WORKSHOP REPORT
"ASSESSMENT OF ANIMAL GENETIC RESOURCES CHARACTERIZATION, INVENTORY AND MONITORING TOOLS TO GUIDE REVISION AND HARMONIZATION PROCESSES"

DAR-ES-SALAAM

TANZANIA

African Union InterAfrican Bureau for Animal Resources (AU-IBAR)

AFRICAN UNION
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES
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Assessment of Animal Genetic Resources Characterization, Inventory and Monitoring tools to guide revision and harmonization processes

Report of the workshop of the Genetics project

AnGR
Animal Genetic Resources

Dar-es-Salaam, Tanzania
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Table of Contents

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We further extend our gratitude to our implementing partners (ILRI, BeCA and CIRDES) who worked tirelessly to ensure a successful workshop. We are confident that through this collaboration, the set-out objectives will be achieved.

Acronyms

AnGR	Animal Genetic Resource
APU	Animal Production Unit
AU	African Union
AU-IBAR	African Union-Interafrican Bureau for Animal Resources
APRI	Animal Production Research Institute
ARC-API	Agriculture Research Council - Animal Production Institute
BeCA	Biosciences eastern & central Africa – ILRI Hub
CBD	Convention on Biological Diversity
CIRDES	Centre International de Recherche-Dévelopment sur l'Elevage en zone Subhumide
FAO	Food and Agriculture Organization
FGD	Focus group discussions
GPA	Global Plan of Action
HH	Household Head
ICT	Information and communications technology
ILRI	International Livestock Research Institute
ISRA-LNERV	Institut sénégalais de recherches agricoles-Laboratoire National d'Elevage et de Recherches Vétérinaires
ITRA	Institut Togolais de Recherche Agronomique
KALRO	Kenya Agricultural and Livestock Research Organisation
MS	Member States
NAGRC&DB	National Animal Genetic Resource Centre and databank
NARO	National Agricultural Research organization
NALIRI	National Livestock Resources Research Institute
NM-AIST	Nelson-Mandela African Institute of Science and Technology
PEDs	Production Environment Descriptors
RAB	Rwanda Agricultural Board
RECs	Regional Economic Communities
SWOT	Strengths, Weaknesses, Opportunities and threats analysis

Executive summary

The workshop on "**Assessment of Animal Genetic Resources Characterization, Inventory and Monitoring tools to guide revision and harmonization processes**" was organized and conducted in Giraffe view hotel, Dar-es-Salaam, Tanzania from the 25th-27th of September 2014. This workshop was organized under **Result 4 Activity 1** "*Develop harmonized tools/protocols for characterization and inventory of AnGR*" under the AU-IBAR genetics project "**Strengthening the Capacity of African Countries to Conservation and Sustainable Utilization of African Animal Genetic Resources**". The project through the above mentioned activity aims at building consensus on methodologies and tools for characterization and inventory of AnGR between AU member states. The project intends to assist countries and Regional Economic Communities (RECs) in the production of inventories and characterization of AnGR, so as to ensure homogeneity of data and easier compilation through the utilization of harmonized tools.

To achieve this key activity, an in-depth assessment of all existing characterization and inventory tools/protocols of AnGR was undertaken during the above mentioned workshop. The workshop enabled participants to establish the extent of usage of the existing tools/protocols in member states, their strengthens and weaknesses in relation to characterization and taking inventory of African AnGR. The most pressing issues that were raised in relation to some of the tools in use were; being too costly, lack of technical capacity, poor infrastructure, lack of relevant equipment and lack of co-ordinated/synchronised efforts. There were evidently key strengths highlighted including robustness and dynamism, easily available and user friendly. In addition, the opportunities raised were of great importance, there seemed to be a unanimous agreement that we need to embrace information and communication technology (ICT) and improve on training that will promote awareness and effective usage.

Through intensive deliberations and thought provoking sessions held, key areas of revision or improvement for the selected tools were identified , for the phenotypic tools, seven main categories were shortlisted being Morphometric, Environmental, Production and reproduction, Adaptive, Socio-economic, Biological samples and indigenous knowledge. These categories were further populated with various data collection aspects as clearly defined in the report. Single Nucleotide Polymorphisms (SNPs) were identified as the molecular genetic characterization tool of choice for Africa. For the improved utilization of this tool, increased capacity building through training in genetic data generation, genetic data analysis and interpretation was fronted as the most strategic approach. For the inventory tools, participant unanimously agreed to the adoption of the livestock surveys as the recommend inventory tool for use in Africa.

Through this workshop, a well-defined roadmap was also developed to chart out the way forward in terms of revision of the selected tools, pre-training and subsequent piloting so as to have robust tools before the final presentation to the member states and various stakeholders for validation. The consensus was that this entire process should be an African led process by AU-IBAR and her collaboration with various relevant partners and stakeholders.

Introduction

Africa is home to a world of diverse Animal Genetic Resources displaying a vast range of Darwinian adaptations that continually evolve due to the ever-changing ecosystems. These Animal Genetic Resources (AnGR) for food and agriculture are essential for Africa's food security, and contribute to the livelihoods of millions of people within and without the continent. It is critical that these resources are effectively managed by ensuring a deeper understanding of their population dynamics, status and trends and spatial distribution. Characterization, surveying and monitoring have remained key elements in the development of effective AnGR management plans and emphasis should be placed on certifying that these critical processes are well executed. Knowledge on population trends and genetic status of livestock populations informs breeding strategies, conservation programs and policy-making processes. This information is vital at local, national, regional and global levels.

The evident gap in relation to the availability of relevant and reliable data on population status and trends of African AnGR, has consequently resulted to misinformed decisions and poor management of AnGR within the African continent. The use of molecular tools for characterization is limited in Africa mainly due to lack of technical skills and availability of the biotechnology equipment. Evidently, poor utilization of characterization, inventory and monitoring tools has contributed largely to this present situation. The ever-present challenges faced by users within the African continent need re-address. There is an urgent need to seek sustainable solutions that will ultimately promote the improved utilization of these tools within Africa.

AU-IBAR is currently implementing a project "**Strengthening the Capacity of African Countries to Conservation and Sustainable Utilisation of African Animal Genetic Resources**". The project aims at strengthening the capacity of countries and Regional Economic Communities to sustainably use and conserve African animal genetic resources through institutionalising national and regional policy, legal and technical instruments. The project will strengthen the inherent capacities of Regional Economic Communities (RECs) and the end-users at community level to improve the utilization of AnGR and rural livelihoods through:

- Establishment of the status and trends of animal genetic resources in Africa.
- Development of Policy frameworks for the sustainable use of AnGR.
- Supporting and strengthening national and regional conservation and improvement strategies and initiatives
- Increasing knowledge, attitude and practice of the contribution of livestock and livestock sector to economic growth, food security and poverty reduction.

In relation to AU-IBAR genetics project - **Result 4 Activity 1 "Develop harmonized tools/protocols for characterization and inventory of AnGR"**. The Genetics project intends to assist countries and RECs in the production of inventories and characterization of AnGR, so as to ensure homogeneity of data and easier compilation through harmonization of standard tools (guidelines, protocols,

templates for data collection etc.). These harmonized tools will be produced and validated before dissemination to Member States.

To achieve this key activity, an in-depth assessment of all existing characterization and inventory tools/protocols of AnGR needed to be undertaken in order to establish the extent of usage of the existing tools/protocols within member states, their strengthens and weaknesses in relation to characterization and taking inventory of African AnGR. The outcome of the deliberations was to further inform the next steps of either revision/refinement or harmonization of characterization and inventory tools/protocols.

To set this in process in momentum a prior e-discussion "**Improving the utilization of Animal Genetic Resources characterization, inventory and monitoring tools in Africa**" was organized from the 17th of July- 30th August 2014 to lay the foundation. The outcomes from this interactive e-discussion were used as fodder in the just concluded technical workshop "**Assessment of existing characterization, inventory and monitoring tools to guide revision and/or harmonization processes**" held in Dar-es-Salaam on 25th – 27th September 2014.

The overall objective of the workshop is to assess and review the existing animal genetic resources characterization, inventory and monitoring tools/protocols so as to improve their utilization in Africa.

The specific objectives of the workshop were to:

1. Assess the existing characterization and inventory tools/protocols,
2. Design a strategy to improve the utilization of the existing characterization and inventory tools/protocols to better estimate population size and monitor breed dynamics
3. Agree on and draft an outline of roles and responsibilities of key actors.

The participants comprised mainly of technical experts stationed in livestock ministries, National, Regional and International research and training organizations/institutions. Additional technical experts drawn from international organizations were also in attendance. The workshop was attended by a total of 37 participants drawn from 22 African countries; Algeria, Burkina Faso, Burundi, Cameroun, Democratic Republic of Congo, Egypt, Republic of Central Africa, The Gambia, Ghana, Gabon, Cote d'Ivoire, Kenya, Nigeria, Uganda, Togo, Tunisia, Tanzania, Malawi, Rwanda, Senegal, Sudan, South Africa, being representatives of the five economic regions (Eastern, Central, West, Northern and Southern). The various organization represented in the workshop included, CIRDES, ILRI, BeCA, NAGRC&DB, KALRO, ITRA, ISRA/LNERV, APRI, NARO, ARC-API-South Africa, Rwanda Agriculture Board (RAB), the Nelson-Mandela African Institute of Science and Technology (NM-AIST)-Tanzania, University of Tlemcen-Algeria, Nassarawa State University-Nigeria, University of Burundi, University of Koudougou-Burkina Faso, University of Dschang-Cameroon, University of Ghana, University of Education, Winneba-Ghana, Makerere University-Uganda, ESA de Mateur - University of Carthage-Tunisia, University Felix Houphouet Boigny-Cote d'Ivoire; Central African Agricultural Research Institute.

This document summarizes the discussions and deliberations that took place during the workshop aimed at improving utilization of AnGR characterization, inventory and monitoring tools. Attached in the annexes are each of the working groups; SWOT analysis for the phenotypic, molecular genetics and inventory tools, proposed suitable tools and the proposed revisions/improvements for the identified suitable tools. In addition, the developed roadmap and list of participants are herein.

Workshop proceedings

Opening ceremony

The opening session was facilitated by Dr. Pissang Tchangai, the Project Officer under the Genetics project and co – facilitated by Dr. Felix Meutchieye. He proceeded to introduce and welcome the Genetics project's technical Assistant – Dr. N'Guetta Bosso who was representing the director General of AU-IBAR – Prof. Ahmed El-Sawalhy, the Acting Permanent Secretary in the Ministry of Livestock and fisheries departments – Dr. Yohana Budeba who was representing the Minister, Dr. Titus Mlengeya Kamani and the Tanzanian National Co-ordinator for Animal Genetic Resources, Dr. Yakobo Msanga.

In his welcome remarks, Dr. Bosso, on behalf of the director of AU-IBAR, extended sincere greetings to all participants to the Workshop. He further extended special thanks and appreciation to the government of the United Republic of Tanzania for accepting to be the host of this workshop. He noted that worldwide efforts are being made to conserve and use genetic resources in a sustainable way and AU-IBAR, has also engaged in the field of sustainable utilization of genetic resources which includes conservation. He emphasized on the knowledge gap in characterization, inventory and monitoring, especially of African AnGR and recalled the objectives of the workshop. He mentioned that it would provide a practical platform to undertake a thorough assessment on the degree of adoption of the existing FAO guidelines. He then wished the participants fruitful deliberations towards achieving the workshop's set out objectives.

Dr. Budeba, on behalf of the Minister of Livestock and Fisheries Development, Dr. Titus Mlengeya Kamani, extended a warm welcome to all the participants in the workshop and expressed his appreciation to AU-IBAR for having chosen Tanzania to host the workshop. He emphasized on the significant contributions livestock make towards food security, livelihoods and being the key drivers of wealth creation and economic development in many African countries. Despite their valuable contributions, budgetary allocations to the sector continue to be relatively low compared with other sectors. One of the major reasons for this is the lack of information and appreciation of these valuable Animal Genetic Resources, particularly by policy and decision makers, and especially their contribution to national economies. He mentioned that characterization, surveying and monitoring are key elements in the development of effective AnGR utilization and management plans. He felt positive that the workshop deliberations would contribute to improvements in data collection and subsequent knowledge and information on AnGR status and trends. He affirmed the commitment

of the Federal Republic of Tanzania to this noble cause and took the opportunity to express sincere gratitude to AU-IBAR for its continual support. He concluded by declaring the workshop opened and wished the participants success in their deliberations.

Adoption of workshop programme

Dr. Pissang Tchangai presented the workshop agenda (see Appendix A) that comprised of two main methodologies being introductory presentations and working groups' sessions on SWOT analysis of characterization (phenotypic and molecular tools), inventory and monitoring tools and implementable strategies to be adopted for the improved utilization of AnGR tools. The Agenda was adopted without amendments.

To conclude the first session of the workshop, he facilitated the introduction of all the participants followed by a group photo.

Workshop Format and Plenary Sessions

The workshop format was a combination of presentations which included giving a general overview of the tools under discussion for the respective sessions mainly to provide a common perspective to all the attendees. Breakout sessions were undertaken to enable detailed and interactive discussions guided by the respective session's queries on various aspects of characterization and inventory tools/protocols in Africa. Brief plenary sessions were held to share the complied group discussions with the larger audience.

Presentations

Phenotypic characterization tools

A brief presentation capturing the general overview of phenotypic tools, uses, constraints and challenges was given by Dr. Mwai Okeyo, Principal Scientist at International Livestock Research Institute.

The presentation captured details of the phenotypic characterization toolkit which encompassed Carefully coded and tested questionnaire (preferably ODK-incorporated in mobile phone), weigh band/weigh scale, tripod, identification systems, high resolution cameras, tape measure and background screen cloth for photography, GPS reader and area map, Bar-coded vaccutainers or plastic envelopes (in duplicates, Barcode readers, a lap top and right protective clothing and foot gear. He highlighted various bad practises that have often resulted to the misinterpretation of phenotypic characterization as well as shared views on why we need to harmonize AnGR tools and how. He spoke of key aspects that need to be harmonized included; the sampling frame and the related procedures, tools (questionnaire designs, design, questions, training of enumerators), the toolkit, the time frame (how long? how often? should be addressed) and clearly outlined reporting format. He also emphasised on the need to manage data through the establishment of a regional or

national database. The farmer centric database should include the synchronization of coding to avoid ambiguity, software that can crosstalk, standardized photography and ensure that there are data back-ups put in place. Currently, a farmer centric and real-time data collection system known as the ng'ombe planner is being utilized in ILRI. It captures information on Production data, Reproduction events, Sickness and has a farmer feedback system on Animal husbandry tips, Farm management tips, Reminders, Notifications and Retrieval of recorded data. This recording system is available on telephones.

In his presentation, Dr. Mwai Okeyo concluded with emphasis on key points that would assist in the improved utilization of phenotypic tools;

- The sampling process is critical and the right tools should be used, he proposed the use of already domesticate global tools. Through the adoption of these tools the reduction of secondary errors is minimized.
- Another key point was that the tools for data collection should be simplified and should not be too demanding as this only makes the farmers avoid using the tools. The main pointer here was to get the farmers on-board by allowing them to be part and parcel of the characterization process. Development of user-friendly tools would be the most suitable way to go. For example do not overburden farmers/ herders with too many records, monthly milk production records would be a good start-off point.
- Elaborate and well-co-ordinated data systems should be in place to ensure effective data flow and with excellent features that will allow cross talking with other established databases or users. Adequate storage space should be availed. If Africa is moving towards large scale genomic data generation this is a prerequisite.
- Enumerators should be well trained. This is a very critical aspect of accurate data collection. The tools may be right but the application of the tools if wrong will result to dire consequences.
- If we are to make an impact with the improved utilization of the tools, then the focus should begin from the very foundation of any activity. For example to implement a robust breeding program, characterization should form a core part of this activity.
- The other critical issue, he raised was that genomics through a versatile tool should be well supported by the availability of accurate phenotypic information. The complementation of these two tools is very important.

Molecular genetic characterization tools

Dr. Guiguigbaza-Kossigan Charles Dayo (CIRDES) and Prof. Morris Agaba (BeCA) presented key presentations on second generation and third generation molecular characterization tools respectively. The presentations captured issues of what has been used, what is yet to be adopted and opportunities available. They both raised similar concerns that the tools have not been fully utilized due to lack of financial capacity and technical skill in the continent. They then proceeded to share key solutions to some of the problems.

Dr Dayo of CIRDES, emphasized on the primary need to accurately capture data as this was the first step towards precise characterization of animal populations especially with regard to integrating phenotypic features with molecular genetic results. To be able to achieve this, there is need to strengthen capacity building of all stakeholders including farmers, scientists, universities personnel and policy makers. Dr. Dayo also emphasized on the need to ensure good data analysis is carried out. He voiced his concern on the lack of well-trained molecular data analysts and highlighted that this has continued to be a major drawback in the identification of key findings that will shape conservation strategies in the continent.

Prof. Morris Agaba shared important research outcomes that have been realized through the use of various third generation molecular genetic tools such as Exon sequencing. Various peaks of interest have been identified through undertaking signatures of selection analysis. For example, during his presentation he drew our attention to some Manhattan plots that revealed peaks indicative of selection located on the same genomic regions across the indigenous pig, warthog and bush pig. This could be interpreted as areas of genomic importance associated with disease resistance. These peaks were absent in the exotic pig breeds. Evidently, there is need to identify signatures of selection for various traits of interest in Africa's AnGR.

An associated microbial diversity approach was also highlighted with emphasis placed on the opportunities such as matching of microbial genotypes to host genotypes and their contribution towards mitigation of climate impacts etc.

Prof Agaba highlighted key opportunities that may bring change, these included;

- Focusing on organizations – identify who is who, doing what and where. This way we can forge alliances that will be instrumental in the improved utilization of molecular genetic tools in Africa

- Secondly, building capacities by sourcing for funding, this will not only include the development of people capacities but also develop infrastructure and equipment.

- Africa should unite and forge towards a bold African effort that will mainstream AnGR management into the production chain, trade, health and breeding.

Inventory and monitoring tools

Dr. Abdulmojeed Yakubu, from Nassarawa State University (Nigeria), spoke in depth of the numerous inventory and monitoring tools, those currently in use in Africa and the various shortcomings of each inventory tool in relation to the African situation.

This presentation highlighted that primary inventories may be undertaken through extension workers, farmers organizations, bottom-up form communities (basically focussing on the grass-root level or rural farmers).

The conclusion arrived at was that most African states have not been involved in the extensive collection of livestock data this has mainly been attributed to the lack of financial abilities. The quality of the available data is questionable based on the completeness and accuracy.

The presenter proposed the use of an integrated approach for inventory and monitoring that would involve systematic and accurate use of spatial, air and ground survey techniques as opposed to national livestock census.

SWOT analysis (E-discussion outcomes)

Dr. Mary Mbole-Kariuki presented the e-discussions SWOT analysis outcomes emanating from the just concluded e-discussion entitled "**Improving the utilization of Animal Genetic Resources characterization, inventory and monitoring tools in Africa**" ran form 17th of July to 31st of August 2014 hosted on the AU- Animal Resources Information System (ARIS) platform. The core participants of the e-discussion included technical experts drawn from within and without the African continent.

The e-discussion undertook an in-depth analysis of the tools in use within the continent and identified their strengths and weaknesses.

Phenotypic tools: For the phenotypic tools, the tools that underwent SWOT analysis were the Production Environment Descriptors (PEDs) and the structured questionnaires (phenotypic descriptors lists). These are tools that are commonly in use across Africa.

Strengths

PEDs - This tool is useful for production system characterization and also provides useful background information for molecular characterization.

Structured questionnaires (phenotypic descriptors lists) – These tools give comprehensive descriptions of AnGR covering both qualitative and quantitative aspects. They are relatively cheap, user friendly, not skill-specific and equipment used including weighing scales and measuring tapes are easily available.

Due to their user-friendliness based on the easy to use templates, these tools collate considerably large amounts of data in a relatively short time. The collated data can also be used in prediction studies such as estimation of body weights (live and carcass) from linear measurements or the direct correlation of testicular and udder traits with sperm and milk production respectively.

Phenotypic characterization tools can be considered as a simple tool for selection. Based on the qualitative measurements, preferred breed traits can be selected for as desired.

Weaknesses

Structured questionnaires (phenotypic descriptors lists) - The equipment used such as the precision weighing scales may not be easy to transport especially given the rough African terrain in some parts of the continent. Difficulties in restraining of animals especially when taking morphometric measurements may result to inaccurate records.
The use of structured questionnaires sometime is subjective particularly during the evaluation of certain qualitative traits.
The structured questionnaires are also too detailed and thus considered cumbersome.

Opportunities

There are numerous opportunities to carry out collaborative studies using these tools

Threats

The continual subjectivity is an imminent threat to the usefulness of this tool in long term.

It was evident that there was a common consensus on the need to revise the present AnGR tools to ensure more effective implementation of these tools within the African context.

Working group sessions

The group work sessions followed the outlined process;
1) Participants were grouped into three (two English speaking groups and one French speaking group), a table facilitator was selected within the team assisted by a Rapporteur. Each group was guided by the pre-set session queries that were shared with the group facilitator.
2) Group's discussion sessions were also guided by the AU-IBAR team members supported by the identified co-facilitator.
3) During 35 minutes, the group members deliberated in-depth upon issues and document the various outcomes to be presented in plenary
4) A selected Rapporteur presented the group discussions in plenary.

The various country representations are listed below;

Group 1: Kenya (2), South Africa (1), Uganda (2), The Gambia (1), Egypt (1), Rwanda (1), Ghana (1), Tanzania (1), ILRI (1).
Group 2: Uganda (2), Sudan (1), Nigeria (1), Malawi (1), Ghana (1), Tanzania (1), Egypt (1), BeCA (1)
Group 3: Burkina Faso (1) Gabon (1), Cote d'Ivoire (1), Togo (1), Tunisia(1), Senegal (1), Algeria(1), Burundi(1), Cameroun(1), Democratic Republic of Congo(1), Republic of Central Africa(1) and CIRDES (1).

The following queries were answered in detail by all the group participants during the allocated working group sessions.

Inventory and SWOT analysis guiding queries

A) An inventory of existing characterization, inventory and monitoring tools/protocols used in Africa.

The primary purpose of this section was to document the current state of knowledge in terms of tools/protocols for the characterization, inventory and monitoring. The participants were guided through the session by the following queries:

- List of the different inventory, characterization and monitoring of animal genetic resources tools currently available and used in Africa
- List their main uses and species on which they have been used on in Africa

B) A SWOT analysis on characterization, inventory and monitoring tools/protocols

The primary objective of this session was to establish lessons learnt and best practices through carry out a SWOT analysis. In-depth assessment of the characterization, inventory and monitoring tools will be undertaken. Participants will be expected to document the strengths and weakness of each listed tool.

- List main strengths, opportunities, weaknesses and challenges that these tools have in Africa
- Outline tools that complement each other by highlighting the specific areas

Strategy/roadmap guiding queries

A) Identify appropriate characterization, inventory and monitoring tools for use in Africa

In this particular session, participants identified the most suitable or appropriate tools for use in Africa considering the various present factors that have affected effective tools use.

- Agree/identify on most appropriate tools for use in Africa

B) Identify key areas that require improvement in the selected tools.

For this session, participants were expected to identify priority areas that require improvement to improve the utilization and effectiveness of the selected tools.

- Agree on key areas of improvement and why?

C) Agree upon approaches to improve the effectiveness of the selected tools based on the identified priority areas.

In this session, the primary objective was for participants to identify suitable potions to be applied to improve the effectiveness and utilization of the selected tools

- What are the options (short-term, medium-term and long-term) for improving the utilization of selected tools?
- What are the needs for each of the selected option in terms of capacity building, policy, costs, etc.

D) Agree on a roadmap that outlines roles and responsibilities of key actors

- Develop a roadmap with outlined roles for the implementation of the activities

Working group outcomes

Plenary Session 1

In summary, rapporteurs shared their respective group outcomes on the inventory and SWOT analysis of phenotypic, molecular genetics and inventory tools. The groups also identified specific species in which these tools have been used on.

Phenotypic tools - Inventory and SWOT analysis

For the phenotypic tools, the working groups identified two main phenotypic tools used in Africa, This included the structured questionnaires (phenotypic descriptors lists) that has been used extensively within the continent and Production Environment Descriptors (PEDs) used to some degree. The phenotypic tools are informative in establishing the baseline information, undertaking comparative studies, developing schemes for conservation and genetic improvement

Strengths:

Several key strengths were described for the phenotypic tools this included being not skill intensive thus considered user friendly (does not require skilled technical capacity like the molecular genetic characterization tools), relatively cheap, captures GIS information, easily adaptable, quick results and guidelines and literature are easily available (FAO templates).(Annex 2a-c)

Weaknesses:

In general, the participants shared common weaknesses associated with the phenotypic tool. These included the tools can be subjective (dependent on the enumerator training- way of taking measurements etc.), unwillingness of farmers to co-operate, Inaccuracy, often incomplete and heavy to analyze.

Opportunities:

The opportunities highlighted were numerous. This included; possibilities of infrastructure development, the availability of numerous versions gives wider range to draw and learn form, literacy level of farmers are on the increase, emergence of novel software (ICT and telephony) and

potential for collaboration is high, literature available, high possibilities of cross linking/Meta-analysis, availability of an unstudied AnGR and encompasses citizen science.

Threats:

In general, the workshop participants highlighted key issues related to the used of the phenotypic tools. This included emergence of molecular tools, increased insecurity and regional animosity that may result to difficulties in actual application of the tools and Climate change

These tools have been used on Poultry (local chicken, guinea fowl, quails, turkey), Cattle, goats, Bees, Pigs, Cavies, Grass cutters, buffalo, pigs, camels, rabbits.

Molecular genetic tools - Inventory and SWOT analysis

Several molecular genetic characterization tools were identified as extensively used in Africa. These included single strand repeats (SSR), Single Nucleotide Polymorphisms (SNPs), PCR-RFLP, Mitochondria DNA, Y-Chromosome Markers and Genome sequencing (mainly through consortia). The main uses of the tools were assessing diversity, conservation, genetic relationships, population structure and identifying population bottlenecks. Identification of signatures of selection linked to adaptive traits, gene discovery studies and genomic selection studies were made possible through the use of large scale genotyping tools.

The working groups presented their SWOT analysis in plenary (Annex 3a-c).The combined summary is highlighted below;

Strengths:

The main strengths of molecular characterization tools as presented included; accurate and robust, results can be easily generated, demographic and historical information can be inferred, large amounts of data can be generated in a short amount of time.

Weaknesses:

Several weaknesses were identified and shared among the participants. These included the tools are costly, their maintenance is costly (thus large investment is needed), limited accessibility, skill specific, computational prowess for storage of data is a prerequisite especially for the large scale genotyping tools.

Opportunities:

With time, the tools are going to become relatively cheaper and thus more accessible, findings from them can be used to support decisions making and development of strategic genetic improvement programs. Increasing capacity development towards these tools is evident.

Threats:

Despite these tools being recognized as being so versatile, the challenges faced will are the evidently rapid evolution of the tools especially the third generation tools and restrictions enforced by the convention on biological diversity.

These tools have been mainly used on cattle, chicken, goats and sheep.

Inventory and monitoring tools - inventory and SWOT analysis

For the inventory tools, all groups listed Household surveys, Focus Group Discussions and Census.

In summary the working groups highlighted key issues in the SWOT analysis (Annex 4a-b) undertaken as discussed below;

Strengths:

Livestock surveys and focus group discussions: Numerous strengths were identified by the workshops participants. They included are relatively cheaper as compared to census, are versatile as can be used for additional and related activities, can be used for cross-referencing, relatively easy to administer, quick to formulate, data analysis can be easily complied and analyzed and are highly representative.

Census: Due to the limited use of census in Africa, the participants had a relatively difficult time identifying this tool's strengths. Only a few were raised which included census being more accurate (depending on how undertaken) and data attained from these activities is relatively robust.

Weaknesses:

Livestock surveys and focus group discussions

Data generated form the use of this tool is often inaccurate and less robust; the design also is not flexible and often covers an underrated sample size.

Census:

This tool cannot be well executed due to the lack of animal identification systems, costly, time consuming, there is limited farmer co-operation, negative cultural taboo affect the application of these tool especially in some African regions, the absence of Acts to guide the implementation process, inability to differentiate between breeds and crosses, data analysis and interpretation is relatively complex, the long intervals between subsequent census is a major drawback and there is often a declined response rate.

Opportunities:

Livestock surveys and focus group discussions:

With the upcoming development ion ICT, the tools can be revised to be more dynamic, increasing literacy levels of farmers will open up further effective use of these tools,

Census:
The Decentralised/devolved systems of administration will form simpler basis for application of the tools, and easy development planning

Threats:

Livestock surveys and focus group discussions

Reduced funding, frequent use of surveys by others with low feedback will hamper the application and use of this tool**.** With increased education level of farmers there will be demand for more rigorous processes. When the livestock industry becomes more commercialized, need for surveys will be less needed and Climate change in case of longitudinal data.

Census:
Decreased funding, increased commercialization, traceability, and identification systems, official registration and recording of animals and use of guesstimates for official reporting are the primary threats to the increased use of this tool for inventory and monitoring AnGR.

Lessons learnt and proposed approaches (E-discussion outcomes)

To introduce this next session facilitated by Dr. Mary Mbole-Kariuki and co-facilitated by Prof. Morris Agaba, a quick overview of the various lessons learnt and proposed approaches raised by e-members in the concluded e-discussion were presented to the participants. This presentation was very critical in the development of ideas on key strategies to be adopted to spearhead these processes.

Technical incapacity: This was a key issue that was highlighted during the e-discussions. Some of the tools in use are skill-specific and due to the evident lack of skilled personnel within the African continent, the extensive use of characterization tools continues to lag behind. The lack of trained personnel in Africa especially in relation to the molecular characterization tools was a common reference in the discussions.

Financial constraints: Livestock census is extremely costly and not within the reach of many African countries. Biotechnology tools and equipment were expensive and maintenance costs relatively high.

Dis-harmony in AnGR tool use: Different member states were using varied characterization approaches thus resulting to fragementation and duplication of outcomes. The generation of variable results was the norm thus making comparative studies difficult.

Policy issues: Lack of irrelevant policies,thus has affected the extensive use of these tools.

Lack of political will: Minimal government funds for AnGR characterization, surveying and monitoring related activities. For example, some researcher especially in parts of western Africa have been forced to use own salaries for research.

Tools insensitivity or unawareness: The farmers are expected to contribute towards the use of these tools but lack any knowledge or understanding of the tool's benefits or impcats of their use.

Inactive/lack of AnGR Committees: Due to the lack of active AnGR committee, no "custodian" is in place to monitor and advise the national governments on corrective measures that may need to be put in place. For example, if a country lacks data on spatial distribution, Socio-economic features, adaptive features and management of their AnGR, then the application of the PEDs tool may be advised.

Lack of common databases and information hubs: The need for a well-established and versatile information system and AnGR database is paramount. Its absence has resulted to poor co-ordination of AnGR related activities within the continent.

Lack of AnGR related Consortia: Effective utilization of AnGR tools cannot be achieved in Africa without the consideration of establishing consortia between the member states. Due to the costly nature of some of this equipment, collaborative proposals may be drafted to attract joint funding that will benefit all countries represented in the consortia.

Value-chain-approach: A value chain approach may need to be incorporated to improve the efficient utilization of AnGR tools.

Proposed approaches to improve utilization of AnGR

Revision and harmonization of AnGR tools: It is proposed the development of harmonized/standardized tools that will be used for all species across the continent. They advocated for a common agenda in the use of characterization, inventory and monitoring tools.

Build a sound technical base: Offer training opportunities and introduce examinable courses of various AnGR aspects in order to grow a technically sound workforce. Develop additional regional training hubs that are equipped with state-of-the-art equipment therefore exposing African scientists to undertake cutting edge research and acquire relevant skills.

Formulation and implementation of policies: Fastrack the formulation of comprehensive policies, Acts and legislation that will support the efficient utilization of AnGR tools within member states. National Consultative Committee (NCCs) on AnGR should actively participate and make inputs into Animal breeding policies and other related AnGR policies.

Raising awareness campaigns: Increased advocacy of the importance of AnGR and the essence of characterization and monitoring to policy makers and various stakeholders is crucial. The primary objective should be to sensitize them towards the importance of carrying out these activities in relation to food security and improving community livelihoods.

Funds sourcing: Through establishment of collaborative projects, member states can identify possible funding organization and foreign agencies and solicit funds to implement these AnGR related projects or funds sourcing through FAO, RECs, international organizations etc.

Establish common information hubs: Sub-regional biological databases that have uniformity in software to ensure cohesiveness of the data collected. These information systems will function as repositories for all publications related to AnGR, conservation activities in member states, proposal calls, workshop and training alerts etc.

Establish African consortia: Through this approach, e-members agreed that this will further open avenues to carry out large-scale characterization activities with the collaboration of both local and international partners. A typical example is the African Goat Improvement Network (AGIN), a collaborative project between USDA-ARS, ILRI and ASARECA.

Plenary session 2

Proposed suitable AnGR tools

For this session as earlier described the key issue was to identify the most appropriate or suitable tools for use in Africa for characterization, inventory and monitoring of AnGR. The groups underwent rigorous brainstorming and thought provoking discussions before arriving at the identification of suitable tools and a proposed strategy for the implementation of this process of either revision or harmonization.

The report presents a combination of the plenary discussions from the three groups' presentations (Annexes 5a-c). It highlights the consensus arrived at in relation to the identification of the most suitable tools for use for phenotypic, molecular genetic characterization and inventory.

For phenotypic characterization, the most suitable tools for use agreed upon by the workshop participants was a composite tool which consisted of aspects drawn from the phenotypic descriptors lists and the production environment descriptors (PEDs) structured questionnaires. The revision of the tool also entailed the incorporation of sketches that would guide taking of morphometric measurements. The African Goat Improvement Network (AGIN) AdaptMap protocol was recommended for adoption for photography standardization. This protocol is currently in use within ILRI and BeCA on the goat project.

The general consensus was for farmers to play an integral part in the characterization process so as to encourage their participation in this important activity. Training of farmers as enumerators was also proposed. The participants highlighted that the lack of integration of farmers at this critical level has contributed greatly to the failed utilization of phenotypic characterization tools.

The revised phenotypic tool will be based on seven main categories with various data collection aspects.

The categories included;

1. **Morphometrics**
2. **Environmental**
3. **Production and reproduction**
4. **Adaptive**

5. **Socio-economic**
6. **Biological samples**
7. **Indigenous knowledge**

The table below summaries the minimum descriptors selected to be included in the revised tool as proposed by the working groups. The individual WG outcomes are in Annex 5a-c.

Categories	Minimum Descriptors selected
Morphometrics	Height at Withers Body Length Chest girth Coat/Feather color Coat/ Feather pattern Facial profile Hump position Horn size Horn Orientations Udder attachment **Additional features dependent on species**
Environmental	Ambient Temperature GIS (Latitude and Longitude) Water Availability/Watering systems Precipitation Humidity Altitude Vegetation cover Soil type Solar intensity Management system(feeds and feeding systems) Season Topography Housing types
Production and reproduction	Meat Milk yield/quality Lactation length Egg size/number/color Wool/hair Dressing percentage No.of offspring Longevity Litter size Fertility

	Mothering ability Growth performance Age at first parturition Scrotal size Semen characteristics
Adaptive	Mortality/ survival rate Heat tolerance Mobility/Trekking ability Disease/parasite Resistance Drought Tolerance Ability to survive on poor forage Morbidity at herd level Body condition score (season, physiological stage, age and sex)
Biological samples	Tissue Blood Hair Nasal Swaps Milk Feacal Urine Semen Ear Notches
Social and Economic	Age of farmer Gender of family head Education level of Household Head(HH) Labour distribution Cultural valuation of livestock Family income from livestock Nutritional Level Other sources of income Occupation of HH Type of production system Decision making Price of Animal Age at market

Indigenous knowledge	Traditional practices (Treatments to diseases, worms etc) Breeding strategies/ trait preference Selection criteria Identification criteria Indigenous feeds and Feeding practices Product management/processing Housing Cultural beliefs/taboos

In addition, one group raised a key issue of adding the product quality descriptors, this would include Carcass quality (leanness, marbling, tenderness), milk quality (fat, protein) wool quality, hides quality, honey quality etc.

For the molecular genetic characterization tool, participants identified Single Nucleotide Polymorphism (SNPs) as the most suitable tool. For the tools to be more informative, it was agreed that the member states would actively participate in the process towards SNP chip development. Their contribution would be primarily towards ensuring a large representation of African livestock populations in the SNP discovery panels. In addition, genome sequencing could be adopted as a preferred tool, but would be executed based on established consortia. For the improved utilization of this tool, increased capacity building through training in genetic data generation, genetic data analysis and interpretation was fronted as the most strategic approach. In addition, one group proposed the continued use of SSR as these molecular tools have an additional advantage since some markers already exist for many animal species on the ISAG-FAO panel.

The most suitable inventory tool proposed by the participants was the livestock surveys; this is a tool that could be adopted within the continent and would substitute the census due to the costly nature of the latter. The livestock survey through proposed needs some areas of revision and improvement focussed on incorporating aspects that will increase sample size and the adoption of emerging ICT software and equipment. To encourage the farmers to actively participate in this, it was proposed that farmers should be provided with innovative incentives which would include farmer trainings, free vaccinations or prophylaxis, on-field lab tests etc.

However, census was not totally discarded as a potential tool but rather in relation to the issues raised below, long term strategies were identified that would enable the use of this tool in future.

(i) The lack of animal identification may be corrected through the formulation and implementation of animal identification systems in national improvement programs as enshrined in legislations and incorporation of traditional animal identification systems on the national programs may have a positive effect;

(ii) For the high costs that are synonymous with census activities, countries may take advantage of targeted animal gathering areas such as cattle dips, vaccination campaigns,

livestock markets, community feedlots, institutions such as schools, devolved units of administration for data collection,

(iii) Adoption of emerging ICT technologies e.g., satellites

(iv) Low farmer participation may be tackled by creating awareness, identifying and educating on short and long term tangible benefits, providing incentives and organizing feedback meetings;

(v) Negative cultural belief, integration of political leaders at all levels may change communities attitudes and

(vi) Lack of legal frameworks to guide the implementation of the activity may be supported by reviewing existing institutions/ bureaus for national statistics and advocating for appropriate policies and legislations.

Proposed Roadmap

A well-defined Roadmap based on the group's proposals was developed, this session was facilitated by Dr. Nguetta Bosso and co-facilitated by Dr. Mwai Okeyo. The key activity was to identify key actors and their roles in the activities implementation. The developed roadmap included actors, institutions and tentative timelines for implementing the harmonization and revision processes. This synthesised roadmap based on the working groups deliberations was further refined by a selected panel consisting of AU-IBAR genetic team (Drs Ng'uetta Bosso, Mary Mbole-kariuki, Pissang Tchangai); implementing partners (Dr. Mwai Okeyo – ILRI, Prof. Morris Agaba –BeCA) and key technical experts (Dr. Richard Osei-Amponsah – Ghana (Western Africa); Dr. Ahmed Elbeltagy – Egypt (Northern Africa); Dr. Donald Kugonza – Uganda (Eastern Africa) and Dr. Felix Meutchieye – Cameroon (Central Africa).

ROADMAP REVISION OF ANGR TOOLS

	Activities	Institutions	deadline
First Draft of revised tools manuals	Harmonization of the different key areas of data to be collected within the three groups. • Synchronization of the coding • Adoption of AdaptMap protocol	AU-IBAR ILRI BeCA FAO CIRDES TAG	End February 2015
Awareness Campaigns	Raise awareness of these tools within the continent	All and stakeholders	Continuous process
1st Revision	Review and refine of first draft • Development of TOR's for the wider audience • Identification of small review team NB: Need to identify person with expertise on the telephony aspect and linkage to data storage hub	AU-IBAR AU-IBAR ILRI BeCA FAO CIRDES TAG	End of March 2015
1st training	Training of pilot enumerators in selected countries Proposed criteria: • Countries with majority of target species and diversity • Transboundary breeds- all inclusive of the species • Countries with data gaps and potentials • Development of TORs – data management, data entry data analysis	AU-IBAR and selected countries	May 2015
Piloting Linked to AAGRIS	Piloting and validation of the Characterization (phenotypic and genetic) Inventory tools	AU-IBAR	Mid July 2015 Mid-August 2015
	Second revision of tools – based on feedback from preliminary data analysis – Second draft		End of October 2015
Ratification	In-house ratification with the National co-ordinators	AU-IBAR	November 2015
	Main Ratification and development of road map for its sustainable use		December 2015
2nd training and roll-out	Training of trainers workshop	AU-IBAR	2016
	Rollout and adoption of tool at national level Adoption at university – tools training modules		

General recommendations from the workshop

Some recommendations were formulated to effectively sustain the achievements of the workshop:

1. Regarding the discussion held on the revised tools, some recommendations specific to the tools were made
    - Adapt and adopt to AGIN (African Goat Improvement Network) protocols-photography
    - Synchronize coding systems
    - Adopt telephony – use of mobile systems for data collection by the farmers (ODK collect)

2. Regarding the implementation of the Road map, the participants, agreed to:

    - Set-up taxonomy advisory groups (TAG) being specific Livestock Species Experts Teams
    - Identify and establish national and regional financial support mechanisms
    - Align national and sub-regional activities for an improved utilization of the AnGR tools
    - Mainstream and link the application and utilization of these tools to academic curricula through RUFORUM and relevant institutions.

3. Regarding the use of "livestock survey" versus "livestock census", the workshop's recommendation was some opportunities can be utilized to make livestock surveying easier such as use of the current devolved governments; schools etc. and the sensitization of livestock keepers at village levels would be more practical.

4. The participants recommended regularly review and update of tools based on lessons learnt and needs.

Take home message "**Effectively use of existing evidence to lobby for recognition and financial allocation**"

List of annexes

Annex 1: Agenda
Annex 2a: Group 1 – Phenotypic tools SWOT analysis
Annex 2b: Group 2 – Phenotypic tools SWOT analysis
Annex 2c: Group 3 – Phenotypic tools SWOT analysis
Annex 3a: Group 1 – Molecular genetic tools SWOT analysis
Annex 3b: Group 2 – Molecular genetic tools SWOT analysis
Annex 3c: Group 3 – Molecular genetic tools SWOT analysis
Annex 4a: Group 1&2 – Inventory and monitoring tools SWOT analysis
Annex 4b: Group 3 – Inventory and monitoring tools SWOT analysis
Annex 5a: Group 1 - Proposed suitable/ appropriate tools
Annex 5b: Group 2 - Proposed suitable/ appropriate tools
Annex 5c: Group 3 - Proposed suitable/ appropriate tools
Annex 6: List of participants

Annex 1: The Agenda

Workshop "Assessment of Animal Genetic Resources Characterization, Inventory and Monitoring tools/protocols to guide revision and harmonization processes"

Tentative Agenda
(Dar-es-Salaam, Tanzania)

25th – 27th September 2014

Day 1: Thursday 25th September 2014

Time	Item	Resource person
8:00-9.00am	Registration of participants	All
Session 1: Opening Ceremony		
9:00-10:00	Opening remarks Introduction to the technical workshop • Presentation of workshop background, objectives, methodology and expected outcomes • Adoption of the Agenda • Introductions Group photo	Permanent Secretary AU-IBAR Director AUIBAR All
10:00-10:30	Health break	
Session 2: Characterization tools		
10:30-11:30 11:30-12:15	Introductory presentations on; Characterization tools (tools overview) • Phenotypic tools • Molecular genetic tools 10 minutes discussions	ILRI BeCA and CIRDES
12:15-13:00	Presentation of detailed assessments of characterization tools/protocols (based on output from e-discussions) • Characterization tools in use within the African Continent • Strengths and weakness highlighted 10 minutes discussions	AU-IBAR

	Group work queries presented	
13:00 – 14:00	Lunch	
14:00 – 15:30	Breakout in groups Group work –SWOT analysis on characterization tools	All
15:30 – 16:15	Plenary summaries of group work presented – characterization tools	Rapporteurs
16.15-16.30	Health break	
16:45-17:30	Plenary summaries of group work presented – characterization tools	Rapporteurs

Day 2: Friday 26th September 2014

Session 3: Approaches to improve the utilization of characterization tools		
8:30-9:00	***Presentation on lessons learnt and proposed approaches to improve utilization of Characterization tools (outcomes from e-discussions)*** ***10 minutes discussions*** ***Group work queries presented***	AU-IBAR
9:00-11:30	***Breakout in groups*** ***Group work*** ▪ Identification of suitable approaches to improve utilization of characterization tool ▪ Develop Roadmap ▪ Identification of key actors and their roles	All (**inclusive of health break**)
Health break		
11:30 - 13:00	***Plenary*** • Plenary summaries of group work presented – framework for characterization tools • Plenary discussions and concurrence	Rapporteurs
13:00 - 14:00	**Lunch**	**All**
Session 4: ***Inventory and monitoring tools***		

14:00-14:30	***Introductory presentations on;*** **Inventory and monitoring tools/protocols (tools overview)** ***10 minutes discussions***	NASAWARA STATE UNIVERSITY
14:30-15:00	***Presentation of detailed assessments of tools/protocols (based on output from e-discussions*** • Inventory and monitoring tools in use within the African Continent • Strengths and weaknesses highlighted ***10 minutes discussions*** ***Group work queries presented***	AU-IBAR
15:00 – 16:00	***Breakout in groups*** Group work –SWOT analysis on inventory and monitoring tools/protocols	All
16:00-16:30	**Health break**	
16:30 – 17:30	***Plenary*** • Plenary summaries of group work presented – Inventory and monitoring tools • Plenary discussions and concurrence	Rapporteurs

Day 3: Saturday 27th September 2014

Session 5: ***Approaches to improve the utilization of inventory and monitoring tools***		
8:30-9:30	***Presentation on lessons learnt and proposed approaches to improve utilization of inventory and monitoring tools (outcomes from e-discussions)*** ***10 minutes discussions*** ***Group work queries presented***	AU-IBAR
9:30-11:00	***Breakout in groups*** ***Group work -*** Inventory and monitoring tools ▪ Identification of suitable approaches to improve utilization of characterization tools ▪ Develop Roadmap ▪ Identification of key actors and their roles	All (**inclusive of health break**)
Health break		

11:00-12:00	***Session 5: Plenary*** • Plenary summaries of group work presented – inventory and monitoring • Plenary discussions and concurrence	Rapporteurs
Session 6: ***Wrap up and closure***		
12:00-13:00	• Recommendations • Way forward	All
End of workshop		

Annex 2a. Group 1 – Phenotypic tools SWOT analysis

Strengths	Weaknesses
▪ User friendly ▪ simple ▪ Relatively cheap (e.g. equipment required ▪ GIS information	▪ Can be complicated ▪ Subjectivity ▪ Inaccuracy ▪ Often incomplete ▪ Unwillingness of farmers to cooperate ▪ Heavy to analyze
Opportunities ▪ Lots of versions to lean from ▪ Emergence of software that can be used (ICT) ▪ Literacy level of farmers is increasing ▪ Potential for collaboration is high ▪ Infrastructure development	**Threats** ▪ Emergency of molecular tools ▪ Insecurity ▪ Regional animosity ▪ Climate change

Annex 2b. Group 2 – phenotypic tools SWOT analysis

Strengths	**Weaknesses**
▪ Adaptable ▪ Not Complex ▪ Relatively cheaper ▪ Guidelines and literature available	▪ Subjectivity ▪ Population admixture
Opportunities ▪ Literature available ▪ Cross linking/Meta-analysis ▪ Availability of an unstudied AnGR ▪ Citizen science	**Threats** ▪ Uncontrolled mobility ▪ Changes in production systems ▪ Un-adaptable to cross breeds

Annex 2c. Group 3 – phenotypic tools SWOT analysis

Strengths	Weaknesses
▪ cheaper, convenient, provides basic information on the RGA in a given country, availability of guidelines from FAO	▪ Provide too much detail (heavy) ▪ relative accessibility, ▪ generate large errors, ▪ need technical capacity, ▪ become expensive at large numbers scale, ▪ need qualified personnel, ▪ tools poorly suited to some local resources, ▪ high subjectivity (measures , appreciation ...) need calibrate methodology tools, ▪ data inaccessibility, ▪ data storage, ▪ low environmental description
Opportunities	**Threats**
▪ Information and communication Technologies , FAO guidelines, GPA on AnGR , AU-IBAR genetics project + regional organization funds (FAO, WAMU, IAEA,) conventions/Protocols on AnGR	▪ absences of general policies, ▪ Financial dependencies, ▪ lack of financial resources, ▪ extensive farming system characterizing animal breeding, ▪ Lack of involvement of farmers ▪ Lack of participatory approaches, no association of breeders

Annex 3a. Group 1 – Molecular genetic tools SWOT analysis

Strengths	Weaknesses
▪ Accuracy ▪ Quick	▪ Still expensive ▪ skill specific ▪ accessibility is still a problem ▪ computation power demand
Opportunities	**Threats**
▪ Is becoming cheaper ▪ Competition (development of genotyping technology and ICT) ▪ Increasing capacity building	▪ rapidly evolving ▪ emerging zoonotic diseases

Annex 3b. Group 2 – Molecular genetic tools SWOT analysis

Strengths	Weaknesses
▪ Definitive ▪ Utilization of information ▪ Historical data utilization ▪ Needed as a prerequisite for conservation ▪ More data can be generated in a short time	▪ Capital investment needed ▪ Human capacity
Opportunities	**Threats**
▪ Technology well developed ▪ Costs becoming lower ▪ Economically availability ▪ Support decision making ▪ Support genetic improvement ▪ Patent product	▪ Convention on Biological Diversity restrictions

Annex 3c. Group 3 – Molecular genetic tools SWOT analysis

Strengths	Weaknesses
▪ more informative, ▪ more accurate for sustainable management and improvement of AnGR	▪ need qualified personnel (laboratory and data analyses), dependency of European and American countries for reagents and consumables ▪ limited financial resources
Opportunities	**Threats**
▪ Subregional laboratories , collaborations, FAO guidelines, GPA on AnGR , AU-IBAR genetic project , conventions on AnGR	▪ absences of general policy, ▪ financial dependencies, ▪ lack of funding, ▪ extensive character of animal farming breeding systems, ▪ lack of involvement of herders, ▪ lack of participatory approaches, ▪ no association of breeders

Annex 4a. Group 1&2 – Inventory and monitoring tools SWOT analysis

Strengths	Weaknesses
Livestock Surveys & FGDs* ▪ Cheaper to conduct vs. Census ▪ Can be used for additional/related activities e.g. sampling ▪ High repeatability and cross-referencing ▪ Relatively easy to administer ▪ Can be developed in less time ▪ Easy compiling of data for analysis ▪ High Representativeness ▪ **Census** ▪ More accurate ▪ Are more robust	**Livestock Surveys & FGDs*** ▪ Often inaccurate ▪ Less robust ▪ Inflexible Design ▪ Underrated Sample Size **Census** ▪ Lack of animal identification systems ▪ High costs involved ▪ Time consuming ▪ Limited farmer cooperation ▪ Some negative Cultural/taxation beliefs ▪ Lack of Acts to guide implementation ▪ Not tied to tangible benefits for farmers ▪ Inability of differentiate breeds/ crosses ▪ Complex data analysis ▪ Long intervals between census ▪ Declined response rates
Opportunities	**Threats**
Livestock Surveys & FGDs ▪ With advent of ICT, these can be made more accurate and efficient ▪ Improved infrastructure ▪ Increasing literacy levels of household members and community leaders ▪ Improved Gender roles + equality **Census** ▪ Decentralized/devolved systems of administration ▪ Easy development planning	**Livestock Surveys & FGDs** ▪ Reducing funding ▪ Frequent use of surveys by others with low feedback ▪ With increased education level of farmers there will be demand for more rigorous processes ▪ When the livestock industry becomes more commercialized, need for surveys will be less needed ▪ Climate change in case longitudinal data **Census** ▪ Decreased funding ▪ Increased commercialization, traceability, and identification systems ▪ Official registration and recording of animals ▪ Use of guesstimates for official reporting

Annex 4b. Group 3 – Inventory and monitoring tools SWOT analysis

Strengths	Weaknesses
Household surveys ▪ Exhaustive ▪ Fast ▪ Low Cost Census ▪ Accurate / Reliable ▪ Easy (no high qualification required) Vaccination campaign ▪ Accurate ▪ Participatory Approach animals	Household surveys ▪ reluctance of some people ▪ Obligation to use an investigator from the same locality ▪ Management of data generated heavy ▪ Need for qualification of investigator ▪ Census ▪ Effective presence of the animal ▪ Costly ▪ More time ▪ reluctance of some people Vaccination campaign ▪ Does not apply to all species
Opportunities	**Threats**
Household surveys ▪ Guide FAO guidelines on Inventory and Monitoring ▪ ICT ▪ Global Plan of Action (GPA) and National Plan of Action (NPA) ▪ Policies systems intensification of livestock ▪ Project Genetics AU-IBAR ▪ TCP AU-IBAR / FAO Census ▪ ICT	Household surveys ▪ sociopolitical conflicts ▪ Tax (fisc) ▪ Extensive System (transhumance, nomadism) Census ▪ sociopolitical conflicts ▪ Tax (fisc) ▪ Extensive System (transhumance, nomadism) Vaccination campaign ▪ sociopolitical conflicts ▪ Tax (fisc) ▪ Extensive System (transhumance, nomadism)

Annex 5a. Group1- Proposed suitable/ appropriate tools

I. PHENOTYPIC TOOLS

Minimum elements to have in tools

1. Structured questionnaire
   - Photographing
     - [B] Adapt and adopt to AGIN (African Goat Improvement Network) protocols
     - [B] (background, distance from the animal, camera resolution)
     - [C] innovatively used, photographs can be used to supplement environmental characteristics e.g. conditions of rangelands
   - Sketches
     - Should be standardized
     - Should be used in specific contexts
   - Quantitative measurements

	Morphometrics	Production measurements	Reproduction	Health/adaptive traits	Product quality	Biological samples
Cattle	Body weight (Heart girth) Body length Height at withers Scrotal circumference Udder size	Age Body weight Milk yield and quality Body condition score	Sex Parity (for female) prolificacy Parturition interval Age at first calving Age at puberty Scrotal size Semen characteristics	Disease incidences (disease) Frequency Body condition score (season, physiological stage, age and sex) Heat tolerance, feed, parasitic Mortality (pre and post weaning) Morbidity at herd level Survival rate	Carcass quality (leanness, marbling, tenderness Milk quality (fat, protein Hides quality	Milk Feaces Blood Hair Ear notches
Small ruminants	All the above	Age Body weight Milk yield and quality Teat numbers Body condition score Hair length and size	Sex Parity (for female) Litter size Parturition interval Age at first calving Age at puberty Scrotal size Semen characteristics	Disease incidences (disease) Frequency Body condition score (season, physical status, age) Heat tolerance	Hides quality	
Pig	Most of the above	Teat numbers		Disease incidences (disease) Frequency Body condition score (season, physical		

				status, age) Heat tolerance		
Poultry(i.e. birds)	Most of the above	Egg size and weight	Age at first egg Hatchability	Disease incidences (disease) Frequency Body condition score (season, physical status, age) Heat tolerance	Egg yolk	
Honey bees					Honey quality	

Coding system should be standardized

Social economic	Gender of the owner Price of the animal Age at market Input costs (feed, labor, health interventions, etc.) Use of the animal (cultural, etc.

Coding system should be standardized

Indigenous knowledge	Traditional practices Breeding selection criteria traditional medicines and practices identification criteria

Environmental	GIS Housing types Feeds and feeding practices Watering systems

II. MOLECULAR TOOLS

1. SNP

Strategically used for introgression of different breeds, cross-border breeds and cross bred populations.

Depending on the breed and context:

- Assessing diversity, conservation and relationships
- Assessing population structure and bottlenecks
- Identifying selection signatures
- Association studies and gene discovery
- Inform genomic selection

2. Genome sequencing

Annex 5b. Group2 - Proposed suitable/ appropriate tools

Categories	Descriptors	Descriptors selected
Morphometrics	Height at Wither Body Length Leg length Chest Girth Rump Size. Weight Facial profile Coat color Coat pattern Udder attachment Hump Position	Height at Wither Body Length Chest girth Coat/Feather color Coat/ Feather pattern Facial profile Hump position Horn size Horn Orientations Udder attachment
Environmental	Ambient Temperature Feed availability Latitude and Longitude (GPS) Water Availability Precipitation Humidity Altitude Vegetation cover Soil type Solar intensity Management system Season Topography	Ambient Temperature Feed availability Latitude and Longitude (GPS) Water Availability Precipitation Humidity Altitude Vegetation cover Soil type Solar intensity Management system Season Topography
Production Measurement	Meat Milk yield/quality Lactation length Egg size/number/color	Meat Milk yield/quality Lactation length Egg size/number/color

	Wool/hair Dressing percentage No.offspring Longevity Litter size Fertility Growth performance Age at first parturition	Wool/hair Dressing percentage No.offspring Longevity Litter size Fertility Growth performance Age at first parturition
Health/Adaptive Trait	Mortality rate Heat tolerance Mobility Disease/ parasite Resistance Drought Tolerance Trekking ability Temperament Solar resistance Mothering ability Feeding selectivity	Mortality rate Heat tolerance Mobility Disease/ parasite Resistance Drought Tolerance Trekking ability Temperament Solar resistance Mothering ability Feeding selectivity
Biological samples	Tissue Blood Hair Nasal Swaps Milk Feacal Urine Semen	
Social and Economic characteristics	Age in Farm Gender of family head Education level of HH Labour distribution Cultural valuation of livestock Family income from livestock Nutritional Level Other sources of income Occupation of HH Type of production system Decision making	
Indigenous knowledge	Treatment of diseases Pricing mechanism Identification/Breeding Feeds and Feeding Tolerance to diseases Breeding strategies/ trait preference Product management Housing Beliefs/taboos	

Annex 5c. Group3 - Proposed suitable/ appropriate tools

Types of characterization	tools
Phenotypic	Morphobiometric(with GIS + ICT)
	performances control (with GIS + ICT)
Molecular	SSR
	SNP
	Sequencing Next Generation

C1 Options for improving the utilization of selected

	Short term (2-3 years)	Middle term (3-7 years)	Long term (More than 7 years)
	- Preparation of a draft of manual on characterization tools - Capacity building on tools - Awareness and Implications of all stakeholders - Better coordination (national and sub-regional cooperation) - Encourage youth to AnGR - Develop a skills inventory on AnGR - Fund raising	- Validation of the manual - Creation of diploma courses on the management of AnGR - Creation of a specialized journal - Valuation of prior research outputs - Fund raising - Establishment of a technological platform - Establishment of reference samples and Implementation of Testing Inter Laboratories	- Establishment of a continental database - Creation of diploma courses (Curricula) on AnGR management - Development of a SNP chip adapted to African AnGR

Annex 6: List of participants

Technical Workshop on "Assessment of existing Animal Genetic Resources characterization, inventory and monitoring tools/protocols to guide revision and harmonization processes"
25TH – 27TH SEPTEMBER, 2014
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