

REPORT

British Council De|PHE - Joint Workshop
Use of Natural Products (fungi, botanicals) for pest control

Muhimbili University of Health and Applied Sciences
(MUHAS), Tanzania

24-26th July 2012



Professor Tariq M. Butt, Swansea University (UK)
Professor Buba Ibrahim, ATBU Bauchi (Nigeria)
Professor Ahmed Hassanali, Kenyatta University (Kenya)
Dr Ester Innocent, MUHAS (Tanzania)



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1. Summary

A highly successful joint workshop of two complementary British Council funded DelpHE projects was held at MUHAS, Tanzania, 24-26th July, 2012. The workshop was organized by Professor Butt (Swansea University, UK), Professor Ibrahim (ATBU-Bauchi, Nigeria), Professor Hassanali (Kenyatta University, Kenya) and Dr. Ester Innocent (MUHAS, Tanzania).

The aim of the two DelpHE projects, entitled **“Establishing capacity of Mosquito borne disease control at MUHAS to bridge academia and community needs”** and **“Development of fungal biocontrol agents for use in sustainable, environmentally friendly, integrated pest management programmes in Nigeria”**, was to build capacities of African institutions that were researching, producing and using agents of natural origin as a strategy to control major arthropod disease vectors and crop pests. The team from Swansea University had already developed several fungal biological control agents (BCAs) which were highly pathogenic to a range of arthropod pests of crops, livestock and humans. They had also provided significant training to colleagues from ATBU Bauchi (Nigeria) in mass production and conducting bioassays and field trials. Dr Innocent had developed botanicals for arthropod vector pest control while the co-PI Professor Hassanali (Kenyatta University, Kenya) had identified behaviour modifying chemicals (i.e. semiochemicals) to attract or repel several pest species.

The workshop provided a unique opportunity for transfer of technology and knowledge to different stakeholders in Tanzania and other African countries. The training and technology transferred will benefit a range of African stakeholders and will improve the lives of rural communities.

More specifically, the workshop helped:

- (1) Train personnel in the development and use of fungal biocontrol agents, botanicals and semiochemicals for the control arthropod pests especially disease vectors which have a devastating socio-economic impact on Africans. For example, mosquitoes transmit malaria, dengue and other diseases which affect millions in Africa. Malaria alone kills ca. 300 African children per hour.
- (2) Transfer technologies in the production of fungal biocontrol agents and botanicals.
- (3) Develop a roadmap for further collaboration with clear, tangible goals.
- (4) Lay the foundation for development of a potential "commercial" unit for producing fungal BCAs.

Synergy between the two projects offered considerable "added value" to both projects. Some of the outputs are outlined in the following sections and appendices.

2. Evaluation of the workshop

There was much interest in the workshop even though it was not widely publicised as the organisers would have liked. The publicity was via a flyer (Appendix 1), writing to interested parties and word of mouth. The workshop was also publicised via a poster presented at a DelPHE meeting held in Kenya, June 2012. Changes to the programme (Appendix 2) were made a day before the meeting as 2 of the key speakers could not attend due to factors outside their control. Fortunately, they had provided materials which were presented by colleagues.

At least 140 persons showed an interest in the workshop. Overseas applications were about 80 from Nigeria; 5 from Kenya; 3 from Sudan; 2 from South Africa; 1 from Ivory Coast; 1 from Uganda; and 1 from Egypt. The rest were from different institutions in Tanzania.

Altogether 60 persons participated in the workshop, 3 of which were guests of honour and 7 were stakeholders. The list of participants is given in Appendix 3. Some of the participants are shown in figure 1.



Figure 1. Group photo of participants on the first day of the meeting.

The organisers believe a much larger workshop could have been organised but there were several **hurdles to overcome**. There were also **many lessons learnt**.

1. TIME MANAGEMENT. The PIs were balancing between organising the meeting and their work commitments. Many persons that wanted to participate were also tied up with existing work commitments. Below are quotes from two scientists who wanted to participate in the meeting:

"I am really sad that I am going to miss the workshop which I had really looked forward to attend personally. I have been an advocator of using entomopathogenic fungus to control tsetse flies which affect human health and his livestock but also a threat to tourism sector in the country".

"I will not be able to come to Tanzania because of some reasons beyond my control despite that, right from the initial time I have a strong interest and assurance of attending the workshop because of the relevancy of the training to my work".

2. TIMING OF PUBLICITY. The time the first call went online was only two months before the workshop. The workshop should have been promoted much earlier to give participants more time to obtain funds and organise other logistics.

3. SPACE & RESOURCE CONSTRAINTS. The workshop consisted of lectures, "hands on" practical training and demonstrations. For the workshop to be effective we wanted a respectful "staff-student" ratio. Although lecture theatres and discussion rooms were of a respectful size, the area for "hands on" training was small. Furthermore, the laboratories had limited resources (e.g. insufficient number of Bunsen burners, lamina flow hoods etc) to allow for one-to-one training or training of groups of 2-3 persons.

In spite of the hurdles, the organisers were able to deliver a highly effective workshop. The overwhelming response of the participants was that they enjoyed the workshop very much (Fig. 2). The participants thought the workshop was well organised, highly educational and a valuable experience. They also wanted more follow up meetings of a similar kind (see Appendix 4). Feedback forms are available on request.

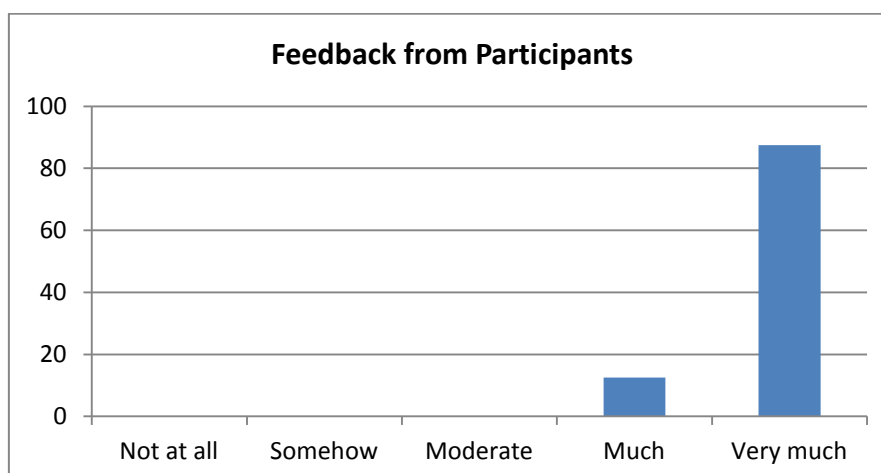


Fig. 2 Response of participants to the question - Did you enjoy the workshop? Approximately 88% said they enjoyed the meeting very much while the remainder said they enjoyed it much.

Programme format

The workshop was opened by Professor Eligius Lyamuya, Deputy Vice Chancellor, who gave a warm welcome on behalf of the MUHAS Vice Chancellor. This was followed by a short welcome by Sally Robinson, Director of the British Council in Tanzania. Sally hosted a reception the following evening which was attended by the organisers and a number of stakeholders. The reception allowed for more informal talks between BC staff and the organisers. Dr Joyce Masalu, deputy director of research and publications, kindly awarded the certificates of participation to the delegates on the last day of the workshop.

The structure and content of the workshop was approved by all the participants. The lectures provided the opportunity for everyone to:

1. **Become familiar with the terms and novo technologies.** Participants came from different backgrounds yet had no difficulty in assimilating the new technologies. Dr Ibrahim (ATBU Bauchi) pointed out how his team quickly acquired skills in liquid and solid production of *M. anisopliae* and had also developed courses which covered fungal biocontrol of pests.
2. **Better grasp the socioeconomic impact of pesticides and target pests.** Participants recognised that there was an urgent need for environmentally friendly alternatives to conventional chemical pesticides. Prof Butt highlighted the risks pesticides posed to human health, the environment and exports.
3. **Understand the strengths and weaknesses of the natural pest control products.** The participants recognised that the fungal and botanical agents increased the range of products available to end users.
4. **See examples where the products have been deployed.** Prof Butt gave examples of how insect pathogenic fungi have been used to control crop pests and strategies developed to reduce costs and increase the efficacy of these agents. Dr Alia Zayed of NAMRU, a guest speaker, outlined her work in the use of fungi to control sandflies in Africa.
5. **Realise the benefits of developing fungal BCAs.** Participants acknowledged the benefits of the fungal BCAs. These products were significantly safer than chemical pesticides reducing health risks to humans and pollution of the environment and offering the opportunity to create cottage industries that would lead to job and wealth creation.

The training showed that the technologies were simple, straightforward and could be easily commercialised. Mr Alexis Poggio of MycoSolutions Ltd (Wales, UK) pointed out that his first degree was in law but when he quickly gained experience in production of fungal based products (mushrooms and fungal BCAs) and was currently a toll manufacturer of fungal BCAs. He currently supports a PhD student and is an active partner in an Welsh Government A4B CIRP project. He offered to provide advice to any of the participants wishing to produce fungi either via a video link or Skype. Martyn Wood demonstrated the efficacy of the insect pathogenic fungus *Metarhizium anisopliae* in killing mosquito larvae. He showed how simple

it was to prepare and apply the fungal inoculum. Participants had the opportunity to see for themselves that the fungus had killed almost 90% of the mosquito larvae in less than 24 hrs. Martyn and Alexis, who had arrived a few weeks earlier, had ironed out most problems before the start of the workshop. Ester Innocent showed how botanicals could be effective in killing mosquito larvae.

Funding opportunities were outlined by Judith James, a member of the senior strategy board at Swansea University. The participants were highly appreciative of this presentation as many were not aware of the funds they were eligible to apply for. Besides examining the different donors, the discussions that followed helped mould a unifying strategy to strengthen ties between the current participants through networks and strategic targeted collaborative research.

The question and feedback session constituted an important component of the workshop. Participants were divided into 4 groups, each group had to address a specific question. At the end of 30 minutes the group representative gave a summary of their discussions. Other participants were then able to comment on the feedback provided. This vibrant session provided the opportunity to reflect on some of the products and strategies informative. On the whole the groups agreed with each others' findings. Some of those findings are outlined in section 3 below.

British Council Reception. A number of stakeholders attended a cocktail evening hosted by the British Council at the National College of Tourism on Wednesday 25th July. The event was attended by the director (Sally Robinson) and her staff as well as key stakeholders. The reception provided the opportunity for informal discussions between stakeholders. A more formal meeting of stakeholders was held the following day at MUHAS..

The stakeholder meeting constituted the final component of the workshop. Now that the participants had time to reflect via the question and feedback sessions, the opportunity existed to look at how to make progress with some of the ideas generated through that session. A number of stakeholders had been invited to attend this meeting including government officials, representatives of NGOs etc. The outcome of this meeting is outlined in section 4 below.

Awards ceremony. Certificates of attendance were awarded by Dr Joyce Masalu, deputy director of research and publications (Fig. 3). Additional awards (gifts donated by Swansea University) were made to the helpers (Rose, Agnes, Bestina, Abdullah, Daniel).



Figure 3. Dr Joyce Masalu making a presentation of attendance certificate to one of the participants. Professor Butt, Professor Ibrahim and Dr Innocent assisted in the awards ceremony.

3. Question and feedback session

Four groups were given the task to address four pivotal questions. The feedback is summarised below.

GROUP ONE:

Question: What do the policy makers need to do to support approaches to reduce input of synthetic chemical pesticides?

Feedback:

- To address this issue, the group first established who were the key policy makers. These included: government ministries (Health, Agriculture, Environment), government regulatory authorities, donors, researchers, extension workers, the media, farmers and public as well as traditional and religious leaders.
- It was felt that there was a need to increase awareness of the public of the harmful effects of certain pesticides and this could be done through the media, extension workers, village elders or chiefs as well as religious leaders.
- The farmers also need to be enlightened about the harm posed by chemical pesticides and the benefits of switching to the use of natural products.
- Since many benign natural agents were not readily available locally, it was felt that the government must support researchers in research and higher education institutions to generate and disseminate the evidence.
- There is also the need for legislation for the phased withdrawal of harmful chemical pesticides and replacement with benign alternatives, with subsidies to encourage uptake of the latter.
- There was a need for improved dialogue between health officials and other official bodies (agriculture, environment) to ensure passing of laws to protect the public from harmful pesticides (direct exposure and indirect exposure via residues in food and water).
- Other actions that could be taken include support to local manufacturers to switch to production of safer products, and increased duties or ban of imported products.
- Farmers and the local community also need to cooperate in adopting the new products and strategies.
- Extension workers were seen as playing a key role in the transfer of the technology to the end users.

GROUP TWO

Question: What actions can we take to accelerate development of new products and strategies for pests control to reduce input of harmful chemical pesticides?

Feedback:

- Firstly the group examined the reasons why we need to reduce inputs of conventional chemical pesticides:
 1. Harmful to human and animal health
 2. Pollute the environment – impacts on biodiversity
 3. Expensive – especially for the majority of poor farmers
 4. Increasing reports of resistance in pest populations
 5. Impacts on pollinators and other beneficial/non-target insects

- With these factors in mind, the group felt the following actions were needed:
 1. Need for more workshops like the current DelPHE workshop as they to reach out to a wider audience to educate them about the risks posed by chemicals and the need for safer alternatives. The workshops should also actively look for solutions which could be customised to meet the needs of different stakeholders.
 2. Search for more environmentally friendly natural products
 3. Development of strategies which integrated new products and reduced or eliminated dependency on harmful chemicals
 4. More training in the use of new products
 5. Natural products formulated so they are easy to use
 6. Greater use of natural products using local materials
 7. More natural products that could be produced locally

GROUP THREE.

Question: How can we get the message across to the end users?

Feedback:

The group felt that the message could be communicated to the end users as follows:

- Small Communities through
 1. Distribution of the information about the new product/ public health impact.
 2. Local media: making end users aware how the product could improve their quality of life
 3. Chiefs or other influential persons who could advise the relevant end users
 4. Extension workers who had received extensive training in the use of the new products and strategies
 5. Volunteers to demonstrate the use of the new products/strategies
- Farmers individually or in groups by
 1. Providing hands on training
 2. Working with the farmers or other end users in trials to demonstrate the new products and strategies
 3. Providing free samples

GROUP FOUR.

Question: Can the methods developed for crop pest control be extended to vector pest control?

Feedback:

The group believed the products and concepts developed for control of crop pests could be extended to vector pest control.

- Components applicable to both crop and vector pest control
 1. Biological control agents (e.g. entomopathogenic fungi, entomopathogenic nematodes)
 2. Chemical agents (safe chemical pesticides, semiochemicals)
 3. Traditional methods (botanicals, habitat management)
 4. Integrated Pest Management (e.g. use of lure and kill and stress and kill pest control strategies)

It was clear from the above feedback that researchers had a pivotal role to play. Key actions they could take:

1. **Identify and develop suitable products which are non-harmful, prepared in an acceptable form and cost-effective.**
2. **Ensure continuous communication with key stakeholders at all levels** (i.e. government representatives, local leaders, religious leaders).
3. **Educating the end-users** (via media, extension workers, volunteers, delPHE like workshops)
4. **Pass on the technology of production locally (capacity building).**

4 Stakeholder Meeting

The stakeholder meeting was held on the 26th July. After initial introduction by participants, the groups were divided into two, the first chaired by Professor Butt and the second by Judith James. The former focussed on vector pest control and latter on crop pest control. The two groups reconvened and provided feedback on their discussions and then developed a strategy as how to proceed which is summarised below.

Workshop result: Project development plans

During the workshop it was agreed that we should form a strong network. The title of the network is **“The Euro-African Network for the control of pests and diseases using biological solutions.”**

It was agreed that a submission for funding to support the network would be made by five of the leaders: Professor Tariq Butt -United Kingdom (UK) , Professor Buba Ibrahim Ahmed- Nigeria (N) , Dr. Ester Innocent- Tanzania (T) Prof. Christopher J.D. Obbo- Uganda(U) and Professor William Kisenska –Kenya (K)

It was also agreed that we would develop our work on the following 9 themes.

Crosscutting projects: the findings of these projects will have impact on all the projects

- a. **The development of the sustainable production of edible, medicinal and entomopathogenic fungi.**
Led by Alexis Poggio (UK), Daniel Kamala and Chrispine Siritto (T) and Fatima Tahir (N)
- b. **The development of vector pest control of arthropod disease vectors with particular focus on mosquitoes.**
Led by Professor Tariq Butt (UK), Dr Esther Innocent (T) and Professor Buba Ibrahim Ahmed. (N)
- c. **The development of using Waxmoth as an alternative to the Murine model for testing pathogens and therapeutics.**
Led by Professor Tariq Butt, Paul Erasto (T) and Chrispine Siritto(T)
- d. **The identification, development and sustainable production of semio-chemicals for a range of applications.**
Led by S.D. Abdul (N), Dr Esther Innocent (T) , Professor William Kisenska (K), Martyn Wood (UK), and Bestina Daniel (T)

Informed by these four cross cutting projects, we will develop 5 further specific projects:

1. **The Development of Integrated Pest Management systems for African crop pests using biological control agents.** The projects will collect and characterize entomopathogenic fungi, establishing laboratory bioassays and field experiments, developing and formulating myco-insecticides by using simple methods and materials, and developing IPM systems for African crop pests.
 - a) Coffee: led by Fredrick Lugoye Magina (T)
 - b) Fruits and Vegetables: led by Mohammed Bello (N)

- c) Cereals: led by Professor Buba Ibrahim Ahmed (N)
- 2 The Development of biological control agents for post harvest pests.**
Led by Nteghenjwa A. Kitufe (T) and Nasiru Murtala (N).
 - 3 The development of botanicals for the control of weeds in cereals.**
Led by Fatima Sawa (N) and Dr Esther Innocent (T).
 - 4 The development of non-chemical methods for the control of disease in crops.**
Led by S.D. Abdul (N) and Navatos (T).
 - 5 The identification and development of botanicals to control diseases (rather than the vectors of diseases)**
Led by Dr Esther Innocent (T) ,Tijjani Ahmady (N) and Nteghenjwa A. Kitufe (T)

Potential funding sources, outlined by Judith James earlier in the workshop, were identified and tentative roadmap plotted.

1st step is apply for funding which could allow for networking between participants and other interested parties. The network would be vital for the success of the consortium as it will facilitate exchanges, establishment of network infrastructures such as video-conference links for regular group discussions. Potential sponsors include the International Foundation for Science (www.ifs.se), the British Council and the Leverhulme Trust International Networks (www.leverhulme.ac.uk/funding/IN/IN.cfm)

2nd step to apply for funding for specific projects to specific sponsors. Some examples are given below.

Example 1. A UK- Tanzania group could apply for a Leverhulme-Royal Society Africa Award which targets Tanzania and Ghana.

Example 2. A group interested in crop protection could apply for funds from the Gatsby Foundation (www.gatsby.org.uk)

Example 3. A group interested in human and animal health could apply for funds from the Wellcome Trust

Example 4. A group interested in mosquito control could apply for funds from Bill and Melinda Gates Foundation (www.gatesfoundation.org/Pages/home.aspx).

Appendix 1 - Publicity Flyer



24-26 July, 2012

Joint DelPHE workshop

Use of natural products (fungi, botanicals) for arthropod pest control

Objectives of the workshop

- Train personnel in the development and use of fungal biocontrol agents, botanicals and semiochemicals for the control of arthropod pests especially disease vectors which have a devastating socio-economic impact on Africans.
- Transfer technologies in preparation/production of fungal BCAs and botanicals.
- Help in the establishment of a unit which could evolve into a cottage industry for producing fungal BCAs and botanicals.

Who should attend/eligibility

Postgraduate students and research scientists interested in arthropod pest control, health officers, biocontrol/natural product specialists, entrepreneurs, environmental groups, growers, and policy makers especially from Africa.



Practical training will be given in:

- Isolation and production of the fungal BCAs
- Efficacy testing of BCAs and botanicals
- Development of integrated pest control strategies

Workshop content

This will consist of lectures and 'hands on' training. The former will cover:

- Why we need alternatives to chemical pesticides?
- Fungal biocontrol efficacy and mass production
- Chemical ecology/Semiochemicals and the use of baiting technologies
- Mosquito behaviour, ecology and control
- Botanicals for pest and vector management
- Development of integrated strategies for pest and vector control
- Conducting bioassays of selected agents against selected pests and vectors



Registration: Free

Venue

The workshop will be hosted by the Institute of Traditional Medicine, Muhimbili University of Health and Allied Sciences (MUHAS), Tanzania.

Application procedure

Interested applicants should forward their letter, CV and a copy of evidence of sponsorship to the event preferably in pdf format by email to "minza@talk21.com" copy to innocent@muhas.ac.tz

Enquiries

For further information please contact:

Dr. Uttrah Nwanzu, Department of Biological and Horticultural Studies,
Institute of Traditional Medicine, 2026001,
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Email: minza@talk21.com



Appendix 2 - Programme

British Council DelPHE - Joint Workshop, MUHAS, Tanzania

Swansea University-ATBU Bauchi in collaboration with Muhimbili University of Health and Applied Sciences (MUHAS)

24-26th July 2012

EI = Ester Innocent, BI = Buba Ibrahim, TMB = Tariq M Butt, AH = Ahmed Hassanali, WNK = William Kisinza, AZ = Alia Zayed,
AP = Alexis Poggio, MW = Martyn Wood, JJ = Judith James, BD= Bestina Daniel, ACK= Agnes Carol Kisanga

DAY		ITEM	CHAIRPERSONS
Tuesday, 24/07/2012	9.00am 9.10am 9.20am 9.40am 10.00am 10.30am 11.00am 11.30am 12.00pm 12.30pm 2.00pm 5.00 pm	Welcome from MUHAS -VC or representative Welcome from the director BC-Tanzania or representative Presentations and group photograph (JJ) Why do we need alternatives to chemical pesticides? (TMB) What are pests and why we need to control them? (TMB) Break –refreshments Enhancing the efficacy of entomopathogenic fungi (EPF) (TMB) Use of EPF to control sandflies (AZ) Mass production of EPF (BI & AP) Lunch Training in mass production and conducting bioassays (AP, MW, TMB) End of 1 st day training	Ester Innocent and Buba Ibrahim
Wednesday, 25/07/2012	9.00am 9.30am 10.00am 10.30am 11.00am 12.30pm 2.00pm 4pm 7.00pm	Mosquito behaviour ecology and control (WNK) Semiachemicals and strategic control of arthropod pests (MW) Botanicals as pest control agents(EI) Break - refreshments Development of strategies for crop pest and vector pest control – group discussions (TMB, AZ, BI, AP, MW, WNK, EI) Lunch Training in mass production and bioassays continued (AP, MW, TMB, AZ, BD, ACK) End of 2 nd day training Cocktails at BC for selected guests especially key stakeholders	Tariq Butt and William Kisinza
Thursday, 26/07/2012	9.00am 10.00am 10.45am 11.15am 12.00pm 12.30pm 2.00pm 5.00pm	Evaluation of assays done on days 1 and 2 Funding opportunities (JJ) Break-refreshments Reflections and feedback from participants (TMB, BI,EI, JJ). Certificates awarded to participants. Lunch (students and stakeholders) Round table discussions with stakeholders (TMB, BI,EI, JJ) End of Meeting	Prof Tariq Butt, Dr Ester Innocent and Director of Research and Publication.
Friday 27th July		Trip to Bogomoyo and Sedan Opportunity to socialise and study environment (large tracts are prime mosquito breeding areas).	

Appendix 3 – List of Participants

	NAME	ORGANISATION-COUNTRY	E-MAIL	TRAINING WORKSHOP	STAKEHOLDER MEETING
1.	ABDALLAH ZACHARIA	MUHAS-TANZANIA	naayz@ymail.com	✓	
2.	AGNES C.KISANGA	UDSM-TANZANIA	Carolagnes2011@gmail.com	✓	
3.	AISHATU BALA HASSAN	ATBU-NIGERIA	Bala-aishatu@yahoo.com	✓	✓
4.	ALEXIS POGGIO	MYCOSOLUTION-UK	alpog@live.co.uk	✓	✓
5.	ALIYA ZAYED	US-NAMRU3-EGYPT	aliazayed@yahoo.com	✓	✓
6.	BANDI VEDASTO JOHN	MUHAS-TANZANIA		✓	
7.	BARAKA SAMWEL	MUHAS-TANZANIA		✓	
8.	BENSON PETER	MUHAS-TANZANIA		✓	
9.	BESTINA DANIEL	MUHAS-TANZANIA	bestinad@yahoo.com	✓	
10.	BUBA IBRAHIM AHMED	ATBU-NIGERIA	biahmed@gmail.com	✓	✓
11.	CHAULA SIMON AYOUB	MUHAS-TANZANIA		✓	
12.	CHRISTOPHER J. D. OBBO	MAKERERE-UGANDA	chrissobo@yahoo.com	✓	✓
13.	DANIEL M. KAMALA	MUHAS-TANZANIA	dkamala@yahoo.com ; dkamala@muh.ac.tz	✓	✓
14.	DEBORA K.B RUNYORO	MUHAS-TANZANIA	drunyoro@yahoo.co.uk ; drunyoro@muh.ac.tz	✓	✓
15.	DENIS T.MWANGOMO	MUHAS-TANZANIA		✓	
16.	DILUNGA EDWARD CANISIO	MUHAS-TANZANIA		✓	
17.	FATIMA SAWA	ATBU-NIGERIA	fsawa@yahoo.co.uk	✓	✓
18.	FATIMAH TAHIR	ATBU-NIGERIA	Fatimahtahir3@gmail.com	✓	✓
19.	FEBRONIA UISO	MUHAS-TANZANIA		✓	
20.	FESTO THOMAS MTANGA	SUA-TANZANIA		✓	
21.	HARUNA ABDULLAHI DANWANKA	ATBU-NIGERIA	hdanwanka@yahoo.com	✓	✓
22.	KHADIJAT MUSA BELLO	ATBU-NIGERIA	Belloma63@yahoo.com	✓	✓
23.	MARIETHA HENRY	UDSM-TANZANIA	mariethahenry@yahoo.com	✓	✓
24.	MARTYN WOOD	SWANSEA-UK	483813@swansea.ac.uk	✓	✓
25.	MIRISHO ROBERT	SUA-TANZANIA			
26.	MOHAMMED ABUBAKAR KOBI	ATBU-NIGERIA	mabubakarkobi@yahoo.co.uk	✓	✓
27.	MOHAMMED BELLO	GIWO FARMS LTD-NIGERIA	mdbanjuma@yahoo.com	✓	✓
28.	MOURICE MBUNDE	SUA-TANZANIA		✓	
29.	MTENGAI KARIM	SUA-TANZANIA		✓	
30.	NASIRU MURTALA	ATBU-NIGERIA	nasirumurtala@yahoo.com	✓	✓
31.	NOVATUS F. MUSHI	MUHAS-TANZANIA	Mushinovatus@yahoo.co.uk	✓	
32.	ROSE TARIMO	MUHAS-TANZANIA	tarimorose@gmail.com	✓	
33.	SALEH MOHAMED	NIGERIA	sirsalehmuhammed@yahoo.com	✓	✓
34.	SHAABANI MSHAMU	SUA-TANZANIA	smshamu@yahoo.com ; smshamu@su.net.ac.tz	✓	✓
35.	SULEIMAN D. ABDUL	ATBU-NIGERIA	Sdanabdul2003@yahoo.com	✓	✓
36.	TARIQ BUTT	SWANSEA-UK		✓	✓
37.	ESTER INNOCENT	MUHAS-TANZANIA	minza@talk21.com	✓	✓
38.	TIJJANI AHMADU	ATBU-NIGERIA	Tijjaniahmadu72@yahoo.com	✓	✓
39.	DOMINIC PARMENA SUMARY	SJUT-TANZANIA, REPRESENTING ST. JOHN'S UNIVERSITY OF TANZANIA (dsumary@gmail.com)		✓	✓
40.	CHRISPINE SIRITO	UDSM-TANZANIA, Representing the Tanzania Forestry Research Institute (TAFORI) (chrisito2000@yahoo-de)		✓	✓
41.	CHRISTOPHER L. MATERU	MARI-TANZANIA, Representing the Mikecheni Agricultural		✓	✓

		Research Institute (chrismateru@yahoo.com)		
42.	EVA MATHIAS SOSOVELE	UDSM-TANZANIA, REPRESENTING THE DEPARTMENT OF MICROBIOLOGY AND BIOTECHNOLOGY, UNIVERSITY OF DAR ES SALAAM (sosovele@gmail.com)	✓	✓
43.	SHAABANI MSHAMU	SUA-TANZANIA, REPRESENTING THE SOKOINE UNIVERSITY OF AGRICULTURE (smshamu@yahoo.com ; smshamu@suanet.ac.tz)	✓	✓
44.	FREDRICK LUGOYE MAGINA	TACRI-TANZANIA, REPRESENTING THE TANZANIA TEA RESEARCH INSTITUTE (FLKMAGINA@GMAIL.COM ; FREDRICK.MAGINA@TACRI.ORG)	✓	✓
45.	GODFREY MBATA	TTRC-TANZANIA, REPRESENTING THE TSETSE AND TRYPANOSOMIASIS RESEARCH CENTRE (geofreymbata@gmail.com)	✓	✓
46.	PAUL ERASTO	MUHAS-TANZANIA, REPRESENTING THE INSTITUTE OF TRADITIONAL MEDICINE (paulkazyoba@yahoo.co.uk)	✓	✓
47.	MAINEN MOSHI	MUHAS-TANZANIA, REPRESENTING THE INSTITUTE OF TRADITIONAL MEDICINE (mmoshi@muhas.ac.tz ; gynura1955@yahoo.com)		✓
48.	OLIPA NGASSAPA	MUHAS-TANZANIA, REPRESENTING THE SCHOOL OF PHARMACY (O_ngassapa@yahoo.co.uk)		✓
49.	STANLEY SILAS LYIMO	MUHAS-TANZANIA, REPRESENTING THE SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCE		✓
50.	QUINITINO A. MAGANI	UDSM-TANZANIA, REPRESENTING THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF DAR ES SALAAM (gamgani@yahoo.co.uk)		✓
51.	NTEGHEJWA A. KITUFE	NIMR HQ- TANZANIA, REPRESENTING THE HEAD OF TRADITIONAL MEDICINE, NATIONAL INSTITUTE FOR MEDICAL RESEARCH (nkitufe@yahoo.com)		✓
52.	NICK BROWN	AGROSENSE-TANZANIA, REPRESENTING PRIVATE ENTREPRENEUR (Nickbrown.brown@gmail.com)		✓
53.	THERESIA NKYA	NIMR-TANZANIA, REPRESENTING THE DIRECTOR, NIMR-UBWARI STATION	✓	✓
54.	LIGGYLE VUMILIA	MoHSW-TANZANIA, REPRESENTING THE TRADITIONAL MEDICINE SECTION IN THE MINISTRY OF HEALTH AND SOCIAL WELFARE (yliggy@hotmail.com ; liggy@yahoo.com)	✓	✓
55.	GEORGE SILAS. SHEMAE	COSTECH-TANZANIA, REPRESENTING THE DIRECTOR OF COMMISSION OF SCIENCE AND TECHNOLOGY (gshemdoe@costech.or.tz)		✓
56.	JUDITH JAMES	SWANSEA-UK, REPRESENTING THE VC SWANSEA UNIVERSITY (j.j@swansea.ac.uk)		✓
57.	S.A. IBRAHIM	ATBU-NIGERIA, REPRESENTING THE VC ABUBAKAR TAFAWA BALEWA UNIVERSITY	✓	✓
58.	SALLY ROBSON	BC-TANZANIA, COUNTRY DIRECTOR		GUEST OF HONOUR-OPENING REMARKS
59.	PROF. ELIGIUS LYAMUYA	DEPUTY VICE CHANCELLOR-ACADEMIC RESEARCH AND CONSULTANCY-REPRESENTING THE VC-MUHAS		WELCOME REMARKS
60.	DR. JOYCE MASALU	DEPUTY DIRECTOR, RESEARCH AND PUBLICATION-REPRESENTING THE DIRECTOR OF RESEARCH AND PUBLICATION-MUHAS		CLOSING REMARKS AND AWARDING CERTIFICATES OFFERING

Note that, all 19 participants from outside the United Republic of Tanzania participated in a special stakeholders' meeting, making a total of 39 participants. The stakeholders from Tanzania represented their institutions at various levels (as indicated) during the discussion.

Appendix 4 – Selected Photographs of Participants



Professor Eligius Lyamuya making a welcome address and then receiving a commemorative plaque from Judith James.



Ester Innocent, Judith James, Sally Robinson, Tariq Butt and Alexis Poggio



Dr Alia Zayed giving her lecture on the biological control of the sand fly



Dr Ester Innocent giving her lecture on botanicals for mosquito control



Martyn Wood giving a talk on semiochemicals on behalf of Professor Ahmed Hassanali



Alexis demonstrating axenic culture and mass production of the insect pathogenic fungus *Metarhizium anisopliae*. Participants examining material prepared earlier.



Participants gathered around a demonstration of botanicals as agents to control mosquito larvae. Below, Ester answers a question from one of the participants.



Bestina explains her work to participants



Tariq and Alia giving support to the trainers

Appendix 5 Feedback forms of Participants

do we attach the pdf of feedback forms?