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# COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

## Item 4 of the Provisional Agenda

### INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE

#### Twelfth Session

Rome, 18 – 20 January 2022

### MONITORING THE DIVERSITY OF ANIMAL GENETIC RESOURCES

#### TABLE OF CONTENTS

	Paragraphs
I. INTRODUCTION .....	1-7
II. STATUS OF DAD-IS DEVELOPMENT .....	8-13
III. MONITORING RESOURCE INDICATORS OF THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES .....	14-27
A. SDG Indicator 2.5.1b (Number of animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities) .....	16
B. Estimation and monitoring of within-breed genetic diversity .....	17
C. SDG Indicator 2.4.1 (Proportion of agricultural area under productive and sustainable agriculture) .....	18-22
D. Population size thresholds used to identify breeds considered to be at risk of extinction .....	23-27
IV. GUIDANCE SOUGHT .....	28
Annex 1 Population size thresholds for assignment of breeds to currently used breed risk categories, according to species reproductive capacity .....	Page 8

## I. INTRODUCTION

1. The first strategic priority area of the Global Plan of Action for Animal Genetic Resources (GPA-AnGR)<sup>1</sup> refers to characterization, inventory and monitoring of trends and associated risks, being prerequisite for the efficient and sustainable use, development and conservation of animal genetic resources for food and agriculture (AnGR). The GPA-AnGR calls for strengthening global and regional information systems and networks for inventory, monitoring and characterization, including the Domestic Animal Diversity Information System (DAD-IS).<sup>2</sup> DAD-IS was established in 1996 as the primary tool for the recording of information on the world's livestock breeds.

2. At its Eighteenth Regular Session, the Commission on Genetic Resources for Food and Agriculture (Commission) requested FAO to further maintain and develop DAD-IS and to include in DAD-IS tools for visualizing data on the diversity of managed honey bees, and to investigate the potential integration of data fields related to: ecosystem services, production environment descriptors publicly available information on breeders, producers and breeding organizations; and genetic and genomic data and indicators of genetic diversity. The Commission requested FAO to develop a tool allowing automated translation of DAD-IS content provided by National Coordinators for the Management of Animal Genetic Resources (NC-AnGR) from and into English, French and Spanish and to investigate the feasibility of translation across all official UN languages.<sup>3</sup> The Commission invited countries to report national data on the diversity of managed honey bees to DAD-IS.<sup>4</sup>

3. The Commission noted the need for countries and FAO to raise awareness of the United Nations Statistical Commission on the necessity to broaden the scope of SDG Indicator 2.5.1b<sup>5</sup> to include all breeds registered in DAD-IS, to account for the entire spectrum of AnGR, and requested FAO to report the outcomes of this awareness raising to the Commission and its Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture (Working Group).<sup>6</sup>

4. The Commission requested FAO to continue providing technical support to countries on the estimation of breed population sizes and in updating their data in DAD-IS and to share with countries the methodology developed for collecting and estimating breed population data in a cost-efficient way.<sup>7</sup> The Commission also requested FAO to undertake, subject to the availability of financial resources, a feasibility study on the availability of, access to, and optimal use of genomic and/or breed demographic data to estimate parameters that may be suitable to complement breed population size data as indicators for monitoring the genetic diversity within livestock breeds.<sup>8</sup>

5. The Commission requested the Working Group to discuss, at its next session, the implementation and monitoring of SDG Indicator 2.4.1<sup>9</sup> and to identify synergies and discuss options for the effective use of this indicator as another tool for assessing the status of implementation of the Global Plan of Action.<sup>10</sup>

6. The Commission also requested FAO to investigate the rationale behind the population size thresholds used to identify breeds considered to be at risk of extinction and to present its findings to the next session of the Working Group.<sup>11</sup>

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<sup>1</sup> <https://www.fao.org/documents/card/en/c/dafd2e54-21d2-51cc-a79d-457fb447a11b>

<sup>2</sup> <https://www.fao.org/dad-is/en/>

<sup>3</sup> CGRFA-18/21/Report, paragraph 75.

<sup>4</sup> CGRFA-18/21/Report, paragraph 82.

<sup>5</sup> <https://unstats.un.org/sdgs/metadata/files/Metadata-02-05-01b.pdf>

<sup>6</sup> CGRFA-18/21/Report, paragraph 78.

<sup>7</sup> CGRFA-18/21/Report, paragraph 77.

<sup>8</sup> CGRFA-18/21/Report, paragraph 76.

<sup>9</sup> <https://unstats.un.org/sdgs/metadata/files/Metadata-02-04-01.pdf>

<sup>10</sup> CGRFA-18/21/Report, paragraph 71.

<sup>11</sup> CGRFA-18/21/Report, paragraph 77.

7. This document provides a summary of FAO's activities related to monitoring the diversity of AnGR since the Commission's Eighteenth Regular Session in 2021. The sections described herein are grouped into two major topics: (i) status of DAD-IS development; and (ii) monitoring resource indicators of the GPA-AnGR. The second group includes four sub-topics, (a) SDG Indicator 2.5.1.b; (b) within-breed genetic diversity; (c) SDG Indicator 2.4.1; and (d) thresholds for assigning breeds to categories for risk of extinction. More detailed information is provided in the information documents: *Status and trends of animal genetic resources – 2022*,<sup>12</sup> *Detailed report on the development of the Domestic Animal Diversity Information System*<sup>13</sup> and *Methods for estimation of within-population genetic variation*.<sup>14</sup>

## II. DAD-IS DEVELOPMENT

8. As requested by the Commission,<sup>15</sup> FAO maintained and further developed DAD-IS and increased its user-friendliness with Regular Programme resources. The activities included (i) development of DAD-IS tools for visualizing data on the diversity of honey-making bees managed for food and agriculture and broadening the scope of the respective data entry tool to allow entering of information on stingless bees, in line with the request of the Sixteenth Regular Session of the Commission to consider other pollinators in DAD-IS;<sup>16</sup> (ii) improvement of data entry procedures, and development of visualization tools related to ecosystem services and publicly available information on breeders, producers and breeding organizations; (iii) automatic language translation of DAD-IS content; (iv) improved interoperability with other databases; and (v) improved options for exporting metadata.

9. In addition to the development of the system, FAO provided technical support to countries to improve DAD-IS content. Technical support included a series of virtual training workshops held in July, September and November 2021, and November 2022, and continued translation of training materials into UN languages. Specifically, the videos on *How to use DAD-IS* and *Trends in risk status* were made available in French<sup>17</sup> and Spanish.<sup>18</sup> The publications *User Manual* and *Data entry: A quick guide for National Coordinators* were made available in Russian.<sup>19</sup>

10. A draft document on the methodology to estimate breed population sizes in a cost efficient way was developed, translated into French and Spanish and shared with all NC-AnGR for comments via e-mail on 29 September 2022, requesting their comments and suggestions for improvement. The document shared with the NC-AnGR is available as *Collection and estimation of population size data for risk classification in DAD-IS, A sampling methodology*.<sup>20</sup>

11. FAO continued to assist countries in accessing existing data, estimating population sizes and entering data into DAD-IS. During the reporting period, seven countries<sup>21</sup> received such direct support. Further, FAO collaborated with Apimondia, the International Federation of Beekeepers'

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<sup>12</sup> CGRFA/WG-AnGR-12/23/4/Inf.1.

<sup>13</sup> CGRFA/WG-AnGR-12/23/4/Inf.2.

<sup>14</sup> CGRFA/WG-AnGR-12/23/4/Inf.3.

<sup>15</sup> CGRFA-18/21/Report, paragraph 75.

<sup>16</sup> CGRFA-16/17/Report Rev.1, paragraph 46.

<sup>17</sup> <https://360.articulate.com/review/content/4489a6f3-8e14-4331-967b-14d3b5c97885/review> and <https://360.articulate.com/review/content/ff5b9a4e-8815-4d8a-bf9a-c9062779e42f/review>

<sup>18</sup> <https://360.articulate.com/review/content/5122dc89-525d-46aa-81c2-969a7072da6c/review> and <https://360.articulate.com/review/content/7b55836e-9bc3-47a5-bcc0-9586cd5ee32a/review>

<sup>19</sup> <https://www.fao.org/3/cb0697ru/cb0697ru.pdf> and <https://www.fao.org/3/cb0698ru/cb0698ru.pdf>

<sup>20</sup> [https://www.fao.org/fileadmin/user\\_upload/animal\\_genetics/docs/ITWG\\_12/other/Methodology\\_data\\_collecton\\_en.pdf](https://www.fao.org/fileadmin/user_upload/animal_genetics/docs/ITWG_12/other/Methodology_data_collecton_en.pdf)

<sup>21</sup> Algeria, Argentina, Indonesia, Libya, Mauritania, Morocco and Tunisia.

Associations,<sup>22</sup> to provide direct support to countries to collect and enter into DAD-IS data related to the diversity of bees managed for food and agriculture. Five countries in Asia and Africa received this support.<sup>23</sup>

12. FAO updated the data entry module of DAD-IS, giving NC-AnGR the possibility to indicate relevant uses of breeds and the ecosystem services to which they contribute by selecting check boxes that categorize the services as either provisioning, maintenance and regulating or cultural. By developing a simplified procedure for data entry, and offering support to upload data on breed uses and ecosystem services, FAO also helped to fill gaps in data on uses of breeds and their associated ecosystem services, as well as on the adaptedness classification of national breed populations. These options were made operational in June 2022, and by September 2022 forty-one countries had updated their data in DAD-IS.

13. To improve the interoperability of national and regional databases with DAD-IS and to facilitate research on the links between breed genotypes, environments and phenotypes, the DAD-IS breed list was shared with the managers of the Online Mendelian Inheritance in Animals (OMIA) database.<sup>24</sup> This will allow the two systems to be syntactically interoperable. Breed names were standardized so that the names in OMIA match those in DAD-IS. This standardization will allow users of both systems to easily combine information from the two sources.

### **III. MONITORING RESOURCE INDICATORS OF THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES**

14. The document on the *Status and Trends of animal genetic resources – 2022*<sup>25</sup> reconfirms that breed-related information remains far from being complete. This is the case despite the fact that the Commission, at its Sixteenth,<sup>26</sup> Seventeenth,<sup>27</sup> and Eighteenth,<sup>28</sup> Regular Sessions, stressed the need for countries to regularly update their national data in DAD-IS. Among the 8 859 breeds (local and transboundary) reported in DAD-IS, 26 percent are currently classified as being at risk of extinction; 13 percent are classified as not at risk; 54 percent have unknown risk status and 7 percent are reported to be extinct. The proportion of breeds with unknown status for risk of extinction has remained relatively stable since 2020.

15. As of September 2022, data had been reported by 25 countries on 53 managed bee species or subspecies. Among these 25 countries, 14 provided estimates on the number of colonies for 26 species and subspecies, thus providing the basis for monitoring of their genetic diversity. Regional aspects of diversity of managed bees were considered in the work undertaken, by the previously mentioned decision to open DAD-IS for entering data on stingless bees. Despite these activities, the current amount and geographical coverage of data is not yet sufficient for informing the development of regional or international policies and strategies to sustain the genetic diversity of managed bees.

#### **A. SDG Indicator 2.5.1b (Number of animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities)**

16. Upon consultation with internal and external experts, FAO prepared a document proposing the broadening of the SDG Indicator 2.5.1b, to include all breeds registered in DAD-IS. This document

<sup>22</sup> <https://www.apimondia.org>

<sup>23</sup> Botswana, Lesotho, Philippines, Thailand and Vietnam.

<sup>24</sup> <https://omia.org/home/>

<sup>25</sup> CGRFA/WG-AnGR-12/23/4/Inf.1.

<sup>26</sup> CGRFA-16/17/Report/Rev. 1, paragraph 46.

<sup>27</sup> CGRFA-17/19/Report, paragraph 89.

<sup>28</sup> CGRFA-18/21/Report, paragraph 78.

was formally approved by the Inter-agency and Expert Group on SDG Indicators (IAEG-SDG).<sup>29</sup> DAD-IS has been amended accordingly to allow reporting on SDG Indicator 2.5.1b for all breeds registered in DAD-IS (available online as of December 2022).

## **B. Estimation and monitoring of within-breed genetic diversity**

17. In September, FAO, in cooperation with the University of Natural Resources and Life Sciences, Vienna, Austria (BOKU), convened a group of experts from multiple regions of the Working Group, to consider a feasibility study on the availability of, access to, and optimal use of genomic, pedigree and/or breed demographic data. As requested by the Commission, the study aimed to estimate parameters to complement breed population size data as indicators for monitoring the genetic diversity within livestock breeds. The results of the expert meeting are provided in the document *Methods for estimation of within-population genetic variation*.<sup>30</sup> The expert group proposed the utilization of the parameter “effective population size” as an indicator for within-population genetic variation, which can be estimated by using either demographic, pedigree or genomic data. A minority of national breed populations currently have data required for reliable estimates of these parameters. Additional research would be required to develop and refine a provisional set of indicators for reporting information in DAD-IS.

## **C. SDG Indicator 2.4.1 (Proportion of agricultural area under productive and sustainable agriculture)**

18. The SDG Indicator 2.4.1 covers only agricultural holdings (as statistical units). The indicator addresses sustainable agriculture across the three dimensions of sustainable development: (i) environmental, (ii) economic, and (iii) social. Eleven themes are defined across the dimensions, each of which has a sub-indicator. The recommended source for collecting data for these sub-indicators is a farm survey; the indicator is first assessed at farm level and then aggregated at national level.

19. The environmental dimension includes a theme on biodiversity. The sub-indicator for this theme is entitled “use of agro-biodiversity-supportive practices” and measures the level of adoption by the farm of sustainable agricultural practices that better contribute to biodiversity at ecosystem, species and genetic levels; both livestock and crops are considered. Among the criteria considered to reflect sustainable agricultural practices is the presence of locally adapted breeds. The recommended survey module for collecting this data item requests respondents to provide a list of the different breeds and crossbreeds on the farm and the numbers of animals for each animal species and breed.

20. At its Fourteenth Regular Session, the Commission had invited countries to provide information on how their breeds recorded in DAD-IS should be assigned to the categories “exotic” and “locally adapted” for the purpose of calculating the resource indicators and to give countries the option of indicating that a given locally adapted breed is native to the respective country<sup>31</sup>.

21. While there may be possible synergies between monitoring SDG Indicator 2.4.1 and indicators for monitoring the implementation of the Global Plan of Action, it should be noted that countries face serious challenges related to data collection for SDG indicator 2.4.1. Currently, no country data have been published on SDG indicator 2.4.1. A first, limited set of country data is expected to be published in the first half of 2023. The IAEG-SDGs agreed in March 2022 to include into the metadata description of SDG indicator 2.4.1 the definition of “locally adapted breed” to help ensure consistency of terms.<sup>32</sup> Discussions are ongoing on how breed information can be collected using farm surveys in a feasible manner, taking into account the expertise needed to identify a breed in the field.

<sup>29</sup> <https://unstats.un.org/sdgs/iaeg-sdgs/>

<sup>30</sup> CGRFA/WG-AnGR-12/23/4/Inf.3.

<sup>31</sup> CGRFA-14/13/Report, paragraph 31 and CGRFA/WG-AnGR-7/12/Inf.7.

<sup>32</sup> <https://unstats.un.org/sdgs/metadata/files/Metadata-02-04-01.pdf>

22. The decision to use the definition of “locally adapted breed” for reporting on SDG Indicator 2.4.1 further underlines the need for countries to classify their national breed populations in terms of adaptedness and to enter this information into DAD-IS. Currently, more than 50 percent of breeds are unclassified for adaptedness in DAD-IS.

#### D. Population size thresholds used to identify breeds considered to be at risk of extinction

23. As requested by the Commission, FAO investigated the rationale behind the population size thresholds used to identify breeds considered to be at risk of extinction. As validated, experiment-based methods have not been available, the thresholds were established 30 years ago on the basis of expert consultations and subsequently developed further. The thresholds were always established in consultation with FAO Members. The first set of thresholds was presented at an FAO Expert Consultation held in Rome in September 1989<sup>33</sup> and was based on five categories with increasing risk status: Normal (i.e. not at risk), Insecure, Vulnerable, Endangered and Critical. The four respective population size thresholds separating the five categories were 10 000, 5 000, 1 000 and 100 animals (i.e. 100 was the upper threshold for Critical and the lower threshold for Endangered categories). As noted, the categories and thresholds were based on the literature and not experimentally proven; their rationale was that risk of extinction increases exponentially as population size decreases. The names of the categories were similar to those used by the International Union for the Conservation of Nature (IUCN) for its Red List of Threatened Species, which was established in 1964.<sup>34</sup>

24. In 1992, another FAO Expert Consultation<sup>35</sup> recommended the publication of a world watch list of threatened breeds and proposed that the term “Rare” be used instead of “Insecure”. On this basis, FAO published the first edition of the *World Watch List for Domestic Animal Diversity*<sup>36</sup> in 1993. For practical reasons (primarily a lack of data), however, the document included only Critical and Endangered breeds, whereas the Vulnerable and Rare/Insecure categories were essentially discontinued. The category “Extinct” was also introduced. The second edition of the *World Watch List for Domestic Animal Diversity*<sup>37</sup> added the modifier “Maintained” to create subsets of the Critical and Endangered categories to distinguish populations for which active conservation programmes were in place.

25. The classification categories used for the World Watch Lists remained in place until the endorsement by the Commission of the FAO guidelines on *In vivo conservation of animal genetic resources*<sup>38</sup> in 2013.<sup>39</sup> These guidelines were developed through expert and regional consultations and reviewed by the Working Group at its Seventh Session. The guidelines established changes to the system of thresholds. First, the guidelines recommended the reintroduction of a “Vulnerable” category, in line with the original proposal presented in 1989, although with an upper threshold of 2 000. Second, a change was made to account for the fact that, among populations of the same census size, species of “low reproductive capacity” (i.e. with an average of one or two offspring per parity) are at a greater risk of extinction than species producing greater numbers of offspring. The existing thresholds were considered to be applicable for the species bearing multiple offspring. For species of

<sup>33</sup> Bodó, I. 1990. Methods and experiences with in situ preservation of farm animals. In: G. Wiener, ed. *Animal genetic resources – A global programme for sustainable development*. FAO Animal Production and Health Paper, No. 80. Rome. [www.fao.org/3/a-t0284e.pdf](http://www.fao.org/3/a-t0284e.pdf)

<sup>34</sup> <https://www.iucnredlist.org/>

<sup>35</sup> Hodges, J., ed. 1992. *The management of global animal genetic resources*. FAO Animal Production and Health Paper, No. 104. Rome. [www.fao.org/3/t0665e/T0665E00.htm](http://www.fao.org/3/t0665e/T0665E00.htm)

<sup>36</sup> Loftus, R. & Scherf, B., eds. 1993. *World Watch List for Domestic Animal Diversity*. FAO. Rome.

<sup>37</sup> Scherf, B.D., ed. 1995. *World Watch List for Domestic Animal Diversity* [Second edition]. FAO. Rome. [www.fao.org/3/x6197e/x6197e.pdf](http://www.fao.org/3/x6197e/x6197e.pdf)

<sup>38</sup> FAO. 2013. *In vivo conservation of animal genetic resources*. FAO Animal Production and Health Guidelines, No. 14. [www.fao.org/3/i3327e/i3327e.pdf](http://www.fao.org/3/i3327e/i3327e.pdf)

<sup>39</sup> CGRFA-14/13/Report, paragraph 60.

“low reproductive capacity”, the thresholds were set greater, by a factor of three (i.e. upper thresholds were, Critical: 300, Endangered: 3 000, and Vulnerable: 6 000). A third change consisted of the introduction of a “Cryoconserved only” category for those breeds with no viable *in situ* populations, but with sufficient material stored in gene banks to allow their reconstitution.

26. The new risk classification system was made operational with the launch of the fourth version of DAD-IS in 2017. Annex 1 provides the overview of current risk categories and thresholds.

27. In conclusion, the rationale behind the population size thresholds used to identify breeds considered to be at risk of extinction has its basis in expert knowledge, rather than experimental evidence. Expert driven methods are by far the most commonly used approach for setting thresholds for conservation management (Hilton *et al.*, 2022).<sup>40</sup>

#### IV. GUIDANCE SOUGHT

28. The Working Group is invited to review the progress made in the development of DAD-IS and in monitoring AnGR and may wish to recommend that the Commission:

- stress the importance of DAD-IS as the international clearing-house mechanism for AnGR;
- request FAO to continue to provide Regular Programme and technical support to further maintain and develop DAD-IS and to continue to increase its user-friendliness, including tools that facilitate data entry and updating, and storage and visualization of geographic distributions of national breed populations;
- stress the need for countries to regularly update their national data in DAD-IS, especially the data pertaining to breed adaptation classifications and to bees managed for food and agriculture, to ensure that decisions on the implementation of the Global Plan of Action for Animal Genetic Resources and achievement of SDG Targets 2.4 and 2.5 are informed by the most up-to-date data and information available;
- request FAO to continue to develop and/or refine cost-efficient methodologies for the estimation of the sizes of national breed populations, and to provide technical support to countries in estimating breed population sizes and other data relevant to monitor the diversity of livestock breed and managed bee populations; and
- request FAO to continue to study, develop and refine genomic, pedigree and/or demographic indicators of within-population genetic diversity and to propose related data fields for DAD-IS, for consideration by the Working Group at its next regular session.

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<sup>40</sup> Hilton, M., Walsh, J.C., Liddell, E. & Cook, C.N. 2022. Lessons from other disciplines for setting management thresholds for biodiversity conservation. *Conservation Biology*, 36(1):e13865. <https://doi.org/10.1111/cobi.13865>

**Annex 1****Population size thresholds for assignment of breeds to currently used breed risk categories, according to species reproductive capacity.**

Risk category	Species reproductive capacity			
	High <sup>a</sup>		Low <sup>b</sup>	
	Lower threshold	Upper threshold	Lower threshold	Upper threshold
Critical	0	≤100	0	≤300
Endangered	>100	≤1 000	>300	≤3 000
Vulnerable	>1 000	≤2 000	>3 000	≤6 000
Not at risk	>2 000	∞	>6 000	∞

<sup>a</sup> Cassowary, Chicken, Chilean Tinamou, Dog, Duck, Emu, Goose, Guinea fowl, Guinea pig, Nandu, Ostrich, Partridge, Peacock, Pheasant, Pig, Pigeon, Quail, Rabbit, Swallow, Turkey

<sup>b</sup> Alpaca, Ass, Bactrian camel, Buffalo, Cattle, Deer, Dromedary, Goat, Guanaco, Horse, Llama, Sheep, Vicuña, Yak