Toward International Collaborative Research between Jomo Kenyatta University of Agriculture and Technology and TOYO University

Date: 14th November, 2016
Venue: 3rd meeting room, No.6 building

Center for Sustainable Development Studies, Toyo University
International Workshop

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Thank you Professor Shima. Let me first of all express my gratitude to Toyo University and Professor Kitawaki for inviting us and taking care of us here. We have had a good time. My senior professor, Professor Odhiambo left yesterday for Nairobi. He had to go earlier because we are having a graduation and he is the DVC In-Charge of Academic Affairs and he has to be there. Graduation is his event and he must be there, but Professor Kitawaki, I can tell you that he expressed a lot of gratitude for the way you took us in for the signing of the MoU and for the future collaboration we are going to have with the Toyo University.

For my case, I should be stating that, for example, this is my first time to be here and I’m really grateful for the way you have taken care of us in the hotel where we are staying and even when we come here and even taking us around to see places in Tokyo. We are really grateful.

So my topic, I have written there as I was asked when we had our meeting in Nairobi, Juja, to give some ideas on what we do as research as a university in Jomo Kenyatta. So, my presentation today may not be very specific but I can show the broad areas under which we do research – the different topics – the different themes. Being a university, offering almost everything, we do research in almost everything. So you will find research in humanities, in engineering, in science, in computer because people do research to develop their own departments and their own schools but we are the one division that controls research.

This is Professor Odhiambo, the Academic Deputy Vice Chancellor, and then we have Professor Esther Kahangi, who is the in charge of research, production and extension. So, we combine those three elements in research. We do research. We produce items and we also take the information to the people outside in the industry, in the agriculture, in the IT sector or whatever you have developed, we also do extension. Extension goes beyond that because we also conduct some short courses for people who come in – women groups. Sometimes even administrators and police because we want to teach them mostly in application of ICT tools, like geographical information systems in our campuses.
We also teach them administration and such kind of related courses. So, he’s actually guiding research in our university. I think that also was introduced last time. The chancellor is the one who gives the degrees. The Council Chairman is the one who runs the university – check if university is running well – financial everything and, of course, the Vice Chancellor is the CEO – the one on day-to-day running of the university. Then we have the DVC Administration on Administration Matters and the one who controls the finances.

Let me repeat again the university vision. As expressed by Professor Odhiambo last time also is to be a global – University of Global Excellence and the mission is to offer quality training, research and innovation. Training because we are training our students also at a graduate up to the Ph.D. level, research for the advancement of science and other areas and innovation to make this research practical and useful for the people outside and we cover all these fields which have been written here and, again, as we emphasized the aim is to cater for a dynamic world because the world is changing everyday – things are changing so we need to change with time also.

The university mandate is given by the Act, which established the university. It is directly or indirectly in collaboration with institutions of higher learning to offer education and conduct research in all these areas; agriculture, science, culture. Incidentally, Jomo Kenyatta University of Agriculture was not originally established for cultural studies but I think as Professor Odhiambo expressed, we later on found that an engineer, who is not grounded in communication skills, in other social studies is a very poor communicator. So, he is not able to express or interact or even extend his idea to the people out there because he doesn’t have the language.

So, those other aspects came in later to produce a whole pathway, so the cultural studies, we also teach Kenyan languages now so that there are people able to communicate when they go outside and especially we have one local language and here you maybe don’t have many languages but in Kenya, we have a unifying language called the Kiswahili. Professor Sugita knows a little bit.
That’s a language understood by almost everybody and even without learning you pick it – students pick it from the ground level in addition of course to English and also another mandate is to participate in discovery. This is where research is discovering new ideas, new methods and new uses and then transmit and preserve knowledge to stimulate intellectual participation of students in all this economic, scientific, agricultural, professional and cultural developments of the country. So, the university is a focus for training level personnel.

Then, we are managing research in the university so that it follows the established policy and it does not deviate from the norms to guard against also a loss of intellectual property things, rights and so on. So these are a committee that guides research – it is called “Research, Printing and Publications Committee.” It guides the research, the publication and also the printing. We have university journals, which are published by the university. So, people send their papers there and they are edited. They are referred to external auditors even and before they are published.

It’s not a very old journal, so you may not find a very high-impact points but it is coming up very strongly and it covers all areas of research in the university. It also advises a senate. Senate is a decision-making body in the university chaired by the Vice Chancellor and ultimately the University Council, because the University Council approves all the funding for research, especially if the funding is coming from the university in France. Then, finally it approves research proposals for funding. Their proposals are written competitively, so depending on the scope of your proposal it can be funded or not funded. It can be funded half way and things like that.

So, they approve research proposals and develop policy and review progress in these areas. The Deputy Vice Chancellor is the one who chairs it and is always Professor Kahangi and she administers all the policies, oversees the management of research programs, that is checking people are following the timelines, which they had given in the proposal, especially for university-funded project and they also assist researchers in seeking external funding. So, if it sees in a call for proposals from wherever – from the government,
from the industry or from international bodies, they make the information available to all the researchers in the university and advise them and encourage them to seek funding.

It also helps in training them to write good proposals which can be considered and they are funded. It promotes interdisciplinary research. This is a key area in our Kenyatta University; however, it is very difficult to get your project funded if you are alone a researcher, so you have to look for somebody from – especially from other universities in East Africa or if it is within the university then a research across departments or schools.

So, you go for a project that covers all the areas and you work together and, of course, it manages the university research fund to see whether it is being used well, accounting is being done well and at timelines and it has the power to stop research if it is found it’s not going in the right direction. After every 3 months’ evaluation if you are not making good progress, the research funding can be withdrawn.

Then, there is the Research Directorate and the Deputy Vice Chancellor which provides now office support. It collects data and it calls for meetings. It does the monitoring and evaluation. They visit even research sites to see whether what is reported is what is on the ground, especially for research which is being done outside the university. They are also responsible for management or postgraduate degrees. In our university to graduate for Masters, after you publish your thesis, you must publish also at least one paper in our refereed journal and attend at least one conference – international conference.

For Ph.D., you have to publish at least two papers and attend two conferences in addition to publishing – submitting your research thesis. So, all those compliances are checked by the Research Directorate and, of course, then we have library which is the repository of all the research work that is done in the university. It also collects research from other universities. There is an archive for journals – online journals – even hand bound journals. It can also provide other help in accessing research material. It has subscribed to
very many journals worldwide so that the students are able to access material without paying, especially in the PDF formats and so on.

Of course, after you finish your research funded by university, you deposit the publication as the thesis with the university library for other people to refer to when they are doing research for literature review. They also guide students in following the right format. For the reference citation, we normally follow the APA format so that we are using the same standards as other researchers all over the world. The university library can be accessed even from outside, so from your laptops and everything and as long as you have the password and so on, so it is accessible.

Then, the university has thematic areas of research which remains for a few years – in four years it comes up. Overall theme sometime now for the last 2, 3, 4, 5 years has been science, technology, and innovation and entrepreneurship for economic development. It is the same theme we use in our conferences so that it is telling that there won’t be such a norm but as I have seen here in this area, they are reviewed every 3 years to find whether there are some that are skilled in the dynamic world and maybe changed something, like for example before a few years ago this one was not there. It was science, technology for development.

Actually even this one was not there until people realized that doing science and technology and stopping there is not helping much. It becomes just published work. It has to be science, technology and innovation – a product that can be marketed and also this one is the science of theme business in the innovations and science and technology. So, it has become very important. So, wherever you do research we always aim to see what innovation can come out of it and how that innovation can be made a business – maybe selling to their industries or before who can take their innovation and now develop it further and beyond the university research mandate.

Of course, the university does not have the money to do the bulk production and things like that. So, these ones have become very important innovation entrepreneurship. In fact, even when making a proposal the question always comes what is the innovation in your proposal, - what is the business chance
in your proposal and if you cannot answer those ones well, the ranking would be low and you may not get funding for your research.

So, these are the sub-themes. You can see they cover everything basically which can be in a university. You have the basic and applied sciences and this is where people like Professor Odhiambo come in. He’s a mathematician, so they develop mathematics; they develop theorems, new ways of analyzing things and then number 2, water sanitation, environment and climate change. This is a big area now.

Actually I think it is a bulk – most of the bulk of the papers come from here because, especially environment and climate change is a hot topic in Africa and in our university as well as water and sanitation, we still have a lot of problems with our water and sanitation in terms of scarcity, in terms of quality, in terms of access and so on. Then, we have advances in human and animal sciences. These are done by the College of Health Sciences and the Departments of Animal Health and so on. ICT is cutting across all of them. Built environment – these are for architects and construction and management, engineering and so on and then the hardcore engineering is here.

This is where I also work for, here in engineering in number 6 and number 2 for energy and so on. Then the Institute – the College for Human Resource – these are the area – the policy, law, governance, socio-cultural development. Then, you see the University of Agriculture and Technology. So, agriculture still remains the core area of research. I don’t know whether that is true here but in our country I have found that the interest in agriculture has gone down in terms of students. Students are not so much interested in agriculture. The numbers have been going down.

I don’t know whether they think because it is a dirty profession or it’s because the report I presented last time due to the lack of use of technology but clearly there has been a drop every year in the students interested in doing agriculture which is serious because it’s still the main stay and we still need to feed and grow food. Sustainable urban development – this one goes with
the built environment by the School of Architecture, civil engineering and so on.

Then production development, commercialization and entrepreneurship; these are areas where this kind of research picks resort from other researches and tries to show that they can develop a product from it, how it can be completely commercialized and how it can be made a business. So this, again, is done by the main division – Division of Research, Product and Extension.

They have a whole section on product development and commercialization and they incubate ideas. We have our incubation center until idea is developed to an area that it can commercialized and then we look for industry to industry that can take their ideas and then make it business, at the same time protecting their IP – their intellectual property rights for their researchers so that again they are not cheated over their innovation or their discoveries.

Then, sources of research funds from the university – I think this is one area where there is always a shortage, they are never enough. People still want more money? When you go for conferences and things, people say there is a lot of money around but getting it is not that easy. Not easy but when you meet – there is a lot of money from Rockefeller Foundation, from Ford Foundation, from Bill Gates and Melinda and so on, even from JICA itself but it is never enough because the competitors are so many – some is international competition.

So, the university itself has established a research fund which is competitive by allocating some of the money collected from students and from others, so there is money to do theory for research. This is for staff and the students. So, every year there is a small amount allocated for Masters students, for Ph.D. students and even for staff. They cannot take many people but if you make a good proposal and implement it well, you become attractive to that kind of funding and it has really helped a lot because I think getting external money is not easy but this one you can write very competitively and you can
get something to study of – the maximum they can give is for 3 years is 4.5 million shilling.

So, it is not much money; 4.5 million shilling is almost like 4.5 million yen. The yen and shilling are almost 1:1 but for a small research, lots of money and when we apply for those kinds of research now we are able to get in our Ph.D. students, Master students to get into them, so this really are helpful for the staff locally and then we look for supplemental funding. The government itself has a research council – National Council for Science, Technology and Innovation which advertises for grants, for the universities, mostly for universities to compete and these ones can give a lot of money, they can give money for what they call educative [ph] research.

They also give money for collaborative research where you have to collaborate with at least two more universities outside your own university and they also give grant for infrastructure development – that is the research where you can buy equipment, you can construct a laboratory, not a very expensive one, and this one, they can give to a maximum of 100 million shillings – it is about a 100 million yen to an institution to develop infrastructure. The only rider is that the moment they give you that money, you should make that infrastructure or that laboratory or workshop hoping to add universities in the country.

You have to show that you allow other universities to come and conduct research there, especially if you purchase good equipment, which may not be in other universities. So, I left before applying for this one. It is now people are applying for it. Deadline is 18th of this month. So, people are very busy. I left my team – my small team trying to apply for something.

Here I can get something from them but, again, it is very competitive I know and they may not – the problem is that because of the distribution of money they may not fund more than one project in a university, so to spread the money around to many universities we have, so maybe only one university can get two only and which looks little again and, of course, this open source of funding for people to try from external sources like for universities, internal research organizations...
...we are talking about like sometimes AfDB (African Development Bank) like Rockefeller Foundation, Oxford, Bill Gates and Melinda are organizations which sometimes call for competitive grants, international donors, industries and so on and this one – the moment the university announces the researchers, sometimes the university forms teams so they can write a comprehensive report proposal and getting people from different departments and you come down and try to write a strong report. We have won several grants from this kind of grants in the past – big projects which are going on all over the country through our university staff.

In the university, we have research institutes, which are specifically for research in addition to all the departments. All the departments are research centers because people have to do research. We have an adage “publish or perish” in our university. I think it is the same thing here but people who are working like they once said if you don’t publish you are perishing because our assessment, every quarter of the year, there is one research publications conferences and we work on what is called “performance contract” so that at the end of every 4 months – 3 months you have to say what you have done.

You agree initially when you sign the contact between you and your Chairman and your Dean and your DVC and after that they say I have attracted this amount of money for research so I will have published this number of papers, I will have attended these conferences, I will have supervised this number of Ph.D., M.Sc. students and every quarter you fill the report, how far you can go with your contract and by the end of the year if you have not achieved 50% of the contract, you get a warning letter.

In the contract you may be the employer but I will do this, I will do this, I will do, of course I am trying to make those contracts but then there is no support to achieve so it becomes very difficult to fulfill all the contracts. So, that is for departments and that’s how we progress in academic line through papers and through the money you have attracted to the university. Then, we have these institutes which support research. They also have their own researchers – permanent staff who conduct research but they also support
staff from other departments like for example IBR. If you have a student in horticulture who is doing by technology, he will use the lab in IBR.

IEET, Institute of Energy and Environmental Technology, also are doing a lot of work on environment and technology, like Professor Odhiambo showed that biogas generation from hyacinth is done by IEET and a lot of energy thing – he is doing a lot of work on solar energy, a lot of work on wind energy also and he is using students from my department, from mechanical engineering, from civil engineering to conduct research there supported by JICA also. A lot of support has come from JICA through Bright Project and so on.

Then this number 3, these are for people in construction management who are developing new materials for road and housing and other structures, especially trying to use local materials and what we call “eco-friendly materials” which do not add to the carbon problems and then we have water research and resource center. This one is currently housed in my department – WARREC and the vision for this center is to be Regional Center for East Africa, where if anybody wants to know anything about water that will be the first place to come. So, we do research.

We become a resource meaning that we will have archived almost all the information you can think about water. So, that is the first place to go to. You see a lot of development. It’s just 1 year old, so we are still building it up and it is one of the institutes that is putting a big proposal for infrastructure development and the one I said have been announced just about last week. So, we are hoping that government will fund us to put up our building and where we can put infrastructure, we can put labs, we can put computers, we can connect things so that all students and anybody coming to Kenya and they also work on water that will be the first stop.

I think you saw some of those things with some of the innovations we are trying. They were shown by Professor Odhiambo also. Electrical discharge machine and the small hydro plants and these ones have become quite popular in the rural areas where you have some stick plants with some small rivers and people can generate up to maybe 15 kilowatts of power which can
light a small village and do some minor work like pumping water for irrigation or meals for grinding maize and other grains. So, these ones have really caught up in the rural areas. Our country is very hilly in some areas and you have water dropping in quite some distances and you are able to tap it in those small hydro plants.

Of course, the mechanical engineers and mechatronics engineers are here, these are student projects mostly. This one might look rudimentary in Japan being a very – using so many robots here even for vehicle manufacture but we are venturing slightly into that area, maybe that’s where to start making small robots. We can do some work in an industry – in our rural sector.

This is the one I talked about where we are digesting hyacinths. Hyacinths, you may not know but hyacinth is a plant that is basically destroying one of our biggest lakes, Lake Victoria. Lake Victoria is between Kenya and Tanzania and Uganda and the plant grows so fast, it has covered almost a third of the lake and eliminating it has become almost impossible. It is covering the whole area. We tried to harvest with tractor and grind it, it just grows very fast. So, now we are trying to see whether we can harvest it and then use it to produce biogas by a normal fermentation.

This is one of the digester – it’s just a thick polythene structure here which will be filled with methane gas and then the methane gas can be taken for cooking, for bottling and so on. We will see what – if we can market it, it will be useful because as we destroy the hyacinths we are also producing gas.

We are not just – but it has become a serious link in that important lake – it is one of the largest lakes in the world I think. This is a thermal gasifier – they are trying to use local materials to produce flue gas which can be burnt like in engines using waste materials, using husks and then you gasify it here and then you can collect the gas and it can be burned to produce energy. So, this one also is being done by Institute of Energy and Environmental Technology.

These solar panels where – this was a challenge by our Former Vice Chancellor that we wanted to make solar panels for all the primary schools at
a very cheap price. The solar panels in Kenya are quite expensive and most of them are coming from here or China. They are expensive, so these people have been trying to come up with cheap solar panels. Initially, they were supposed to produce foldable solar panels but I think it became a bit difficult to develop that one. I don’t know, maybe they are still working on it so that if somebody can fold and carry home and in the morning you spread it like that. So, we are still using the hard panels and small panels here to do even lighting in the rural areas.

In the rural areas people use kerosene – small lamps producing a lot of smoke for the children, so at night they read and they get affected in the eyes. So if they can have solar lamps, they can read well and it helps them seriously in passing exams without serious eye problems and we have a lot of sun in Kenya. Professor Kaneko [ph] was asking me how can Kenya is – Kenya is a just right at the equator – half of our country is North and the other half is South. So, equator is passing in the middle so we have a lot of solar radiation – a lot of heat. If we can trap it, we can actually help even people in very remote areas of the country.

This one I showed in the symposium. We are trying to remove the drudgery of using the hole for digging by trying to bring in the small tractor. These tractors are there in Japan here, I know. They are the hand tractors, which actually were introduced very early in the country when Jomo Kenyatta was being started. Jomo Kenyatta was built by Japan – I think you know – from the beginning 1978 – so they brought – you people brought a lot of this technology. Incidentally, I don’t know why they didn’t catch up – the hand tractors. They did not get adopted widely. We are still to find out why. One thing is that our floors are very hard, so planning it is very difficult.

The same thing happened when we tried to bring this model from India. Still when you try to plough it can’t move – the plough gets stuck to the ground. So, our engineers and technicians have been modifying it in our workshop. Actually, this is being done in my own workshop to try to make it stronger, to change the gear issues so that it has more torque, more force and also making it a multi-purpose tractor which, I said, can be used for cultivation but you can hitch a small cut or a small trailer behind it for transportation.
It has a PTO, power takeoff shaft, which can be used to do post-harvest technology like milling, like thrashing, even spraying and so on.

So, we want to make it a multi-purpose tractor which can do very many things, not just one because even if it’s just cultivation it is only one short season, then it is not useful anymore, so it must do many of the things and they have tried to harden it and it has become very popular and we are hoping very soon Jomo Kenyatta can even develop a production line to produce many.

Currently, you don’t have any, so it becomes even if people order them we cannot supply – maybe we have to get from India and modify itself, taking a lot of time. That’s a big challenge we have but this one we are seeing it revolutionizing agriculture and removing that hard work from the local people who are working so hard and in very drastic conditions.

Again, horticulture is doing a lot of work in biotechnology, propagation of crops using biotechnology, tissue culture of aloe vera. Aloe vera is an oil plant that produces so many – I think I have seen some oils here also from aloe vera itself and we are trying to tissue culture it. Bananas, of course Jomo Kenyatta is famous for tissue culture bananas. It is the first thing we were asked to produce them in bulk. Even now we still produce a lot of them and at the beginning of every rainy season you see lorries and lorries coming to collect these seedlings.

**Female Speaker**
Is it sweet banana or for cooking?
Patrick Home
All of them. With tissue culture, all of them. You just come and say which one you want and then you are given either for sweet bananas or for cooking bananas and in fact they encourage people to bring traditional varieties from their rural areas so that they can be propagated by tissue culture. So even for Matoke – Matoke, it is there if you want it, they have also propagated for Matoke. Matoke is the ones you cook before they are ripe – boil them and eat them or roast them and eat them like that.

Of course the mushrooms – they are also and of course we talked about these products for our food science people so that – Africa has been known to just to sell raw materials before you process them but you get a very poor price for them but when processed to this level you can get higher pay for them. So, this is going on. It’s not all of them are not here even there’s beer – lot of wines made by the university, everything we got from here. That’s their work – from strawberry – from whatever – sugarcane and so on.

Here, I just put our performance indicator showing how our universities are performing in terms of research, in terms of recognition, publication and you can see Jomo Kenyatta is not the last but almost came last here. Maseno is one – these are the main universities in the country. There are main and smaller ones but you can see in terms of international collaboration, we are not doing very well and so we need more and this collaboration with Toyo University will make us maybe go up a bit towards these ones here. So, you can see not only we are only beating Maseno which is dangerous.

Nairobi University is our main university. Kenyatta is just next to us and people confuse these two universities. This is Jomo Kenyatta University – this is Kenyatta University. So when you come to Kenya you may go to the wrong university here – it’s possible but it’s the same person. He was our first president and therefore for our university, he gave us the land to construct the university – 200 hectares, so it was named after him. By the way, his son is a president now. So, it has gone like that. So, you can see this Egerton has the highest collaboration. This is one of the old universities – very famous for agriculture and so on but we are coming up.
In terms of agriculture research output, again you can see we are still a bit low here, with the biggest here, this university in Ethiopia, it seems to be doing quite well in terms of agricultural output, in terms of research. So, we need to go up a bit, especially for us being called agricultural university and technology we should have been somewhere here but I think we are trying.

We were cited in 7 publications. These are publications that are referred to by other researchers – the more times you referred to, the higher your impact is – you are picked by high standard paper and it is guiding research elsewhere. So, we need maybe to publish more high quality papers in more reputed journals all over the world.

And, of course, now this is the research output showing where people are publishing the most and you can see agriculture is not doing bad in terms of publications. We are maybe number 2 in Medicine and then all the other disciplines are falling in there. Medicine seemed to be doing a lot of work because there are a lot of problems. It is easy to get a research problem in medicine because you turn this way, there is a disease – you turn this way there is another pest there.

So, it’s not very difficult to get a research topic. So, they are doing well in terms of research and their research also makes impact because it is seen directly after it helps people in health and so on. Physics also is there – computer science, biochemistry and this one is almost like Medicine here - medicine will even go higher to 30 because immunology and microbiology is still part of medicine.

Then, the broad themes when you split the current research going on – the one I give the global and switching guide every time. These are the things again which I have talked about and the ones which are going on. We are trying to expand every now and then something because people come and complain our area is not in the list so we added. Our area needs to be expanded. If it’s too many maybe it is clubbed together. So, these are now the current research areas and sample topics are given in the word document in this folder here.
Then, Manago-san [ph] told me he’s going to present some of my work I have been doing with my students in different areas. As I said in the beginning I am basically trained as an agriculturalist in Kenya, specializing in soil, water and environmental sciences mostly, so you will find my research finding on irrigation, waste water, hydrology, all that area of soil, water and environmental engineering. So, it is the white and the yellow is water field in this and for this one – one of my students was trying to see the effect of fertilizer application in tea.

We are main tea grower in our country and it was strange to see whether people are applying too much or are you applying too little. You can see basically we found that we are applying too much which goes into water pollution – ground water pollution. Tea is harvested on the leaves, you know, I think you know that so you need to apply a lot of nitrogen to grow the leaves but I think people are getting excited and applying more than the plant actually needs and so on. So, he did some experiment work and this is what he found in general – in the last statement here. The other results are there.

This one, we did with one of my Master’s students. Now, she’s doing Ph.D. in our university. This is one on water and environment with the impact of water and sanitation activities on the environment in Upper Mara Basin where she found that most water sanitation and hygiene sites become centers of other problems.

For example when you develop a watering point for people and livestock, it becomes an erosion spot because livestock will be coming there in big numbers and the whole area is eroded and the grass is gone again just because of that water point and so on and also we found that when you have a water point where the animals and people are mixing, there is a lot of bacterial contamination because when animals come they urinate there and then that water goes back to the river and people are taking water from the nearby river where you have put this.

So, it was an interesting finding that we are doing, we are providing water but at the same time creating another problem which we need to look further
beyond that – the water solution and see beyond so that you also protect the site.

That’s why we are saying that the study recommends that water sanitation and hygiene project implementers should make comprehensive efforts to implement an environmentally sustainable project. Not just look – look beyond water and see what your solution has done to the environment also and so on but, of course, there are other things that we found. A lot of the water was not good for drinking in terms of E. coli. E. coli is a bacteria that causes vomiting and diarrhea so in most wash sites that water was still contaminated.

This one was a study we did to find whether different technologies can be used for treating waste water from tanning industry. The tanning industry is an industry that makes leather for shoes and from cow skins and other skins and the water coming out of that industry is heavily polluted, seriously polluted because they use chromium to tan leather so that it does not rot and removing chromium is not easy and chromium, as you know, is a carcinogenic, it causes cancer if it is released to the environment. Here we were trying to see whether you can use constructed wetlands, you can use charcoal or a mixture of many things to remove that chromium.

This is one of my M.Sc. students – she is also now doing Ph.D. and she’s part of our staff also and incidentally we found that using these technologies this is charcoal actually, you could remove almost everything. Now, the problem is the biggest question was that you are using charcoal and people don’t want trees to be cut. So, you are solving the problem but creating another problem by deforestation because how much charcoal do you need for a whole industry – it’s a lot of charcoal. So, that’s another thing you have to think about that you have found a solution but by finding a solution you’ve created another problem and that was the biggest question even when she was defending her work.

How can you solve a problem by creating another problem but you are able to remove but the constructed wetlands is another paper which I have not shown here. Constructed wetland using these water loving plants was found
to be quite effective, maybe not as effective as charcoal from this acacia tree and the acacia tree, this one is a tree found in dry lands. It takes a long time to grow – long, long time actually. By the time it is charcoal age, it could be 20 years or more. So, that’s quite a question that was raised – you are destroying a tree that grows so slowly and that is the danger in providing results.

The other one was mostly in irrigation. We are trying one type of irrigation to save water with one of my students also. These are students we shared from horticulture. I was doing part of irrigation and the horticulture people are doing their part of agronomy and we were trying to find different technologies that can save water and using this simple technology of AFI – it is Alternate Furrow Irrigation.

In furrow irrigation, you have furrows but you don’t irrigate them, at the same time you irrigate one you skip this one this time, like that, like that. The next cycle, the one you left you irrigate with it and we found that you could save water to this level, 38% to 48% with insignificant reduction in the yield. So, the yield is almost the same which means that you have saved water which can be used for other purposes.

This one again – we did the one with my students – is one of my students also and we were trying to remove heavy metals from wastewater. In Kenya, current sources are notorious and the industries are notorious for releasing water into the river systems without taking it through the sewer system so you find most of them just release water into the river system and we were trying to see whether constructed wetlands of different macrophytes – macrophytes are these water loving plants which grow in wetlands – what is their effect in absorbing the heavy metals and we were dealing with lead, cadmium and zinc and we found that they could absorb a lot – in fact almost 90% of heavy metals they could get.

As much as 80% of the zinc can be taken up by the plants. Of course, the question always come now what happens when you destroy the plant, you bring the zinc back into the environment but when it is not in the water
system it is not as dangerous as when it is in the plant themselves, so you are able to remove a lot of it.

This one is we tried to see the effect of human settlement and industries along one of our main rivers in the country. This is the main river – this is Mara River. You may not have heard of Mara itself here but it is the river that serves the national park that has the largest number of wild wilder beast. They are some animals that migrate, a lot of them, like last season I think they were migrating – millions of them, they migrate from Kenya to Tanzania crossing the river where they are jumping and the crocodiles are eating them – the whole ecology balance and so on.

This is the main river that serves that national park – it goes from Kenya to Tanzania and we found that it is a lot of pollution and the uptake of that water and there were many traces of what we call “environmental flows.” What is the minimum flow that should be left in the river so that you don’t change the ecology of the river and in most cases people tend to check the ecological flow by seeing the animal that needs most water, like along this river the animal that needs a lot of water, not for drinking but for protection, is the hippopotamus. You know hippopotamus – you know it. You can’t translate. Big animal – it’s very big.
Male Speaker
Hippopotamus, they are round and very dangerous.

Patrick Home
The hippopotamus needs some level of water in the river for it to go otherwise it gets skin burn – burnt by the sun, so it needs to go under the water. So, the water left in the river must be able to cover it. So, you have to leave a height of water such that the hippo goes in and the danger was that the water was going so low when they go in their back is still left in the sun.

So, we did a lot of calculations here to find what should be the amount left and then the government would restrict – no more extraction from that river otherwise that ecosystem, that animal can disappear – can become extinct itself. So, we did this one again with one of my Master’s students who is now doing Ph.D. also – he works for the government and is still in the government but doing Ph.D. now in our university.

This is one of our students who was doing public health – a bit of public health and he was trying to give an assessment on water borne diseases in his district and why people are not using very simple technology, like you saw this solar distribution. People just put water in bottles and put them on top of houses and the temperature rises and you are able to destroy the germs, so this is what we found.

This was one of our main studies that we did in Nairobi with two or three of Master’s students. We had tried to find the heavy metal content in crops irrigated with untreated sewage. Incidentally because of – I don’t know what I can call it – big parts of Nairobi are irrigated with raw sewage – that is the sewage before it is treated. What people actually do – they block sewage lines, big tunnel, they block it and the water comes out instead of going to their treatment plants and that water they use it for irrigation and because they have been doing that for so many years people have even started thinking that is the river because the water is always there because the sewage is always running.
For the last 20-25 years, they have been irrigating with sewage. The most dangerous thing is that sewage is very rich nutrients – nitrogen especially. So the best vegetables looking from outside, you don’t know what is inside, the best vegetables are the ones which are irrigated with sewage. So, we found that people in Nairobi are consuming vegetables with very high contents of heavy metals because they look beautiful, the leaf is very green and very attractive but when you do the analysis of heavy metals, we found that they were so high, you see beyond the world standards and there was a lot of resistance to release this information and because what is the impact and what will happen.

If people realize they are eating contaminated vegetables and we give this information to the government and one time the government decided to destroy 200 acres of cabbages but before they could destroy it because of political thinking they did not destroy it because you destroy it and that government will be out in the next election because you affected so many lives of people who are depending, so they didn’t, so people are still even now they are still consuming those vegetables but the information is with them.

We give them the information that people are eating heavy metals, serious high levels of heavy metals and the heavy metals have got this factor of bioaccumulation, that is fortified in the roots, fortified in the stalks and in the leaves and fortified in the grain is very different, fortified in the grain is maybe 10 or 20 times more than you find in the roots – it is bioaccumulation of heavy metals. This is the problem we are faced with but again because of the poverty and those people who are using less water it is a difficult to solve.

If you are thinking of if you could just develop a small technology, just to treat that water from the sewer, they have punctured before it goes to the crops maybe it can help them. In Nigeria they are trying a bit of treatment – not treatment but actually that water, when it comes from the sewer line, instead of going for irrigation they dig a pond first of all, so the water settles and most of the heavy metals are in sediment, so the sediment settles and then the water continues, so there is some treatment when you have a pool first before the water goes there to the field. We have not tried that one in
our country yet. So, this was a serious finding that we found last time. I think there is...

Now, this is another – this is water quality again in one of their suburbs, a town near Nairobi here, just next to Nairobi – it’s about 20 kilometers from Nairobi settlement. In Kenya, we have a lot of unplanned settlements surrounding the main city. So, this river here, if you read all these values, they are so high that you can see what we are talking about here. The BOD is – the biochemical oxygen demand is 200 and 400. The maximum allowed is 30. So, you can see how many times it has gone up. This is serious pollution of water but the biggest problem is that those towns – those very urban towns do not have a sewer system.

They are not served by sewers, so all the sewage water goes to the river and the river becomes very polluted downstream and then the same river, people are using for their water use. Sometimes people ask why do this kind of research when you don’t solve the problem because here we just told them there’s a problem but no action. So, there is a big move in our research that when you discover a problem we provide a solution but it’s not easy all the time to do that because you don’t have the capacity to do the solution but it’s good even to bring the information out is important so the government knows that people are using very poor water so they come and they can set aside some money to clean up those rivers.

That’s when I – I think with Manago-san yesterday – there’s a river that runs near our hotel. He says it is polluted. I told him it is not polluted. Actually we were talking with Professor Kaneko there and so the water might look dark but it is not very polluted if you measure the characteristics – it’s deep that’s why it looks dark. But really if you take up below it, it’s quite clear. It may not be...

These are serious pollution. This is like a sewer. This river is like a sewer system actually. These kinds of levels are only found in sewage – direct sewage before you treat it. This is a big, big problem that we have. So water problem, water pollution problem, sanitation is a serious problem in our country even now and maybe in the near future.
Now, here I put some other research which I am doing now. Number 1 is a collaborative research. This research has attracted a lot of attention because it is a rare theme that you do. In our low countries, anal cleansing is not talked about much. It is very private. Nobody wants to do research on that kind of an area. You know anal cleansing? You understanding anal cleansing

Male Speaker
A little bit.

Patrick Home
When you go to the toilet.

Male Speaker
She’s a specialist.

Female Speaker
I tried using leaves when I was in Uganda.

Patrick Home
I see. We wrote this proposal because most of our communities still use leaves but traditionally they are leaves which were used for that purpose but they have disappeared. In many places, they have gotten finished. So, currently people are using any kind of leaves and our hypothesis was that there is a reason why communities chose different kind of leaves. In fact, I don’t know whether the one you are using is a soft one – it is a very soft one – very soft almost like velvet – very soft and very good smelling – very good smell but in many areas it has disappeared and now people are using anything they find around, some of them very toxic and some of them very hard.

So, we decided to do research on this area, first they want to discover why were they chosen and that you are being helped by my colleagues in biochemistry. They are getting the plants and they extract the chemicals from it and see were they selected by our traditional people, by our forefathers because they had some medicinal value, were they maybe healing
that area if you have a wound or some infection when you wipe yourself with it, it heals or because the same leaves were used for cleaning babies, so they are very soft. There must be a reason why they are used.

So, one of my colleagues they are doing the biochemistry part checking for aromatic values, medicinal values and antibacterial value for the same plant.

We have another student also from public health who is now seeing the prevalence – he is assessing the prevalence of anal cleansing and this is a very difficult research to do because you have to get authorization from the government, from Ministry of Health and so on because you are dealing with people and you want to see where there is a problem of accessing or getting enough material for anal cleansing because this could be an area we are ignoring and we think people are just cleaning themselves but they are not and they are not doing it because they have nothing to clean themselves with. Maybe it is difficult to imagine but here we don’t talk toilet paper in urban areas in Kenya.

Because one thing it is expensive – it is difficult – you have to decide whether you buy toilet paper or do you buy bread. So, mostly you go for bread. You can’t remain without cleaning yourself and so on. The other thing is we want to see if we discovered something useful in those plant-based materials. Are we able to impregnate the same chemicals or the same medicine into toilet paper itself? We don’t know how this one we haven’t done yet. We don’t know how we shall extract and then put it in toilet paper, so that by the time you wipe yourself you are also taking advantage of the medicinal value and the aromatic value of the plant themselves.

So basically what we want to produce is sweet smelling toilet paper so that you don’t need to spray yourself or something, you come out smelling good even after going to the toilet. This is going on now. I am leading this one. My main area is to this part here – the manufacture of toilet paper when my other colleagues are now doing biochemistry and propagation and so on but it is a difficult project to do because interviewing people on their unknown hygiene is not easy. It is not easy at all. People are very closed – nobody
wants to talk about – we ask them do you do it all the time. We know they don’t but we can’t see.

So, we are not able to get statistics of people who do it all the time, who don’t do it all the time, who do it sometimes and what intervention can we make and Professor Sugita may know that we are trying to approach this research in the same way we approach sanitary towels for girls. Many girls in our country could not get sanitary towels during their periods until some investigation was done, research was done and we discovered so many and then we have so many bodies and many organizations that have come to support school girls by providing them sanitary towels.

If you discover there’s a problem here we also assume people can come forward and provide anal cleansing toilet paper to schools, to primary schools, secondary schools for children who cannot afford to buy toilet paper instead of going and they don’t have. What we have is in our Minova schools you will find a lot of – Professor Sugita, you may have seen it – a lot of writing on the wall – not real writing but people who have gone to the toilet and then they have nothing to wipe themselves with and they wipe with their hands and then they wipe it on the wall, so you can find a lot of marks and so on.

It’s very bad, very unsanitary, terribly unsanitary and some research has shown that the boys are seriously affected by this problem more than the girls, I don’t know why, but the boys feel more uncomfortable than the girls when they go to a toilet and they come out without cleaning themselves. They feel bad because they feel like everybody can know that I have not wiped myself. I am smelling and I am doing things like that. So, in addition to doing our work we also want to create awareness of the scarcity of lack of material in schools – in rural areas for anal cleansing and we hope it will get somewhere. We don’t know – yet, we have just started the project.

The next one is food engineering and so we are developing a rice harvester with my colleagues in biomechanical engineering. It has gone now to testing stage to see whether it will help our farmers in the rice industry to harvest rice and again I’m still working on wetlands. This is one of my Ph.D. students who is trying to model wetlands for cleaning waste water itself.
Way forward in research, I think this calls for adaptive since now the emphasis is adaptive. Adaptive research means that you do research which can be implemented. It’s different from basic research where you do research to discover and add to science only. In our country, mostly people want someone to do research – adaptive research. That means research which gives a solution. For example if you are dealing with water, give a solution to the water problem, give a solution to the climate change problem, poor problem, to environment problem, so you don’t adapt just by collecting information without providing a final solution. So, there is a big emphasis on this.

In fact, the idea is that let’s leave basic research to the rich countries. For us let’s do adaptive research – research you do and you take it to food directory when people use it and so on. Of course, you still need to do basic research also to generating new information. Africa can gain much through collaborative research with partners from developed countries. This avoids re-invention of the wheel – reinvention of the wheel means starting something that is already known. It is not a new discovery – it’s only that you didn’t do enough maybe literature review to know it is there.

So what I mean collaborative research, there could be technologies which have been developed already elsewhere in Japan – which can be adapted without going back to the basics from zero. You just modify it at that level to be adaptable to the African condition and, of course, again ICT has provided an efficient means of accessing research database and that is why we are not starting from zero.

African researchers can get a lot of information from published work and so on but again this one I emphasized also in my presentation last time that African government also needs to support research. We can’t depend so much on external research. So, enabling policies – the Kenyan government had committed I think 1.5% of its budget for research. As yet it has not even gone to 0.5 yet. So, we need to commit for research. Countries that develop technologies commit a lot of money for research and with that I think that’s the end of my presentation. I appreciate your attention. Thank you.
III. Appendices
a. PowerPoint
Vision
A University of global excellence in Training, Research and Innovation for development.

Mission
To offer accessible quality training, research and innovation in order to produce leaders in the fields of Agriculture, Engineering, Technology, Enterprise Development, Built Environment, Health Sciences, Social Sciences and other Applied Sciences to suit the needs of a dynamic world.

Motto
Setting trends in Higher Education, Research and Innovation.

University Mandate
• Provide directly or indirectly or in collaboration with other institutions of higher learning, facilities for University education (including agriculture, scientific, cultural, technological, and professional education), and integration of teaching, research and effective application of knowledge and skills to the life, work and welfare of citizens of Kenya.

• Participate in the discovery, transmission and preservation and enhancement of knowledge and to stimulate the intellectual participation of students in the economic, scientific, technological, agricultural, professional and cultural development of Kenya.

Research Management in the University
Research, Printing and Publications Committee (RPPC)
• Chaired by Deputy Vice Chancellor – Research, Production and Extension (DVC – RPE).
• Advises the Senate, and ultimately the University Council, on research strategies to be pursued.
• Approves research proposals for funding, develops policy and reviews progress in these areas.

Deputy Vice Chancellor – Research, Production and Extension (RPE)
• Establishes and administers the policies governing the conduct of research.
• Oversees the management of research programs.
• Assists researchers seeking external funding,
• Promotes interdisciplinary research and,
• Oversees the University’s research fund.

The Research Directorate
• Provides research support services for staff.
Board of Post Graduate Studies, Schools and Faculties
• Responsible for ensuring that the management of postgraduate research for graduate degrees complies with the relevant University Statutes, policies and procedures.

University Library
• Is the repository for outcomes of research undertaken in the University.
• All publications from research undertaken by staff must be deposited with the University Librarian.
Thematic Areas of Research

Overall Research Theme
Science, Technology, Innovation and Entrepreneurship for Economic Development

(Research activities are reviewed every three years to ensure coherence with national, regional and international research needs and emerging research needs of the University and country)

The research sub-themes
1. Basic and Applied Sciences for Advancement of Research and Innovation
2. Water, Sanitation, Environment and Climatic Change
3. Advances in Human and Animal Health Sciences
4. Information Communication Technology for Development
5. Built Environment and Infrastructure for Industrialization and Sustainable Development
6. Engineering Technologies and Energy for Sustainable Development
7. Policy, Law, Governance, socio-Cultural Development
8. Agricultural Sciences and Bio-Systems Engineering for Food Production, Security and Agribusiness Development
9. Sustainable Urban Development
10. Product Development, Commercialization and Entrepreneurship

Sources of Research Funds
1. University Research Fund
   - Funds are allocated competitively from the university finances for staff and students.
2. National Council for Science, Technology and Innovation (NACOSTI)
   - NACOSTI administers the Kenya Government Science, Technology and Innovation (ST&I) competitive Grant.
   - The grant supports scientific research and innovations for national development.
3. External grants and collaborations
   - Research funding from external sources such as foreign universities, international research organizations, international donors, industries, etc.
   - Staff are encouraged to compete for external research funding as they arise.

Research Institutes of the University
These are institutes dedicated to research and postgraduate studies:
1. Institute for Biotechnology Research (IBR)
2. Institute for Energy and Environmental Technology (IEET)
3. Sustainable Materials Research & Technology Centre (SMARTEC)
4. Water Research and Resources Center (WARREC)
   - These institutes carry out research with their own staff and PG students and offer facilities to PG students from other schools and faculties of the university

Notable outputs from JKUAT Researchers
Electrical Discharge Machine
Micro-hydro Power Generating Plant
"Pick and Place" Robot
Biogas digester using hyacinth
Solar panels and solar lamps for rural areas
Thermal gasifier
The shujaa (hero) tractor being developed by Jomo Kenyatta University of Agriculture and Technology from an Indian model. The tractor can be utilized in cultivation, transportation and post harvest technology.

**Tissue culture**

- Aloe vera
- Banana seedlings
- Oyster mushrooms

**JLUAT OUTPUTS**

- Yoghurts, jams, juices

Value addition for enhanced food security

**Kenyan Universities performance in Engineering 2010-2015**

Egerton has highest international collaboration; highest Field-weighted Citation Impact and most citations per publications.

**Regional Agriculture Research Output 2013 - 2016**

JKUAT 407 publications, FW Citation impact of 1.07 (above global average), 250 Collaborations.

**Research Output JKUAT**

Source: Kenya Education Network (KENET)
Some research topics by the presenter


**Abstract**

As the most important cultural practices for production, single effects of nutrients (N) and phosphorus (P) fertilizers on rice are widely documented but their dynamic rates are poorly understood. It was necessary therefore to assess the dynamics of nutrients and phosphorus in rice cultivation environment as influenced by different application rates. The objective of this study was therefore to assess the dynamics of nutrients and phosphorus in rice cultivation environment as influenced by different application rates. The study was carried out at a comprehensive field station in Kenya using rice (Oryza sativa L.) cv. NERICA-3. The study was replicated thrice. Treatments were N (0, 100, 200, and 300 kg ha⁻¹) as sole and P (0 and 50 kg ha⁻¹) as sole. The experiment was laid out in a randomized complete block design (RCBD) in three replicates. Data were analyzed using appropriate statistical techniques. Results showed that plant height, leaf area, and plant yield were significantly affected by the levels of N and P fertilizers. Increasing the rate of N and P fertilizers significantly increased plant height, leaf area, and plant yield. The results are in agreement with previous studies, which observed that increased rates of N and P increased growth and yield of rice. Thus, the results from this study also showed that fertilizer application rates improve plant growth and yield of rice. However, the rate of N and P fertilizers should not be excessive as it may lead to environmental degradation. The study therefore recommends that farmers should apply appropriate rates of N and P fertilizers to improve rice production.

**Keywords:** Nitrogen, Phosphorus, Rice, Plant height, Leaf area, Plant yield.

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**Abstract**

The adsorption of chromium (VI) ions from aqueous solution by charcoal from acacia (Acacia tortilis)/tree was studied in a batch adsorption system. Various parameters such as the effect of initial chromium concentration, pH, and contact time on Cr (VI) removal were investigated. The removal of Cr (VI) ions was observed to increase with contact time, and reduced with increasing initial chromium concentration. The optimum pH for chromium (VI) removal was attained between pH 2.5-2.7. Various kinetic models results showed that the pseudo-second-order kinetic model (R²=0.999) best describes the kinetic sorption Cr (VI) ions onto the charcoal matrix. Moreover, Langmuir and Frumkin models agreed very well with the experimental data with a regression coefficient of 0.999 and 0.988, respectively. Description studies using isotherms and (R²=0.999) indicated high capacity of chromium removal with description of higher than 99% being observed. Use of acacia tree charcoal for adsorption of Cr (VI) ions in this study exhibited high potentials for chromium ions removal from aqueous solution. These results suggest that acacia tree charcoal can be employed as an efficient adsorbent for Cr (VI) removal in contaminated waters and can be utilized for recovery of chromium. Results from this study can be utilized in assessing the effectiveness of acacia tree charcoal for Chromium heavy metal at the field scale.

**Keywords:** Adsorption Isotherm, Chromium (VI), Natural charcoal.

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**Abstract**

Water saving irrigation technologies are key for crop production in arid and semi-arid lands (ASALs) considering the scarcity of water in these regions. A study was set up to test one such technology, the alternate furrow irrigation (AFI) on tomato at farm level. The experiment was conducted in a furrow irrigation scheme in Kiambaa, which is an ASAL in Kenya. The objective of the study was to determine the effect of AFI on growth, yield and water use of tomato variety “Raura”. Furrow irrigation water was applied through furrows in two ways: Alternate Furrow Irrigation (AFI) where two neighboring furrows were alternately irrigated during consecutive watering, existing Partial Root Drying (PRD) and Conventional Furrow Irrigation (CFI), which was the farmer practice of filling each furrow with irrigation water at each watering. The cumulative irrigation water supplied to the AFI treatment was 60-82% of that supplied to the CFI treatment. This amounted to water savings of 38-40%. Plants in the AFI trial that received water and those in the CFI trial, had higher leaf area, which was significant on limited sampling dates. Most parameters of growth both vegetative and reproductive were higher in CFI compared to AFI, but the difference was not significant.

Any words: Conventional Furrow Irrigation, Dry matter, Partial Root Drying, Plant growth, Plant height, Relative Water Content.

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Industrial wastewater has high quantities of heavy metals emanating from industrial processes. The long-term effect of these metals in the environment is hazardous to animals and humans. Constructed wetlands are inexpensive and highly effective in removal of heavy metals from wastewater. This study assessed the efficiency of different mixes of macrophytes in removing heavy metals from wastewater using constructed wetland. The results showed that treatment with mix of Alternanthera philoxeroides, Phragmites australis, Polygonum persicaria, and Rumex crispus achieved the highest removal for Lead (89.8%) while maximum removal for Cadmium was achieved with the macrophyte mix 1. The treatment with Phragmites australis, Polygonum persicaria and Rumex crispus in the ratios 2:2:2 recorded relative high removal rates for all metals and was recommended in the future. The analysis of the metals in the macrophyte mix 1 was characterized with more than 50% Cr, Pb, Cu, and Cd in the effluent sewage were below the maximum allowable concentrations for discharge into the environment. The constructed wetlands were therefore effective in removing the heavy metal concentrations from the raw sewage to tolerable levels.

**Keywords:** Constructed wetland, heavy metals, macrophytes, Atomic Absorption Spectrophotometer (AAS).
The heavy metal content of crops irrigated with untreated wastewater: A case study of Nairobi area, Kenya


Abstract

Use of untreated wastewater for irrigation could have devastating effects on crop quality. A study was conducted to determine the content of lead, cadmium and chromium in food crops irrigated with untreated wastewater in Nairobi. Crop samples were collected from farms irrigated with untreated wastewater during the dry and wet seasons. While the sampling, 40 samples (20 in the dry season and 20 in the wet season) of crops were randomly selected from the areas irrigated with untreated wastewater. The results showed that mean levels of lead, cadmium and chromium in crops grown in the wet season were 48.4 and 26.5 ppm, respectively.

There is need to support research in Africa by African researchers. Crop samples were collected from farms irrigated with untreated wastewater during the dry and wet seasons. While the sampling, 40 samples (20 in the dry season and 20 in the wet season) of crops were randomly selected from the areas irrigated with untreated wastewater. The results showed that mean levels of lead, cadmium and chromium in crops grown in the wet season were 48.4 and 26.5 ppm, respectively.

Surgeon water quality in Kenya's urban environment: Giluwa Case Study


Abstract

Safe, clean drinking water and sanitation facilities are key to economic development and public health in Kenya. Rapid urbanisation and population growth mean worsening conditions for millions of Kenyans, especially the poorest. Sanitation is one of the greatest problems especially in the informal settlements where 20% of the people in the urban centres reside. In fact, 10% of all preventable illnesses in Kenya are related to water, sanitation and hygiene. This study was conducted to establish the level of indicator water quality parameters and establish water quality parameters for water derived both from the household tap and the Giluwa borehole. A total of 200 samples were collected from a local hospital and a local house in the Giluwa area. The samples were analyzed for BOD, COD, TDS, TSS, and turbidity. In laboratory analysis of the Giluwa samples, we found that the BOD, COD, TDS, and turbidity were all above the recommended standards. The quality of water from these sources does not meet WHO standards. This would explain the high percentage of people (54%) suffering from water-borne diseases in the community. This is also a reason for the need for water treatment and distribution to the community.

On going Research


2. Development of a rice harvester: JKUAT Innovation Fund, Research and Production Division (RPE)


Way Forward in Research

• The call for adaptive research in Africa is gaining credence in contrast to basic research. However both are needed.

• Africa can gain much through collaborative research with partners from developed countries. This avoids re-invention of the wheel mistake. Proven technologies can also be adapted for African conditions.

• ICT has provided an efficient means of accessing rich research database which can guide and support research in Africa.

• There is need to support research in Africa by African governments themselves through enabling policies and funding.
b. Reference Paper
Introduction

Jomo Kenyatta University of Agriculture and Technology (JKUAT) is a well-established public university in Kenya reputed for producing professionals who are leaders in the fields of Agriculture, Engineering, Technology, Enterprise Development, Built Environment, Health Sciences, Social Sciences and other Applied Sciences to suit the needs of a dynamic world. The university was started in 1981 as a Middle Level College (Jomo Kenyatta College of Agriculture and Technology (JKCAT)) by the Government of Kenya with the generous assistance from the Japanese Government. In September 1988 JKCAT was elevated to a constituent College of Kenyatta University. Under the name Jomo Kenyatta University College of Agriculture and Technology (JKUCAT). It was finally established and inaugurated as Jomo Kenyatta University of Agriculture and Technology in December 1994. The university has four administrative divisions namely: (1) Administration, (2) Academics, (3) Research, Production and Extension and (4) Finance. The mandate of research is under the Division of Research, Production and Extension (RPE).

Recent research focus of JKUAT

As a public university, Jomo Kenyatta University of Agriculture and Technology is required to “participate in the discovery, transmission and preservation and enhancement of knowledge and to stimulate the intellectual participation of students in the economic, technological, agricultural, professional and cultural development of Kenya.” The university encourages and supports research by providing directly or indirectly or in collaboration with other institutions of higher learning, facilities for University education (including agriculture, scientific, cultural, technological, and professional education), and integration of teaching, research and effective application of knowledge and skills to the life, work and welfare of citizens of Kenya and
participation in the discovery, transmission and preservation and enhancement of knowledge and in stimulating the intellectual participation of students in the economic, scientific, technological, agricultural, professional and cultural development of Kenya.

**Thematic areas of research**

Research activities pursued at JKUAT are drawn from its mission, values, mandate and philosophy, and are aligned with the University Strategic Plan. The activities are reviewed every three years to ensure coherence with national, regional and international research needs and emerging research needs of the University and Country. The overall University’s research theme is: **Science, Technology, Innovation and Entrepreneurship for Economic Development.**

The research sub-themes are:

1. Basic and Applied Sciences for Advancement of Research and Innovation
3. Advances in Human and Animal Health Sciences
4. Information Communication Technology for Development
5. Built Environment and Infrastructure for Industrialization and Sustainable Development
6. Engineering Technologies and Energy for Sustainable Development
7. Policy, Law, Governance, socio-Cultural Development
8. Agricultural Sciences and Bio-Systems Engineering for Food Production, Security and Agribusiness Development
9. Sustainable Urban Development
10. Product Development, Commercialization and Entrepreneurship

**Sources of Research Funds**

Resources in support of research come from various sources the main ones being:

**(a) University Research Fund**

The general principle governing the allocation of all research funding in the University is that it is an investment intended to maximise the range of outcomes that the University gets from staff and student research. Funds are allocated from the university finances.

**(b) National Council for Science, Technology and Innovation**
The National Council for Science, Technology and Innovation (NACOSTI) administers the Kenya Government Science, Technology and Innovation (ST&I) Grant. The grant supports scientific research and Innovations for national development.

(c) External grants and collaborations
Research funding from external sources provides a major source of research income to the University. All staff are encouraged to compete for external research funding as they arise.

Summary of University funded Research Projects in various thematic areas
Below is a summary of university funded research projects in all thematic areas. This list excludes research funded from external sources.

<table>
<thead>
<tr>
<th>Project Title</th>
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<tbody>
<tr>
<td>Modeling the influence of land use changes on soil erosion and dam siltation in Thika River catchment</td>
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<tr>
<td>The use of Satellite Remote Sensing (SRS) and Geographic Information Systems (GIS) to map the trend of spread of invasive tree species, Prosopis ssp.</td>
</tr>
<tr>
<td>Study and improvement of alcoholic beverage (Mnazi).</td>
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Effect of nitrogen fertilizer on thrips population dynamics and their management using Entomopathogenic Nematodes and Anthociric predators on French beans in Kenya.

Evaluation, documentation of indigenous plants used in processing and preservation of the livestock products amongst the pastoral communities in Kenya

Aquaculture Dynamics in selected Reservoirs of Kenyan Highlands and its effects from Feeder Streams.

Isolation of antibiotic and enzyme producing bacteria from termite guts

Calibration of lime requirement tests for acid soils of Kenya through maize yield and development of a quick liming test kit-intermediate and appropriate technological innovations for enhanced food security.

Commercial and industrial development of papaya (Carica papaya L.): varietal improvement, production and processing technologies for wealth creation in rural areas

Diversity and pesticide-Biodegradation potential of microorganisms in horticultural farms in Rift Valley and Central Kenya

Enhancing travelers’ safety and comfort: planning of rest stops on Kenyan highways

Antischistosomal activity of medicinal plants from Kakamega in laboratory mice infected with Schistosoma mansoni.

Characterization of three plasmodium falciparum proteins, P. falciparum glycogen synthetase – 3 (PfGSK – 3), P. falciparum casein kinase 1 (PfCK- 1) and P. falciparum 14-3-3 (Pf 14-3-3) and the response of Pf GSK -3, PfCK1, PfMRK and PfPK6 to various flavanoids

Towards improvement of entrepreneurship education at Kenyan universities

Improving basmati rice quality and production through Physico-chemical and molecular characterization

Assessment of Water use Efficiency of Slender leaf (Crotalaria ochroleuca) for food, nutrition and health security in Kenya

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Soil fertility assessment in tea growing area of Ngere tea factory, Thika District

Development of nano structured smart delivery systems for fertilizer and pesticides

Development of micro satellite DNA markers for application of wildlife forensics in Kenya

Factors influencing borrowing from the informal financial sector

Transformation of maize with efficient phosphorus genes for increased grain yield and striga hermonthiga suppression.

Characterization of indigenous poultry and wild relative from different agro ecological zones in Kenya towards genetic improvement.

Yellow Oleander project
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### Exploring natural ways to exceptional long healthspan – the naked mole-rat case

### Establishment of absolute gravity stations at referenced to IGSN 71 datum levels at county levels in Kenya

### Analysis and Assessment of potential pesticides residues in Tomatoes and tomato products in Kenya

### Development and implementation of the Rhinoceros DNA Index Register (rhodir) database as a tool to protect and manage the Kenyan Rhinoceros

### Climate change impacts on distribution and abundance of wildlife species in the Mara Ecosystem: An analytical approach using GIS

### Climate change and food security: Capturing impacts of climate change mitigation measures in forecasting and crop disease control

### Chemical synthesis and antimalarial evaluation of hybrid drugs using artemisins, quinolines, anilines and cyclopentanediol pharmacohores as scaffolds.

### Developing sustainable solutions to the challenge of value addition in the seafood supply chain along the Kenyan coast.

### PANCAKE (Portal for Free and Appropriate Computer Science Research Resources for Kenyans).

### Marketing of eggs in Kenya: an investigation into price interrelationships between the city of Nairobi and other major urban centres

### Evaluating nutritional value of moringa oleifera in the management of asymptomatic HIV/AIDS patients.

### Genetic profiling of rapists

### Reservoir survey using multi frequency acoustic profiling system for sustainable watershed management and development

### Investigating maize farmers information gaps across the crop cycle in order to develop an appropriate ICT solution

### Noise pollution in Nairobi: sources, effects and control.

### Towards a policy on clustering as a county industrialization strategy to accelerate the sustainable achievement of Vision 2030: A case study of Bungoma Country.

### Appropriate materials to stabilize expansive clay for low cost urban roads construction: Enterprise Road, Nairobi case study.

### Rehabilitation of post-quarried sites as a function of management regime, landscape biogeophysical variables and visual preference of emerging habitats.

### Prospecting for bio-active potential of endophytes associated with medicinal forest trees in Kenya, and their efficacy against pathogenic fungal pathogens

### Improvement of dairy goats’ health through control gastro-intestinal nematodes by utilization FAMACHA® system & urea molasses blocks supplemented with pineapple by-products.

### Experimental validation of *Glossina morsitans morsitans* Odorant Receptors

### Analysis of genetic diversity within & among indigenous & imported rabbit breeds in Kenya

### Development of recycle friendly aluminium alloys for automotive & structural applications
To evaluate small nerve fibres as biomarkers for the semi-invasive diagnosis of endomeriosis.

| The effect of infra-red blocking films on the growth, yield & quality of paprika (*Capsicum annum* L) |
| Studies on the availability, propagation, biochemistry of plant based anal cleansing materials for manufacture of affordable toilet paper for rural & poor urban Kenya |
| Groundwater mapping, quality assessment & hydrogeophysical modelling in Makueni County, Eastern Kenya. |
| Controlling Rift Valley Fever Virus Using RNA Silencing |
| Health Information Technology in Kenya. A simulated model for computer aided home based health system |
| Medicinal plants project |
| High Value Crop Project |
| Utilization of natural products from tropical plants biodiversity in the control of HIV-1 infection |
| Simulating and modeling of the growth of M-commerce in Kenya due to mobile phone usage. A systems dynamics approach |
| Towards achieving vision 2030: production of 3D digital topographical / thematic maps of Kenya |
| Protected cultivation: using light filtration to control pests and diseases for sustainable greenhouse vegetable production in Kenya |
| The conditional pricing of currency and inflation risks in Africa equity Markets |

In addition the university is well known for leading innovations in such areas as biotechnology, tissue culture, energy, environment, agriculture, engineering and human resources management. Some of the highly publicized research can be found in the university web site: www.jkuat.ac.ke.
Toward International Collaborative Research between Jomo Kenyatta University of Agriculture and Technology and TOYO University

Center for Sustainable Development Studies
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