الهيئة العامة للإحصاء
General Authority for Statistics

Methodology and Quality Report for Land Accounts Statistics

V-3.1

Quality Management

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2. Methodology and Quality Update

2.1.	Methodology and Quality Latest Update	24/12/2024

3. Statistical Presentation

3.1. Data description
The Land Accounts Publication presents data on changes in land cover and land use in Saudi Arabia. The Land Accounts Publication is a statistical product designed to collect statistical information on land cover and land use and to disseminate such statistical information

periodically in time and space, showing the relationship between economic activities and environmental processes as they occur.

The land accounts consist of as Physical asset accounts:

- Determine the size and cause of changes occurring in each land cover category.
- Determine the size and cause of changes occurring in each land use category.

3.2. Classification system

The following classifications have been applied in the Land Accounts Publication in accordance with the harmonization of the classifications contained in the data sources and the Environmental-Economic Accounting Reference Framework.

Land cover Classification System (LCCS)

It is a global classification of land cover issued by the Food and Agriculture Organization of the United Nations (FAO).

This classification is used in the Land Accounts Publication to classify land cover.

Land use Classification (System of Environmental-Economic Accounting - SEEA - Central Framework 2012):

It is the classification contained in the central framework of the economic environmental accounting system to classify lands according to their type of use.

The sub class are organized and processed to allow for the production of outputs according to all relevant classifications.

3.3. Sector coverage

The Land Accounts Publication covers all economic sectors.

3.4. Statistical concepts and definitions

Concepts and Definition of Land Accounts Publication:

First: Concepts and Definition of Land Cover:

- Land cover:

It is a layer that represents the surface cover of the physical and built environment observed in Saudi Arabia by satellite. They include the following categories:

- Crops:

Areas with cultivated crops that are not as high and dense as areas covered by trees.

- Built-up areas:

This refers to all types of built-up land, in addition to any surface classified as an artificial surface (man-made), such as paved roads. It also includes exposed lands that are directly connected to built-up areas.

- Bare ground:

Large areas of sand, rocks, or mountains, and there are only a few divergent plants, such as sand dunes and dry valleys.

- Rangeland:

Natural meadows and fields with sparse vegetation that contain a number of trees or grasses.

- Other:

These are the categories that may be less accurate classification at the level of the Kingdom, namely:

- Water:

These are areas where water is found mainly throughout the year (or most days of the year).

- Tree-covered ~~lands~~:

Areas with dense vegetation clusters where the plants are approximately 15 feet tall or more. They typically cover the ground as closed canopy.

- Flooded vegetation:

Areas that include any type of plant (grass, trees or shrubs) with clear mixing of water on most days of the year, such as mangroves.

- Managed expansion:

Expansion as a result of human planning or intervention.

- Unmanaged expansion:

Expansion as the result of natural factors without human intervention.

- Unclassified expansion:

Unclassified expansion, meaning it may be managed or unmanaged.

- Managed Reductions:

Reductions because of human planning or intervention.

- Unmanaged Reductions:

Reductions as the result of natural factors without human intervention.

- Unclassified Reductions:

Unclassified reductions, meaning it may be managed or unmanaged.

Second: Land use Concepts and Definition:

- Land use:

It is a description of land uses for human activities in natural and built environments, including existing and planned uses.

- Built-up area and related areas:

Land affected or adapted by man, under buildings, roads, mines and quarries and any other facilities, including their auxiliary spaces, deliberately planned for human activities (excluding agricultural activities). Included also are certain types of open land (non built-up land), which are closely related to these activities, such as waste tips, derelict land in built-up areas, junkyards, city parks and gardens. Land under closed villages or similar rural localities are included.

- Agricultural:

The land used for all agricultural activities. And includes the total areas covered in: The framework for lands bearing temporary crops includes grains (wheat, rice, yellow and white corn, barley, rye, oats, and millet), vegetables and melons, temporary oilseed crops

(soybeans, peanuts, castor seeds, flax seeds, mustard seeds, Niger seeds, rapeseed, cottonseed, sesame seeds, sunflower seeds, and other oilseeds), root tuber crops with high starch or lanolin content (roots, tubers, potatoes, sweet potatoes, cassava, yam), temporary spice crops (chili, anise, fennel), leguminous crops (beans, broad beans, chickpeas, lobia, lentils, peas), sugary crops (sugarcane, sugar beets), and other temporary crops not classified elsewhere. Lands bearing temporary meadows and pastures: Lands cultivated with temporary forage grasses for mowing or grazing, used for less than five years. Temporary rest land is land where seeds are not laid for one or more planting seasons. The maximum period of rest is less than five years. Lands bearing permanent crops, including fruits and nuts (almonds, chestnuts, hazelnuts), permanent oilseed crops (coconut, olives), beverage crops (coffee, tea, cocoa), permanent spice crops (cardamom, cinnamon, cloves, ginger), and other permanent crops not classified elsewhere. Lands bearing permanent meadows and pastures are lands used for cultivating permanent forage grass crops (with a cultivation cycle of five years or more) either through cultivation or naturally. Agricultural lands with protective cover, are the surfaces occupied by farm housing and similar structures: Residential places, operating buildings (barns, stables and silos), animal production buildings (barns of cows, sheep, and poultry) also include lands that have been planned for practicing agricultural activities.

- Land used for maintenance and restoration of environmental functions:

This class includes protected areas as defined by IUCN, International Union for Conservation of Nature, i.e., clearly defined geographical spaces, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

- Land uses not classified elsewhere **(Others):**

Land is not classified elsewhere. This category also includes unused lands.

- Managed Expansion:

Planned expansion.

- Unmanaged Expansion:

Unplanned expansion.

- Unclassified expansion:

Unclassified expansion, meaning it may be managed or unmanaged.

- Managed Reductions:

Planned Reductions.

- Unmanaged Reduction:

Unplanned Reduction.

- Unclassified Reduction:

Unclassified reduction, meaning it may be managed or unmanaged.

3.5. Statistical unit

Not applicable.

3.6. Statistical population

Not applicable.

3.7. Reference area

The Land Accounts Publication covers data on national level of Saudi Arabia.

3.8. Time coverage

Available data cover the time periods (2017 and 2023).

3.9. Base period

Not applicable.

4. Unit of measure

- Most results are measured in units of area (e.g: Area of the built-up area) (hectares).

- Results calculated as a percentage (e.g.: Percentage of the built-up area).

5. Reference period

References period to the variables as following:

- Land cover data are based on the reference period (1/1/2017 to 31/12/2017) and (1/1/2023 to 31/12/2023)
- Land use data are based on the last day of the calendar year

6. Confidentiality

6.1. Confidentiality - policy

According to the Royal Decree No. 23 dated 07-12-1397, data must always be kept confidential and must be used by GASTAT only for statistical purposes.

Therefore, the data are protected in the data servers of the Authority.

6.2. Confidentiality - data treatment

Data are displayed in appropriate tables to facilitate its summarization, comprehension, results extraction. comparison with other data and coming up with statistical connotations for the study community. It is also easier to check tables without the need to see any sensitive or confidential data, which violates the confidentiality of statistical data.

7. Release policy

7.1. Release calendar

The Land Accounts publication has been included in the statistical calendar.

7.2. Release calendar access

Available on the: https://www.stats.gov.sa/en/future-releases

7.3. User access

One of GASTAT's objectives is to better meet its clients' needs, so it immediately provides them with the publication's results once the Land Accounts publication is published.

It also receives questions and inquiries of the clients about the Publication and its results through various communication channels, such as:

- GASTAT official website: www.stats.gov.sa
- GASTAT official e-mail address: info@stats.gov.sa
- Client support e-mail: cs@stats.gov.sa
- Official visits to GASTAT's official head office in Riyadh or one of its branches in Saudi Arabia.
- Official letters.
- Statistical telephone: (199009).

8. Frequency of dissemination

Every four years.

9. Accessibility and clarity

9.1. News release

The announcements of each publication are available on release calendar as mentioned in 7.2. Release calendar access. The news release can be viewed on the website of GASTAT through the following link:

https://www.stats.gov.sa/en/news

9.2. Publications

GASTAT issues publications and reports of the Land Accounts Publication regularly within a pre-prepared dissemination plan and is published on GASTAT's website. GASTAT is keen to publish its publications in a way that serves all users of different types, including publications in different formats that contain (publication tables, data graphs, indicators, and Methodology and Quality Report) in both English and Arabic.

The results of the Land Accounts Publication are available at:

Link to the newsletter results:

9.3. On-line database

Not available.

9.4. Micro-data access

Not available.

9.5. Other

Not available.

9.6. Documentation on methodology

The Land Accounts Framework assigns concepts, definitions, issues, and classifications according to international standards within the central framework of the System of Environmental and Economic Accounts (SEEA):

- United Nations (2012).

  System of Environmental-Economic Accounting 2012 Central Framework . New York.
- United Nations (2017).

  SEEA Technical Note: Land accounting. New York.

- Karra, K., Kontgis, C., Statman-Weil, Z., Mazzariello, J. C., Mathis, M., & Brumby, S. P. (2021, July).
- Global land use/land cover with Sentinel 2 and deep learning. In 2021 IEEE international geoscience and remote sensing symposium IGARSS (pp. 4704-4707). IEEE.
- Global land use/land cover with Sentinel 2 and deep learning. In 2021 IEEE international geoscience and remote sensing symposium IGARSS (pp. 4704-4707). IEEE.

9.7. Quality documentation

Quality documentation covers documentation on methods and standards for assessing, measuring, and monitoring the quality of statistical process and output. It is based on standard quality criteria such as relevance, accuracy and reliability, timeliness and punctuality, accessibility and clarity, comparability, and coherence.

10. Quality management

10.1. Quality assurance

GASTAT declares that it considers the following principles: impartiality, user orientated, quality of processes and output, effectiveness of statistical processes, reducing the workload for respondents.

Quality controls and validation of data are actions carried out throughout the process in different stages such as the data input and data collection and other final controls.

10.2. Quality assessment

GASTAT performs all statistical activities according to a national model (Generic Statistical Business Process Model - GSBPM). According to the GSBPM, the final phase of statistical activities is overall evaluation using information gathered in each phase or sub-process. This information is used to prepare the evaluation report which outlines all the quality issues related to the specific statistical activity and serves as input for improvement actions.

11. Relevance

11.1. User needs

Internal users in the GASTAT for Land Accounts Publication data:

- Environment, Agriculture, and Energy Statistics.
- International indicators Statistics.

Some several external users and beneficiaries greatly benefit from the Land Accounts Publication data, including:

- Government agencies, most notably (Ministry of Municipal and Rural Affairs and Housing, Ministry of Environment, Water and Agriculture, General Authority for Surveying and Geospatial Information).
- World Bank.
- Regional and international organizations, most notably the United Nations (Sustainable Development).
- Research institutions.
- Media.
- Individuals.

11.2. User satisfaction

Not available.

11.3. Completeness

Land Accounts Publication data are based on three main sources in order to provide comprehensive information on changes in land cover and use, and the status of the data is complete.

12. Accuracy and reliability

12.1. Overall accuracy

- Data is checked with previous years to identify any significant changes in the data.
- The internal consistency of the data is checked before it is finalized.
- The links between variables are checked and coherence between different data series is confirmed.
- Relying on spatial products with scientifically recommended accuracy by reviewing the accuracy and reliability report by the geospatial data producer.

13. Timeliness and punctuality

13.1. Timeliness

The General Authority for Statistics is committed to applying internationally recognized standards in announcing and clarifying the publication time of statistics on the official website through the statistical calendar. In case of any delay, it will be updated accordingly.

13.2. Punctuality

It is published according to the publication dates of the statistical calendar published for the Land Accounts Publication on the General Authority for Statistics' web page.

The data are available at the expected time, as scheduled in the statistical release calendar, If the publication is delayed, reasons shall be provided.

14. Coherence and comparability

14.1. Comparability - geographical

Land use data are geographically comparable at the level of the Kingdom and the administrative regions, while land cover data are geographically comparable at the level of the Kingdom.

14.2. Comparability - over time

Not applicable.

14.3. Coherence- cross domain

Not applicable.

14.3.1. Coherence - sub annual and annual statistics

Not applicable.

14.3.2. Coherence- National Accounts

Not applicable.

14.4. Coherence - internal

Land Accounts Publication estimates have full internal coherence, as they are all based on the same corpus of microdata, and they are calculated using the same estimation methods.

15. Data revision

15.1. Data revision - policy

Not applicable, only final results will be published.

15.2. Data revision - practice

Not applicable, only final results will be published.

16. Statistical processing

16.1. Source data

Land Accounts Publication data is based on three main sources:

- Administrative records data.
- open-source data (big data).
- spatial modelling.

First source: Administrative records of Land Accounts Publication statistics:

- General Authority for Survey and Geospatial Information.
- Ministry of Environment, Water and Agriculture.
- Ministry of Municipalities and Housing.

The main published variables from the administrative data source are:

- Indicator of change in the area of the built-up area and related areas.
- Indicator of change in the area of land used in agriculture.
- Indicator of change in area used for the maintenance and restoration of environmental functions.

Second source: From Open-Source Data (Big Data) to the Land Accounts Publication:

- Sentinel-2 10m imagery (2017-2023)
- Karra, K., Kontgis, C., Statman-Weil, Z., Mazzariello, J. C., Mathis, M., & Brumby, S. P. (2021, July). Global land use/land cover with Sentinel 2 and deep learning. In 2021 IEEE International"

The main variables published from open-source data (big data) are:

- Indicator of change in the area of the built-up area.
- Indicator of change in the crop area.
- Indicator of change in Rangeland.

- Indicator of change in Bare ground.
- Indicator of change in the area of classifications grouped under "Other".

As open-source land cover data have been used, which has been classified at the global level, this may affect the accuracy of some classifications at the Kingdom level, which we have included in the land calculations under the classification "other".

Third Source: spatial modelling for interpolation missing data as on 16.5.

16.2. Frequency of data collection

Annual.

16.3. Data collection

Data collection from administrative records:

In coordination with the relevant departments of the Authority, the data on the Land Accounts Publication are obtained from the Ministry of Environment, Water and Agriculture, the Ministry of Municipalities and Housing, the General Authority for Survey and Geospatial Information, which includes data on spatial strata related to land use. The data is stored in GASTAT's databases after undergoing auditing and review processes following approved statistical methods and recognized quality standards. If errors or discrepancies are detected, the data is cross-referenced with the data source for correction or clarification.

16.4. Data validation

Data are reviewed and matched to ensure their accuracy and precision in a way that suits their nature with the aim of giving the presented statistics quality and accuracy.

The data of the current year publication are compared with the data of the previous year to ensure their integrity and consistency in preparation for processing data and extracting and reviewing results.

In addition to the data processing and tabulation to check their accuracy, all the outputs are stored and uploaded to the database after being calculated by GASTAT to be reviewed and processed by specialists in Data Management and Geo Mapping Department through modern technologies and software designed for this purpose.

16.5. Data compilation

Data Coding:

In the Land Accounts Publication, data are collected and include a detailed description of the fields. This information is then coded in-house by an automated process, which is reviewed by a small-dedicated team of coding experts using a series of consistency checks.

Data editing:

Specialists in Data Management and Geo Mapping Department have processed and analyzed data in this stage, and this step was based on the following measures:

- Sorting and arranging data in groups or different categories in a serial order.
- Summarizing detailed data into key points or data.
- Combining many data segments and ensuring their interconnection.
- Processing incomplete or missing data.
- Processing illogical data.
- Converting data into statistically significant data.
- Arranging, presenting, and interpreting data.

Compensation (for non-response or extrapolated and weighted datasets:

In cases of incomplete data, compensation is applied using the nearest neighbor method.
The average ratio of the nearest neighbor is given as follows:

(1) $$ANN = \frac{\bar{D}o}{\bar{D}_E}$$

$\bar{D}o$The average observed distance between each cell (pixel) and its nearest neighbor:

(2) $$\bar{D}o = \frac{\sum_{i=1}^{n} d_{i\acute{g}}}{n}$$

$\bar{D}_E$The average expected distance of cells (pixels) in a random pattern:

(3) $$\bar{D}_E = \frac{0.5}{\sqrt{\frac{n}{A}}}$$

In the equations above, d_i it is the distance between a cell i and its nearest neighbor, n represents the total number of cells, A is the smallest rectangle area surrounding all cells or is the value of a user-defined area.
The Z value of the nearest contiguous mean is calculated as follows:

(4) $$z = \frac{\bar{D}o - \bar{D}_E}{SE}$$

Whereas:

(5) $$SE = \frac{0.26136}{\sqrt{\frac{n^2}{A}}}$$

16.6. Adjustment

Not applicable, only final results will be published.

17. Comment