultural Research Center (NARC Jordan)**

## ABSTRACT

Jordan's national agricultural development strategy emphasises managing and conserving the natural resource base while sustaining and enhancing the productivity of agricultural lands. In this context, a team from the National Agricultural Research Center's (NARC) Geographic Information System and Remote Sensing (GIS & RS) Department, the International Fund for Agricultural Development (IFAD) and the International Center for Agricultural Research in the Dry Areas (ICARDA) conducted a study to identify and map potential land suitability in Jordan for ten land-use types under current and future precipitation patterns and climatic conditions. As a result, NARC, IFAD and ICARDA launched the Climate Change and Drought Atlas for Jordan, containing maps which track land suitability for agriculture, annual precipitation, changes to weather conditions, and the length of growing periods (LGP) under rain-fed conditions.

The Atlas provides information on the expected threats to increase climate change adaptation measures as part of Jordan's new climate change strategy, which aims to mitigate the negative impact of climate change on the rural poor. It focuses on the complex relationships between soils, land-use options, and climate change and how these changing relationships will likely affect the land's suitability for agriculture in the future. Several hundred maps included in this Atlas will benefit land managers, decision-makers, and farmers by guiding sustainable agricultural land use according to its potential physical suitability, climatic and soil conditions, and land use.

## ILC COMMITMENTS

*Strong small-scale farming systems* | *Diverse tenure systems* | *Inclusive decision-making*

INTERNATIONAL LAND COALITION

NARC
المركز الوطني للبحوث الزراعية
National Agricultural Research Center

# COMPETENCIES

| AREAS | SKILLS |
|---|---|
| SUSTAINABLE FOOD SYSTEMS | USE OF MEDIA AND COMMUNICATION |
| CLIMATE JUSTICE | MAPPING AND LAND REGISTRATION |
| | RESEARCH AND TRAINING |
| | KNOWLEDGE AND INFORMATION MANAGEMENT |

## BACKGROUND

Land suitability mapping was developed using an innovative approach that integrates soil and climatic data for the specific objective of a land suitability assessment under climate change. The method uses an extensive database of soil auger observations, covering all parts of the country and the climatic data layers for both current and future conditions as projected by climate change.

The Food and Agriculture Organization's (FAO) approach to land suitability evaluation classifies land according to a range – from highly suitable to not suitable – based on climate, terrain, soil properties and other land use-related characteristics. The evaluation of land suitability deals with the ranking or classification of land into distinct categories, each corresponding to a different use.

## THE CHALLENGE

The Atlas describes the suitability mapping for ten land use types:

1. Rainfed annual field crops
2. Rainfed perennial field crops
3. Rangelands
4. Drip irrigated vegetables
5. Drip irrigated trees
6. Surface irrigation
7. Runoff generation
8. Water harvesting using small runoff basins for trees
9. Water harvesting using contour furrows for range shrubs or minor pits for improved range
10. Forestry

The focus of the Atlas is on the complex relationships between soils, land-use options, and climate change and how these changing relationships are likely to affect the suitability of land for agriculture in the future. The Atlas contains more than 400 maps with unique characteristics, such as a map for each criterion, an indication of the suitability of each class of land, and soil depth examples.



## OVERCOMING THE CHALLENGE

The Atlas has 423 maps with ten annexes for each land use type. These maps indicate:

**CURRENT SUITABILITY FOR:**

- Each land use type, soil, climate, and overall suitability,
- Each criterion is represented by four suitability maps (S1, S2, S3, NS).

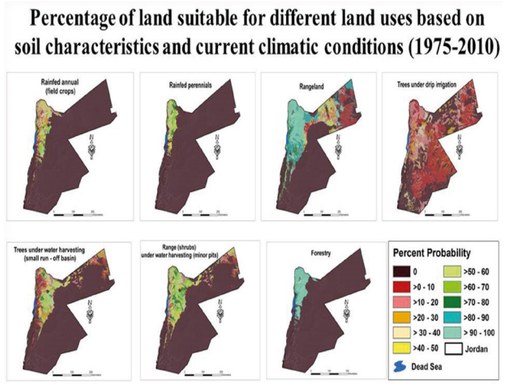
**PROJECTED SUITABILITY:**

- By measuring the change in percentage between projected and current suitability maps,
- In the thirty tables covering ten land use types contained in the Atlas. They contain:
  - A summary table of land suitability under current and future climatic conditions for each land use type.
  - A summary table of changes in land suitability between present and projected future conditions for each land use type, and
  - A summary table of the suitability of precipitation and winter growth potential (WGPT) under current and projected climatic conditions for each land use type.

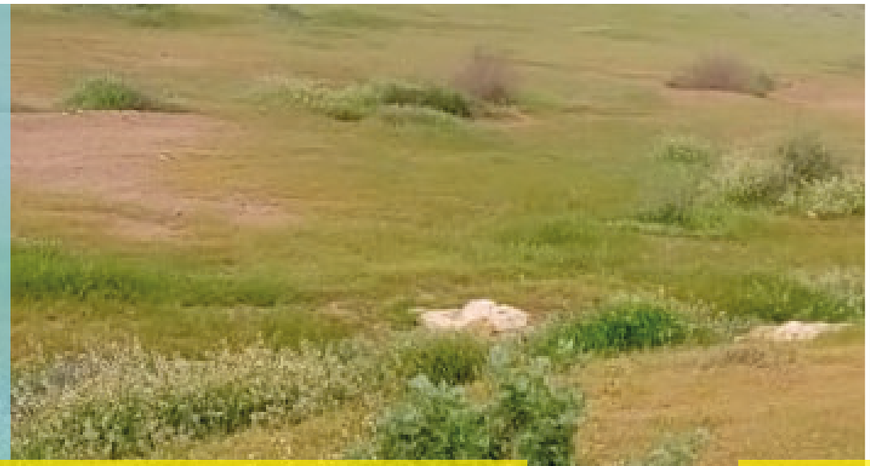


## MOVING TOWARDS PEOPLE-CENTRED LAND GOVERNANCE

The maps created by NARC will benefit land managers, decision-makers, and farmers by providing guidance for sustainable agricultural land use according to potential physical suitability, climatic and soil conditions, and existing land use. The Atlas focuses on technologies that enable farmers and livestock producers to adapt to climate change in arid areas.
The maps highlight productive lands to increase income-generating opportunities and food security in arid regions. The Atlas also supports the agricultural sector, protects the environment, and improves resource efficiency. Additionally, the research findings and recommendations will guide Jordanian farmers and stakeholders on the most sustainable agricultural uses of their lands.



# THE GOOD PRACTICE IN FIVE SIMPLE STEPS



**1**

### STUDY AREA

Jordan is located within the geographic coordinates: 31°00 N, 36°00E. The country is divided into three agro-ecological zones: the highlands, valleys, and deserts (Badia). These three zones cover twelve governorates over a total area of 89000 km2. Jordan has warm, dry summers and mild, wet winters with temperatures ranging from 12 to 25° C and reaching 40ºC in the desert regions. Annual rainfall ranges between 50 mm in the desert and 800 mm in the northern hills, some of which falls as snow.

**2**

### DATA COLLECTION AND PREPARATION

In this study, NARC and partners used a database of soil auger observations to store information on soil depth, texture, erosion, rock outcrops, stones, and the surface horizon. Additionally, they collected data on the soil's available water holding capacity (AWHC) and salinity using pedotransfer functions and descriptions contained in the reconnaissance soil survey report. These characteristics were then used to express the probability of the soil's usability, considering the different soil characteristics, in line with the Soil Map of Jordan. Finally, NARC and partners then used the digital elevation model (DEM) to derive the slope of Jordan and the climatic data layers for both current and future conditions as projected, considering the threat of climate change.

**3**

### LAND SUITABILITY EVALUATION

The Food and Agriculture Organization's (FAO) approach to land suitability evaluation classifies land according to a range – from highly suitable to not suitable – based on climate, terrain, soil properties and other land use-related characteristics. These suitability categories are defined by FAO as follows:

- Highly suitable (S1): Land with no significant limitations to a specified sustained use and is therefore expected not to reduce productivity or benefits and will not raise inputs above an acceptable level.
- Moderately suitable (S2): Land that has limitations, which in aggregate, are moderately severe for a specified sustained use.
- Marginally suitable (S3): Land that has limitations, which in aggregate, are severe for sustained application of a given use and will so reduce productivity, benefits or increase required inputs, such that the expenditure is marginally justified.

Unsuitable (NS): Land with limitations that appear so severe as to preclude any possibilities of successful sustained use of the land.



**4**

### PARTICIPATORY DEVELOPMENT OF EVALUATION CRITERIA WITH LOCAL FARMERS

NARC and partners used local farmers' knowledge and experiences in formulating and selecting land use options with high land suitability probabilities (S1, S2 and S3). The participatory formulation of evaluation criteria allows farmers to simplify, analyse, and summarise data and develop reliable suitability maps that support the implementation of sustainable land use alternatives in arid environments.

**5**

### EVALUATION OF THE IMPACT OF CLIMATE CHANGE SCENARIOS ON LAND SUITABILITY

This study employed GIS tools to analyse overlays or spatial analysis operations and to combine the different map layers of soil, soil observation, slope, rainfall, and temperature to determine the most suitable lands for agricultural development. Four hundred and twenty-three maps were produced for ten land use types under current conditions and projected scenarios. The land use types include rainfed annual field crops, rainfed perennial crops, rangelands, drip-irrigated vegetables, drip-irrigated trees, surface irrigation, runoff generation, water harvesting using small runoff basins for trees, water harvesting using contour furrows for range shrubs or minor pits for improved range and forestry.

# KEY FACTORS
## OF SUCCESS FOR REPLICABILITY AND ADAPTABILITY PURPOSES



- The maps will benefit farmers, land managers and decision-makers by providing guidance for the sustainable agricultural use of land according to its potential suitability and taking into cognisance current land use, climatic and soil conditions.
- Land suitability evaluation can contribute toward better land management, land degradation mitigation, and designing land use patterns that prevent environmental problems by segregating competing land uses.
- Land use planning must be preceded by an evaluation of land management practices to identify and minimise the causes of soil degradation.



## LESSONS LEARNED

- Conducting a suitability analysis allows the researchers to identify the main limiting factors for agricultural production in the area and enables decision-makers to develop crop management plans to increase land productivity.
- Soil conservation practices are recommended in some parts of the area to decrease erosion hazards and protect the soil from further degradation.
- Rainwater harvesting improves water and land productivity and assists in coping with climate change in drier, marginal environments.
- Data processing and interpretation using geographic information systems (GIS) provides new opportunities to improve the reliability of suitability mapping using the available soil data.

## MORE INFO

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