Steven:
This is Terms of Reference Podcast 170.

Muthoni:
We combine what has come from the farmers, with what has come from the sensors and then we come up with a prediction. And this prediction is different from what we are used to. It does not tell the farmers things like "the rainfall will be near normal" because they don´t know what that is. It tells them that the fact that the ants are been seen walking in a straight line and the fact that the temperatures have reached very high, we don't tell there are 30 degrees that doesn't resonate with them, then the effect is the rain in two days. Those of us plant who have not planted you need to plant. And we can also tell now the amount of rainfall will not be enough to sustain your usual crops this year. So you may have to plant things like sweet potato or just traditional vegetables. So it's comprehensive information we are giving the farmer.

Steven:
This is Terms of Reference, I'm your host Steven Ladeck. When you think about innovation you think about the future, right? At least that's what I think about. My mind is usually filled with things like flying cars, holographic displays in a moneyless world, but I know that's the super-geek talking. Innovation is really all about solving an old problem in a different way, but the reason I bring up the future is that typically when I speak to those interested in innovation they are focus on how we use new, and even sometimes yet to be invented technologies, processes, and options, to solve the issues at hand. Today's guest for the 170th episode of Terms of Reference Podcast, Muthoni Masinde, is also a future thinker, but she also remembers and knows how to honor the past. Her invention that we'll discuss on this episode, an innovation to detect drought, combines the latest of sensor and mobile technologies with the indigenous knowledge from local farmers. I'm sure you are going to love this episode where we'll talk about her invention, it's called Itiki, but also about her path from Kenya, where she was born, to become an inventor and Head at the Department of Innovation Technology at the Central University of Technology in South Africa. I spoke with Muthoni in South Africa.
But before we get started, a quick word from our sponsor.

Steven:
Hello, Muthoni, thank you so much for being on the the Terms of Reference Podcast today.

Muthoni:
Hello Steven, I'm happy to be with you on the show today. Thank you.

Steven:
Muthoni, we have a fantastic connection you sound like you are literally sitting right next door even though we are on different parts of the planet right now. And I know, I have to tell all our listeners this, that you have just made an extraordinary effort to get up at the crack of dawn so that you we have this great internet connection. Thank you so much for doing that. I really appreciate it.

Muthoni you are a professor in Central University of Technology in South Africa, why don't you tell us a little bit about the types of things that you look at in your research at the University there and then we'll get into why exactly we are talking today.

Muthoni:

Thank you Steven, I currently Head a unit we call the Unit for Research on Informatics for Drought in Africa. So basically what we doing in that unit is to develop solutions to solve Africa's persistent drought and we do this using technologies such as wireless sensor networks, mobile phones, and we mix this with indigenous knowledge of African people.

Steven:

I think that, and you can correct me, I believe that you've named your technology Itiki - or the combination of technologies that you use. Why don't you first tell me if I've got that right and second can you sort of breakdown that whole process. Like how do you combine indigenous knowledge with sensor information? I don't even know how to wrap my brain around that.

Muthoni:

Ok. Ititki, yes you got it right, is an acronym it stands for "Information Technology and Indigenous Knowledge with Intelligence", "I-T-I-K-I". But it does have a second name, it is actually a traditional bridge. It is used among some group of local people in Kenya to cross from one side of the river to the other. So the old notion is to ensure that we can be able to bridge what we call the modern science of weather prediction and drought prediction with indigenous knowledge. So that's how I came up with this concept of a bridge, crossing over from one way to the other. And one reason we call it a bridge is because a bridge is two way. It's not using indigenous knowledge to complement a modern science neither using a modern science to complement indigenous knowledge. It's a bridge and it's two way. So we enhance, we combine the two and came up with something more unique that works for African farmers.

Steven:

Mmhm. That's gorgeous, I love that, and I love it when something indigenous, such as Itiki, can be used in a modern context like that, as well as an acronym. Dial it back for me in that why drought? I know you are not from South Africa, you are from Kenya originally. Why was it that you woke up one day and said this is my problem? How did you choose drought as your problem?

Muthoni:

Well I resonate with the problem because I grew up in the village myself and most of my earlier life was helping my mother in the farm. So, I noticed that she didn't have any source of information that could help her decide when to plant. And I noticed that the only thing she and our neighbor, everybody in my village, everyone across the borders did was to observe some indicators. What you call "indigenous knowledge." This would mean things like looking at the pattern of the flowering of some trees, looking at how the animals are behaving if they are coming home, looking at the insects. A good example is the dragonfly. It's such a predictor

because depending of the height at which it's flying, if it's three feets from the ground it will rain in three weeks, if it's one foot it will rain in one week, and sometimes is so accurate that my mother knew it will rain tonight and then she would start making arrangements. So that motivated me. Later in life when I pursued careers in computer science, I remembered. Now, it's possible to have several knowledge of seeing my mother use all these years and combine it with my science. And that's how this whole concept was born.

Steven:

So now take us to that science itself. I'm actually looking at you personal website "muthonimasinde.net", and you know it looks like something that will be like raspberry pie, kinda of a circuit board with you know with obviously two or three sensors maybe four sensors attached to it one of them look like a drum, another one looks like a microphone. So walk us through what exactly this all contraption does.

Muthoni:

Ok. (laughter)

Steven:

I'm glad you enjoyed my description of it.

Muthoni:

I like the drum part. So what I do, I collect the normal data on weather using the sensors. So we are looking at things like atmospheric pressure and temperature but the most important one is the rainfall. And then on the other hand, we work very closely with the farmers. We hand them a mobile phone that has a mobile app where we have already collected and worked with them to build a database of possible indicators. So when they do witness them, whatever they are, they just select on their phone and say "today is 6th of September, I have witnessed the dragonflies." And the other farmer on the other side will notice something different "a smaller mango tree is flowering" - this means this. So this information, once they save it, comes directly to a database, and looking together with what our sensors are saying, then I might opt to predict. So this prediction I'm talking about is I'm using artificial intelligence which is artificial networks and we combine the what is coming from the farmers with what is coming from the sensors and then we come up with a prediction. And this prediction is different from what we are used to, it does not tell farmers things like "the rainfall will be near-normal" because they don't know what that is. It tells them that the fact that the ants have been seen walking in a straight line and the fact that the temperatures have reached very high, we don't tell them 30 degrees, that doesn't resonate with them. Then the effect is that it will rain in two days. Those of us who have not planted, you need to plant, and we can also tell the amount of rainfall will not be enough to sustain your usual crops this year. So you may have to plant things like sweet potatoes or just traditional vegetables. So it's comprehensive information we are giving the farmers. We even go ahead and translate it to their languages. And on that website, we are able to generate sound files which can be played to the farmers who can't read or write. So that's how it works.

Steven:

Holy smokes. A whole bunch of questions of out of that. When you are receiving this, and this is a complement, it seems like a "Farmer's Almanac." You know, the farmer who goes out and sort of records every day - oh, the sun came up and and the rain happened and here's the answer. So you have all these farmers, sending you this information, which is great, do you have staff that is listening to all of this information coming in and then doing it manually or do you have an automated process for that?

Muthoni:

Oh not every farmer does that. We have what you call "champions" who do it, only specific people. And remember these phones are smartphones and they are expensive so we don't so we don't give to every farmer. So the champions, we trust them and we've asked them because indigenous knowledge, like any knowledge, can have errors. It can be that only "my tree is just flowering" and that is not enough to predict, so we ask them to reconcile their knowledge. So it's not an everyday thing that they send everything they see. So come up to, they are by sitting or they call each other and they say " do you think, have you witnessed, has there been enough threshold for us to report." So we let them vett it themselves.

Steven:

Are you prompting them in any way to have these meetings or, you know, if you haven't heard from one of your champions in a while you say "hey," you know, you send them a message, "We haven't heard from you in a couple weeks"?

Muthoni:

Up to this moment in time we were running this as a research project so yes we did. We are just about to go into the next phase of commercializing so then the approach would be different. We will have to pre-empt them because the moment people start paying for this, we better get it very right, so yes we will have to preempt them.

Steven:

Tell me about that. I did not know that, that's exciting. So this has been a research project, obviously you're a professor you have been doing this in your lab. Usually one of the questions I ask in these interviews is "what do the next two or three years look like for you." So you're embarking on a commercialization project, so that means taking this, packaging it, figuring out a business model. How are you finding that, as coming from sort of the research lab and looking to build essentially a commercial service? Is this something you are outsourcing to somebody else or are you taking this on?

Muthoni:

I'm actually taking it on.

Steven:

Good for you! Nice.

Muthoni:

It's not a straight line. But I have prepared myself and run for an MBA, I'm almost done. So I more or less have an ideal of how to write a business plan. But more greatly, is that I got funding from USAID.

Steven:

Boom. That's awesome.

Muthoni:

Through their project: Securing Water for Food. So through that they are hiring for me a consultant to write a business plan, we have the money to buy the phones, and I have a whole year to make mistakes with somebody else's money before we are making, generating, money. So that's really the boost. It's been the turn around, one eighty degree turn, for me and it's really exciting.

Steven:

Can you give me like one, maybe one or two of the biggest lessons that you've learned? Both about the predictiveness of what you're doing, so how your framework and analysis is, but also just about creating a product like this - from the time that you had that first idea until now, you've got this, essentially this project that you are going to be commercializing. Where have been some of the biggest hiccups where you went "ooof", you know you really learned something. You had to change paths.

Muthoni:

The main challenge is the perception of our farmers. Over there they're used to getting hand-outs so everything they get is given to them for free, so to turn around that and ask them, you can pay ten cents of dollar to receive, this it's been a huge challenge. The second challenge is actually infrastructural. Everything we try to develop here, when you see things in our lab we are thinking an ideal situation. When you go on the ground the situation is very different. For example I assumed that having a 3G connection is something common but when I went on the ground it was completely the opposite. So it is the challenge of our people living in the rural areas because the development tends to take place around the towns, around the cities, beyond three kilometers radius then everything just becomes a challenge. So those are the two main challenges. The one of them I am still struggling with, the one of the perception of the farmers, but the other one we found our way around it through our research.

Steven:

What was the solution? The connectivity of rural areas is one that is endemic to all development work. What was your solution to that or have you just set up repeaters, have you worked with the network providers, are you using more powerful phones or something like that, what was your solution to that?

Muthoni:

The two approaches, We decided to provide them with the phones.

Steven:

Ah, yes. Actually getting them connect. That's a great solution.

Muthoni:

Living connected. Which again might not be sustainable in the long run, but it's working for now.

Steven:

And tell me about the team that you work with. I'm going to assume you aren't doing all of this heaving lifting by yourself. Do you have research staff? Do you have, you know, are you basically putting graduate students to work? How much are you cooperating with people in the field in terms of advocating and getting the message out or it's you, you know, getting in a car and driving out?

Muthoni:

Oh I must acknowledge I have a huge and supportive team of people. First, being a professor I do have students I supervise. So in this project I have two PhD students and also have two master's students. On the ground we, I, have three project managers, because the commercialization is taking place in three countries. It's taking place in South Africa, in Kenya, and Mozambique. For each of those three countries I have project managers on the ground. At the university we have very supportive strategies, we are about to create a spinoff. So that spinoff we have a finance person helping, we have a managing terms of business development manager on board. We have a marketing person. So I'm not alone, so it's a well set structure for this roll out. Yes.

Steven:

So, I wanna get you perspective on, I guess it's not a sensitive topic, but is a very specific topic. One of the reasons that we wanted to talk with you is because you've recently being awarded with the "Distinguished Woman in Science Award". How much is the fact that you are a woman in South Africa and a South African or Kenyan women to begin with, how much is that either presented a challenge or giving you opportunities as pursue this path? Like what's that, tell us that story?

Muthoni:

Is a huge challenge not just in Kenya, not just in South Africa. It's in Africa, because we are grown to become mothers and wives, and for you to break that ceiling you need some extra motivation. In my case it came in the form of my father. As much as he was not educated he did not selectively take us to school, so he would tell us you can do anything you want to be. And secondly is a challenge for me, in fact I keep comparing myself with my colleagues because I'm basically in a faculty of engineering and IT. Where for every one woman we have six men so like now I'm one H.O.D. [Head of Department] vs. 7 H.O.D. who are men.

Steven:

Wow.

Muthoni:

I've got to do almost double the work. Because I'm a family person with four children. I have to take them to school, I have to wake up early. By the time I get to sit to do my research I'm very tired. So that is a huge challenge, but the South African Government recognizes that and gives us sometimes an upper hand, motivates us, gives us more priorities to make sure that we can be seen out there. So the Women in Science Award is an annual event held each year. I was the first recipient of the category called "Research and Innovation", and that's changed my whole world. I'm very proud of that.

Steven:

And you should be. You lost me yet you have four children, I didn't realized you had four children. And you are still doing, it's just; I have three kids and my wife and I, you know, we, share responsibilities for those the children, but man getting out the door in the morning is an impossible task. And here you are you know putting together this technology. That's incredible. What advice would you have for young women who are going to listen to this and say wow here is a woman who has done it. You are brilliant, you have a PhD, you are innovating, you are putting your technology out there, and now you are commercializing it, right? You might have a commercial success here. That's to be determined, but what are the pieces of advice you would give them about how you managed to get to where you are.

Muthoni:

First is to believe in themselves. That's what I mean because it brought me this far and believe in myself so they must believe in themselves and no one should put them down. Secondly, they must work hard because nothing comes handed to us on a plate. So working hard and it is my belief that working hard can not kill anyone. Working hard will just open more and more doors for you, but at the end of the day I always want them to be themselves, they must tell their story. Because the moment you copycat someone else you cannot take it very far. Authenticity with what you are doing, if pursuing biological sciences do it because that's your passion. If you are doing human science and linguistics, everything you do if it's from your passion, you will go very far. That's what have brought me this far, from my side.

Steven:

Have you been supported by your family still, you told me that your father. I don't know if you have a partner or has that been a key part of your life?

Muthoni:

Yes. I'm actually the advocator, I don't say feminism, but if we don't have the support of our spouses, support of our fathers, support of our brothers, support of our sisters you don't go far. I

have a very supportive husband myself, I must say he´s supported me up to this far. And I also seek support - and men should support us because without supporting we wouldn't excel.

Steven:

I want to circle back to the sort of research and technology you've put out there. You said that you are researching in Mozambique, South Africa, and Kenya right now. What kind of area we talking, are you covering it is thousand of acres, or hectares, or you know are there small plots? And then secondarily, take me through the process of how the research was set up. Do you go and place you sensors? Is it one per acre? What kind of distribution do you have to place your sensors in order to get enough data that you can be predictive?

Muthoni:

Ok, I'm only doing smaller plots at the time. In South Africa we are targeting only one place called Kwazulu Natale. We are working with a small group of farmers. At the moment 220 farmers only, because our solution is bottom up. We must ensure the coverage, the network is dense enough to get correct readings. For instance in a small area of about 10 kilometers square, we put 10 sensors. So it has to be very dense to compare to the professional weather stations. So we will do village after village. So after the Kwazulu Natale in South Africa, we go to another place near Poperinge and Poperinge river. Similar in Mozambique there we started working with only 50 farmers in a highly agriculturalyl productive area. In Kenya, the same with targeting 500 farmers. So we are starting very small then we'll keep increasing our radius as we move along. And in three years we are targeting to have 4000 farmers, so it is not something huge scale at this moment.

Steven:

4000 farmers is definitely a good chunk and if you find a way to have a business model really picks up, it would really scale pretty dramatically. But what I hearing you say is this is the technology you know as you continue to refine it is scalable relatively quickly assuming you have the funding behind it right.

Muthoni:

Perfect, yes. If anything we are thinking as a university we don't what to spread ourselves too thin. Eventually we'll end up franchise model.

Steven:

So you'll basically really to sell to distributors or agents and then you'll be eventually the management hob. Fantastic.

Muthoni:

Yeah.

Steven:

What else, you know, I'm trying to think about the ecosystem - that you in the head of department there. What are the kind of cool or interesting research and technologies are coming out of the department right now?

Muthoni:

We attempt to create solutions that address the African people's problem. One of the ones that is coming strongly at the moment is we are using cloud computing to come out with a solution for health, because there are some places in South Africa where we don't have doctors reaching there. So then we are implementing this solution where they can use a mobile phone to record some vital signs and the doctors can be constantly aware and then if there is a drastic change in a patient's conditions then the doctors can go there and save lives. And because of connectivity again we are using the same approach to solve the problem of the data storage for schools. Some schools are very remote they don't have their own website, so creating what we call a "cloud based school system". So they don't have to need any computer we give them tablets and they can capture any information about the school's information, the maps, and so on. So that's working very well with the Department of Education and we just launched an internet of things project. You know internet of things is becoming the talk of the day.

Steven:

Yeah sure it is everywhere now .

Muthoni:

Yeah, but this one we are doing we have a collaboration with the University of Germany, so we are the first in South Africa to run courses on internet of things we just want to ensure that we its becomes everyday tool we are equipped our people with the skills for programming sensors, and solving, interpreting the data from the sensor so those are the main research projects we are doing. But I will do it injustice if I don't mention that within the larger faculty where I am in the country and in the region we are known for 3D printing of human body parts that need to be replaced. So we are doing very as a unit and as a university.

Steven:

You are known for 3D printing human body parts? You can't put that on the table and not explain that more. So are you, are we, talking prosthetics?

Muthoni:

Yes, yes.

Steven:

Or we are talking about lungs and kidneys, and hearts?

Muthoni:

No, no. Not the kidneys, yet. Maybe we'll get there, but we are not there yet.

Steven:

I'm pretty sure I saw someone printed a kidney a little while back. So great, that's interesting so you are doing custom printed prosthetics for individuals. Is that a model that is starting to be cost efficient and viable business because I know that 3D printing can be much more expensive that the polyurethane you know the sort of standard method for creating prosthetics?

Muthoni:

It's still expensive, but we are working with the Department of Health to save lives. But apparently, I happen to sit in that committee, they do make profit, interestingly.

Steven:

That's fantastic, Muthon. I just have two more questions for you. This has been a wonderful conversation and a true inspiration, it's fantastic. Who do you pay attention to? You know, you have this unique path that you've taken from Kenya, now through South Africa through your research and now you've received not only this award but you're launching this commercial project. Who do you, besides the colleagues that sit around you, do you have news sources or special pieces of inspiration where you get your ideas from or motivate you to have these new ideas?

Muthoni:

Yes, I do. I admire people who have achieved a lot in technology. Yeah, I used to read, and I still read about, Steve Jobs. I look at Bill Gates and what he has achieved and their humble stories of how they started small and became huge. So, and I tell myself that we are not, as African countries, we haven't reached there yet but we reach there if we have many Muthonis doing these things. So I work very hard and I ensure that I look and I read a lot, I almost what's happening in technology all the time just to keep myself motivated to get there.

Steven:

The last question I have is one I ask everybody on the show and you've described some of the different technologies that are being implemented in your university, is there something outside your university, either a technology or a process or what I call a "shiny new object" that you think is just super cool - you don't have to be working on it, you just think is just really really cool and is going to be important for the future that other people should pay attention to?

Muthoni:

Yes, there is a huge project opening in the southern hemisphere, when I say " Southern Hemisphere" I mean beyond, it's a project that is involving people beyond Africa. They are creating a large telecommunication device, very many satellites. It's call SKA - Square Kilometre Array that will enable capturing of data of trillions, things we can't count on, amount of data about anything in the world, be it medical, be it weather, be it crops, everything. And the good thing is that South Africa is the host of that project. Its phenomenal, it's going to change very

many things, from here, Africa, to Australia. I would like people to took at that and see how much technology can change the world.

Steven:

Muthoni, this has been a fantastic, fantastic conversation. Thank you so much for getting up early to talk to me and I wish you all the best.

Muthoni:

Thank you, it was very pleasant to speak to you, Steven. And thank you for having me, again.

Steven:

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