# Forage Production and Utilization for Increased Productivity of Uganda's Smallholder Dairy Systems

## *Forage Experts' Consultative Workshop*



**5th March 2015**

**Kifu, Mukono**

**Agroforestry Research Programme**
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## Introduction

Smallholder dairy development can be a catalyst to agriculture-led economic development given its possible contribution to household nutrition and incomes. In Uganda, however, development of this sub-sector remains constrained by limited availability and access to quality feeds especially during dry seasons. Although fodder trees and shrubs have potential for enhancing feed availability on farms and subsequently boosting milk production, their use among smallholder farmers is still low.

The National Forestry Resources Research Institute (NaFORRI) of the National Agricultural Research Organization (NARO), through its Agroforestry Research Programme is conducting a study under the Agricultural Technology and Agribusiness Advisory Services (ATAAS) project, aimed at "improving forage production and utilization for increased productivity of Uganda's smallholder dairy systems". This study analyses forage options used by farmers to determine their potential for enhancing milk productivity; evaluates management practices for optimal feed production; and uses these as a basis for enhancing farmers' capacities for sustainable production and use of improved forage.

Given that the dairy enterprise cuts across a wide range of domains, the need for combined technical expertise in areas of veterinary medicine, animal nutrition, extension and product marketing, agroforestry, socio-economics and other related disciplines has been noted from time to time on this project. It is in view of this that a consultative forum on forage production and utilization was considered necessary to share methods, progress and plans with experts in different fields, check technical validity of ongoing processes and thereafter recommend strategies for improvement.

A one-day workshop to this effect was held on 5th March 2015 in Dr. J.W.R. Aluma Conference Hall, at NaFORRI Headquarters, Kifu, Mukono district. Participants comprised of experts in animal nutrition, veterinary medicine, forestry, agronomy and agricultural extension, drawn from institutions like the National Livestock Resources Research Institute (NaLIRRI), Makerere University College of Veterinary Medicine, Livestock Programs at Buginyanya and Mukono Zonal Agricultural Research Institutes (ZARDIs), the East African Dairy Development (EADD) Project, District Veterinary Departments, as well as dairy farmers' representatives and the study team at NaFORRI. This report presents the proceedings of this workshop.[1]

[1] This report has been compiled by a team of rapporteurs that included Ms. Susan Nansereko, Mr. Gerald Ongodia and Mr. Kenneth Eryau assisted by Dr. Hillary Agaba, Mr. Jude Sekatuba and Mr. Joel Buyinza. As authors, we acknowledge the contributions of the various participants during the consultative workshop.

**Session 1: Opening (Chair: Dr. Hillary Agaba)**

***Opening***

The workshop began at 10:00am with a word of prayer led by Ms. Nakirabira Florence. Thereafter, participants introduced themselves by names, designations and institutions represented (see Appendix 2 for list of participants).

***Opening remarks and workshop overview***

Dr. Hillary Agaba, the Programme Leader, Agroforestry Research at NaFORRI, welcomed participants to the institute and the workshop in particular. He expressed gratitude about the good response to invitations extended. He then gave an overview of the workshop, indicating the context within which it was deemed a necessity. He went ahead to outline the objectives of the workshop as follows:

1) To share project progress and outputs and other relevant information with key stakeholders;
2) To share future plans and strategies of the project with the stakeholders;
3) To obtain technical advice and opinions on project progress and planned activities.

***Overview of the "Forage Project"***

Mr. Jude Sekatuba gave an overview of the "Forage Project" at NaFORRI which he leads. He pointed out the prospect of smallholder dairy as means to agriculture-led economic development, which though is curtailed by poor nutrient composition and seasonal unavailability of animal feeds. He highlighted that fodder trees and shrubs can contribute to feed security given their ability to withstand extended dry periods. Currently, dairy farmers use various trees and shrubs to feed their animals, although in rather haphazard manner.

This project aims at increasing productivity of smallholder dairy systems in two agro-ecological zones (AEZs) of Uganda, i.e. Eastern highlands (Mbale, Manafwa, Sironko and Bulambuli), and Lake Victoria Crescent (Masaka, Mukono, Luwero and Mpigi districts). The study addresses four objectives:

1. To analyse forage production and utilization options;
2. To determine milk productivity potential of priority forage species;
3. To evaluate forage management practices for optimal feed production and utilization;
4. To enhance dairy farmer's capacity for sustainable production and utilization of improved forage.

He further outlined the studies/experiments that run under the project as follows:

1. Analysis of forage production and utilization options and their contribution to milk production;
2. Determination of milk productivity potential of priority forage species;
3. Evaluation of forage management practices for optimal feed production and utilization;
4. Enhancement of dairy farmer's capacity for sustainable production and utilization of improved forage;
5. Enhancing availability of improved forage germplasm to farmers;
6. Development of forage pests and diseases management options.

**Session 2: On-going forage management and nutritional content studies (Chair: Dr. H. Agaba)**

***Presentation 1: Management options for optimal forage production***

Mr. Joel Buyinza is an Agroforestry Scientist at NaFORRI and the Principle Investigator (PI) of a study entitled "Assessing Biomass Production of Selected Forage Species under Different Management Options" the protocol of which he presented. This on-station experiment involves three fodder shrub species, i.e. *Calliandra calothyrsus, Vernonia amygdalina* and *Morus alba*, with the following as its objectives:

1. To assess the effect of varying cutting heights on the amount of biomass produced;
2. To evaluate the effect of spacing on biomass/foliage production;
3. To determine harvesting intervals for optimal foliage production.



Mr. Buyinza also shared the location, duration and hypotheses of the study as well as describing the methods of data collection, processing and analysis. He reported progress in assessment of shrub survival, growth performance and biomass production. He outlined biomass assessments, study protocol revision, data analysis and manuscript development as some of the ongoing and planned activities on this study.

***Presentation 2: Contribution of forage options to milk quality and quantity***

Mr. Buyinza also presented a protocol for another experiment entitled, "Assessing Impact of Varying Forage Combinations on Milk Quality and Quantity in Uganda's Smallholder Dairy Systems". This study addresses the low nutritional quality of feeds used in Uganda's dairy systems, which though rich in roughage are deficient in proteins. Tree fodders offer promise in this regard as they are known to be richer in protein and mineral contents than natural grasses. However, the nutritive contents in most forage tree species in Uganda are yet to be quantified and their appropriate combinations for optimal milk production remain uncertain. This study seeks to address this anomaly through the following objectives:

1. To determine the quantities of vital nutrients in 14 potential forage species[2];
2. To assess the quality (fat, nutritive content, odour, thickness) of milk produced under different forage combinations;
3. To assess the quantity (litres) of milk produced by a lactating cow fed on different forage combinations.

This study has two components:

a) Laboratory analyses of nutrient content in priority forage species;
b) Forage combinations for milk enhancement in lactating cows.

Mr. Buyinza explained the methods proposed for data collection and analysis on either component as well as the terms to be agreed upon when entering agreement with farmers to experiment using their lactating animals.

He reported progress on comparison of leaf sample nutritive content with a significant difference evident across species ($P<0.05$) in most attributes, apart from gross energy and ash content. Species also showed similar attributes across the two AEZs. Results for mineral content analysis are yet to be received from National Agricultural Research Laboratories (NARL). Other plans on this study include prioritization of five forage species, raising fodder for feeding lactating cows, experimenting farmer selection, selection of lactating cows and replicates, development of terms of reference (ToRs), updating study protocol and drafting of a manuscript from the data collected and analyzed.

***Demonstration: Visit to the on-station fodder management trial at Kifu***

Ms. Phiona Kwaga, the Agroforestry Technician in charge of the on-station fodder management experiment (Presentation 1) welcomed participants to the trial site and gave a chronology of stages that the experiment has gone through since its establishment in April, 2014. She illustrated the randomized complete block design (RCBD) used on the trial that has three blocks and each block representing a given fodder shrub species spaced at 50 x 50 (Control); 75 x 75 and 100 x 100 cm. Beside the control plot (50 x

[2] The species under assessment are *Calliandra calothyrsus, Sesbania sesban, Ficus natalensis, Artocarpus heterophyllus, Leucaena leucocephala, Cajanus cajan, Trema orientalis, Mangifera indica, Vernonia amygdalina, Morus alba, Gliricidia sepium, Tithonia diversifolia, Sapium ellipticum* and *Albizia lebbeck.*

50 cm) that was subjected to only one level of cutting height of 50 cm, other plots have sub-plots/parcels that are subjected to two cutting heights of 25 cm and 100 cm at varying cutting frequencies.



She also explained the procedures followed in leafy biomass collection and data management. In doing this, a sample of leafy biomass for each fodder species is collected from which two sub-samples are produced for oven and air drying to constant weight. The data for both fresh and dry fodder biomass are recorded and entered in MS Excel worksheets.

**Session 3: Developing capacity for sustainable fodder production and use (Chair: Dr. H. Agaba)**

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***Presentation 3: Development of forage pests and diseases management options***

Mr. Peter Kiwuso is an expert in forest entomology and heads the Forest Products and Services Research Program at NaFORRI. He presented a study on "Management of pests and diseases in selected tree fodder species in Uganda," which is premised upon the fact that much as fodder trees can enhance productivity of farming systems, their use is constrained by associated pests and diseases. This problem is gaining even more prominence due to: (i) planting one or two fodder species in same site continuously; (ii) exotic nature of some of the fodders; (iii) increased trade and movement hence increased pest

introductions; and (iv) climate change. In recent years, fodder pest and diseases are causing economic losses to farmers, creating need for intervention.

This study seeks to control pests and diseases of selected forage crops by: (i) identifying key pests and diseases of priority forage crops; and (ii) evaluating and recommending appropriate control options against key pests of selected fodder trees and shrubs.

Mr. Kiwuso explained the methodology to be used in: (i) sampling and collecting pests, diseases and associated natural enemies; (ii) taxonomic identification of species collected; (iii) ranking pests and diseases according to damage levels and farmers perceptions; (iv) identifying and evaluating potential control options; and recommending appropriate control options. Data are to be collected on pest and disease species/diversity; pest and disease species frequency/abundance, severity/damage per species, associated natural enemies and efficacy, location of occurrence and host-pest relationships.

***Presentation 4: Capacity for sustainable production and use of improved forage***

Mr. Sekatuba Jude is Principle Investigator for a study entitled "Enhancing Smallholder Dairy Farmers' Capacity for Sustainable Production and Utilization of Improved Fodder". He presented the protocol of this study, highlighting that efforts aimed at addressing the problem of feed unavailability had yielded several *technological* interventions, but not much has been done in addressing *non-technological* aspects e.g. fodder seed distribution systems, knowledge management etc.

He outlined the research questions this study seeks to answer:

1. Are farmers aware about proven forage options?
2. Can smallholder dairy farmers access planting material of key forage species?
3. Will farmers use "quality" forage if availed with planting material?
4. Do farmers "practice" what is "preached" to them about forage?
5. Does "strengthening" of farmers' capacities in forage production and use increase productivity of smallholder dairy systems?

The study has three objectives:

1. To increase availability of quality planting material of priority forage species to smallholder dairy farmers;
2. To equip smallholder dairy farmers with knowledge and skills to undertake best-practices in forage production and utilisation;
3. To determine the contribution of farmer capacity development interventions on productivity of smallholder dairy systems.

He also described the methods used in undertaking each objective and data requirements therein. Progress to date was reported mainly on objective 1 (availability of quality planting material of priority forage species to smallholder dairy farmers increased), whereby 16 sites for establishment of fodder seed stands have been identified in Eastern Highlands (8) and L. Victoria Crescent (8) AEZs. Soil samples from

these sites were under analysis to establish site compliance with species requirements. Planting materials are also being raised in preparation for seed stand establishment.

Plans on this study include: (i) establishment and maintenance of fodder seed stands; seed acquisition, packaging and distribution to dairy farmers, demonstration and popularizing good fodder management options through dissemination materials, exhibition events and exchange visits.

**Session 4: Discussions (Chair: Dr. Hillary Agaba)**

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***a) Key discussion***

Dr. Swidiq Mugerwa is a livestock nutrition expert at the National Livestock Resources Research Institute (NaLIRRI) and was the key discussant of the day. In his analysis, Dr. Mugerwa pointed out the following as important issues to consider for the project to deliver upon its intended outputs:

- Feed supplementation experiments are complicated and expensive undertakings involving high costs of acquiring and maintaining required numbers of experimental animals. Such experiments are even more complex when conducted on-farm where conditions are not controlled. The following are especially critical for such experiments:

    i) *Parity*: The same standards should be maintained, i.e. experimental animals must be of the same breed, age, health status etc.
    ii) *Compensation*: There should be mechanisms for compensating for any loss encountered during the experiment. For instance, the project may be required to pay farmers for the foregone milk yield in cases where feed treatments cause milk reductions.
    iii) *Medical examination*: Proper medical examination of the animal is a prerequisite before, during and after the experiment.
    iv) *Ethical issues*: There are animal welfare issues that need to be observed, and about which the project team should seek permission from appropriate boards. Alternatively, it would be strategic to collaborate with institutions like Faculty of Veterinary Medicine of Makerere University and NaLIRRI that already have permission to and vast experience in conducting such experiments.
    v) *Quality and quantity of feeds*: Regulating the quality and quantity of feeds is very important in feeding experiments. This though presents a serious challenge when working with farmers.
    vi) *Good records*: Proper record keeping is also important although most farmers do not do this as a routine activity.
- There is need to sharpen the objectives of the feed combinations protocol – at the moment the objectives of this protocol and the problem being addressed are not very clear. A forum comprising a few members of the study team and selected livestock nutrition specialists (proposed Dr. S. Mugerwa, Dr. B. Oweyesigire and Dr. S. Byenkya) needs to convene and improve this protocol.
- Preferably, "feed supplementation" regimes should be studied rather than "feed combinations" as fodder is not a basal feed. It is also unlikely that dairy farmers will have all the fodder species being studied!

- Work needs to be focused on agro-ecological zones given that farmers' fodder species preferences tend to differ and as such, feed packages ought to be customised to particular contexts.
- The project needs to focus on "fodder" rather than "forage" as the former is more accommodative of shrubs and trees, and fits well into NaFORRI's niche and mandate.
- A serious review of what has been done around fodder trees/shrubs needs to be conducted and validated. Along with this, it is important to understand the constraints hindering adoption/integration of fodder trees in farming systems. It is based on this that best options/practices are to be selected for promotion among dairy farmers.



- Dr. Mugerwa also highlighted three important areas of collaboration:
  i) An on-going project in districts of central Uganda (Nakasongola,Kiboga, Mubende, Sembabule and Nakaseke) enhancing availability of fodder seedlings. The fodder project at NaFORRI could tap into already established structures of that project.
  ii) A research area on rumen ecology and functionality that is yet to be explored. Fodder trees have elements that improve rumen functionality from the by-pass proteins from tree fodder supplementation.
  iii) Saponins high in fodder trees inhibit the build up of methanogenic bacteria thereby reducing production of methane into the atmosphere.

***b) Plenary discussions***

The plenary discussions that followed covered a wide range of issues as summarized in the following sections:

*1) Exhaustive review of work in the field of tree fodder and dairy animal feeding in East Africa*

Dr. Jolly Kabirizi, a livestock nutrition expert from NaLIRRI emphasized the need for an exhaustive review of related work and advised the project to build on what has already been done in the field of dairy animal feeding in Uganda and the East African region. Reference should be made to earlier work on fodder shrubs like *Calliandra calothyrsus* (Dr. Kabirizi's PhD thesis) and *Gliricidia sepium* (Dr. Mpairwe's PhD thesis). Dr. Kabirizi expressed willingness to avail the project with detailed accounts of such work dating as far back as the 1920s! She noted that this project could as well benefit from work done on *Tithonia diversifolia* by Ngetta ZARDI.

Mr. Pius Lutakome, a Dairy Feed Extension Specialist with the East African Dairy Development Project volunteered to provide literature on *Gliricidia sepium* and *Morus alba*. He pointed out that to some extent farmers have *Calliandra calothyrsus* on their farms, unlike species like *Gliricidia sepium* which though beneficial have not been widely adopted. He advised that this project considers popularizing such fodder shrubs as alternatives to *C. calothyrsus*. Dr. Kabirizi added that palatability improvement of *Gliricidia sepium* is possible and requires drying, mixing with hay in a ratio of 1:3, and soaking in molasses. She has developed a feed block following the aforementioned procedure, 2 blocks of which are sufficient for a dairy animal per day. Participants recommended promotion of *G. sepium*, a species which when pre-treated well before feeding to the animal, can be as good as or not even better than *C. calothyrsus*.

Some participants were of the view that there is a lot of "re-inventing the wheel" in the project. For instance, issues of cutting heights in fodder shrub management were said to be already proven. It was advised that instead of presenting a long list of "fodder shrubs", the study team ventures into virgin territory of "fodder trees" such as *Ficus natalensis* and *Balanites aegyptica* that have traditionally been fed to cows by farmers, yet their contribution to milk production remains unknown.

*2) Duration of monitoring lactation*

The proposed 3 to 4 months period for monitoring lactating cows fed on fodder supplements was noted to be inappropriate as lactation could last up to 10 months. This though varies according to breed, animal health and milking method. On the other hand, even when 3 or 4 months of monitoring lactation are taken as moderately permissible, it needs to be clear when exactly observations and measurements should actually start.

*3) On-station versus on-farm animal feeding trials*

Both on-station and on-farm animal feeding trials need to be considered. It was suggested that on-station feeding experimentation be conducted first then followed with on-farm verification. In spite of fears about on-farm experimentation, it is possible with good supervision especially through student attachments and

peer influence among groups of farmers. It was also advised that on-station feeding trials are done in close collaboration with NaLIRRI, Mukono ZARDI and Buginyanya ZARDI since these institutes have experimental animals and expertise in undertaking such trials.

A proposal was also raised that research on live animals be minimized and instead focus shifted to modelled research. With funding becoming increasingly scarce, the development of predictive models presents a cheaper option that would base on available information on milk production to make predictions and thereby reduce on the amount of on-farm field work necessary.

*4) Basal feed and feed supplementation*

The experts provided guidance on feed supplementation dynamics. Basal feeds comprise mostly of grasses (e.g. *Napier*, *Hyperrenia* etc.) and form the bulk of the animals' diet. It is important first to understand the composition of basal feeds used by dairy farmers, and base on the shortcomings therein to recommend suitable feed supplementation. It also necessary to consider returns to investment in feed supplementation and keep a close check on whether the fodder supplementation options proposed are economically viable in farmers' contexts.



The discussion took an interesting twist when it was argued that "no one has ever fed a cow" given that its digestion is not through direct processes. Instead, it is the microbes in a cow's rumen that are fed, and such microbes need three major things (enzymes) in the process of digestion, i.e. Butyrate, Propyonet and Acetate. There was clarification that a cow can to some extent "be fed" as the microbes in its gut produce

only 60% of the required proteins with the other 40% by-pass proteins obtained through fodder supplementation.

*5) Critical parameters for nutritive content analyses*

Livestock nutrition experts pointed out that the nutritional analyses conducted so far by the project are lacking, given that not all crude proteins indicated by these analyses are readily accessed and utilized by animals. An example was given of *Albizia* spp. which has high amounts of crude proteins but also anti-nutritional compounds that render it unpalatable to animals. A parallel study on protein degradability by animals was thus recommended, whereby the nutritive content findings would be complemented by analysis of rumen biosynthesis extract.

It was furthermore explained that the critical nutrients to test for in fodder were: (i) dry matter and (ii) vitamins A, D and E (but not C). A cow needs to eat 3% of its body weight of dry matter daily, which is the reason why dry matter matters more than fresh weight. In fact, animals may get emaciated even when fed on large quantities of fresh feed if dry matter content is low. Experts cautioned though that getting the dry matter is usually a challenge.

*6) Fodder planting materials*

Experts emphasized the issue of limited supply and low quality of fodder shrub planting materials. An example was given of *Calliandra calothyrsus,* whose planting materials are not readily available to farmers in spite of the species being sought after. It was suggested that this project ventures into producing seeds of proven fodder species especially *C. calothyrsus* in an effort to address this problem. Strategic locations or distribution points need to be established where farmers can access planting materials of such fodder trees. This should be supplemented by demonstration sites to enable farmers see good practices in tree fodder management.

*7) Fodder biomass production patterns*

Some participants inquired about the stage at which "good biomass production" actually starts and ends! Is there a possibility of the law of diminishing marginal returns applying to the fodder shrubs? Answers to such ought be sought from the work on fodder biomass management, and later on used to inform farmers' investment decisions. Participants also saw need for more fodder biomass management trials to be set up in other AEZs as the fodder trees are likely to exhibit varying growth characteristics under different agro-ecological conditions.

Experts also noted that before administering the treatment of standardized cutting heights on the fodder biomass management trial, of the three shrub species, *Vernonia amygdalina* had already shown variation in growth. It was therefore advised that a mixed model procedure be used instead of a repeated model approach as this would be more suitable for data analysis.

*8) Adoption of fodder trees by smallholder dairy farmers*

The need to explore reasons why farmers were not adopting and integrating fodder trees on farms also drew participants' attention. Is it as a result of lack of planting materials, inadequate extension services or lack of awareness about fodder trees? Adoption of fodder trees and their integration into farming systems was noted to be a major challenge which this project should seriously consider addressing. It was suggested that innovative strategies for integrating fodder trees into farming systems are explored with focus put on tapping into added benefits of fodder trees (e.g. soil fertility improvement, income generation and provision of various tree products and services).

In this regard, reference was made to a project that was promoting *Morus alba* for sericulture in Bushenyi district but failed because its implementers did not clearly link it to other income enhancement opportunities likely to accrue to participating households (e.g. fodder). Another example was given of farmers in Sembabule that took up fodder trees when presented as part of a silvo-pastoral package, while their counterparts in Luwero accepted the same trees as shade trees in coffee plantations.

*9) Understanding processes at different segments of commodity value chains*

Experts argued that solving the fodder shrub adoption problem will require addressing processes at other segments of the milk and fodder value chain other than the farm. Increase in milk production per se, is not likely to farmers to adopt fodder trees if market for the additional milk is not guaranteed. Benefit-cost analyses of technological innovations therefore, are necessary as these provide realistic impression of returns to farmers' investment and their motivation for technology adoption.

Besides income from milk sales, opportunities for income generation and job creation around fodder trees/shrubs need to be explored. Getting farmers organized into fodder seed collection, bulking and marketing networks, for example, would enhance distribution of fodder planting material from areas of high concentration to where it is in high demand. Also, research along upper segments of commodity value chains needs to be strengthened to generate options for value addition and marketing of fodder.

*10) Forage species preferences*

The project implementation team was also advised to explore farmers' preferences and attitudes towards fodder species under consideration. It is important for farmers to provide information on availability and preference of the fodder species under study instead of the project team alone "thinking on behalf of the farmers". Extension specialists warned that fodder shrub species selected on behalf of the farmers stand high chance of being rejected even when technically proven to be effective.

An example was given of "Kafadanga" – a local herb known to enhance milk production and widely appreciated by dairy farmers in Busoga region, Eastern Uganda, where it is preferred even to "proven" and commonly promoted forage species. It was therefore recommended that this project endeavors to understand farmers' genuine perception about the technological options availed to them and thereafter provide feedback to research. The study team was also advised to work more closely with farmers in identifying opportunities for integrating fodder trees/shrubs into farming systems.

**Session 5: Workshop recap and way forward (Chair: Dr. Paul Okullo)**

***Workshop recap***

Ms. Susan Nansereko, on behalf of the team of rapporteurs for this workshop, gave a synthesis of the key issues raised during the discussions of the day. These comprised mainly of technical advice and opinions on feed supplementation; fodder biomass production; adoption of fodder tree/shrub by farmers and ways of improving the project's deliverables. These have been highlighted in the preceding section.

***Way forward***

Drawing from the key issues as outlined in the recap, a way forward was suggested to include the following:

1. *Formalizing of collaborations between all relevant institutions and individuals:* Frequent sharing of information and ideas of benefit to the project is considered a good way to nurture effective collaborations. Individuals listed on various study teams in the protocols need to be brought on board and engaged actively.

2. *Review of existing resources on tree fodder in Uganda:* It was agreed that the study needs to benefit from earlier work on fodder in Uganda and the East African region to identify gaps for further research and identify innovations for scaling up. The project team at NaFORRI will coordinate this review, but will draw a lot from the networks and contacts emerging from this consultative workshop.

3. *Organizing forums for improving upon protocols of various studies under the project:* It is expected that through this consultative workshop, continued interaction thereafter and exhaustive review of other work on tree fodder, this study will gain new direction on several fronts. Current protocols will be revised by select focal teams of experts convened for this purpose, the outcome of which will guide implementation of subsequent activities.

4. *Implementing "no regret" activities:* (i) There are opportunities for publishing findings from ongoing experiments under the project. To guarantee this, it was suggested that the project liaises with universities to identify student to attach to these studies. (ii) Secondly, the project is to base on the review of fodder work in the country to design and implement farmer capacity development activities even as current studies are still ongoing. Cases in point are: (a) streamlining forage seed systems of proven fodder trees; (b) understanding drivers of fodder technology adoption (or rejection) by farmers; and (c) identifying opportunities and constraints for smallholder dairy development along the milk and dairy feed value chains.

**Session 6: Closing (Chair: Dr. Paul Okullo)**

In his closing remarks, Mr. J. F.O. Esegu, the Director of Research, NaFORRI extended his appreciation to the participants for their dedicated contribution towards improvement of the livestock sector in Uganda. He said the discussions held during the workshop were to be used as guidelines in refining fodder research activities at the institute. He asked the project team to use this opportunity to prepare for the upcoming NaFORRI Review and Planning Meeting 2015.



He commended the agroforestry team for undertaking work on this project and for seeking wisdom of various experts in efforts intended to ensure effective research. He thanked the experts for their sincere views on the project activities and promised to ensure that this workshop form a solid basis for improving the technical quality of tree fodder work at NaFORRI.

Mr. Esegu acknowledged the need for livestock and forestry to form very strong partnerships and strive to work as a team in implementing fodder research activities. He stressed that many disciplines have a contribution to make towards improvement of the dairy sub-sector, in which case, there should be strong partnership and collaboration between institutions in order to tap into potential synergies. On that note, he called the meeting to a close at 4:30 pm and wished participants journey mercies to their respective destinations.

**Appendix 1: Key issues to address, Strategies and Action points arising from the workshop**

| Issues | Strategies | Action points |
|---|---|---|
| 1. Where to site feeding trials | • Planned animal feeding/nutrition trials should be conducted both on-station and on-farm. | • Collaborate with BugiZARDI, NaLIRRI and MuZARDI on possibility of using their cattle for on-station feeding trial. |
| 2. Problem addressed on feeding trial not clear | • Assess composition of basal feed of smallholder dairy farmers and base on that to establish the need for and composition of feed supplements.<br>• Focus on protein deficiency in basal diet and degradability of fodder as the key problems to address. | • Consult livestock nutrition specialists at NaLIRRI and other NARO institutes to develop a protocol on protein degradability by animals (analyzing rumen biosynthesis extract) for priority fodder trees and shrubs. |
| 3. Fodder tree-crop interactions not addressed adequately | • On-station fodder management trial explores options for integrating fodder production into farming systems.<br>• Establishment of fodder management trials on-farm to analyse applicability of technologies e.g. boundary planting and hedgerows. | • Intercrop maize into Calliandra seed stand at Kifu to demonstrate component interaction. |
| 4. Venture into the unknown rather than "reinventing the wheel" | • Exhaustive review of fodder work to identify gaps to address. Venture into novel species instead of dwelling on those that have been over studied. | • Follow up on participants' that promised reference materials;<br>• Online search for more relevant literature;<br>• Form DropBox group to facilitate sharing of resources<br>• Initiate study protocols on propagation, management and nutritive content analyses of indigenous fodder species e.g. *Ficus natalensis* and *Balanites egyptica*. |

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|---|---|---|
| 5. Getting publications out of ongoing and planned studies | • Engage student attachment to hasten delivery of project outputs. | • Collaborate with universities (e.g. Makerere, Busitema) to identify an MSc student in a field related to animal nutrition to be part of the feeding experiment. |
| 6. Compliance with ethical requirements for conducting research on animals | • Seek permission from appropriate boards to conduct feeding trial experiments.<br>• Collaborate with specialist livestock research institutions (e.g. NaLIRRI and Makerere University). | • Establish contacts and initiate dialogue with College of Veterinary Medicine at Makerere University.<br>• Engage NaLIRRI, BugiZARDI and MuZARDI on prospects of collaboration in undertaking on-station feeding trials. |
| 7. Farmers' lack of access to tree fodder seed | • Establish fodder seed distribution systems by setting up seed stands and organizing farmers into seed production and exchange networks that link them to markets. | • Establish seed stands for "proven" fodder species e.g. *Calliandra calothyrsus, Morus alba, Gliricidia sepium* etc.<br>• Initiate an appraisal of fodder seed distribution systems in Uganda. |
| 8. Low adoption of fodder trees/shrubs by farmers | • Consider innovative and profitable options for integrating fodder trees in existing farming systems.<br>• Draw farmers' attention to added benefits of fodder trees that accrue as a result of such options (e.g. soil fertility improvement, income generation from sale of fodder planting material and associated tree products). | • Initiate a study to investigate incentives and disincentives for adoption of fodder trees/shrubs by farmers.<br>• Design interventions to enhance incentives as well as address disincentives to adoption of fodder trees/shrubs by farmers. |

**Appendix 2: List of workshop participants**

| No. | Name | Designation | Institution |
|---|---|---|---|
| 1. | Dr. Mugerwa Swidiq | Senior Research Officer | NaLIRRI |
| 2. | Dr. Kabirizi Jolly | Senior Research Officer | NaLIRRI |
| 3. | Ms. Kugonza Jane | Programme Coordinator | EADD Project |
| 4. | Mr. Lutakome Pius | Programme Officer | EADD Project |
| 5. | Dr. Byenkya Stephen | Senior Research Officer | Bulindi ZARDI |
| 6. | Dr. Oweyesigire Brian | Research Officer, Livestock | Buginyanya ZARDI |
| 7. | Dr. Mwesigwa Moses | Research Officer, Livestock | Mukono ZARDI |
| 8. | Dr. Muhangi Dennis | Lecturer | Makerere University |
| 9. | Dr. Kiryabwire David | Deputy District Veterinary Officer | Mukono District |
| 10. | Mr.Wamimbi Damian | Dairy Farmer | Mbale |
| 11. | Dr. Agaba Hillary | Senior Research Officer | NaFORRI |
| 12. | Mr. Buyinza Joel | Agroforestry Scientist | NaFORRI |
| 13. | Mr. Sekatuba Jude | Research Officer/Socio-economist | NaFORRI |
| 14. | Ms. KwagaPhiona | Technician | NaFORRI |
| 15. | Ms. Nansereko Susan | Research Officer | NaFORRI |
| 16. | Mr. Ongodia Gerald | Research Officer | NaFORRI |
| 17. | Mr. Opolot Vincent | Research Officer | NaFORRI |
| 18. | Mr. Eryau Kenneth | Technician | NaFORRI |
| 19. | Mr. Kiwuso Peter | Senior Research Officer | NaFORRI |
| 20. | Mr. J.F.O Esegu | Director of Research | NaFORRI |
| 21. | Mr. Akellem Richard | Technician | NaFORRI |
| 22. | Ms. Nakirabira Florence | Volunteer | NaFORRI |
| 23. | Mr. Kimenya Geofrey | Volunteer | NaFORRI |
| 24. | Ms. Mudondo Scovia | Technician | NaFORRI |
| 25. | Ms. Ssempala Sara | Technician | NaFORRI |
| 26. | Ms. Masibo Miriam | Technician | NaFORRI |
| 27. | Mr. Balitta Paul | Research Assistant | NaFORRI |
| 28. | Dr. Okullo Paul | Senior Research Officer | NaFORRI |

**Appendix 3: Workshop programme**

| Time | Activity | Responsible |
|---|---|---|
| 8:30am-9:00am | Arrival and registration | Phiona Kwaga |
| | **Session 1: Opening** | **Facilitator** |
| 9:00am-9:30am | Opening prayer | Florence Nakirabira |
| | Introductions | Participants |
| | Opening remarks and workshop overview | Hillary Agaba |
| 9:30am-9:45am | Overview of the "Forage Project" | Jude Sekatuba |
| | **Session 2: On-going forage management and nutritional content studies** | **Facilitator** |
| 9:45am-10:15am | Management options for optimal forage production | Joel Buyinza |
| 10:15am-10:45am | Contribution of forage options to milk quality and quantity | Joel Buyinza |
| 10:45am-11:15am | Visit to forage management trial | Scovia Mudondo |
| 11:15am-11:45am | *Coffee/Tea break* | Phiona Kwaga |
| | **Session 3: Plans to develop farmers' capacity for sustainable production and use of improved forage** | **Facilitator** |
| 11:45am-12:00pm | Capacity for sustainable production and use of improved forage | Jude Sekatuba |
| 12:00pm-12:15pm | Enhancing availability of improved forage germplasm to farmers | Sam Gwali |
| 12:15pm-12:30pm | Development of forage pests and diseases management options | Peter Kiwuso |
| | **Session 4: Discussions** | |
| 12:30pm-1:00pm | Key discussion | Swidiq Mugerwa |
| 1:00pm-1:30pm | Plenary discussions | Participants |
| 1:30pm-2:30pm | *Lunch break* | Phiona Kwaga |
| | **Session 5: Synthesis and way forward** | **Facilitator** |
| 2:30pm-3:00pm | Recap | Rapporteurs |
| 3:00pm-4:00pm | Way forward | Jude Sekatuba |
| 4:00pm-4:30pm | *Coffee/Tea break* | Phiona Kwaga |
| | **Session 6: Closing** | **Facilitator** |
| 4:30pm-5:00pm | Closing remarks | J.F.O. Esegu |
| 5:00pm | Departure | Participants |
| **Rapporteurs:** Susan Nansereko, Gerald Ongodia and Kenneth Eryau | | |