Synthesis report of the AnGR e-discussion

Improving the utilization of Animal Genetic Resources characterization, inventory and monitoring tools in Africa

17th July – 31st August 2014

AU-IBAR

Improving the utilization of Animal Genetic Resources characterization, inventory and monitoring tools in Africa.

Preamble

As part of providing leadership and coordination in the sustainable development of the continent's Animal Resources, AU-IBAR intends to build consensus on the methodologies and tools for characterization, inventory and monitoring of AnGR between AU member states with the ultimate goal of improving their utilization across the continent. Therefore, the need to engage in interactive online discussions was considered pertinent.

An e-discussion entitled "**Improving the utilization of Animal Genetic Resources characterization, inventory and monitoring tools in Africa**" was conducted from the 17th of July to 31st of August 2014 hosted on the AU- Animal Resources Information System (ARIS) platform. Technical experts drawn from within and outside Africa were invited to participate in the first e-discussion on AnGR tools moderated by AU-IBAR.

This report is a synthesis of the e-discussion which encompassed an in-depth assessment of the existing tools and proposals of implementable and sustainable approaches geared towards the improved utilization of characterization, inventory and monitoring tools in Africa.

The objectives of the e-discussion were to;

- Assess the utilization of characterization, inventory and monitoring tools within Africa
- Propose implementable and sustainable approaches to improve the utilization of the existing characterization, inventory and monitoring tools/protocols to better estimate population size and monitor breed dynamics.

The e-discussion outcomes reported will provide discussion points for the on-coming technical workshop "**Assessment of existing characterization, inventory and monitoring tools to guide revision and/or harmonization processes**" that will be held on 25th – 27th September 2014 in Dar-es-Salaam, Tanzania.

Problem Statement

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.

Characterization and inventory of AnGR are fundamental components of breed improvement programmes and conservation strategies. However, the first State of the World's Animal Genetic Resources for Food and Agriculture report documents that actual population sizes for over two-thirds of African breed populations is missing. The lack of this vital information places Africa's rich AnGR diversity at risk as declines in numbers of indigenous populations may remain undetected and result in the complete loss of ecologically-important traits or entire local animal populations. The lack of/poor application of checks that contribute towards preventing the loss of these valuable AnGR that are the economic backbone and bread basket for many in rural Africa has resulted in adverse consequences.

Characterization of AnGR is pertinent as knowledge on population trends and genetic status of livestock populations informs breeding strategies, conservation programs and policy-making processes. However, in Africa, characterization processes have continued to be plagued by various challenges resulting in scarce and inaccurate information in relation to breed population dynamics and architecture. Most characterization studies are undertaken using phenotypic tools. Often, the choice of tools is driven by the primary factor of being cheaper, readily available and do not require high level skilled technical knowledge thus more user friendly. However, these tools are subjective and each user tailors them to meet their own objectives making any comparative studies even between transboundary breeds unfeasible.

The introduction and utilization of novel molecular genetic tools, that are highly informative has been adopted extensively in other continents except Africa. This slow adoption process can be attributed to the financial incapacities, high cost of the biotechnology equipment and lack of skilled technical personnel. For example, Sudan has since established a molecular lab but the lack of skilled manpower has turned the facility into a white elephant. The computer specificity of molecular generated data storage and its analysis poses yet another drawback to the extensive usage of molecular tools in Africa. Additionally, use of production environment descriptors (PEDs) characterization tool has remained an alien concept in most Africa states, yet this is a versatile tool that enables the collection of a wide range of important management and environment variables. Interestingly, the usage of this tool is limited to a few countries such as Kenya and Tanzania, the key query to pose is why this robust tool's usage has not gained ground in Africa?

Inventory and monitoring of AnGR within the continent has been faced with numerous challenges, the primary challenge being the lack of financial ability by member states to put into action the recommended tools such as livestock census. The continual documentation of population size estimates in Africa is a clear indication taking inventory of their animal populations is a serious challenge. Livestock censuses are national enumeration activities that require considerable financial ability that is evidently lacking in our African countries coffers. There is an urgent need to identify other possible options that will enable member states to avail reliable and dependable records on population status and trends.

The lack of effective monitoring strategies/tools linked to an established early warning and response system has contributed greatly to the continual reduction of indigenous Africa breeds. Despite the

high existence of transboundary breeds (total 91[1]) in Africa, concerted efforts should already be in place in regards to the establishment of monitoring and early warning tools in Africa. In addition, knowledge of present threats on AnGR should be documented to avert future population reductions and effective management strategies put in place.

In a nutshell, there is a huge gap in relation to the availability of relevant and reliable data on population status and trends of African AnGR, consequently resulting to misinformed decisions and poor management of AnGR within the African continent. Evidently, poor utilization of characterisation, 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.

Queries that need clarity are:

- What are the most pressing challenges users of characterization, inventory and monitoring AnGR tools face in Africa?
- Which strategies can be adopted to improve the utilization of characterization, inventory and monitoring AnGR tools?

Session 1: Assessment of existing characterization, inventory and monitoring tools in Africa

In this session, the primary objective was to carry out an in-depth assessment of the current tools in use within the continent, establish the extent of usage, identify their strengths and weakness and highlight lessons learnt within the African setting.

Extent of usage

From the e-discussion, the main characterization tools in use across the continent are phenotypic characterization tools. These included FAO phenotypic descriptor lists and FAO phenotypic checklists. Phenotypic data collected comprised of photographs, biometric data, performance traits data and morpho-structural data. Detailed information on qualitative variables, quantitative variables (from repeated visits), and quantitative variables for morphometric measurements are captured.

From the e-discussion, it is evident that to a greater extent, several livestock species undergone phenotypic characterization. In regards to the PEDs tool, Ghana, Nigeria and Ethiopia mention the use of this tool though not to a large extent. In particular to Nigeria, this tool has been used to some extent on poultry species.

[1] FAO (2013) Status and trends Animal Genetic Resources,item4.2 provisional Agenda Fourteenth Regular Sessions,Rome 15-19 2013, CGRFA-14/13/Inf.16 Rev.1

In Africa, molecular genetic characterization tools are not extensively in use. Some countries mentioned the use of first and second generation tools namely microsatellite/SSRs (Single Sequence Repeats) especially FAO recommended, Y-chromosomal markers, mitochondrial DNA markers, protein markers, Random Amplified Polymorphism DNA (RAPDs), Single Strand Conformation Polymorphism (SSCP) and Restriction fragment length polymorphisms (RFLP). New/third generation markers namely Single Nucleotide Polymorphisms (SNPs) are utilized at a very small-scale with related activities often supported through collaborations with developed countries. The SNP genotyping technology is still not available in most of Africa.

However, regional hubs such as BeCA-ILRI have been fronted as possible platforms to access biotechnology equipment such as the 454 sequencing machine. Africa is characterised by extremely low usage of next generation sequencing tools - Copy number variations (CNVs), Exome sequencing, Whole genome sequencing, genotyping by sequencing (GBS) etc. For example, an e-members contribution reports that Nigeria has virtually no published work on the genetic diversity of their livestock populations using these next generation sequencing tools. This also applies to other countries in the West African region.

The use of inventory and monitoring tools was mentioned in the e-discussion but mainly used for small-scale collection of data. The tools named include household surveys, rapid appraisals and focus groups. However, large-scale collection of population size data through livestock censuses appears to be rarely utilized within African states.

Strengths and weakness of tools

Phenotypic tools:

Strengths

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

Phenotypic characterization checklists – 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 weigh scales, 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

Phenotypic characterization checklists - 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 phenotypic characterization checklist sometime is subjective particularly to the evaluation of certain qualitative traits.

The phenotypic checklist are too detailed and thus considered cumbersome.

Molecular genetic tools

Strengths

Second generation molecular tools – Microsatellites are relatively easier to use in comparison to the third generation tools and their data analysable without the need of large computer storage and intensive computing requirements. Though skill-specific, training is relatively easier and the equipment required to undertake molecular characterization using second generation tools is relatively cheaper in comparison to third generation tools.

Third generation molecular tools – These tools have been described as robust tools that generate large amounts of data that can be analysed for population and evolutionary studies, genomic selection, selective sweep analysis etc.

These tools exhibit high accuracy and precision especially in relation to better understanding the genomic architecture and history of African AnGR and establishing the population structure. Identification of genomic control regions through genome-wide studies is also feasible.

Weaknesses

Molecular genetic tools: Due to the associated costs for both reagents and equipment to undertake molecular genetic characterization especially for third generation and next generation sequencing technologies, most African countries have been unable to adopt and extensively use these tools. These tools are also skill specific and the lack of trained personnel in African states has resulted to a slow adoption and utilization of these fast evolving tools. The established of a state-of-art laboratory is necessary to successfully utilize molecular tools posing another challenge to Africa.

Inventory tools:

National censuses are costly and most African national governments who attempt to undertake these activities collect baseline data on livestock populations often not fully informative.

Strengths

Household surveys, rapid appraisals and focus groups were considered as versatile inventory tools that enable the collation of relevant and all inclusive information, promote farmers/community participation and are cost-efficient.

Weaknesses

National censuses are costly and most African national governments who attempt to undertake these activities collect baseline data on livestock populations often not fully informative.

Lessons learnt and experiences

An overview of the lessons learnt, documents issues that have influenced and/or contributed to the poor/low utilization of characterization, inventory and monitoring tools in Africa. These include;

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. Efficient usage of these molecular tools also requires computer literacy and genetic data analysis prowess which lacks in Africa.

Knowledge in the biotechnology field is not limited to acquiring laboratory dexterity but also data handling and analysis skills. Most of the technical staff in Africa possess minimal or completely lack skills in large-scale data handling, large-scale genomic data analysis, bio-informatics, novel programming languages (R) etc. of which are primary components to the effective usage of these tools. The successful generation of molecular data is a small component of the final product which requires analysis and interpretation of the data. The final outcomes contributed largely to making informed decisions concerning African AnGR.

In reference to geo-referencing of African AnGR, Geographical Information System (GIS) mapping expertise is a prerequisite to successfully undertake geo-referencing activities. It also requires skilled knowledge on the use of relevant software. For the African continent to enjoy the benefits of information systems, basic training on efficient data entry is necessary. Specialized expertise on Information technology, Information systems and design, Database and Knowledge Management will be important to ensure the sustainability of these Information systems within the continent. The lack of skilled personnel in the continent as well as basic AnGR training institutions of higher learning continues to be a major drawback in the actualization of efficient usage of AnGR tools in Africa.

Financial constraints: This was a recurrent issue that affected the efficient utilization of majority of the characterization, inventory and monitoring tools. The lack of available funds within national governments has resulted to irregular inventorization of AnGR within African states. Considering

that livestock census is an expensive activity, most governments have not been in a position to fund this activity regularly. This has resulted to of the misrepresentation of the actual state of AnGR in the respective countries.

The high cost of tools (Biotechnology tools, GIS tools, Monitoring and early warning systems etc.), their maintenance and the evident lack of adequate finances in most African countries have resulted to the poor utilization of the related tools. In most countries there are no budgets allocated for the upgrading of national research laboratories with modern technologies, often these national bodies depend on donations of equipment from developed countries or governments attempt to purchase some equipment that more often than not is mediocre. The establishment of functional laboratories is costly and thus many African countries have shied away from venturing into such costly investments.

Dis-harmony in AnGR tool use: Across the continent, as evidenced, numerous member states extensively use phenotypic tools for characterization, but the lack of harmonization or standardization of these tools has resulted to fragmentation and duplication of outcomes. The need to establish harmonized or standardized protocols is key to promote uniformity in data collection, training programs and synergy in management and conservation strategies.

The lack of standardized tools has resulted to generation of variable results making comparative studies difficult, establishment of a standardised breed template especially in relation to transboundary breeds unfeasible and increased redundancy. Standardization of definition and description of landrace populations would guide development and implementation of plausible conservation programs across the continent.

Policy issues: The lack of relevant policies has affected the effective utilization of AnGR tools due to the absence of laws that govern AnGR issues. The availability of livestock policies backed by sound Acts and Legislations may compel national governments by law to recognise the importance of AnGR and therefore allocate resources annual to this cause. These policies must be drafted to include the need for countries to develop, upgrade and extensively use tools for characterization and inventory as stipulated. For example, livestock census can be mandatory after every 10 years as stipulated by law.

Lack of Political will: Political good will is lacking in Africa and may be attributed to the lack of sensitization to the importance and value of animal genetic resources. It was noted that in Nigeria and parts of West Africa, minimal government funds are allocated for AnGR characterization, surveying and monitoring related activities. Often researchers are forced to support their field and laboratory work through personal funds (salaries).The availability of these funds would offer a common fund which would be competitively sought for the implementation of the relevant and impactful researches.

Tools insensitivity or unawareness: The evident lack of awareness in the utilization of characterization, inventory and monitoring tools was discussed. Contributors agreed that due to lack of knowledge on the importance of characterizing animal populations. Most of the grassroots

stakeholders such as farmers tend to disregards characterization activities associating them with normal government and research activities. Without the active participation of the livestock keepers, data collected may be lacking. Farmers are well versed with certain livestock attributes that need to be captured. For example, collection of adaptive traits was highlighted as a challenge yet with the involvement of farmers this aspect of characterization may be well captured.

Inactive/lack of AnGR Committees: It was agreed that the lack of or scarcity of operational AnGR committees within member states has contributed to the poor utilization of AnGR tools. The data generated from the use of these tools avails results that can be used to make informed decisions concerning various aspects of AnGR. However, 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. If the need arises to undertake breed-level characterization, AnGR committee may advise on the best approach to implement this activity within their respective countries. The lack of active AnGR committees has an indirect link to the effective utilization of AnGR tools.

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. Through the establishment of sub-regional databases, cross talking and cross sharing of information will be promoted.

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. Through this approach standardized and harmonized tools may be advocated for and put in place promoting comparative studies and synchronized conservation and management strategies.

Value-chain-approach: A value chain approach may need to be incorporated to improve the efficient utilization of AnGR tools. In context, this will involve considering the product being developed as AnGR and characterization, inventory and monitoring as tools supporting the delivery of the final product. This may be implemented at national and regional levels.

Session 2: Proposed approaches to improve utilization of characterization, inventory and monitoring tools in Africa

In this session, we sought the e-discussion member views on the characteristic features of an ideal AnGR tool as well as share proposals on how best to tackle the pending issues as pertains improving the utilization of AnGR tools in Africa.

The ideal tools should be;

- Standardized – utilizable in all African member states
- Affordable
- Uniformly applicable across member states
- Robust – give actual representation of AnGR status and trends
- Tailor – made to fit African AnGR specific needs
- Informative – ability to function as early warning tools and put corrective measures in place
- User friendly – at all levels professional and village/grassroots level
- Readily available and accessible – standardized downloadable templates
- Modernized – incorporate digital and manual components especially for recording phenotypic traits
- Guided by framework conditions (macroeconomic policy, financial policy, legal framework, economic infrastructure and administration).

Short term approaches towards improving the utilization of AnGR tools

These are the proposed approaches that we may refer to as low hanging fruit. They are easily implementable and their impacts may be realized in a relatively shorter period of time.

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.

Proposed approaches included;

i. Revision of FAO recommended tools focusing on the peculiarities of the African situation. These revised tools will be adopted by African member states, research institutes and universities.
ii. Development of farmer friendly guidelines for breed identification purposes produced in the key official languages of the continent. These guidelines should include pictorial images, local names of breeds and simple self-explanatory instructions on how to take basic

morphometric measures. This proposal was made in particular reference to the phenotypic characterization checklists that are too detailed and cumbersome. Summarised versions were advocated for.

iii. Revision of traditional phenotypic characterization tools by inclusion of image processing tools to score metric data and categorical phenotypic variables. Revision of FAO descriptor lists, development of new phenotypic templates tailor-made to African AnGR.

iv. Inclusion of collection of indigenous knowledge such as myths and legacy of African AnGR. This information is pertinent to the rich history of our African breeds and is equally important in understanding the occurrence and geographical distribution of certain traits in relation to the inhabitants.

v. Establish an African-led forum to spearhead the harmonization/standardization agenda.

Build a sound technical base:

To improve the current status of lack of skilled personnel, there to;

i. Offer training opportunities and introduce examinable courses of various AnGR aspects in order to grow a technically sound workforce. This approach has been implemented to some degree through ILRI-SLU training of trainers program, BeCA-ILRI hub offers capacity building activities to African scientist and research institutions staff to use tools of modern biology. Currently BeCA offers training opportunities in biotechnology techniques especially molecular characterization tools and genetic data analysis. Through offering research placements especially for national agricultural staff and university students, the technical workforce is slowly gaining ground in Africa.

ii. 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.

iii. Regularly organize capacity building workshops to promote training and sharing of experiences that will enrich the continent's technical workforce. These workshops could be organised within sub-regions facilitated by selected organizing sub-regional committees to ensure sustainability and specificity.

iv. Enhance collaboration between member states through participation and implementation of collaborative projects

Formulation and implementation of policies

During the e-discussion, it was agreed that there is an urgent need to;

i. Fastrack the formulation of comprehensive policies, Acts and legislation that will support the efficient utilization of AnGR tools within member states. With good policies in place, then the governments will be compelled by law to improve the utilization of these tools through ensuring budgets are allocated to conduct these activities e.g. Census. Ghana has begun the process of developing a livestock policy as part of their National Strategic Action Plan (NSAP).

ii. National Consultative Committee (NCCs) on AnGR should actively participate and make inputs into Animal breeding policies and other related AnGR policies.

Raising awareness campaigns

i. Increase advocacy of the importance of AnGR, the essence of characterization and monitoring to policy makers and various stakeholders. 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. For example some African countries have not conducted livestock census for years resulting to inaccurate AnGR population status and trends.
ii. Creating buy-in of farmers to characterization and inventory of AnGR. Involvement of farmers during these important activities will promote the adoption and efficient utilization of these tools. The revision of tools should include inputs from farmers.

Funds sourcing

There is evidently a deficiency in availability of funds to undertake AnGR characterization, inventory and monitoring activities. During the e-discussion it was proposed that;

i. Through establishment of collaborative projects, member states can identify possible funding organization and foreign agencies and solicit funds to implement these AnGR related projects
ii. FAO through sub-regional focal points for AnGR can fund specific projects to utilise selected AnGR tools.
iii. Regional Economic Communities may be approached to offer financial support to some of these activities
iv. National governments must take an active role in the characterization, taking inventory and monitoring of their animal genetic resources through allocating some budgets that could be used to upgrade their national agricultural research centres for example in Kenya, Kenya Agricultural Research Institute has an established biotechnology department whose molecular laboratory can be improved upon.

Establish common information hubs

It was highlighted that due to the lack of efficient communication and availability of African AnGR related information such as publications, there has been continual duplication of efforts and a sense of ambiguity in relation to AnGR matter. E-members made calls to establish;

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. This preposition is currently underway within the AU-IBAR genetics project with the proposed establishment of an African Animal Genetic Resources Information system (AAGRIS) that will

function as a "one-stop-shop" where a wide range of end users will be able to obtain relevant information to acquire knowledge, inform policy makers, raise awareness and promote best practices in the management of AnGR.

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. Its primary objective was to encourage cooperative efforts to develop and apply genomic tools for the identification and preservation of locally adapted goat populations, and to leverage these collaborations to enhance African expertise in genomics. The long-term goal is to develop genetically superior adapted goats to help meet the demands of local food security

Long term approaches towards improving the utilization of AnGR tools

Establish Livestock Monitoring Committees (LMC)

It was proposed that livestock monitoring committee should be established in African countries. The committees would be appointed "sentries" of AnGR. The proposed mandate will be to monitor animal genetic resources. The LMC committee could be constituted by the countries ministries of agriculture and composed of experts drawn from across countries AnGR centres of excellence. However, there is a need to clearly define their mandate as some countries already have established National Advisory Committees and National Consultative Committees on AnGR. It was proposed that the NCCs mandate may be expanded to include departments that are dealing with AnGR statistics.

Integrate a value-chain approach

A value chain approach was proposed, that will enable Africa to have a comprehensive knowledge of particular breeds inclusive of their potential products and the likely consumers. Information on three main aspects should be captured; livestock keepers, livestock processors and livestock marketers. This will identify breeds that may be over utilized, underutilized and of not economic value.

Recommendations:

Some recommendations made during the e-discussions;

i. AU-IBAR to establish an African led process to develop and adopt appropriate characterization, inventory and monitoring tools suited to African AnGR by selecting a panel of experts from each sub-region to develop manuals. Through these initiatives, AU-

IBAR will be supporting the establishment of mechanisms that will drive the process of revision and harmonization of these tools within each sub-region.

ii. Prompt establishment of an all-inclusive information systems or databases hosted by sub-regional institutions to ensure the collation of standardized data that will give a clear continental representation of the status and trends of AnGR.

iii. Establishment of specialized AnGR training centres of excellence that will offer theoretical and practical training opportunities to students, researchers and technical staff of ministries and various AnGR research institutions.

iv. Urgent push for the development and update of livestock policies relevant to AnGR and supporting Acts or legislative instruments through an AU-IBAR lead initiative.

v. Increase collaboration and establishment of consortia within the African continent through an AU-IBAR lead initiative.

vi. Priority areas captured in the standardized tools should include information on population size and structure of each breed, images of breeds (both sexes and at different age groups), geographical information, production systems capturing indigenous knowledge and use of breeds.

vii. AU-IBAR to establish recognition awards (plaques or trophies) for Member States who give regular updates of the status and trends of their AnGR.

Concluding remarks:

The e-discussion was a very successful exercise that highlighted African - specific challenges faced during utilization of AnGR characterization, inventory and monitoring tools and proposed dynamic solutions to these challenges.

The general consensus was for Africa to work towards standardization/harmonization of AnGR tools with the primary intention of tailoring these tools to suit the continent's specific needs and ensuring appropriate mechanisms are in place so as to promote the adoption of these harmonized tools throughout the continent.

Acknowledgements:

We appreciate the vibrant and interactive e-discussions that were made possible by the active participation of all our e-members. To the AU-IBAR ARIS technical team for ensuring the smooth operations of the e-discussion.

ANNEX: E-DISCUSSION QUESTIONS

Session I:

Session one sub-topics:

A) **Assessing the utilization of tools and protocols for characterization**

1. What are tools currently used by you or your institution for characterization of AnGR?
2. What are the main features and opportunities that these tools offer?
3. What are the challenges in using these tools?
4. What are the lessons learnt and best practices acquired from the use of these tools

B**) Improving the utilization of tools and protocols for characterization**

1. What are the options for improving the utilization of tools for characterization?
2. What are the implications for each option (capacity, policy and institutions, funding, revision/harmonization)?

Session II:

A)

1. What would you IDEALLY want AnGR tools for characterization, inventory and monitoring to achieve?
2. What solutions would you recommend to address the persisting issues listed below that have been highlighted in session 1
    a) Revision and harmonization
    b) Funding issues
    c) Lack of technical capacity
    d) Policy issues
    e) Farmer sensitization
    f) Lack of collaboration

B)

1. The Issue of a livestock monitoring committee has been shared in the e-discussions; can we share proposals on how best we can implement this as well as sustain its operation within member countries?
2. Harmonization and standardization of tools is another key strategy raised, can we expound on implementable approaches to best realize this as an African led-process?
3. Inventorization of our livestock populations seems to be our weakest point, how best can we review/revive this activity with the support of our governments? What has been the cause of the poor documentation as not only is cost contributing to this evident missing knowledge gap?
4. Establishment of a biological database is very crucial, a hub that we can pool our AnGR information. How best can we set this in place?

C)

1. In our discussions we highlight the need to establish functional committees run by governments or other supporting organizations, however, one key issue we are not addressing is the fact that the inventory tools are not robust as most data gathered is not fully representative of the present-day AnGR state. It is evident that the tools do not capture information to breed level (population figures for breeds missing). The data collected that we propose to use for meta-analyses would probably be based on estimates and a collation of species rather than specific breeds. Africa as a whole needs to improve on the utilization of inventory tools, can we revise and standardize these inventory tools to be more friendly and robust by identifying key priority areas of information to capture and which ones are they?

2. Do we realize that, for example phenotypic tools are cumbersome and too detailed, can we revise and create farmer friendly guidelines that can be used in identification of breeds and ultimately contribute towards making inventorization much easier through farmer participation during livestock census? What approaches can we embrace?