SDG Indicators 2.5.1 and 2.5.2 – Plant and animal genetic resources

Lesson 6: Gathering information and data on animal genetic resources

Text-only version

The interactive version of this lesson is available free of charge at: https://elearning.fao.org

Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

working for Zero Hunger

In this lesson

In this lesson, we will examine the data and information needed to measure Indicators 2.5.1 (for the animal component) and 2.5.2.

This will also include how data and information are gathered, and the importance of inserting them into the Domestic Animal Diversity Information System (DAD-IS).

Learning objectives

At the end of this lesson, you will be able to:

- identify what Sustainable Development Goal (SDG) Indicator 2.5.2 measures;
- identify what Sustainable Development Goal (SDG) Indicator 2.5.1 for animal genetic resources measures;
- examine the information and data needed to calculate these two indicators;
- understand the importance of providing information to DAD-IS.

Introduction

Sustainable Development Goal Indicators 2.5.1 (animal component) and 2.5.2 are calculated based on the information provided to FAO's Domestic Animal Diversity Information System (DAD-IS), http://www.fao.org/dad-is/en/ .

Riza: *"As you know, in order to submit our country's annual update to FAO on SDG Indicators 2.5.1 and 2.5.2, I have to collect specific information and data."*

Julian: *"How can I help you identify the information and data needed for these indicators? "*

Riza: *"I think we can identify them by further examining both indicators.*

Let's start with the animal component of SDG 2.5.1."

You can find an introduction to the SDG indicators (including the plant component) in Lesson 1.

Animal component of SDG Indicator 2.5.1

Indicator 2.5.1 is the "number of plant and **animal genetic resources** for food and agriculture secured in either medium- or long-term **conservation** facilities."

The animal component of the indicator identifies:

- the **number of local breeds stored within a genebank collection,** and
- whether the genetic material stored is **sufficient to reconstitute the breed** in case of extinction.

The conservation of animal genetic material over the medium- and long-term is done through **cryoconservation.**

As you may recall, cryoconservation is an *ex-situ in-vitro* method of animal genetic conservation.

Return to Lesson 5 for an introduction to the *ex-situ in-vitro* conservation method.

SDG Indicator 2.5.1: Types of genetic material to conserve

Many types of genetic material exist and include semen, embryos, eggs or other types of tissue. The type of genetic material that should be conserved depends on the species and the purpose of the genebank.

Somatic cells	**Somatic cells** (except the sex cells) are taken from the body of an animal and can be used in cloning. They may **represent a male or female** animal. Somatic cells from **at least 50** different animals are needed **to reconstitute a breed:** 25 from males and 25 from females. The technology used for this genetic material is still under development.
Sperm cells	Liquid containing **sperm** is generally stored in plastic straws. This is the most established method. Sperms **do not represent part of the DNA called mitochondrial DNA.** For semen, the **minimum number needed to reconstitute a breed depends on the livestock species, physiological and technological conditions**. For example, different numbers are needed for ruminants and for more prolific species (such as pigs). A combination of semen, embryos and oocytes is best.
Embryos	**Embryos** at various stages of development are collected after treating the female animal with hormones, so that it produces multiple fertile eggs. They may **represent a male or female animal.**

	For embryos, the **minimum number needed to reconstitute a breed depends on the livestock species, physiological and technological conditions**. A combination of semen, embryos and oocytes is best.
Oocytes	**Oocytes** are immature and/or unfertilized egg cells. They can be harvested from female animals, whilst alive or after they've been slaughtered. For oocytes, the **minimum number needed to reconstitute a breed depends on the livestock species, physiological and technological conditions**. A combination of semen, embryos and oocytes is best.

SDG Indicator 2.5.1: Sufficient material

When collecting genetic materials, it is always important to include:

- genetic material from **as many different males and females as possible**;
- as much material to **reflect the full diversity within a breed**; and
- the **amount of genetic material needed to reconstitute a breed**.

How much genetic material is needed to reconstitute a breed?

Each country's genebank management or national coordinator must decide how much genetic material must be deep frozen to be able to reconstitute a breed.

Even if the material is not sufficient to reconstitute a breed, it is **valuable for characterization, conservation and research.**

SDG Indicator 2.5.1: FAO's cryoconservation guidelines

FAO guidelines on Cryoconservation of Animal Genetic Resources provides **recommended minimum amounts of genetic material** for cryoconservation.

Based on the data collected, **DAD-IS can suggest whether the material is sufficient**. However, the decision lies with the national coordinator.

Riza: *"I wonder what information I can find in this document."*

*Cry*conservation of animal genetic resources:

www.fao.org/elearning/Course/SDG251-252/en/story_content/external_files/i3017e00.pdf

Covered aspects in the FAO guidelines on Cryoconservation of Animal Genetic Resources:

- The role of cryoconservation
- The objectives, implementation and organization of cryo programmes
- The different types of tissues to be conserved
- How to establish and develop a gene bank
- How to collect the genetic materials
- Sanitary recommendations
- Database and documentation considerations
- Legal issues
- Capacity building and training

SDG Indicator 2.5.1: Sufficient material

DAD-IS uses the scheme below to **identify whether or not the local breed's genetic material is sufficient.**

Sufficient

Enough materials are deep frozen to reconstitute a breed**.**

For example, with more than 2 000 semen straws collected from 34 male donors in 2015, the genetic material collected in Austria for the Tux-Zillertaler cattle breed can be considered sufficient to reconstitute the breed.

Not sufficient

Some materials are stored in genebanks, but **not enough to reconstitute a breed**. More is needed to have a sufficient amount.

For example, with only one semen donor, there is not enough material to reconstitute the Sipsu sheep in Bhutan.

No material

No genetic material of a breed is stored.

For example, in 2010 it was reported that no material was available for the Austrian Heidschnucke sheep breed.

No information

The **country did not provide data** on whether a breed is cryoconserved.

For example, there is no information available on material stored for the Caballo de Pura Raza Chilena horse breed in Chile.

SDG Indicator 2.5.2

Indicator 2.5.2 refers to the proportion of livestock breeds among local breeds with known risk status classified as being at risk of extinction.

This indicator focuses on **live animals**.

It is based on the number of **animals kept on farms or in the field** (*in-situ in-vivo).*

It includes the number of animals kept in *ex-situ in-vivo* programmes, such as **zoos**.

This SDG indicator divides breeds into two categories, according to their **level of risk of extinction**.

Many breeds remain of "unknown" risk status.

Not at risk | **At risk** | **Unknown**

DAD-IS Risk Classifications

DAD-IS also assigns risk categories to breeds. To determine the risk of a breed becoming extinct or undergoing a loss in genetic variation at a non-sustainable rate, **DAD-IS considers different factors when assigning the breed risk categories and sub-categories**.

These factors include population size and changes in population size.

In many cases, there is no updated information on the population size, and status of the breed may therefore considered unknown.

Some breeds may already have been reported as extinct, with only cryomaterial stored.

In vivo conservation of animal genetic resources:

www.fao.org/elearning/Course/SDG251-252/en/story_content/external_files/i3327e.pdf

DAD-IS risk categories	
Not at risk	No risk for extinction
Vulnerable	Medium risk for extinction
Endangered maintained	High risk for extinction, but there is a conservation programme in place
Endangered	High risk for extinction
Critical maintained	Very high risk for extinction, but there is a conservation programme in place. A disease outbreak or disaster could wipe the bread out
Critical	Very high risk for extinction – when there are very few breeding animals left. A disease outbreak or disaster could wipe the bread out
Cryoconservated only	No breeding males or females remain, but sufficient material is available to reconstitute the breed
Extinct	No breeding males or females remain, not enough cryoconserved material available
Unknown	Population data is unavailable or more than 10 years old

Mini-lesson 1 – Assigning Risk Categories in DAD-IS

This is a Mini-lesson on how DAD-IS assigns risk categories. Remember, these categories are automatically calculated in DAD-IS based on the information provided.

In this Mini-lesson we will identify the grouped parameters that DAD-IS uses:

- Breeding population
- Reproductive Capacity
- Active conservation programme

We will then apply some of these parameters to an example and exercise.

Breeding population

The main determinant of the breeding population is the **overall population size**. This is determined by the three parameters below. Let's take a look at them.

- **Population size**

The number of living animals belonging to a breed. The lower the number of animals, the higher the risk of extinction, for example, due to catastrophic events or disease.

- **Number of breeding females and males**

The number of breeding females and males is the size of the breeding population. If this is too small, inbreeding may be unavoidable, and it may be impossible to rebuild the population. A particular danger is that too few males are available for breeding.

- **Population trends - Inbreeding**

Population trends are considered as decreasing, stable or increasing. These trends can increase or decrease risks related to the scarcity of the breed and inbreeding. Generally a decrease in population size means an increase in a breed's risk of extinction.

Reproductive Capacity

The reproductive capacity reflects **the capacity of a breed to reproduce itself**. It is the number of breeding females that each female produces during her lifetime.

Species differ greatly in their reproductive capacities. To keep things simple, **FAO divides species between two categories: high and low reproductive capacity**. Let's look at these below.

- **High reproductive capacity**

Species with high reproductive capacity are **able to produce a large number of offspring in a limited amount of time**. These include pigs, rabbits, guinea pigs, dogs and all avian species.

For example, female pigs can give birth to ten or more offspring per litter, and multiple litters per year. A pig population may easily double its size within a single year.

- **Low reproductive capacity**

Species with low reproductive capacity are at **greater risk because they take more time to produce** a new generation of breeding animals. These include alpacas, asses, Bactrian camels, buffaloes, cattle, deer, dromedary camels, goats, guanacos, horses, llama, sheep, vicuñas and yaks.

For example, a mother horse, or mare, gives birth to a single foal after carrying it for 11 months. It takes time for a horse population to grow.

Active conservation programme

Active conservation programmes also impact the risk categories that breeds are assigned to. Some governments, breed associations and individuals have programmes to conserve a rare breed. Such active conservation programmes have **helped to preserve many breeds** around the world.

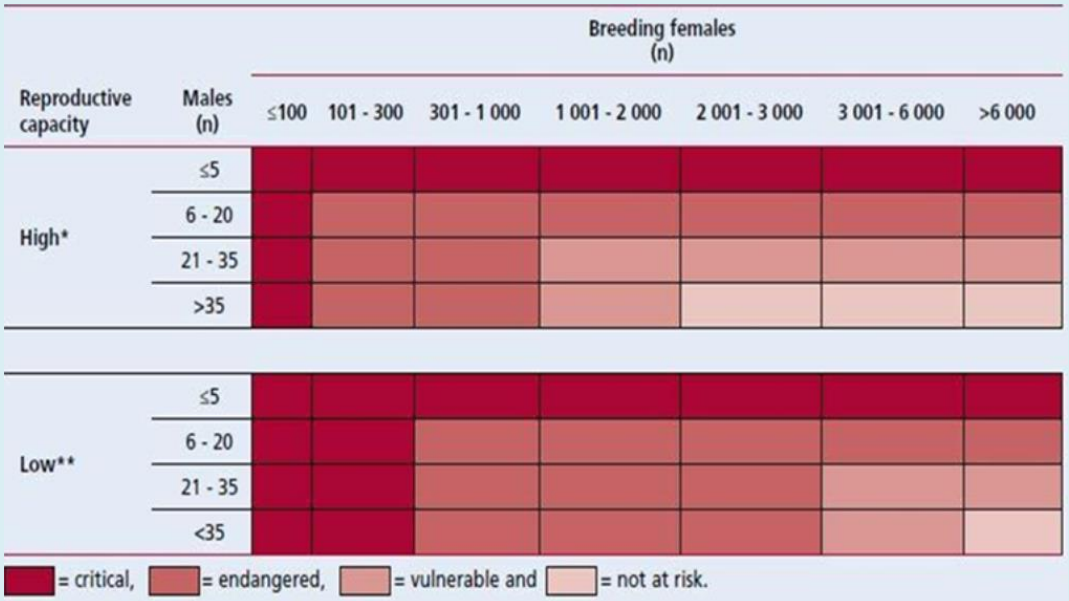
If a breed has an active conservation programme, then DAD-IS takes this into account when assigning the risk category.

For example, the population criteria for a breed may put it in the "critical" or "endangered" categories.

However, if it has an active conservation programme (including cryoconservation), or if it is maintained by a commercial company or research institution, DAD-IS puts it into special "critical-maintained" and "endangered-maintained" sub-categories for reporting purposes.

How to assign risk categories

Using some of the parameters that we have just identified, the table below provides insight into how DAD-IS uses information to classify a breeds risk category. Here are some steps to identify what you need when using this table.



*High reproductive capacity species = pigs, rabbits, guinea pigs, dogs and all poultry species.
**Low reproduction capacity species = horses, donkeys, cattle, yaks, buffaloes, deer, sheep, goats and camelids.

Step 1: Check whether the species has **high** or **low reproductive capacity**.

Step 2: Check the number of **males** and **breeding females** in the population.

Step 3: Look up their **risk category** in the table shown here.

Julian: *"Riza, we have just concluded our figures on Diani pigs. We have found **895 breeding females and 131 breeding males**."*

Riza: *"Thanks Julian. If we apply this information to the table, we should be able to determine the risk category that pigs belong to. "*

DAD-IS category assignment

Presented here is information on how DAD-IS' risk categories are assigned to breeds. Please note that values that aren't in parenthesis reflect species with high reproductive capacity. Values in parenthesis reflect species with low reproductive capacity.

Not at risk	A breed is categorized as not at risk if the population status is known and the breed does not fall in the critical or endangered categories (including the respective subcategories), or the vulnerable category.
Vulnerable	A breed is categorized as vulnerable if: • the total number of breeding females is between 1 000 and 2 000 (3 000 and 6 000 for species with low reproductive capacity);

	• the overall population size is greater than 800 (2 400) and less than or equal to 1 600 (4 800) and increasing, and the percentage of females being bred to males of the same breed is greater than 80 percent; or • the overall population size is greater than 1 200 (3 600) and less than or equal to 2 400 (7 200), but stable or decreasing; or • the total number of breeding males is between 20 and 35.
Endangered maintained	Categorized as endangered with an active conservation programme.
Endangered	A breed is categorized as endangered if: • the total number of breeding females is greater than 100 (300 for species with low reproductive capacity) and less than or equal to 1 000 (3 000); or • the overall population size is greater than 80 (240) and less than 800 (2 400), and increasing in size, and the percentage of females being bred to males of the same breed is above 80 percent; or • the overall population size is greater than 120 (360) and less than or equal to 1 200 (3 600), and the trend is stable or decreasing; or • the total number of breeding males is less than or equal to 20 and greater than five. If the population trend is unknown, then it is assumed to be stable.
Critical maintained	Categorized as critical with an active conservation programme.
Critical	A breed is categorized as critical if: • the total number of breeding females is less than or equal to 100 (300 for species with low reproductive capacity); or • the overall population size is less than or equal to 80 (240) and the population trend is increasing, and the proportion of females being bred to males of the same breed is greater than 80 percent (i.e. cross-breeding is equal to or less than 20 percent); or • the overall population size is less than or equal to 120 (360) and the population trend is stable or decreasing; or

- the total number of breeding males is less than or equal to five.

If the population trend is unknown, then it is assumed to be stable.

Presented here is information on how DAD-IS' other categories are assigned to breeds.

Cryoconservated only	Breeds that have no living male or female animals remaining, but for which there is sufficient cryopreserved material to allow for reconstitution of the breed, are assigned to the category "cryoconserved only".
Extinct	A breed is categorized as extinct when there are no breeding males or breeding females remaining, and any cryoconserved genetic material that may be available is insufficient for breed reconstitution.
Unknown	No information allowing the categorization has been provided over the past 10 years.

Summary

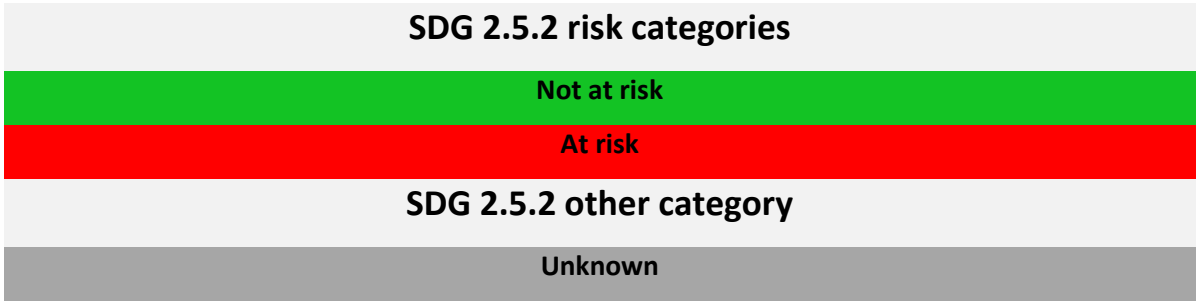
- Risk categories are based on different parameters, with the "population size" being the most commonly used parameter.
- The number of breeding females and males **is the size of the breeding population. Population trends** can increase or decrease risks related to the scarcity of the breed and inbreeding.
- **Inbreeding rates** impact the risk categories and **are generally unfavourable**. This is because inbreeding may result in decreased fertility and productivity, putting the **breed's survival at risk**.
- The reproductive capacity reflects **the capacity of a breed to reproduce itself**. FAO divides species between two categories: high and low reproductive capacity.
- Active conservation programmes have **helped to preserve many breeds** around the world.
- The risk classification is based on the information available and provided in DAD-IS.

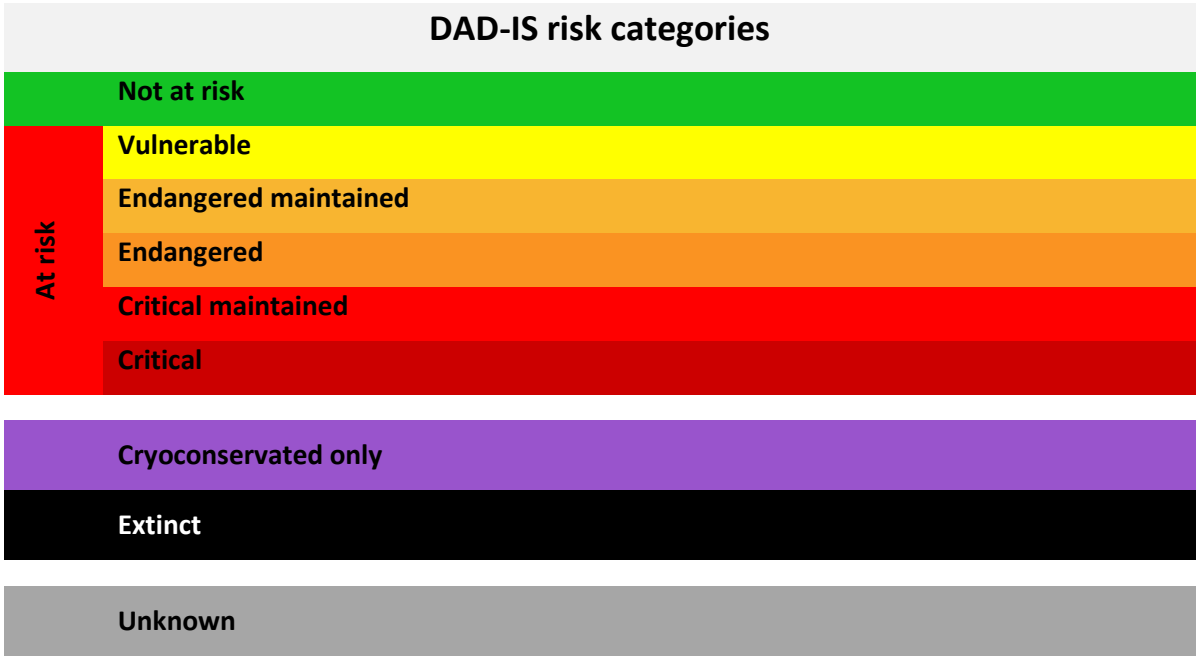
SDG Indicator 2.5.2 and DAD-IS Risk Classifications

Julian: *"What are the similarities between the two risk classifications?"*

Here are both classifications. You can see which of the DAD-IS Risk Categories are combined to form the SDG 2.5.2 "At risk" category.

"Cryoconserved only" and "Extinct" classifications are **not considered in SDG 2.5.2** because this indicator focuses on live animals.





Information and Data Collection

Julian: *"It seems that there is a lot of information and data that needs to be collected! How would you propose that we gather it all? "*

Riza: *"Since DAD-IS automatically calculates the indicators, we should look at the information and data that it needs. Let's start there."*

Information and Data in DAD-IS

DAD-IS stores various types of data on breeds, as listed below. To calculate the indicators, you need specific information on population data and conservation programmes.

General information

General information includes:

- Breed names;
- Breed uses;
- Breed classifications: exotic/locally adapted and local/transboundary;
- Risk classification;
- Images of these breeds.

Basic characteristics

Examples on the information on a breeds basic characteristics include:

- Origin and development: herdbook, description of origin and its location within the country.
- Qualitative information: distinctive traits, special qualities, specific resistance or tolerance, adaptability to specific environment.
- Morphology: wither height, weight and other specific visible traits (such as number of horns).
- Colours: including specific characteristics such as plumage, shank, and foot or egg shell colour, and visible patters.

Performance data

Information on a breeds performance includes:

- Birth weight;
- Age of maturity;
- Length of productive life;
- Parturition interval;
- Carcass weight;
- Milk;
- Prolificacy;
- Fibre (type of wool or hair, fibre diameter);
- Eggs;
- Management conditions when measured:
    - Management system;
    - Feeding of adults;

- Mobility.

Population data

Data on a breeds population includes:

- Number of breeding males and females;
- Trend;
- Herd size;
- Reliability of population data;
- Source of population data;
- *In-situ* conservation programmes.

This information is particularly important for SDG 2.5.2.

Conservation programmes

Information on conservation programmes includes:

For *in-vivo* programmes:

- Number of herds included in the programme;
- Location and geographical distribution in the country;
- Source of financing;
- Description of the programme;

For cryo conservation programmes:

- Number of sample for different genetic materials;
- Number of female and male donors according to the genetic materials;
- Whether the genetic material stored is considered as sufficient to reconstitute the breed.

This information is particularly important for SDG 2.5.1.

Organizations

Information on organizations includes institutions.

Publications

Information on publications provides further sources of information and support the data inserted in DAD-IS.

This information may be a website link or a published document. Don’t forget to insert the authors as well as the description of the source.

Information and Data Sources

Listed below are various sources that can provide you with the data and information needed to calculate both SDG indicators. These are also part of the **national coordinator's network**.

- **Conservation Trusts**
- **Genebank – especially for SDG 2.5.**
- **Breeders, farmers and livestock keepers' associations**
- **Universities and Research Institutes**
- **National Statistics Office and statistical divisions within ministries**
- **Government Units - such as Ministries of Agriculture and Environment**

You can see in the table below which information, method and institution can assist in calculating SDG Indicators 2.5.1 and 2.5.2.

	Information needed	Method used to collect information	Institution where you can get this information
2.5.1	Genetic data	Gene bank records	Gene banks
2.5.2	Population data	Livestock census, surveys or estimates based on various sources	Ministries of Agriculture/Environment, breeders' associations, etc.

Methods for Gathering Data for SDG 2.5.2

To collect information and data for **SDG Indicator 2.5.2,** you may need to use a series of methods. The FAO publication **Surveying and Monitoring of Animal Genetic Resources** provides guidelines on the following methods.

Mapping expedition - A trip to gather exploratory information about breeds of species in an area.

Breed search tour - An expedition to find breeds that are not yet recorded.

Transect - A technique adapted from wildlife surveys: it counts the animals along a line across an area.

Aerial survey - Taking photographs of a large area from an airplane to identify animal locations. Useful in sparsely populated pastoralist areas.

Household survey - Interviews using a questionnaire with a random sample of households. **This method also measures population size**.

Rapid appraisal - A set of participatory exercises with community members and key informants. Quicker and less structured than a household survey. **This method also measures population size**.

Group interview, group exercise - Interviews with a group, focus group discussion or discussion during a community meeting.

Key informant - In-depth interviews with well informed individuals. **This method also measures population size**. - **Breed societies**

Collecting data from breed societies and breeding groups. **This method also measures population size**.

Census - Regular (usually every 10 years) enumeration of livestock. Usually part of a larger agricultural census. **This method also measures population size**.

Surveying and Monitoring of Animal Genetic Resources:

www.fao.org/docrep/014/ba0055e/ba0055e00.pdf

SDG 2.5.2: Reliable sources and data

These are great questions that you may have been wondering about.

Julian: *"What are the most reliable sources of data? "*

Breed societies, and when available, breeds censuses, generally provide more reliable information on population data.

Riza: *"What do I do if I have raw estimate data? "*

In these cases, as a national coordinator, you can always insert this information/data into DAD-IS. The system allows you to indicate a range and an estimate of the data's reliability. This can be done when inserting information on a breed's population size.

Inserting data into DAD-IS

Riza: *"And all I have to do now is insert the information and data into DAD-IS. The system will then provide me with our country's SDG indicator values for the diversity of animal genetic resources. "*

Julian: *"Fantastic! I guess once they're inserted, you can submit our country's annual update to FAO on these indicators…"*

Riza: *"Not so fast! The indicators need to be analysed and presented in a report. We'll discuss this in the next lesson."*

Mini-lesson 2 – How to enter data into DAD-IS

This mini-lesson, for **national coordinators**, demonstrates how they can enter data in DAD-IS, and modify data on breeds in their country.

Data needed to calculate both SDG Indicators, 2.5.1 and 2.5.2 are also highlighted.

If you are a national coordinator and want more information, please email: dad-is@fao.org

Logging in

Start by going to the **DAD-IS website**. https://dadis-ws.firebaseapp.com/#/login

Log in by entering your email address and password.

If you need to request a new password, please email: dad-is@fao.org.

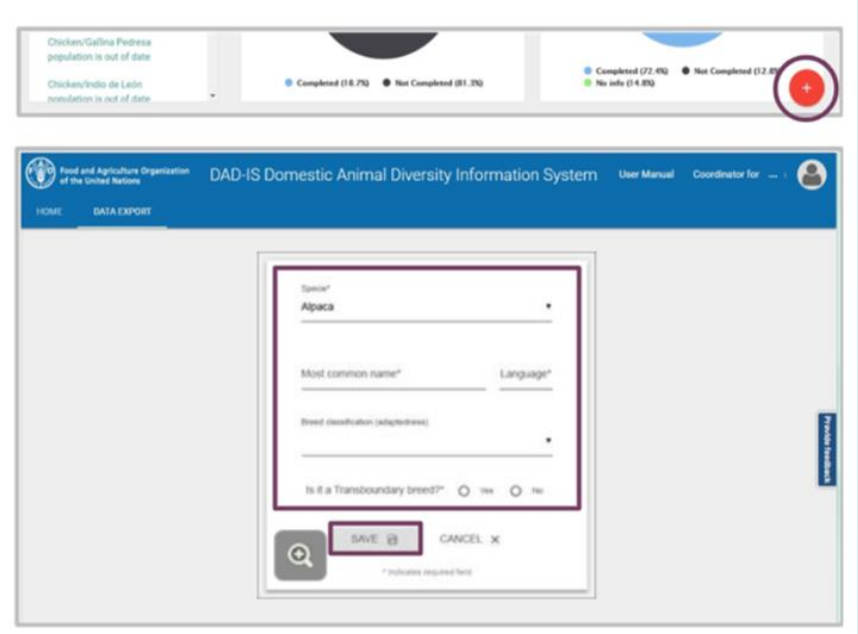
Home page

Below is your country's home page. It provides useful general information on the data inserted into DAD-IS. As you can see, once data are inserted, SDG Indicators 2.5.1 and 2.5.2 are automatically calculated and presented.

1) **List of breeds**: To view a list of existing breeds that have been inserted into DAD-IS, click on the green icon.

2) **Search**: You can view or update an existing breed by using this search bar.
3) **Notifications**: DAD-IS alerts you to any problems. These problems are found in the list of alerts and notifications regarding the breeds you have inserted into the system.
   For example, you will receive a notification when data are outdated.
4) **SDG Indicator 2.5.1**: This chart represents your country's status with regards to SDG Indicator 2.5.1.
5) **SDG Indicator 2.5.2**: This chart represents your country's status with regards to SDG Indicator 2.5.2.
6) **Completeness of Breed Data**: This chart shows the ratio of the filled data fields to all possible data fields of the records entered by one country.
7) **Completeness of population size data**: This chart refers only to population size data. "Not completed" means no population information, or data that are older than 10 years.
8) **Add a new breed**: Clicking on this button will allow you to add a new breed in DAD-IS. You will be provided with a list of species that the breed belongs to. Once selected you can insert more information on the breeds classification, population size, and other relevant data and information.

Adding and Editing Species and Breeds in DAD-IS

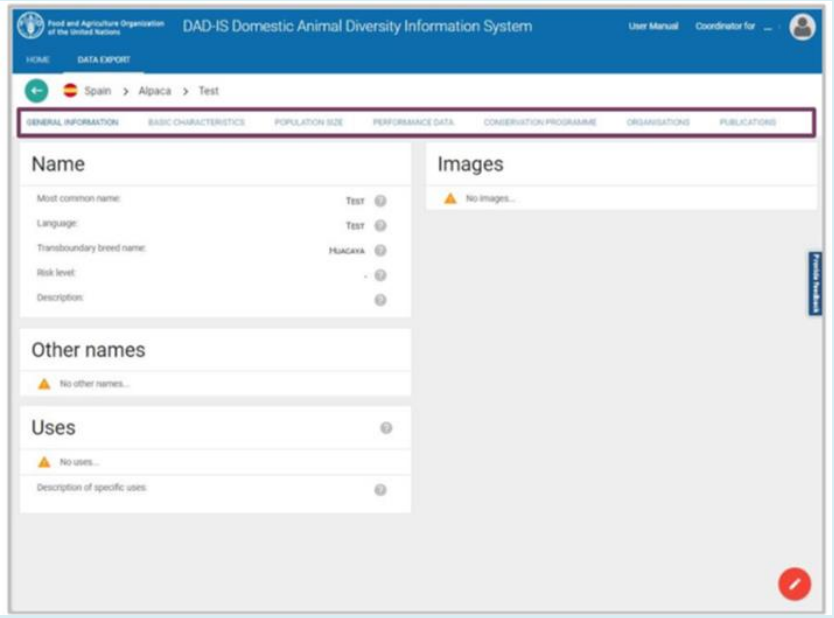


Step 1: Click on the red button on the homepage to add a new breed.

Step 2: Click on the downward arrow to select a species. Once selected, insert the following information:

- most common name;
- language;
- select breed classification; and
- identify whether or not it is a transboundary breed.

Step 3: Click on the "Save" button.



This page provides you with all the data in DAD-IS for a given breed.

The top bar shows the types of data, and categories that DAD-IS stores for breeds. It is recommended that you insert all data requested under these categories.

Step-by-step instructions on how to edit or add data to these categories:

Step 4: Select a category - e.g. "**Population size**".

Step 5: Click on the red icon to add or edit the data.

Step 6: You can now add or edit any data on this page. When you've finished, click on "**Save**".

Data in the "Population size" category is especially important for calculating SDG Indicator 2.5.2. Data in the "Conservation programme" category is especially important for calculating SDG Indicator 2.5.1.

Systematic Data Entry

You are now familiar with the basic use of DAD-IS.

As a national coordinator, you can choose how to enter the data: all in one go, or by making small additions and corrections throughout the year.

Recommendations

Here are two recommendations when entering data into DAD-IS.

1. **Entering data in a systematic way**

   Try to enter data in a systematic way: after a livestock census or data gathering exercise, collate the information and enter it all in one go.

   That will reduce the number of gaps and errors.

2. **Entering data on an *ad hoc* basis**

   You can also enter or correct data on an ad hoc basis.

   For example, if you recieve an update about a particular breed, or if you spot an error in the database.

Summary

- Editing and adding information in DAD-IS can only be done by a country's national coordinator.
- The homepage provides the following:
  - SDG Indicatiors 2.5.1 and 2.5.2 expressed in pie charts;
  - how complete is the data in DAD-IS; and
  - alerts and notifications on outdated data.
- Adding or editing data in DAD-IS is done simply using a six-step process.
- It is recommended that you enter data in a systematic or an *ad hoc* manner.

Things to remember

Before moving on, here are some key points that you should remember.

Riza: *"In order to submit our annual update to FAO for the SDGs it is important to **keep the data updated**. Having updated data is crucial because it enables DAD-IS to have **current information!** It is important to update our data **every year, or at least every two years**. We have to get **support from the Ministry and other branches of government,** so that we get the data we need.*
***As national coordinator I lead these efforts**. "*

Summary

Indicator 2.5.1 of the **Sustainable Development Goals** measures the number of cryoconserved specimens kept in liquid nitrogen in genebanks. These specimens include somatic cells, semen, oocytes and embryos.

Indicator 2.5.2 reports the risk status of breeds kept as live animals. "**At risk**" breeds may be vulnerable, endangered or at critical risk of extinction. Up-to date data are crucial for managing and reporting the conservation of animal genetic resources.

DAD-IS calculates these two indicators based on the information provided. This information can be gathered from various sources, including research institutes and breeders' associations.

National coordinators have responsibility for keeping information in this database up to date. This should be done at least every two years.