NATIONAL BIOSLURRY EXTENSION CONFERENCE REPORT

THEME: FOSTERING PARTNERSHIPS FOR IMPROVED BIOSLURRY EXTENSION IN KENYA

November 2017

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LIST OF ABBREVIATIONS AND ACRONYMNS

ABPP	African Biogas Partnership Programme
AD	Anaerobic Digestion
BCEs	Biogas Construction Enterprises
BESPs	Biogas Extension Service Providers
BMHs	Biodigesters Marketing Hubs
GIZ	German Agency for International Cooperation
ILRI	International Livestock Research Institute
JKUAT	Jomo Kenyatta University of Science and Technology
KALRO	Kenya Agricultural and livestock Research Organization
KBP	Kenya Biogas Program
KES	Kenya Shillings
Mathenge	Prosopis Juliflora
NACOSTI	National Commission for Science, Technology and Innovation
NGOs	Non-Governmental Organizations
PH	Potential of Hydrogen (*is a scale of acidity from 0 to 14*)
SDGs	Sustainable Development Goals
SE4ALL	Sustainable Energy for All
Sistema.bio	Hybrid reactor biodigester that transforms animal manure into biogas
SNV	Netherlands Development Organization

ACKNOWLEDGEMENT

The conference would not have been possible without the work of the organizing committee to whom we are highly indebted. Gratitude is also extended to all of our distinguished presenters, plenary speakers and to our Session moderators. We would like to thank the Burkina Faso delegation led by Deita Sylvie - Senior Programmes Officer, promotions and marketing- Programme National de Biodigesters du Burkina Faso and other distinguished guests who graced the event.

We would also like to acknowledge the important contributions of all of our conference participants and in particular those who use our services for sharing their personal insights and aspirations through testimonials. The conference was organized and supported by the Kenya Biogas program with technical assistance from SNV.

1.0 INTRODUCTION

The Africa Biogas Partnership Program (ABPP) is a partnership between Hivos and SNV (Netherlands Development Organization) that is supported by the Directorate General for International Cooperation (DGIS) of the Dutch Ministry of Foreign Affairs. ABPP promotes biodigester technology in five African countries namely, Kenya, Uganda, Tanzania, Ethiopia and Burkina Faso. The Kenya Biogas Program (KBP) is the National Implementing entity for ABPP in Kenya where over 17,000 biodigesters have been installed across the country to date. KBP envisions a commercially viable domestic biogas sector that would contribute towards food security, clean/sustainable use of energy and environmental conservation. KBP's value proposition has a clear focus on Energy and Agriculture sector (covering both livestock and crops). Promoting Biogas and Bioslurry use is at the centre of the transition to sustainable energy economy while checking on reduction of pollution and greenhouse gas emission; minimizing waste and inefficient use of natural resources; maintaining biodiversity and strengthening energy security. The biodigester sector in Kenya has evolved and grown in leaps and bounds however the significance of bioslurry to development has not been fully explored. A large part of both the scientific and grey literature focuses on the production of energy, but does not venture into the multiple uses and intricacies of bioslurry benefits. It is against this background that KBP sought to profile Bioslurry and its benefits to development practitioners, NGOs, bioslurry users, policy makers, among others in a conference. . The national bioslurry extension conference was held on 29th to 30th November 2017 at the Pride Inn hotel in Westlands, Nairobi, the theme was *'fostering partnerships for improved bioslurry extension in Kenya'*. The conference was graced by presence of senior government officials/Directors from the Government of Kenya, ABPP partners from Burkina Faso, Farmers, Farmer cooperative leaders, Biodigester Construction Enterprises (BCEs), Researchers/Academia (from Egerton University, Kenya Agricultural and Livestock research Organization –KARLO), development practioners among others (see Annex).

1.1 OBJECTIVES

The general objective of the conference was to create a platform for the stakeholders to share and learn about Biodigester technology to develop and roll out sustainable use of bioslurry.
The Conference sought to specifically to:-

i. Highlight the success factors in the biodigester technology/sector in Kenya

ii. Unravel bioslurry and its benefits and chart away forward for bioslurry extension in Kenya

iii. Draw a roadmap towards sustainable Biodigester sector development in Kenya for Bioslurry optimization

iv. To offer opportunity for sector exhibitors to display and demonstrate Biodigester services and products

To this end, top priority was given to audience participation, both in the key note addresses, presentations and plenary sessions and panel. Active participation was encouraged through structured networking in the exhibition room. This active participation was none more evident than during the group work and panel discussions.

2.0. CONFERENCE PROCEEDINGS: DAY 1

2.1. Key Note Addresses and Opening Remarks

Preliminary

The first day morning session started with Welcome remarks from Mr. Kevin Kinusu who welcomed the participants to the conference and gave a background on the significance of the conference. He facilitated a session for climate setting which included introduction of participants, sharing conference objectives and setting conference norms. Some of the expectations raised by participants were:-

- Share credible knowledge on Bioslurry research and practical cases
- Learn how to effectively disseminate knowledge i.e. from Ministry of Agriculture, researchers, farmers, and participants.
- How to package bioslurry information for end users.
- How to begin a conversation that will lead to policy discussions.
- Encourage invention and innovations on Bioslurry.
- Promote the uptake of biodigesters in line with the SDGs Number (2, 6, 7, 13, 16,) and linking biogas bioslurry with the SDGs realization.
- Share practical approaches from farmer to policy levels.
- Build farmers capacity in effective use of biodigesters.

2.2. OPENING OF THE CONFERENCE

The official opening of the Conference was done by SNV Country Director (Mr. Harm Duiker) who is also the Rotating Chairman of the ABPP Program Committee (PC). Mr. Duiker informed the participants that ABPP started off in 7 African countries but now the implementation is in 5 countries. He commended the National Biodigester Programme of Burkina Faso (PNB-BF) for being the most progressive in bioslurry uptake and has obtained remarkable results in improving food security through the use of bio-compost, savings in non-renewable biomass and the quality of life particularly for women and children. He congratulated the Burkina Faso government for taking lead in implementation of PNB-BF and financing the initiative. In October 2017 the Burkina Faso Government initiated and convened an International Conference on Biodigester Technology in Ouagadougou with the President of Burkina Faso, His Excellency Roch Marc Christian Kaboré presiding over the public reading of the "Declaration of Ouagadougou" concerning the promotion and dissemination of biodigester technologies in West and Central Africa. The conference was an initiative of the Government of Burkina Faso with the theme "Africa in the Era of Climate Change" and was attended by 150 participants from 11 African countries and consisted of three meetings of experts, two field visits, a ministerial session and a closing ceremony under the chairmanship of the President of Burkina Faso. He recognized the presence of senior officials from the Government of Kenya (GoK) and requested them to take after Burkina Faso since Kenya is leading in the number of Biodigester users. Mr. Duiker added that Hivos and SNV have built a high level of technical

capacity having overseen construction of over 70,000 biodigesters installed globally. He noted that in Kenya the private sector is playing a key role in biogas production and urged the stakeholders to work together. The benefits of biogas in Kenya cannot be over emphasized but of importance is to note a worrying trend of women and children suffering from ailments associated with indoor pollution. At the beginning of the program in 2009, the entry point of selling biodigesters was anchored on fuel savings but bioslurry bears a bigger proportion of the benefits. Effects of climate change, increasing temperatures, irregular rainfall are some of the issues affecting millions of Kenyans. Green house agriculture is responsible for gas emissions, estimated 40M tons of carbon dioxide equivalent. Soil degradation is at worrying rates in Africa with over 33% of soil is degraded from chemical pollution, nutrients erosion in what farmers refer to as "*soil is tired."* Due to decrease soil fertility, biogas and bioslurry can play a key role in increasing soil productivity for example, in Vietnam farmers have been using biogas energy in tea plantations for irrigation systems. He called upon the participants to take a paradigm shift and focus the total benefits of the technology than focusing on and energy alone. He challenged the participants to reach out to more than 6million dairy farmers in Kenya which is a huge biogas market. He welcomed the biogas investors getting into Kenyan market and challenges them on the need to start implementing "*shelved solutions.*"

2.3. KEYNOTE ADDRESS ON THE ROLE OF NATIONAL GOVERNMENT IN PROMOTING BIOGAS AND BIOSLURRY

By Mr. John Maina, Director Renewable Energy - Ministry of Energy & Petroleum

Mr. Maina thanked the Kenya Biogas Program for organizing such a forum to discuss total benefits of biodigesters. He informed the participants that the Government of Kenya is keen to achieving the SDGs and that the Ministry of Energy has a directorate on Renewable energy where Biogas is domiciled. He added that the ministry has been working with SNV and Hivos on ABPP and sits on the steering committee of the program. The government has interest in the biogas program and is ready to support the ABPP in Kenya due to successes in Phase 1 and indications show that the second phase is likely to do better than other related programs. The idea is to reach as many households in Kenya as possible, an increased uptake means greater impact. Biogas and other forms of clean energy for cooking are important in replacing traditional cooking methods. The government provides an enabling framework for all practitioners to operate and promotes the development and use of biodigester technologies. He added that GoK promote the development of appropriate local capacity for the manufacture, installation, maintenance and operation of bio-digesters through energy centres and demonstration plants. He noted that as a country has a long way to go on research and development related to Biodigesters and urged all to collaborate with the ministry to have a repository of knowledge for dissemination.

Reactions to the Key note Address

Q. Why can't the government involve other ministries e.g. Education, Environment, Youth and Gender? Ministry of energy is working with many other stakeholders such as primary schools. Tenders are open to the public including the youth. Note that the steering committee is comprised of diverse stakeholders from Kenya Prisons department, education sector, environment and livestock.

Q. How is the Ministry of Energy working with County governments? What's the importance of having demonstrations across all regions and how were the regions selected? The ministry of energy is working with the council of governors as part of the representation in sustainable Energy for all (SE4ALL) Sensitization of various energy management issues is done at the county level and a uniform template is used is for all counties. The cabinet secretary receives information from all counties that forms basis for an integrated national framework. Technical evaluation was conducted and we worked closely with strategic energy centers to identify demo regions through a selection criteria.

2.4. KEYNOTE ADDRESS ON THE ROLE OF PUBLIC SECTOR/GOVERNMENTS IN EXTENSION SERVICES AND ENABLING POLICY ENVIRONMENT: A CASE OF BIOSLURRY EXTENSION

By Dr. Samuel Guto; Ministry of Agriculture, Livestock and Fisheries Development

The promotion of biodigesters in Kenya has been anchored on energy with the misconception that bioslurry is a byproduct while biogas is the main product. In literature, emphasis has been on biogas than bioslurry. Most households in rural areas people are unaware on bioslurry benefits and risks associated with its use. Dr. Guto informed the participants that due to the impacts of climate change, there is need to adopt biodigesters as one of the mitigating measures. The ministry of Agriculture needs to build capacity on bioslurry extension services to market bioslurry as an alternative to fertilizers. He note that some of the farmers who have already adopted are suing bioslurry in fish production, as animal feeds, as compost manure among others uses. Farmers can reduce farming costs by using bioslurry to counter excessive use of pesticides, soil conditioning and sell excess bioslurry can be sold to generate farm income. Use of bioslurry assist in saving time and energy for women and children hence contributing to Gender empowerment.

Dr. Guto urged all actors to work together towards developing knowledge on Bioslurry as there gaps and highlighted some of the risks associated with bioslurry use as:-

- Bioslurry used as an animal feed in livestock some diseases have been reported.
- Establish whether direct bioslurry incorporation kills all pathogens. There is a risk if this is not addressed since bioslurry maybe spreading disease causing microorganisms.
- The risks of triggering uncontrollable weed growth
- Indication of heavy metals deposits in bioslurry and overuse can cause metal accumulation in food chain, however this is not confirmed and more research is needed.

The Extension policy framework that would contribute to on bioslurry extension is still in draft form awaiting parliamentary process before full adoption. Even though bioslurry was not one among issues raised in the policy framework, there is no clear information on bioslurry application rates i.e. how much, when and which crops to be applied. After the risks have been addressed, bioslurry use can be enforced across the 3 sectors under the ministry. Bioslurry can be anchored on the Climate smart agriculture strategy (2017-2026) which was launched in May 2017. In conclusion Dr. Guto highlighted the following as possible areas of collaboration to increase adoption of bioslurry use in Kenya:-

- There is an urgent need to formulate standards to be used in regard to use of bioslurry for crops, livestock and fisheries.
- Develop surveillance mechanisms to check on the set standards.
- Prepare a handbook-manual on bioslurry covering how it is produced, uses and addressing critical questions.
- There will be need to formulate training curriculum and launch capacity building programs especially for Ministry of Agriculture staff who will roll out training of farmers once the manual is available.
- Mainstream gender issues in the program by having clear roles.
- The future of agriculture is in the hands of our youth hence the need to create interest and attraction to bioslurry utilization.

Reactions to the Key note address

Q. Is the risk of heavy metals in bioslurry a worry? Research conducted shows no evidence of heavy metals but we still recommend further research on amount standards and appropriate crops etc. Bioslurry composition varies in the feeds thus risk factor cannot be ruled out. The focus should mostly be on medium scale farmers with small farms and resources to invest compared to large scale farmers with clear plans.

Additional comments

Government should provide field agents with basic needs i.e. equipment, knowledge to farmers, application skills etc. Ministry of agriculture should take a key role on bioslurry uptake. Sometimes extension staff in the ministry have no idea on bioslurry because their major orientation is on biogas while bioslurry is under the Ministry of Energy.

There is need to increase conversations on the importance of bioslurry since it has been taken overtaken by biogas adoption. KBP has an existing manual on bioslurry application and the information is updated on regular basis however, little knowledge has been disseminated to farmers.

2.5 ABPP BIOSLURRY CASE OF BIODIGESTER IN THE ERA OF CLIMATE CHANGE

By Deita Sylvie Senior Programme Officer and Bassono Yameogo
Promotions and Marketing, Programme National de Biodigesteurs du Burkina Faso

Ms Sylvie shared proceedings of a similar international conférence on biodigester technology under the theme *"Africa in the Era of Climate change"* in Burkina Faso. The conference was an initiative of the Government of Burkina Faso and was graced by 150 participants from 11 African countries The event was co-sponsored by the West African Economic and Monetary Union (WAEMU) represented by Prof. Filiga Michel Sawadogo and attended by several representatives from diplomatic missions and technical and financial partners including the World Bank (WB), the West African Development Bank (WADB) and the African Union (AU). The conference's main goal was to help common farmers benefit from the creation of the opening common market for organic produce to change their lives. The idea was to convene decision makers (ministers of different countries) to meet the participants to shorten the decision making processes. At the end, the experts, ministers concluded by making the

Ouagadougou declaration 2017. The resolutions made under the chairmanship of the President of Burkina Faso, His Excellency Roch Marc Christian Kaboré were:-

1. Commitment of the countries to strengthen and scale up ongoing programmes on biodigesters.
2. Countries to implement a program that will see the creation of a viable and common market by 2019.
3. Institutionalize biodigesters program in the Government structures and systems in the West and Central Africa.
4. Lobby for support from other institutions such as AU, ECOWAS for funds to support biodigesters program and implementation of a regional body on the same.
5. Burkina Faso was mandated to urge other countries to embrace marketing of biodigesters and commitment on the program.
6. The president was urged to use his leadership skills to lobby for peers and financial partners in implementing biodigesters program and necessary networking.

Reactions to the ABPP Case study:
Comments
Public private partnerships is key, there is need to involve CSOs, financial sector then government can support the program in various ways. As a lesson from Burkina Faso, we need high level government involvement in Kenya, Africa and at the global level.

Q. ***How did Burkina Faso manage to involve high level government officials and buy in from the President on a program on sustainable agriculture?*** At program inception government officials were involved through formation committees linked to relevant ministers where we shared reports, updates and progress. For the last 9 years, the president, first lady, ministers and strategic partners would visit demo sites for acquaintance and field discussions were mentioned at the parliamentary level.

2.6 THE BIOSLURRY CASE STUDIES:

By Lucas Chacha, Project Manager Coffee Programmes – Hivos and Bert Van Nieuwenhuizen- Chief Technical Advisor ABPP

Drawing experiences from Sustainable and Secure Smallholder Systems @ scale (4S@Scale) project and ABPP experiences from 2009, this session was more practical with video testimonials capturing farmer's stories in the coffee value chain, Dairy and horticulture. The participants intrigued by the savings farmers make from use of organic fertilizers, improved crop productivity and the intensification of good agricultural practices; women and youth employment among other benefits presented. From the video testimonials, there were clear cases of farmers in Kenya whose lives changed and attempts to show monetary benefits from Bioslurry using excel worksheets. The testimonials were not scientifically captured rather were real life experiences providing practical evidence by the farmers. The business cases can help farmers in accessing credit to purchase biodigesters from financial institutions. Lessons from the farmers testimonials shows that using bioslurry means savings in fertilizers and energy

and making extra cash for crop increase. The net savings enables farmers to pay back on digester investments within a year in most cases.

Plenary

Q. ***Is bioslurry in coffee farming replacing fertilizers only or it also enhance the quality and quantity of coffee?*** Cases from North America and East Africa has shown that bioslurry improves the quality and quantity of coffee as shown by studies conducted by Hivos.

Q. Why the lag on bioslurry uptake in Kenya while most farmers focus on biogas? Is it a question on the marketing strategy? We need an enhanced marketing strategy to sell bioslurry and biogas products and increased collaboration with the Ministry of Agriculture. KBP has biogas extension providers also trained in bioslurry attached to SACCOs and cooperatives. They have also trained farmers on value proposition of bioslurry.

Comments

In Burkina Faso some regions experience land degradation and soil acidity but bioslurry helps in soil recovery which makes it more productive. When the biodigesters program was introduced the focus was on bioslurry then biogas later.

2.7 ROLE OF COUNTY GOVERNMENTS IN BIOSLURRY EXTENSION: CASE OF NAKURU COUNTY GOVERNMENT BIODIGESTER SECTOR SUPPORT

The council of Governors (CoG) nominated Nakuru County Government to present this subject matter owing to its involvement in the sector. Engineer Sammy Mwaura, made a presentation give an undertaking of the CoG towards building cleaner and green counties. Engineer Mwaura advocated for use of biodigesters as septic tanks in urban areas since use of biodigesters would help in improving the environment and water. There was limited evidence on use of Bioslurry in the county but he noted that evidence shows it can improve agricultural productivity. He called upon KBP to undertake expansive training on biodigesters through awareness campaigns for the Nakuru residents and technical support to the investors in the counties. He committed that Nakuru County would conduct baseline studies on the usage of the technology and develop 5 year strategy. He urged stakeholders to have concerted efforts in ensuring counties develop sanitary landfills and harness the advantages of modern ways of disposing waste.

Plenary

Comments

Biogas energy is necessary for small scale farmers who cause deforestation and air pollution. There is need to promote biogas drawing lessons from similar programs with GIZ. When farmers invest so much, they can benefit from surplus income from energy consumption savings to increase agricultural productivity. County governments needs to develop tangible strategies to promote biogas production.

In order to transform small holder farmers, their priorities should be addressed realistically for them to acquire knowledge and means to buy and build digesters in their farms. The Min of

Agriculture should formulate strategies to propagate better uptake of biodigesters the idea is to approach biodigesters more holistically not just on farmers.

3.0: SCIENTIFIC RESEARCH FINDINGS ON BENEFITS OF BIOSLURRY

3.1 USE OF BIOSLURRY/DIGESTATE AS ORGANIC FERTILIZER

By Hans Langeveld – Director Biomass Research, Wageningen

Mr. Hans presententation focused on 'Clean Fuels, Better Soils and More Food'. Biodigester technology contribute towards achieving Sustainable Development Goals (SDGs) 2[1], 7[2], 12[3], 13[4] and 15[5]. The presentation focused on soil quality in sub-Saharan Africa, how to improve it and role of Bioslurry/Digestate in improving the soils. The soils in Sub-Saharan Africa are inherently poor and losing nutrients due to underfertilization. The land is under pressure from population growth, overexploitation and urbanization leading to biodiversity loss, decreased resilience and degradation of agricultural soils. Unpredictable weather patterns increase risks for crop failure. The soils generally require more nutrient inputs are needed, but access to fertilizers often is limited therefore nutrient and water retention must be improved and Bioslurry has a role in improving nutrients coupled with Good Agricultural Practices. Biomass Research provided evidence that Anaerobic digestion (AD) involves decomposition of complex organic molecules into soluble organic molecules which relies on specific preferences, condition requirements and the result is a compromise. Co-digestion on the other hand is synchronous decomposition of crop material, household waste or residues with animal manure. Smallholder farmers in sub Saharan Africa stand a bigger chance to benefit from the biodigester technology because there is increased nutrient input throughout the year, there is more constant feedstock availability, better digestion quality for soil amendment.

The changes that occurs when farmyard manure is composited was presented providing evidence that compost manure increases Bioslurry value and its versatility. Basically after digestion, manure loses 1 to 5% of its dry matter; Organic matter loss varies between 5 and 15%; the amount of total nitrogen does not change but is made available as ammonium – which is readily available for crops. Concentrations of phosphorus, potassium and other nutrients does not change much. The digestion process does increase the pH of the manure.

Bioslurry composition was presented to be containing up to 50% of solids with PH is generally above 7; 3 to 14% of nitrogen in the solid phase; one third to two thirds of this is ammonium, which is readily available for crops while Phosphorus and potassium contents are 0.2 to 0.4% of dry matter. A comparison was made between Bioslurry and alternative fertilizers, though not much research has been done on this; It appears to bio-slurry generally performs as good as – or better than – other fertilizer types. There is however high variability, and results vary for different crops. Anaerobic digestion helps to get rid of pathogens normally found in manure. Common pathogens are killed effectively as a result of constant high temperatures. It can take 2 to 6 weeks before 90% of the most prevalent pathogens in untreated slurry are

[1] End hunger, achieve food security and improved nutrition and promote sustainable agriculture
[2] Ensure access to affordable, reliable, sustainable and modern energy for all
[3] Ensure sustainable consumption and production patterns
[4] Take urgent action to combat climate change and its impacts
[5] Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

killed when it is stored at temperatures around 20 degrees. When stored at lower temperature, this can take more than 20 weeks. Digestion at moderate temperatures (35 degrees) takes less than one week. In most cases, 90% of pathogens are killed within 3 days. On the other hand, other biological contaminants such as weed seeds can also be degraded during the digestion process. Pieces of metals or other inert materials and larger pieces of organic material, as well as chemical contaminants (such as heavy metals and organic pollutants), pass through the digestion process unaffected. A high accumulation of heavy metals in the soil may cause toxic effects and should be avoided. Very toxic pesticides like DTT or HCH should also be avoided. They are not affected by the digestion process. When applied via bio-slurry they can accumulate in soils and the food chain. The quality of bioslurry (the digested product) is largely determined by composition of the feedstock. The composition is expressed as amount of solid materials or dry matter, and share of so-called volatile materials (referred to as Volatile Solids). As a rule, organic waste and manure are low in solids. Straw, lignocellulosic crops and energy crops contain more solids. Cattle manure contains more solids than pig manure. Meat and fish waste are high in proteins which provide nitrogen after decomposition. Straw and woody materials contain a large share of solids which are not easily broken down during digestion. They increase the amount of organic matter in the bioslurry – which can be helpful to improve soil quality. Therefore, adding residues to manure in the digestion process is recommended as it allows a better handling of manure, increases availability of nitrogen, phosphorus and potassium for plant consumption. Higher pH helps to combat soil acidification and promotes crop growth. Pathogens are reduced during the digestion process, but not all will be killed.

In conclusion, bioslurry is generally recommended Soils in Sub-Saharan Africa because it makes generally good organic fertilizers, the type of feedstocks (organic materials) that are digested are affecting the composition and quality of the Bioslurry and adding other feedstocks to manure allows more efficient manure handling and more efficient nitrogen use.

3.2 BIOSLURRY UTILIZATION IN SMALL HOLDER AGRICULTURE IN KENYA

By Dr.Jane G. Nyaanga & Professor D.M. Nyaanga - Egerton University

The research was funded by National Commission for Science technology (NACOSTI) in Kenya, the study site was Egerton University and was carried out in 2014. Many regions in Kenya demonstrate soils with severe erosion and low fertility which is a major cause of food insecurity and poverty in rural households. A nutrient rich bioslurry (effluent) could be a valuable additive in such areas. The scenario is that bioslurry is not seen as a resource is discharged into the surrounding field, bush or public drain.

The research objective was to evaluate bioslurry application methods which optimize nutrient uptake by crops. The study focused on maize, cabbage, capsicums (*hoho*) and spinach monitoring on pest damage, growth rate and yield rates. The crops underwent 5 treatments in Randomized Complete Block Designs (RCBD) in two seasons whereby T0 = Untreated

control;T1 = DAP fertilizer;T2 = Incorporation (bio-slurry ploughed in whole plot);T3 = Basal (bioslurry in planting holes);T4 = Inter-row (bioslurry applied between crop rows).
The results were presented and conclusions made were that basal and incorporation bioslurry application methods have better results than commercial fertilizer; have higher germination percentage and low attack by stem borer; Proper bioslurry application significantly improves: resistances to biotic and abiotic stresses and crop yields; Bio-lurry utilization on smallholder agriculture will save on farm inputs (fertilizer and pesticides).

Some of the recommendations from the study were

- Further appropriate bioslurry application methods should be developed and disseminated
- Bio-slurry might be better suited for some crops than for other crops hence need to investigate the nutrient supply of bio-slurry *vis-a-vis* the nutrient requirement of various crops.
- Investigations should be made to provide scientific explanation for the mechanism behind reduction in pest and disease occurrence.
- Possibility of micro-mechanization of bioslurry application.
- A comprehensive analysis of bioslurry: impetus for its management and utilization in sustainable crop production (agriculture).

*Ongoing research includes use of bioslurry in sattice flower production and use of bioslurry in vermicomposting.

3.3 KENYA AGRICULTURAL AND LIVESTOCK RESEARCH ORGANIZATION (KALRO) RESEARCH FINDINGS ON BIOSLURRY UTILIZATION AND COMPOSITING

By Mr. Peterson Njeru

The research aimed at providing scientific evidence that bioslurry utilization can improve composting. The results showed positive results when using Effective Microorganisms (EM) in Bioslurry compost. The compost promotes germination, crop establishment, fruiting and ripening; improves chemical, physical and biological environment of the soil e.g. it lowers soil pH as it acts as buffering material to the soil among other benefits. The participants were taken through the EM1 in composting process which involves 7 steps and Bioslurry is incorporated at each step. KALRO together with farmers in Makueni county have applied the composited Bioslurry during land preparation, planting-in rows, tiers, furrows; on farm rainwater harvesting as coping strategies on climate change; and treatment before harvesting healthy crops. The results show that there is significant difference on ratings of treatments by farmers. There was healthy crop and increased yields. The research findings were disseminated to farmers through farmer-field-days and workshops with farmers to better explain the findings and forge close collaboration with Ministry of Agriculture and extension officers.
More research needs to be undertaken to address the following gaps:-

- More research is needed on bioslurry compost improvement on its quality
- Stakeholders such as Minjingu Mines & Fertilizer ltd needs to be incorporated in such work since owns natural deposits of biogenic phosphates and is currently producing various multi-nutrient fertilizer blends
- More research is needed on bioslurry utilization in agricultural systems

4.0 DISCUSSION PANELS

There were three discussion panels during the conference:-

PANEL I: DISSEMINATION OF RESEARCH FINDINGS UTILIZATION AND PROMOTION OF BIOSLURRY FOR INCREASED PRODUCTION.

Moderated by Judith Libaisi and Panelists were Egerton University (Dr. Jane Nyaanga and Prof. Nyaanga), KALRO (Peterson Njeru) and NACOSTI (Dr.John Kaburu). This panel aimed at unravelling the myths surrounding Bioslurry utilization, understanding the impediments to adoption and assessing impact of research on Bioslurry promotion. The conclusion made was that there is a lot of knowledge around Bioslurry, the same needs to be disseminated in farmer friendly languages, focus on application rates on staple crops in Kenya. Researchers need to disseminate findings and incorporate other stakeholders in their work especially extension workers. There is need to lobby the government to get more actors to be involved and encourage people to use biodigesters (biogas and bioslurry). However we need to establish the limit on the use and application. Encourage farmers to test soils before using bioslurry. NACOSTI is a commission at the Ministry of Education and Science and informed participants that NACOSTI funds doctoral degrees, research grants, women grants, innovators and young innovators and more concepts on bioslurry were invited. The end users get the findings, NACOSTI has 5 days per year program where you can disseminate research findings.

Panel II:- HOW CAN DEVELOPMENT/SECTOR PLAYERS SYNERGIZE ACTIVITIES FOR BIOSLURRY PROMOTION

Moderated by Tim Mwangi, Panelists were:-Biogas International (Dominic Wanjihia); Fair Trade Africa (Marion Ng'ang'a), and Takamoto (Harrison Gikunda).

The discussion aimed at understanding the private sector perspective on barriers to bioslurry utilization and how to stimulate its utilization and creating synergy of activities amongst partners in the sector. The discussion acknowledged that there were some efforts from farmers in commercializing bioslurry though there is low awareness among farmers on bioslurry extension. There are many actors in the sector who seem not to prioritize bioslurry as a core product of the biodigester technology. The main focus is provision of energy for cooking. Most farmers dispose of bioslurry as 'waste'. There is need to disseminate available information to farmers on the importance of bioslurry through appropriate media with wide audience e.g. radio and TV. Other actors from different sectors i.e. NGOs like KBP use social media platforms to increase dissemination. There is need to influence policy towards Bioslurry utilization and conduct more research on Kenyan agriculture e.g. on coffee; tea; maize and beans. Private sector can invest into commercialization of bioslurry. Main barrier to bioslurry utilization is limited knowledge on benefits of bioslurry by most farmers coupled by weak extension support system. The biodigester technology is also unaffordable to ordinary farmers hence need to find innovative ways of encouraging farmers i.e. construct centers of excellence for other farmers and interested parties to learn.

Panel III: EXPERIENCE SHARING ON COMMERCIALIZATION OF BIODIGESTER TECHNOLOGIES

The panel discussion was moderated by Brenda Aluda and panelists were Joseph Kuria- GM-CIDES- Center for Innovative Development Solutions; Yvonne - Marketer - Biogas International; Maxx Affre from SISTEMA bio.)

The discussion aimed at the private sector players/ biogas enterprises share insights on whether bioslurry is a driver in marketing the technology or not. The discussion established

that the technology is mostly promoted from the biogas point of view however farmers are increasingly adopting the technology for bioslurry. There is need to demonstrate the importance and clear benefits of bioslurry to farmers. Develop a value chain approach to agricultural commodities, work with SACCOs in the dairy, coffee, tea sectors to reach more farmers. A multi sectoral approach involving researchers, private sector, NGOs, Farmers etc. to encourage buy-in. Brand, package and disseminate clear bioslurry message that farmers can easily understand. Create centers of excellence for bioslurry. The consumer preference for organic foods is a clear niche for bioslurry promotion. Biogas technology is a smart technology and it fits well with modern technology such as smart agriculture. We need to integrate bioslurry as a holistic product for farmers. Empower farmers to get maximum benefits from biogas and bioslurry.

From the panel discussions, participants asked KBP to organize more forums to discuss bioslurry; influence policy in the governments (National and County) to focus promotion and uptake of the technology while intensifying bioslurry uptake including commercialization to improve livelihoods and contribute towards climate change adaptation. This calls for collaboration from all actors in the sector to realize the desired outcomes.

6.0 BIOSLURRY TESTIMONIALS

Testimonials on benefits of bioslurry presented were :-

1. **BLUE FLAME AND GOLDEN FERTILIZER** by Somda Winyaon Serge, Programme National de Biodigesteurs du Burkina Faso.
   The experience is that farmers appreciate the technology more from bioslurry perspective. Key learning points from Burkina Faso:-
   - Work closely with other partners in government and NGOs.
   - Document information in journals, documentaries and other publications.
   - Have clear follow up mechanisms and mobilization at all levels. They have engaged United Nations organization (UNFCC) to lobby for selling agricultural produce grown using bioslurry.
   - The media is key in creating awareness for their programmes.
   - Note that any government is keen to support a program that has potential in generating revenues for the government.
   - Kenya should work persistently in pursuing this cause.

2. **BIOSLURRY EXTENSION SERVICE PROVISION** by Daniel Mungai, KBP
   KBP has biogas extension service providers (BESP) who work with farmers as field officers. There are 12 BESPS all over Kenya, 22 Biodigesters Marketing Hubs (BMHs) - Dairy cooperatives, SACCOS applying KBP marketing model and over 10,000 Biodigester users trained. Challenges ins biolsurry extension service provision were that some farmers prefer their farm hands to be trained on the technology and this means that farm onwers have limited knowledge on bioslurry. It's important for biodigesters installers to know about bioslurry. KBP has disseminated some materials on biolsurry and is in use during farmers trainings but more can be done. There is need to have collaborative efforts by all actors to encourage farmers to acquire biodigesters for bioslurry even if they don't need biogas.

3. **FARMER SUCCESS STORIES** by Solomon Mutahi and Mrs. Mumbi Kimunya
   Solomon from Nyeri county, uses bioslurry on Coffee and in fodder production. He advocates for use of bioslurry in all crops since he has stopped buying fertilizers and has experienced tremendous increase in his dairy enterprise. Mrs. Kimunya from Kiambu county is a banana farmer from Limuru trading in the exports market. She encourages water harvesting while working collaboratively with sub-county committees. Her call to action is to share ideas with other farmers e.g. market access.

4. **BIOLSURRY: CASE OF FIXED DOME TECHNOLOGIES** by Joseph Kuria, GM- Center for Innovative Development Solutions (CIDES)
   CIDES runs a biogas commercial enterprise, natural resource management and soil preservation and bioslurry gas use and management. He noted that Bioslurry is easily available in the farms. The organization has installed over 40 biodigesters in 2017 through the HUB and using personal marketing strategies. Promoting biogas technologies means farmers are investing in sustainable agriculture though bioslurry. These are changing trends towards climate smart agriculture (CSA) - management of climate change Bioslurry will remain a sure way for farmers to cope with effects of climate change, it's a great opportunity for using bioslurry to market biogas.

5. **BIOSLURRY: CASE OF PREFABRICATED BIODIGESTER TECHNOLOGIES** by Chandu Shah, Managing Director- AquaSanTech Group (Kentainers limited, Kenya)
   Mr. Shah presented the 'New Green Revolution – "More with Less" by, of and for the Smallholders through BlueFlameBioslurrigaz product, which is a floating drum plastic digester. The digester is a onestop basic needs package as it is branded 'Smallholder's Own Fertilizer & Biogas Factory'. AquaSanTech group vision is enriching peoples' lives by enabling them to access clean water, organic fertilizer, energy (biogas), improve nutrition, food production and storage, raise incomes and savings and practise safe sanitation. Experiences from the users who have adopted this technology and are using bioslurry was shared. Farmers say it significantly improved yields and quality and gives longer shelf life. Kentainers has developed Bioslurry user manual and also use System of Root Intensification (SRI)/ System of Crop Intensification (SCI) manuals for most crops are available. Specific results in Bananas, Maize, Beans, forage were shared from Ethiopia, Kenya, Vietnam and Uganda. Through Bioslurry promotion, Kentainers has been able to establish and maintain transformational networks and linkages with partners such as Financial Institutions, Kenya Government, Farmer cooperatives and groups, Domestic Biogas programs among others.

6. **BIOSLURRY COMMERCIALIZATION** by Ezekiel Kibe - Afrisol Energy Ltd
   Afrisol Energy Limited is a social enterprise that was incorporated in the year 2010 with the aim to promote a sustainable future through the use of green energy. It focus on waste management, water, energy and sustainable agricultural and food supply through appropriate technology. The main reason for venturing into bioslurry business was the desire to utilize the discharge from the bio digesters and convert it into a more useful product for soil improvement and plants nutrients. This will ensure that the bio

digesters not only manage waste and generate energy but also provide food security by enhancing sustainable farming by utilizing the bio slurry in our farms. Afrisol's product (Bioslurry / organic fertilizer) is an excellent soil conditioner that enhances the soil's capacity to retain water; boost both nutrient efficiency and organic matter content in the soil reducing dependency on chemical inputs among other benefits. Mr. Kibe shared the steps in processing bioslurry from collection of raw materials, decomposition process to packaging for the market. Afrisol packs and sells liquid bioslurry. 5 litres costs KES 475 retail price after distribution and KES 300 at the farm gate. The target market includes large scale/plantations both in horticulture and cash crop production and small scale farmers.

7. **FIELD VISIT TO KIBE'S FARM IN LIMURU SUB-COUNTY**

   Participants visited Kibe's farm in Limuru to have a practical understanding how biodigesters work and the benefits of bioslurry. The farmer practices mixed agriculture from food crops to flowers for exports to Holland. The bioslurry is mixed with other materials to produce compost which he applies in most of the crops. Kibe had surplus bioslurry and was advised by the participants how to package and resell or proper storage. He was also advised to create a shade for his bioslurry to avoid direct sunlight and rain water which destroy vital nutrients. The farm focuses on organic farming thus benefiting from bioslurry application. Mr. Kibe encouraged participants to focus on organic farming which he termed as a process and not an activity.

6.0 ROADMAP FOR SUSTAINABLE BIODIGESTER SECTOR DEVELOPMENT

6.1 GROUP BREAKOUT SESSIONS

Participants worked in four thematic groups based on their areas of interest. The groups were:-

1. Promotion and Marketing
2. Research and development
3. Utilization and management
4. Commercialization of Bioslurry

The groups sought to unravel the opportunities and constraints towards sustainable bioslurry extension. The presentations are captured in the table below:-

GROUP BREAKOUT PRESENTATIONS

Group 1: Promotion and Marketing **Opportunities** 1. More than 1.6 Million dairy farmers with 4-5M other farmers. a. Land, cattle, family labour, good climate (2 rainy seasons) • Research/demonstration farms and farm models • Stakeholders, NGOs, donors, county government and faith based organizations. b. Possibility on earnings	**Group 2- Research and Development** **Opportunities** 1. Existing academic and research institutions i.e. Egerton university, KALRO and JKUAT 2. The devolved government. 3. Networking with KBP 4. Biogas technology as clean energy to mitigate climate change for the production of bioslurry that will eradicate poverty and provide food security.

2. Reduced cost of production i.e. fertilizers and system of crop intensification.
3. Simple minimal training of bioslurry and utilization on both the farmers and the technicians.
4. Model farmers will be the trainer of trainers. Massive awareness i.e. social media, commercial media i.e. TV and radios outlets
5. Devolved institutions of higher learning
6. Referrals

Constraints

1. Lack of capital, interest rates on loans, collaterals, compulsory loans.
2. Lack of knowledge and skills for farmers and extension staff
3. Inadequate experienced BCEs
4. Inadequate expertise experience extension team.

5. To fill the knowledge gap on bioslurry i.e. the long-term effect of bioslurry on soil and biodiversity, action mechanism of bioslurry as a pesticide.
    - The impact of bioslurry on health.
    - How biodigester operations impact the quality of bioslurry on farm.
    - Research on bioslurry handling and application frequency of application, response on different crops.

Constraints

1. Bioslurry has not been considered a resource by the biodigester users.
2. Lack of knowledge by the user on bioslurry i.e. application rate on fish, pigs, crops etc.
3. Lack of resources i.e. funding and laboratory equipment.
4. Dissemination of research findings to the end user.

Group 3: Utilization and Management

Opportunities

- Extension services on the utilization and management of bioslurry.
- Access to organic market
- Increased awareness on the use of bioslurry
- Improving soil fertility and amendment.
- Mechanization on modes of application.

Constraints

- Farmers lack of knowledge on utilization and benefits of bioslurry.
- Labour intensity on application of bioslurry
- Non- functional biodigesters
- Limited land for production
- Financial constraints on mechanization
- Farmer perception
- Psychological rejection i.e. use of human waste.

Group 4: Commercialization of bioslurry

Opportunities

- Use of bioslurry as animal feed i.e. pig, chicken, fish etc.
- Used as organic fertilizer i.e. folia, compost manure
- Pesticides - fungicides, nematocides control in agriculture
- Business opportunity - packaging, distribution of bioslurry
- Promotion of organic farming – increased for commercialization
- Bioslurry opportunities and empowerment

Constraints

- Labour intensive on application as compared to conventional fertilizers
- Availability - you need biodigesters to generate bioslurry
- Bioslurry is very bulky for transportation
- Inadequate research on utilization and information
- Bioslurry standards aren't clear
- Short shelf life – bioslurry quality declines if stored for long
- High cost of production - you need the plant to generate bioslurry
- Packaging challenges (do you package in sacks or containers)

6.2 WAY FORWARD

To overcome the constraints and seize the opportunities presented in the groups, the participants agreed on the following:-

A. The delivery Structure:-

1. KBP to convene a Bioslurry Working Group involving all key stakeholders represented in the workshop
    a. Synthesize the conference/workshop report
    b. Develop a joint policy brief
2. Convene a high level pitching round table targeting government and development partners
3. Facilitate Multi stakeholder annual conferences on bioslurry as platforms for knowledge sharing and consensus building on how to collaboratively enhance bioslurry utilization

B. Call to Action:-

I. KBP to facilitate development and coordination of a knowledge and information platform/repository on organic farming using bioslurry
II. The ministry of agriculture livestock and fisheries to take lead in building a vibrant bioslurry extension program in collaboration with KBP, BCE's, Companies, Hubs and the academia/research
    - Development of curricula
    - Develop extension materials
    - Training extension workers on bioslurry
III. Propose and lobby for an inter-ministerial approach in biodigester promotion and development at county and national governments
IV. Lobby county governments to dedicate resources and create an enabling policy and regulatory framework for biodigester (undertake baselines, and prepare action agendas)
V. Research, academia , private sector and development organizations to collaboratively work in advancing research on bioslurry especially on management and utilisation with support from NACOSTI
VI. Fast track development of bioslurry standards and regulations under the leadership of the MoALF
VII. Develop a stronger value proposition for biodigesters that appreciates the multiple gains of the technology including;
    - Climate change adaptation and mitigation
    - Sustainable development goals
    - Sustainable Energy for All (SE4ALL)
VIII. Companies, BCE's and Masons to make bioslurry a core value proposition for marketing their technologies of biodigesters, this will refocus the value for money from tech to utility (bioslurry benefit + gas)
IX. To explore innovative ideas that will attract both public and private sector investment in the biodigester sector.

KBP to convene the first meeting early 2018 and propose clear timelines in achieving the action points, formalize a working group to advice on this.

7.0. CLOSING REMARKS

The conference was officially closed by Mr. John Maina- the Director Renewable Energy from Ministry of energy and Petroleum. Mr. Maina from the promised to share the information on bioslurry from the conference with the Cabinet Secretary and top government officials. He urged the participants to continue disseminating the knowledge and pointed out that the county integrated development plans (CIDPs) will provide a good entry point for bioslurry. He said *"This is creation of wealth and we need to make our people see the potential." "Food requirement is a challenge with our growing population."*

8.0 APPENDICES

8.1 LIST OF PARTICIPANTS

8.2 CONFERENCE PROGRAM

8.3 PRESENTATIONS