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Preface

With the economic crises, contestation about the role of universities in industrial and other innovation processes has shifted. The emphasis in the past has tended to be on whether and how universities should support economic development and growth through industrial innovation processes, and what research, new knowledge and technology can contribute, particularly in relation to high-technology formal sectors. Much research centred on how to enhance technology transfer, establish effective incubation facilities, support patents and licensing, or other forms of profitable commercialization of intellectual property.

Such a discourse tends to obscure a more inclusive and developmental form of engagement and interaction that could contribute to innovation and economic development. In countries that belong to the Organization for Economic Co-operation and Development (OECD), the recent economic crisis has shifted debate from innovation for global competitiveness, to consider how to mobilize shrinking resources to best address growing inequality, poverty and unemployment. In emerging economies, there are growing claims that science, technology and innovation-led growth can in fact result in higher levels of poverty and inequality *within* a country.

Thus, while in the recent past the link between innovation and growth was indivisible, recently a new debate has emerged, centred on the connection between innovation and social inclusion. Indeed, in transitional and developing contexts like those in southern Africa, for many years, universities were challenged to establish a new social compact where they became key agents for inclusive social and economic development. Greater emphasis is accorded to the roles the knowledge work of university academics play in poverty reduction and the ability of all social groups to create opportunities, share the benefits of development and participate in decision-making.

New study on innovation in southern Africa

Such an emphasis drives the focus of the present study, Universities and Innovation for Inclusive Development (UNIID) Africa, funded by the International Development Research Centre (IDRC). It seeks to build a stronger African empirical research base in collaboration with partners in four SADC countries - Botswana, Malawi, South Africa and Tanzania - as well as Nigeria and Uganda. The UNIID-Africa project seeks to address the limited attention paid to how universities contribute to innovation for inclusive development, specifically, to innovation activities that provide livelihoods to the excluded and disadvantaged.

The project aims to make a significant conceptual and methodological contribution to research on innovation, development and higher education. It challenges the focus of innovation studies - typically on science and technology, radical innovation and economic development in formal sectors - and extends the remit to encompass innovation that is incremental, takes doing, using, and-interacting modes, and is based in informal settings. In turn, the tendency of development studies to focus on top-down development is challenged in favour of inclusive development that focuses on participation by the marginalized as active agents. In taking such an approach, the project aims to contribute to a theoretical bridge between innovation studies and development studies that is under-explored and under-theorized.

Linking knowledge generation and the public good with innovation

Similarly, the innovation studies literature is often marked by a conceptual myopia towards the substantive knowledge-generation role of universities and their contribution to the public good. A corresponding myopia exists within the higher education literature, which has insufficient accounts of the role of universities in innovation, technology transfer and diffusion toward economic development. The project seeks to overcome this impasse by linking the knowledge imperatives of universities in relation to the public good and social justice, with those of innovation and technology transfer.

Based on such ambitious conceptual integration, the research conducted empirical research in African universities, in order to make innovation that may be taking place visible; to make the nature of university-community interactions explicit; and to highlight the university as an actor in the innovation system engaging the community. In terms of higher education governance, it addresses issues of accountability to social needs, and promoting scholarship that is more socially and economically responsive to (local) contexts. In terms of the implications for higher education management, the issue is how to create a stronger coherence between research, teaching and community engagement. Finally, the research aims to identify what kinds of incentives will be appropriate as drivers and to address bottlenecks.

Methods and mapping

An interlocking set of research and policy oriented activities commenced in October 2012, founded on a survey methodology to map forms of university interaction with the full range of possible social partners in each country – whether firms, farmers, communities, government, or social organizations. Such a process provides an overview of the main kinds of partners, the main types of relationships, channels of interaction, the outcomes and benefits of interaction and the main barriers and blockages, across distinct types of institution in each higher education system. The analysis draws on interviews with senior university management and

academics, as well as analysis of institutional documents to understand the governance and management conditions within universities that support diverse patterns of interaction.

The mapping provided a rich descriptive foundation of the existing interactive practices of the universities in the Tanzanian national system of innovation and an empirically contextualized baseline for investigating specific cases of innovation for inclusive development.

We have for the case of Tanzania chosen three cases in which we studied how universities and communities interact to innovate in informal settings to enhance livelihoods. Our cases are a stone crusher case, a case of value-addition to seaweed farming and a case of improved banana farming techniques.

Our Tanzania specific findings can also be compared with the other UNIID country team case studies; these cross country contexts provide an evidence base of the facilitators of and constraints on innovative and interactive practice in sectors critical to the informal livelihoods of marginalized communities.

This report is divided into 2 separate parts. PART 1 provides an in-depth exploration of three different types of universities (a general one, one with an agricultural focus and one with a health focus) in Tanzania as regards their interactions with external partners. This has been done through a survey and an analysis of how the intention and importance of interactions with external actors is addressed in policy documents, reflected in ongoing collaborative research projects and by interviews with academic staff of these universities on the specific kinds of interactions, their benefits and obstacles. PART 2 presents and analyzes three specific cases of university interaction with marginalized groups with the aim to develop new (stone crusher case) or improve existing technology (banana farming technique) and further develop potential products from cash crop (seaweed case) with the overall aim of livelihoods. The three cases show different constellations of actors in the process of initiation and implementation of each of the cases. They all investigate the role of the university in inclusive development and their contribution to innovation in informal settings through engagement with the communities.

1. INTRODUCTION

Tanzania is among the sub- Saharan developing countries whose 87.9% of its population lives below the international poverty line of U. S. $ 2 per day (African Development Bank Group, 2013). The Tanzanian economy is dependent on the agricultural sector, which employs 80% of the work force and accounts for 85% of its exports and is the major contributor to the gross domestic product (GDP). However, the agricultural sector is underdeveloped and difficult to assess given that the Tanzanian agriculture is subsistence and comprised of small holders with many of the farmers operating in the informal economy. Thus, the main development challenge of the country – not only with respect to the agricultural sector - is poverty eradication and to speed up and assist in the socio- economic development of its people.

The government of the United Republic of Tanzania has responded to this development challenge through a conducive policy environment and by developing strategic development plans. Particularly, the Development Vision 2025 (TDV 2025) and the Big Results Now (BRN) are the main policies targeting to speed up the development agenda. These policies are underscoring the importance of science, technology and innovation in the development process. As knowledge generating agents and supplier of skilled human resources, Tanzanian universities have a key role to play in promoting science, technology and innovation. This raises the question on the universities' contribution to poverty alleviation and in promoting inclusive development that includes marginalized Tanzanian communities. Such discourse on the potential of universities in contributing to innovation is increasing in African countries and existing among international organisations. A number of policy documents and initiatives have been formulated and put in place to support and enhance the contribution of universities to innovation in Africa, however most of the African innovation policies tend to have a narrow perspective with a main focus on science and technology and an emphasis on high-tech innovations, while low-tech solutions may more adequately address many local challenges of marginalized communities and in the dominant sectors of many African countries, such as the smallholder subsistence farming in Tanzania. Indeed, initiatives that involve universities to work on socio-economic improvements of the countries are witnessing an increased interest by international donors as for instance the Talloires Network (an international association consisting of more than 300 institutions that are committed to enhance and strengthen the civic roles and social responsibilities of higher education) reflects or also the Eastern Africa university-community engagement network, that brings 7 East African countries together with the overall aim of better interacting with their communities. All this shows the need for universities to link up with and work together with external social actors in order to increase their contribution to national development via (inclusive) innovation. Against this background, we

therefore aimed to assess the role of Tanzanian universities in innovation and inclusive development, not least to complement recent activities in Tanzania towards poverty reduction and development.

The targeted intervention from the government of the United Republic of Tanzania has mainly been through economic reforms and policy guidelines as underlined in various policy documents. After its socialist state controlled economy that existed after independence, the second half of the 1980s witnessed economic transformation into a market based one. The private sector has become the engine of growth and measures are steadily being taken to enhance its role and participation in the socio economic development of the country. Initially, the transformation focused on removing constraints for private sector actors, restructuring the public sector, with the main focus on macroeconomic stability and to secure a high quality of the public financial management system. The recent reforms aimed at improving the investment climate, promoting growth and to improve livelihoods. The reforms put in place policies and institutional framework for conducive investments like the Mining Policy (2009), the Public-Private Partnerships (2009), as well as the establishment of the Tanzania Investment Centre (TIC), special economic zones (SEZs), and the export processing zones (EPZs).

The policy interventions are evident in the Tanzania Development Vision 2025 (TDV 2025); Poverty Reduction Strategies – PRS (1997/2001); the National Strategy for Growth and Reduction of Poverty (NSGRP); The Five Year Development Plan – FYDP (2011); and the recent Big Results Now (BRN).

The Tanzania Development Vision (TDV) 2025 addresses various economic and social development objectives to be achieved by 2025. The TDV 2025 emphasizes that by 2025, Tanzania should have gone through an unprecedented economic transformation and development to achieve middle income status, which will be characterized by high levels of industrialization, competitiveness, quality livelihood, rule of law; and having in place an educated and pro-learning society. Specifically, the TDV 2025 outlines the country's social, economic and political aspirations for the first quarter of the 21st century with an underlying drive to reaching the middle income country (MIC) status, with a per capita income of USD 3,000 (in nominal terms) by the year 2025. The TDV 2025 was designed to be put into operation through a series of five year development plans. However, in the period following the adoption of the TDV 2025, Tanzania embarked on further policy and institutional reforms, which had a negative impact on the country's poor. In view of this and with the help of the development partners, short and medium term Poverty Reduction Strategies – PRS (2001) were adopted as a safety net for the poor. First came the three year PRS (2000 – 2003) and the National Strategy for

Growth and Reduction of Poverty – NSGRP (Ministry of Finance and Economic Affairs, 2010). In the absence of five year medium term plans, the NSGRP took precedence as the medium term plan to implement the Vision 2025. Within this policy, specific attention is given to the importance of innovativeness, and in this connection the low productivity in the agricultural and other sectors is outlined. This is explicitly linked to low levels of innovativeness, including insufficient use of S&T and low level of education. The latter is due to low student enrolments, gender imbalance, poor financing, an under appreciation of the value of academic programs, uncontrolled and unregulated proliferation of tertiary training institutions. Among the various strategies to address these challenges is the hurdle to more effectively match the curriculum of higher education organizations with the changing role of science, technology and innovation in development. Thus, there is awareness of the need to understand and analyse the higher education system as an embedded part of the overall innovation system.

The Five Year Development Plan – FYDP (2011) was prepared in order to assist the country to achieve the noble development goals outlined in the Vision 2025. The Plan provides insights into responses of Tanzania to the increasing challenges of development; and outlines what it will take to succeed, and the expected outcomes in delivering sustainable development. The Plan is formulated on the principles of accountability, equality, credibility, integrity and effective resource utilization. The Plan singled out key priority areas and identified strategic interventions that will accelerate economic growth, create employment, and support industrialization efforts. These core priority areas are infrastructure, agriculture, industry, water and human resource development. The main tools of strategic intervention in these core areas comprise of special economic zones (SEZ's), private public partnerships (PPP's), institutional reforms, improving business environment, enhancing the skill base and adapting technological innovation in all fields. The recent Big Results Now (BRN) programme was launched in year 2013 to be an integral part of the TDV 2025. The programme aims at speeding the achievement of the TDV 2025 through 6 national key results areas (NKRA) of education, water, energy, agriculture, resource mobilization, and central corridor transport. The key results expected to be achieved by year 2015 are detailed in Table 1.

Table 1: National key results areas

SNO	NATIONAL KEY RESULTS AREA (NKRA)	KEY RESULTS BY 2015
1	Agriculture	1) 25 commercial farming deals for paddy and sugarcane
		2) 78 collective rice irrigation and marketing schemes
		3) 275 collective warehouse-based marketing schemes
2	Education	1) Pass rate of 80% for primary and secondary school students
		2) Improve students' mastering of 3R in Standard I and II by implementing skills assessment and training teachers
3	Energy	1) Increase generation capacity from 1,010 to 2,260 MW
		2) Access to electricity to 5 mil more Tanzanians
		3) Eliminate EPP reliance
4	Transportation	1) Passage of 5 mil tons per year through the Central Corridor
		2) Increase port throughput by 6 mil tons, rail by 2.8 mil tons
		3) Reduce road travel time from 3.5 to 2.5 days
5	Water	1) Sustaining water supply to 15.2 mil people
		2) Restoring water supply to 5.3 mil people
		3) Extending water supply to 7 mil new users
6	Resource mobilization	1) Increase tax revenue by T. Sh. 3 trillion
		2) Implementation of PPP projects valued at T. Sh. 6 trillion

As a result of two decades of efforts in economic growth and reducing poverty, Tanzania is now experiencing macro-economic stability. Gross domestic product (GDP) growth has been impressive at an average of 6.6 per cent. For five years (2004 to 2008) growth reached an average of 7.1 per cent. The sectors that recorded high growth rates of more than 10 percent in 2010 were communications (22.1%), followed by construction and electricity and gas (10.2%) and financial intermediation (10.1%). Overall, GDP growth was mainly driven by trading and repairs, agriculture, manufacturing and real estates and business services.

However, while the TDV 2025 aspires to achieve the development goals by applying science and technology, an assessment is made here of the science, technology, and innovation (STI) indicators for Tanzania. Table 2 presents an overview of selected education, science, technology and innovation indicators available for Tanzania. As illustrated, primary and secondary school enrolment has increased drastically between 2000 and 2007/2008. Important STI infrastructure improvements are the increased internet users, which is also visible from an increased number of internet service providers as well as mobile phone subscriptions.

Table 2: Education, science, technology and innovation data for Tanzania

INDICATOR	YEAR			
	2000	2005	2007	2008
Primary education enrolment, all grades (total)	4,382,410	7,541,208	8,316,925	8,601,814
Primary education enrolment, all grades (females)	2,169,937	3,685,496	4,101,754	4,243,671
Secondary education enrolment (total)	261,896	524,325	1,020,510	..
Secondary education enrolment (females)	120,248	244,571	477,314	..
Tertiary education enrolment (total)	-	41,419	55,134	..
Tertiary education enrolment (female)	-	13,206	17,803	..
Internet users (per 100 people)	0	..	0	1
Data operators and internet service providers	..	23	34	60
Mobile cellular subscriptions (per 100 people)	0	0	0	20
Scientific ISI publications	269	371	418	..

Source: National Bureau of Statistics, (2012); Southern African Regional Universities Association – SARUA (2007:176); SARUA, (2008); The World Bank, (2012)

Another interesting measure to provide a picture of the STI situation in a given country is the knowledge index (KI). It measures the ability of a country in the generation, adoption and diffusion of knowledge. One of the useful methodologies in assessing knowledge index is The World Bank's Knowledge Assessment Methodology – KAM (2012). KAM shows the application of knowledge as manifested in four pillars of economic and institutional regime, education and skills, information and communication infrastructure, and innovation system. The KAM makes comparisons based on 83 structural and qualitative variables that serve as proxies for the four knowledge-economy pillars. All the 83 variables are normalized on a scale from 0 (weakest) to 10. The KAM assessment results for Tanzania shows that the knowledge economy index in Tanzania has dropped by 1.06 units from 2.85 in 1995 to 1.79 in 2012. One of the widely reported KAM indexes is knowledge economy index (KEI), which assesses how far the environment is beneficial for the effective use of knowledge in economic development. The KEI is an aggregate index capturing the general level of development of a specific region or country with respect to the knowledge economy. Four pillars namely, economic incentive and institutional regime, education and human resources, the innovation system, and ICT provide the information on which the KEI is calculated. The KEI is constructed as the simple average of the normalized values of these indicators, from 0 to 10. A KEI score that is close to 10 implies relatively good development of the four knowledge economy pillars as compared to other countries, while a score close to 0 indicates relatively poor development. The Tanzanian results

have been selected in comparison with the other countries of the UNIID project as presented in Table 3. For obvious reasons, South Africa shows the highest scores for the overall KEI as well as for the four pillars individually. In this comparison generated and presented below, the knowledge readiness of Tanzania does not score very high. The only visible increase is in the education category. In general, it is important to note though that the indexes may reveal that a "country's absolute performance on the relevant indicator has actually deteriorated" or "that the absolute performance has improved" but not by as much as in the comparator countries. These are two quite different situations and it is very important to know what exactly is happening.

Table 3: KEI indicators for UNIID countries

COUNTRY	KEI		ECONOMIC INCENTIVE AND INSTITUTIONAL REGIME		INNOVATION		EDUCATION		ICT	
	RECENT	1995	RECENT	1995	RECENT	1995	RECENT	1995	RECENT	1995
South Africa	5,21	6,05	5,49	3,74	6,89	7,26	4,87	6,33	3,58	6,89
Botswana	4,31	5,07	5,82	5,77	4,26	4,76	3,92	4,26	3,23	5,47
Uganda	2,37	2,97	3,97	4,18	2,54	2,49	1,09	1,04	1,88	4,18
Nigeria	2,2	2,53	1,26	1,22	2,56	2,67	1,62	2,06	3,35	4,18
Malawi	1,92	2,9	3,33	4,06	2,65	2,7	0,54	0,68	1,15	4,18
Tanzania	1,79	2,85	3,07	3,99	1,98	2,58	0,83	0,67	1,26	4,18

Source: World Bank, (2012)

Furthermore, the number of publications and patents are among the indicators of scientific outputs from higher learning and R&D institutions. An assessment for Tanzania HE shows that the total research output during the period 2002 to 2006 was 2,172 Institute of Science Index (ISI) articles. In comparison, the total output of ISI Journals by SADC countries during the period 2001-2007 is 47,694 papers (SARUA, 2008). This is an annual average of around 6800 articles. The research output is clearly dominated by South Africa which published 38,232 articles. After South Africa, comes a group of four countries, including Tanzania, which is in first place in this group, followed by Zimbabwe, Botswana and Malawi who published more than 1,000 papers during the seven years period. These are followed by Zambia and Madagascar who produced more than 500 ISI articles during the period. The total output for the years 2002 – 2006 in Tanzania is 2,172 ISI articles. The majority of all African countries has increased their ISI Journal articles during the last three years, with the exception of Angola, Mauritius, Swaziland and Zimbabwe who remained rather stable. A decline has not been found in any of the countries (ibid). An analysis of the 2004 publications shows high international collaboration and co-authored articles from Tanzanian organizations. These collaborations are mainly made

in cooperation with USA (50), England and Denmark (25) (ibid). To illustrate the contribution of individual institutions in Tanzania, Figure 1 is presented covering years 1994 to 2004. In terms of scientific output, the University of Dar es Salaam, Muhimbili University College, Sokione University of Agriculture and State University of Zanzibar are the highest ranking.

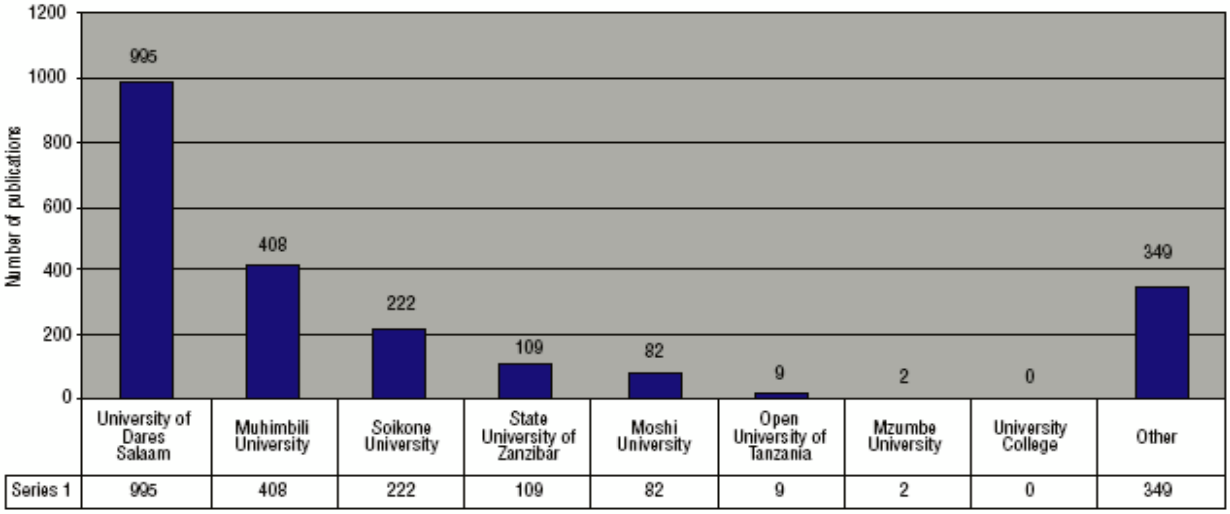

Figure 1: Main producers of scientific output in Tanzania

Source: SARUA, 2007:176.

In Tanzania patents are granted through an organization called Business Registration and Licensing Agency (BRELA). BRELA was established as a government executive agency under the Government Executive Agencies Act No. 30 of 1997. BRELA collaborates with the regional office, the African Regional Intellectual Property Organization (ARIPO) and the World Intellectual Property Organization (WIPO) on the protection of patents at regional, national, and international levels. In addition to filing and granting patents, this organization also serves as a crucial information centre for various R&D organizations with regard to specific information on patents. Analysis of the patents information shows that patents for Tanzania are increasingly granted by ARIPO while patents granted by WIPO have drastically declined from the highest number of patents, 405, in 2001/02 to only 37 patents in 2003/04 (Table 4). In comparison, ARIPO granted 797 patents that same year. The national office is still granting the lowest number of patents.

Table 4: Number of patents granted in Tanzania (1999 – 2004)

GRANTING BODY	YEAR				
	1999/2000	2000/01	2001/02	2002/03	2003/04
National Office	9	10	8	24	13
Via ARIPO	112	81	688	578	797
Via WIPO	198	207	405	281	37

Source: BRELA, (2004)

While the contribution of Tanzania Universities to knowledge generation is paramount, their role to poverty alleviation and inclusive development is not well perceived. This research was therefore designed to provide information as to whether the research and innovation undertaken by Tanzania Universities are contributing to poverty alleviation and inclusive development. Our research findings provide a strong evidence base that can be used for promoting a policy agenda intended to strengthen the complex and multiple intersecting roles of African universities as drivers of innovation and inclusive development. In Tanzania the research was conducted at three Universities namely, the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), and the Muhimbili University of Health Sciences (MUHAS). Their respective location within Tanzania is shown in Figure 2.

Part 1 of this project and as presented in this final report examines the type of interactions that these three universities (an agricultural university, a general university and a health focused university) participate in. It maps and aims to understand the most commonly used mechanisms as well as the motivation and outcome of the various different interactions the university participate in. The project aims to engage with this question as a means towards the role of the university in inclusive development.

Part 2 presents three case studies of livelihoods that have carefully been chosen as a result of the findings of part 1. In part 2 we have moved from the overall picture of different mechanisms of interactions and overall types of external, social actors to an investigation and in-depth analysis of cases of engagement of the university with concrete marginalized communities in an endeavor to innovate in these informal settings that the marginalized groups are part of with the overall aim of increased and sustainable livelihoods. Here, we analyze the different types of knowledge transfer and the type of learning processes in the specific web of actors that each of the cases is embedded in with an overall focus on facilitators and success factors as well as constraints in terms of benefits and contribution to inclusive development. Also here we apply a systemic perspective on the participating actors with the university located at the center of

analysis. Two of the cases demonstrate a long term sustainable case, while one has had no multiplication effect and no long-term perspective.

Figure 2: Location of the three studied Universities

1.1 Theoretical Point of Departure

The importance of understanding dynamics of innovative activities in the informal economy and livelihoods of marginalized groups of people can hardly be over-emphasized. As part of this concern, inclusive development has become a major priority for governments in emerging and developing countries and is on the agenda for policy discussions in both OECD and non-OECD countries.

There is consensus among academics and policy makers that innovation, understood in a broad sense, as embracing upgrading and capability building is a crucial “ingredient” for development (Lundvall et al. 2009; Lundvall, 1992; Muchie et al. 2003; Intarakumnerd and Chaminade, 2007;

Lall and Pietrobelli, 2002). The relation between development and learning has largely been recognized by innovation system research and innovation has become the centre of analysis and debate around upgrading in developing countries (e.g. Lundvall et al 2009, Muchie and Baskaran, 2012). Scholars in the innovation system tradition highlight that innovation is the result of interactive learning taking place between organizations located in a specific national, regional or sectoral systems (Edquist and Hommen, 2008; Lundvall et al, 2006), i.e. innovation takes place within a network of actors that fosters interaction and learning.

The learning capabilities of a system are linked to elements of its social capital, meaning that they are person embodied and can be transferred for instance via doing, using and interacting. The learning capabilities are likely to be higher in systems in which citizens regularly cooperate and engage in interactions with each other, that is, where citizens and organizations are part of stable networks which are featured by mutual trust (Lundvall and Borras, 1998). Thus, linking actors to each other and encouraging interactive learning between them is essential for the performance of innovation systems and ultimately for catching up and development. If people are not able to access and use any new technology – as tends to be the case with marginalized groups of people - they cannot improve their situation. Therefore, building the capacity to understand and adopt new technologies is essential. Interestingly, despite their lack of access to technology, we found that people are still innovating in informal communities.

The *innovation system* approach received increasing prominence as analytical tool to comprise both different sources of innovations and relationships among actors in the innovation process, but the literature has largely focused on innovation occurring in the formal economy and we know comparatively little about the dynamics of innovation and interaction in the informal economy. We situate our own research at the interplay between the formal and informal economy. More specifically, we investigate the role of the universities with regard to their potential contribution to increased and sustainable livelihoods through inclusive development in particular in informal settings. This focus is relevant for innovation system research where up to date processes of knowledge absorption and diffusion in informal firms as well as constraints to knowledge transfer between informal and formal actors are still not well explored (Altenburg, 2009). Indeed, it is still a recent concern that informal settings do need more attention from innovation scholars (Cozzens & Sutz, 2014:6). Needless to say, the type of learning curves and innovations that we expect are here often characterized by simpler, cheaper and adopted versions of already existing products and hence of low-tech rather than high-tech and new to the world innovations. In other words, there are incremental innovations which are based on adjustments of existing technologies and products rather than radical innovations. “Pro-poor innovation” and “innovation for the bottom of the pyramid” are concepts that also describe these

types of innovation. Thus, contrary to very technology intensive innovations these innovations are inclusive as due to low entry barriers all can participate because very specialized skills are not required. Increased training might eventually lead these groups towards active innovators also for more complex innovations.

In this study we have in part 1 operationalized the concept of innovation systems in the sense of applying it for diagnostic purposes as regards the role and position of universities in the NSI of Tanzania along with a specific focus on the interactions these universities engage in. We know from many of the empirical findings from innovation system research that interactions are essential for innovation capacities of firms and countries and hence for innovations to come about. Looking at earlier development studies, the innovation system approach has added a new focus away from an emphasis on intervention and on the supply of knowledge and technology to an analysis of the multiple public and private actors that demand knowledge in order to interact with each other, access and use knowledge for the purpose of creating change. Importantly, as Hall argued already in 2007 "a priority within this new focus is to find ways of developing and adapting habits and practices that foster a capacity to innovate that integrates pro-poor and pro-market agendas" (Hall, 2007b: 14). This point is essential also for part 1 of our study when analyzing the policy environment in which the Tanzanian universities operate and whether a pro-poor focus is inherent in these policies through a focus on livelihoods and inclusive development and it is – following Hall`s arguments – crucial to keep in mind that we are dealing with a range of different types of innovation systems where the goal only can be to understand the specific at hand in each individual case. Hall (2007) continues to argue with respect to the work and findings from agricultural innovation systems research that these findings should not be understood as prescriptive recommendation and suggestions of pre-specified roles of the participating actors, - a view that we adopt in this report.

Since two of the cases that are part of part 2 of this report are from the agricultural sector we engage below a little more with the literature on innovation in the agricultural sector to place our own observations and findings in this context.

It is striking that questions concerning how best to transfer appropriate technologies to farmers in need of them have been debated for more than 30 years (Stewart, 1977). The typical focus in these debates can be described as a delivery focused approach. This conventional organization of agricultural research and development was characterized by a linear way of technology transfer to farmers. The specific physical, social and economic settings of the recipients were here mostly not taken into account and as a result the desired social and economic changes were not reached. Since 2006 the World Bank and other organization have promoted the

innovation system approach as a tool for supporting agricultural innovation in a non-linear way and beyong the mere strengthening of research systems (e.g. World Bank, 2006). In agricultural innovation, we find in the literature several types of participatory modes of innovation which represent promising alternatives to the traditional linear approaches. We know for instance from South African cases (e.g. Letty et al., 2012) but also in other African contexts that the linear approach from researcher via extension agent to farmer and/or end user is restraining (e.g. Letty et al., 2012). Two broad categories of alternative approaches can according to Letty et al. (2012) be identified in the literature:

a) "functionally oriented" types of participatory innovation that draw farmers into closer interaction with the formal research and extension system, with the primary aim to increase the effectiveness of the extension services and
b) Less often examined than the functionally oriented approaches of participatory innovation are "empowerment-oriented" types. These are "designed to foster informal modes of innovation oriented projects that are driven and implemented by smallholder farmers themselves – described here collectively as Grassroot's innovation" (Letty et al., 2012: 33).

The aims with such projects are twofold: 1) to strengthen grassroots innovation and 2) to develop its existing links with the formal research and extension system for knowledge sourcing purposes. The contribution of innovation studies applied in informal contexts could thus be that of a much less delivery focused approach towards much more of an empowerment approach (e.g. Letty et. al., 2012 for a nice synthesis). The participatory research movement in the early 1990s brought together ideas that were among others inspired by Paul Richard`s *Indigenous Agricultural Revolution* (1985). However, this developed into an over-emphasis on the role played by farmers and failed to effectively link the different actors in the process and the crucial role that science after all can play.

Reflecting on the various experiences in agricultural research and applying the analytical lenses of the innovation system approach, a research group around Andy Hall started in 1998 experimenting with participatory methods and instead of only looking down the chain found that it was crucial to look "up the chain at the private sector and NGOs". Importantly, "these organizations were viewed as necessary partners in a much big process of change involving linking rural communities to emerging markets and relevant information and resources needed to engage in more productive and competitive practices" (Hall, 2007: 8). They found that partnerships were a crucial ingredient in research projects and importantly between "dissimilar partners" (ibid) – i.e. private/non –private, research/ non-research etc. A crucial further step was the realization that a conceptual framework was needed that could assist in understanding "the interplay between the linkages required for innovation and the institutional setting needed

to make those linkages work" (Hall, 2014: 10). The innovation system approach offers here a framework that points to the complexity of the innovation process. Hall (2007) argues that given the nuanced process of innovation the "trick" that has to be mastered "is to try and glean from all of this thinking on the subject some basic principles that can be used to design and implement projects" (Hall, 2007: 11). Based on the work of their own agricultural research projects he derives the following as important principles: selecting who to work with, managing roles, providing incentives, organizing interaction, investigating interactions, timing interactions. These principles are essential for the design of a project. Importantly though, as Hall argues, the innovation system approach "goes one step further". The innovation system concept shows that "the different elements and the organization of the innovation process are very context specific and that this context is itself evolving" (Hall, 2007: 13). Hence, very important is the conclusion derived from this that "there simply isn`t a blueprint for how to do this". This means in practice that not only technical questions have to be addressed but also organizational, institutional and policy issues have to be addressed for best supporting and promoting an innovation process in a specific context (ibid). Put differently, one investigates the role of different players in the innovation task. Thus, it has to be considered and decided how to organize the linkages and interactions among the various actors in a way that a) facilitates a process of change and broader development including marginalized groups and b) supports and enables innovations to arise.

We do this for the case of the role of the university in contribution to innovation in informal settings and analyze facilitating and constraining factors in this endeavor. Importantly, we adopt the view b) as outlined above on the "recipients" where these are considered as active agents in the interactive innovation process.

1.2 Specific Objectives in the Tanzanian context

The present study consists of 2 parts. In part 1 three different universities were selected, Sokoine University of Agriculture (SUA), (representing an agricultural university) University of Dar es Salaam (UDSM) (selected to represent a general university) and Muhimbili University of Health and Allied Sciences (MUHAS) (used as an example of a health oriented university) with the objective to analyze their interactions with external partnerswith respect to what promotes the interaction and outcomes thereof. Differences in terms of the frequency and nature of interaction among the universities have been investigated. Furthermore, specific functions of the universities have been analyzed (e.g. special units and institutes, research and extension). Part 2 examines concrete examples of engagement and joint work with communities that lead to innovation and increased livelihood of the participating communities. Given the high importance

of agriculture in the country, two cases are from the agricultural sector while the third case is also an illustration of a low-tech innovation case.

1.3 Research Goals

The role of universities in innovation studies, higher education studies and development studies with regard to the recent debate on the connection between innovation and social inclusion and the focus on how to best address growing inequality, poverty and unemployment still leaves some blind spots. For instance, the interactions between formal and informal economic spheres via the university are a crucial issue. The motivations of academics to participate in collaborative research projects are another important aspect and these academics in research projects and consultancies may link these spheres. Related to this is also the question of who sets the research agenda in the country. We aim to contribute theoretically to this field by a) examining the nature of the university-community/external partner interaction at three different Tanzanian universities and by b) analyzing major driving forces and motivations for interactions at the universities.

These issues are interesting to study in Tanzania because in Tanzania, as in many LDCs, a very large amount of all economic activities is taking place in the informal economy, which is beyond any state control and statistics, and hence difficult to grasp. Despite of its dominance in terms of income and employment it has been empirically comparatively neglected. Therefore, an understanding of the dynamics, mechanisms, incremental innovations, interactions between formal and informal settings is important. The university may furthermore play a crucial role in reaching out to peeople in rural areas and assist in the generation and improvement of capacities that may increase their livelihoods as examined in our cases on livelihoods.

Importantly, our re-examined three cases of innovation as a result of university-community interaction all illustrate strong and important initiatives taken either from the communities themselves (e.g. stone crusher case) or from a university professor (Seaweed cluster). While financial support also from international donors is important and also highly present for instance in the Seaweed cluster initiatives, the initial local initiative appears to be a crucial factors for the long term sustainability and success of a given project.

Based on this observation we argue that countries like Tanzania should be encouraged to formulate inclusive innovation policies are derived from and based on empirical evidence from their unique and context dependent cases, featured by high informality etc. and not adopted from innovation policies of socio-economically more developed countries.

2 METHODOLOGY

The research on mapping higher education interaction with external agents in Tanzania (presented in part 1 of this study) used a methodology to survey the scale and forms of interaction in terms of the types and channels of relationships and their benefits and constraints. The intended types of interaction ranged from those that are indirect, tacit, informal and not knowledge intensive, to those that are direct, codified and tacit, formal and very knowledge intensive.

The adopted survey built and expanded on a methodology implemented by the HSRC in South Africa. Further methodological approach and tools were borrowed and adapted from a study by Kruss et al. (2012), which was conducted in South African universities. The interview guides and questionnaire forms can be found as Appendix 1.

Further to the use of information schedules a thematic analysis of the policies, structures and incentive mechanisms within each university (or public research institute) that promotes social engagement, research and innovation was also undertaken. With this, it was therefore possible to analyze how a specific pattern of engagement is supported by institutional policies, cultures and structures, to inform institutional level and national higher education policy making.

2.1 Overview of the Survey Tools

The survey tool comprised of a number of different interview protocolsfor the interviews, depending on the type of information we were looking for and the background/employment position of the persons that were interviewed. The different schedules are briefly described below. There were four different interview protocols used in the first phase of data collection to better understand the type of interactions the universities engage in.

2.1.1 University Information Protocol

The protocol on university information collected general information on the university (faculties, year of establishment, location, size, enrolment numbers of under-graduate and post-graduate students, the total number of academic staff) and questions on how the staff distributes their working time among academic functions and other professional work.

Performance of the university in terms of number of funded research, number of academic publications, number of patents awarded to the University, including policies and incentive mechanisms that promotes interaction was also collected by this schedule.

2.1.2 Interview Protocol for Senior Management and Leadership

One interview protocol was used when interviewing senior management and leadership. Our crucial question on how the interaction with external social partners fit into the main university missions was addressed, the main types of interactions discussed, as well as e.g. incentive mechanisms that have been put in place to support interaction, successes as well as obstacles in terms of the outcomes of interactive activities.

2.1.3 Individual Academic Interaction Protocol

Through this schedule, the interacting academicians were mapped with respect of to what extent they interact with external social actors; the extent in which their academic scholarship involve these types of relationship with external social actors; to what extent the academicians used the channels of information to transfer knowledge to external social actors; the outcomes of their interaction with external social actors; obstacles experienced; and finally, listing the best example of their academic teaching, research or outreach projects in which they interacted with external social actors.

2.1.4 Protocol for Academics with no Interaction

As opposed to the previous schedule that bases on academicians that interact with external actors, this one was intended for those who had no interaction. Consequently, the information collected was mainly to identify obstacles to the interaction.

2.2 Response Rate

We decided to interview a mean number of 30 researchers of each Faculty/College that was identified for participation in the study. The exception was for MUHAS where the Institute of Traditional Medicine had a total number of 8 researchers. The exact number of surveyed persons is presented in Table 5.

Table 5: Questionnaires response rate

PROPOSED NUMBER OF INTERVIEWEES PER COLLEGE/ FACULTY/ INSTITUTE	UNIVERSITY AND COLLEGE/FACULTY/ INSTITUTE	TOTAL INTERVIEWEES	RETURNED QUESTIONNAIRES	RESPONSE RATE
	UDSM	120	88	73.3
30	College of Engineering and Technology (CoET)			
30	University of Dar es Salaam Business School (UDBS)			
30	UDSM School of Education (UDSE)			
30	College of Natural and Applied Sciences (CoNAS)			
	SUA	120	93	77.5
30	Faculty of Science			
30	Faculty of Forestry And Nature Conservation			
30	Faculty of Veterinary Medicine			
30	Faculty of Agriculture			
	MUHAS	68	19	27.9
30	School of Medicine			
30	School of Public Health			
8	Institute of Traditional Medicine			
	OVERALL	308	200	64.94

Source: own draft

Note:

(1) Proposed number of interviewees per college/faculty/institute

Were the total questionnaires that were planned to be distributed to researchers per college/faculty/institute

(2) Total interviewees

Were the total questionnaires distributed to the researchers to the University. This sums all questionnaires in (1) above

(3) Returned questionnaires

These were the questionnaires that were actually filled in and returned to us

(4) Response rate

Equal to (3)/(2)

2.3 Selection of participating universities

For our research public universities and public research institutes had to be selected as research sites. The participating Tanzanian universities that were selected were the oldest and well established ones in terms of enrollment and research. Given that the Tanzania economy is agricultural led, it was considered mandatory to include one agricultural university. The reason to also include a medical university was due to the perceived research findings in tropical diseases which are frequently occurring in the country. The universities that were therefore selected are: the University Dar es Salaam (UDSM), the Sokoine University of Agriculture (SUA) and the Muhimbili University of Health and Allied Sciences (MUHAS). The general research characteristics of the three universities are summarized in Table 6.

Table 6: Characteristics of participating Universities

SNO.	NAME OF UNIVERSITY	AREA OF SPECIALIZATION	EXISTING COMMUNITY INTERACTIONS
1	University of Dar es Salaam (UDSM)	College of Arts and Social Science (CASS) - Entrepreneurship, marketing, business development	Outreach tailor made training programs on entrepreneurship, business development and marketing to rural women communities
		College of Natural and Applied Sciences (CoNAS) - natural resources utilization/extraction, small scale mining	Development of natural dyes and training on application of the same to the boutique entrepreneurs; Training schemes to rural communities on environmental-friendly extraction methods
		College of Engineering and Technology (CoET) - Rural agro processing technologies, small-scale mining, skills development to rural communities, low cost housing, environment, rural energy systems	Rural technologies transfer for agro processing, mining, soap making, low cost housing, environment, energy
2	Sokoine University of Agriculture (SUA)	Agriculture, animal husbandry, poultry, rural technologies and entrepreneurship, forestry and environmental conservation, nutrition, extension services	Disseminating appropriate techniques for agriculture and climate change, animal husbandry, poultry, breeding technologies, forestry, nutrition and environmental conservation
3	Muhimbili University of Health and Allied Sciences (MUHAS)	Malaria, HIV/AIDS, traditional medicine (indigenous knowledge), health livelihood, community health	Development of malaria vaccines and protective technologies, training on health livelihood and community health; development and testing traditional medicine for treating tropical diseases like elephantiasis and hernia

Source: own draft

2.4 Research Tools Administration in the Participating Universities

In order to map the interactions at each university we decided to choose an informant for each university to identify relevant academics who could participate in the study. After discussing with the University management (Vice Chancellor - VC), one academician was appointed by the VC as our focal person for the study. The three informants attended a one day seminar at TIRDO to clarify the project and its research tools/questionnaire. This seminar ensured a participatory and acceptable approach, which was important to the project´s success. The informants later formed a team at their respective university that constituted of persons from different areas such as college managements/researchers and assistant researchers. The informants used prospectus and other university documents as well as web information about the employees to identify those researchers that were later interviewed. The focal person distributed questionnaires and research assistants were responsible for day to day follow up and collection of the questionnaires.

The use of university prospectus assisted to gather a list of all prospective interviewees for each university. The interviewees were therefore by our team supplied with the research tools to fill in. On a daily basis the collection of completed surveys was the responsibility of the collaborators who were also assisted by research assistants.

2.5 Data Analysis Methodology

2.5.1 Data Upload and Compilation

The collected survey tools were exported into Microsoft Excel for qualitative and quantitative analysis. Each respondent was therefore mapped to all questions that were responded. In this way, the summarized response for the individual university and for the three universities, cumulatively, was obtained.

2.5.2 Weighted Average Index (WAI)

Further exploration of the data from the Microsoft Excel sheet was done by calculating the average/mean weighted average index (WAI) for each item based on a Lickert scale response was done. Averages for each item were calculated for each institution and also for the total survey population. The averages were then sorted in descending order by dimension within each institution and within the total survey population in order to form an index of weighted averages. This was done to facilitate the exploration of the importance of each variable within each dimension and within each institution. The following dimensions were included in the

analysis: types of external social partners (30 variables), types of relationships (25 variables), channels of information (20 variables), outputs (12 variables), outcomes and benefits (20 variables), obstacles and challenges (13 variables), reasons for non-engagement (13 variables). The weighted average index for each variable was calculated by dividing the sum of the responses for each variable (a value between 1 and 4) by the number of responses. The formula indicated in equation 1 below was used in calculation of the WAI:

$$WAI = \frac{\sum_{i=1}^{4} F_i W_i}{N} \quad (1)$$

Where *F* equals the frequency of a specific value (between 1 and 4) selected by the respondents, *W* equals the actual value selected, i.e. the weight (value between 1 and 4) and *N* represents the number of responses.

2.6 Methodology for Part 2 on cases of Livelihoods

Semi-structred interviews were the main method used to collect data for the case study component of this study. These interviews were conducted with project implementing researchers from the individual universities and the respective partners of these projects. Thus, project team leaders were interviewed separately, the discussion of which revealed the required information from the researchers themselves. The information gathered from the researchers included organizational arrangement, structure of the interaction, reasons and motivation of the interaction, perceived innovation and results of the project. After researchers' interviews, project beneficiaries from the implementing communities were interviewed in June 2014. This was important for collecting their independent views on the projects. The beneficiaries' views and feedback on their backgrounds, social settings, their participation and roles in the project, innovation, technology transfer, and results of the project were thus collected. At the community level the interviews were therefore conducted with village leaders and the individual beneficiaries. The available interviewees in the community were randomly selected to represent the existing partners. The selection also tried to reach a gender balance. The following table shows the types of participants interviewed and the number of participants interviewed from each of the three case studies.

Table 7: List of interviewees

SNO	INTERVIEWEES	NUMBER AND DETAILS
1	Project Team Leaders	3: • 1 College of Engineering and Technology (CoET) Project Leader – CIMA crusher • 1 Sokoine University of Agriculture (SUA) Project Leader – banana • 1 Institute of Marine Science (IMS) Project Leader – Seaweed
2	Village and Group Leaders	7: • 1 Umoja ni Nguvu Women Group, Tegeta Mtongani quarry – Crusher • 1 Mwarusembe village, Mkuranga – Banana • 2 Wakulima wa Migomba na Uhifadhi wa Mazingira, Hembeti Village, Turiani – Banana • 2 Tusife Moyo Women Cooperative, Kidoti village – Seaweed • 1 Bado Tupo Bweleo Group, Bweleo village – Seaweed
3	Project beneficiaries	33: • 4 Umoja ni Nguvu Women Group - Crusher • 4 Mwarusembe village, Mkuranga – Banana • 9 Wakulima wa Migomba na Uhifadhi wa Mazingira, Hembeti Village, Turiani – Banana • 14 Tusife Moyo Women Cooperative, Kidoti village – Seaweed • 2 Bado Tupo Bweleo Group, Bweleo village – Seaweed
TOTAL:		**43**

The mapping exercise identified various potential case studies from each university, however, selection of the cases for conclusion in the detailed analysis based on meeting a set of selection criteria with respect to the presence of innovation, informality setting, participation of marginalized communities, and livelihoods. The extent of community participation was also considered as an important aspect.

By assessing the identified three case studies, part 2 on livelihood cases will present an analysis of the role of the interviewed universities with respect to their potential contribution to inclusive development and innovation in informal settings. This includes their ambition and capability of improving livelihoods of marginalized groups. The presented three cases investigate and present the extent of involvement of the communities, the degree of participation of diverse actors of the communities and the type of interaction with the particular university. The cases document the motivating factors behind the initiation of the project, its

success and constraints with respect to different forms of innovation (product innovation, process innovation, market innovation and organizational innovation) as well as the development of technological capabilities in the context of the project and finally an analysis of enablers.

For the purpose of structuring the case study interviews, presented in appendix 4 are the checklists that guided the main areas of interview with the individual project team leaders and the respective individual beneficiaries. Further to the interview, available project documents were utilized to compliment the information.

3. THE ROLE OF THE NATIONAL HIGHER EDUCATION SYSTEM IN RELATION TO THE OVERALL INNOVATION SYSTEM IN TANZANIA

This chapter is a contextual chapter that analyses the higher education system in Tanzania in relation to the overall innovation system. After introducing a brief history of Tanzania, the chapter presents and discusses the existing informal economy. This is deemed important since the Tanzanian economy is largely supported by small holder informal settings and the informal sector is at the core of the UNIID focus. Furthermore, this chapter sets the scene for our selected cases presented in part 2by contextualizing them in the national higher education and innovation system landscape of Tanzania. .

3.1 Historic Background

On 26th April 1964, the United Republic of Tanzania was formed by uniting two sovereign states, Tanganyika and Zanzibar. Tanganyika became a Sovereign State on 9th December 1961 and a Republic in 1962. Zanzibar became independent on 19th December 1963 as a constitutional monarchy under the Sultan and the People's Republic of Zanzibar was established after the Revolution of 12th January 1964. Tanzania is the largest country in Eastern Africa with a surface area of 886,100 km². According to the 2012 population and housing census the population of Tanzania is 44,928,923 out of which 21,869,990 are males and 23,058,933 females. Currently, Tanzania has 30 administrative regions shown in Figure 2.

Key social indicators for Tanzania are detailed in Table 8 below. The statistics show that the population has increased by more than thirteen million people during the years 2000 to 2012. The life expectancy is still low, with an average age of 56 in 2008 and it increased to about 60 in 2012 (for comparison, the world average life expectancy was 69 in 2007) and a high infant mortality rate of about 54% currently. The literacy rate is somewhat higher for males, with 86%

in 2000 compared to 78% for females, which has decreased to 79% for men and 76% for women in 2007.

Table 8: Social indicators for Tanzania

SOCIAL DATA	YEAR							
	2000	2005	2007	2008	2009	2010	2011	2012
Population total (millions)	34.1	39	41.3	42.5	43.6	45.0	46.4	47.8
Life expectancy at birth, total (years)	51	54	55	56	58	59	60	..
Mortality rate, under -5 (per 1, 000)	143	124	116	..	66	62	57	54
Literacy rate (youth female, % of females ages 15-24)	78	..	76	..	76	..	..	..
Literacy rate (youth male, % of males ages 15-24)	86	..	79	..	..	78	..	..

.. Data not available

Source: The World Bank, (2013)

3.2 The higher Education System in Tanzania

As detailed in Table 5, the expenditures on education in general and higher education in particular have increased drastically over the past ten years. The number of higher learning institutions in Tanzania has also grown over the past years (Table 9). The number is somewhat fluctuating due to the on-going restructuring in the higher education system. While the number of public full Universities has increased from five in 2005 to eight in 2008 and further to 11 recently, the number of public university colleges has remained rather stable, from three in 2005 to four in 2007, and dropped to 3 again in 2012. However, the public full Universities showed an increased trend from 5 in 2006 and jumped to a stable number of 8 Universities and then recently to 11 Universities in 2012. On the other hand, private Universities, after a long stagnation at only 10 Universities, increased suddenly to 19 Universities in 2012. Teacher training colleges have exhibited a consistent increasing trend over the whole analyzed period.

Table 9: Tanzania higher education expenditure data

FINANCIAL YEAR	TOTAL EDUCATION EXPENDITURE (MILLION TANZANIA SHILLLINGS)	HIGHER EDUCATION EXPENDITURE (MILLION TANZANIA SHILLLINGS)	TOTAL EDUCATION EXPENDITURE (% GDP)	HIGHER EDUCATION EXPENDITURE (% GDP)
1998/99	107,457	19,000	1.59	0.28
1999/00	138,583	32,494	1.80	0.42
2000/01	218,051	46,679	2.53	0.54
2001/02	323,864	57,015	3.31	0.58
2002/03	396,780	70,540	3.52	0.63
2003/04	487,729	86,140	3.74	0.66
2004/05	504,745	84,315	3.37	0.56
2005/06	669,537	138,059	3.97	0.82
2006/07	958,819	209,859	5.08	1.11
2007/08	1,100,188	287,876	5.16	1.35

Table 10: Number of higher learning institutions in Tanzania

CATEGORY	YEAR						
	2006	2007	2008	2009	2010	2011	2012
Total Higher Learning Institutions:	**45**	**33**	**32**	**33**	**33**	**33**	**49**
Public Full Universities	5	8	8	8	8	8	11
Public University Colleges	4	4	3	4	4	4	3
Private Universities	17	10	11	11	11	11	16
Private University Colleges	19	11	10	10	10	10	19
Total Teacher Training Colleges:	**54**	**55**	**66**	**77**	**92**	**109**	**105**
Public	32	32	32	34	34	34	34
Private	22	23	34	43	58	75	71

Source: National Bureau of Statistics, (2012)

3.3 The Research and Development System

The government has established supportive industrial research and development (R&D) organizations. All major national research and development institutes of Tanzania are affiliated to the Tanzania Commission for Science and Technology (COSTECH), which is a governmental body responsible for science and technology (S&T) landscape. It is a parastatal organization that was established in 1986 by Act of Parliament No. 7 as a successor to the Tanzania National Scientific Research Council. It started operating in 1988 and is responsible for the co-ordination and promotion of research and technology development activities in the country. One of COSTECH's major roles is to provide advice on S&T policy formulation and

implementation matters. It is the chief advisor to the government concerning all issues on science and technology and their application to the socio-economic development of Tanzania. COSTECH reports to the higher authority, the Ministry of Communication, Science and Technology.

COSTECH categorizes research institutions into four main groups: agriculture and livestock institutions, industry and energy institutions, natural resources institutions, and medicine and public health institutions. The number of institutions under each category is 30, 9, 4, and 6, respectively. This shows a clear dominance of agriculture being the main pillar of the economy. The key industrial research institutes include Tanzania Industrial Research and Development Organization (TIRDO), Tanzania Bureau of Standards (TBS), National Construction Council (NCC), National Housing and Building Research Agency (NHBRA), Tanzania Automotive Technology Centre (TATC), Tanzania Engineering and Manufacturing Design Organization (TEMDO), Tanzania Atomic Energy Commission (TAEC), Centre for Agricultural Mechanization and Rural Technology (CAMARTEC), and Small Industries Development Organization (SIDO). These aim to enhance industrial R&D in the country and perform most of R&D, being the main actors in the overall innovation system.

3.4 The Informal Sector in Tanzania

After this macro oriented presentation of socio-economic features, industrial development and growth in the formal economy, the following sections proceed with an overall profile of the informal economy in Tanzania. Before doing so, the difficulty to estimate the exact size of the informal economy (ILO, 2002) should be taken into consideration. However, the measurement methods for capturing the size of the informal economy and how it contributes to national accounts exist. The informal economy data does not include agriculture, which is included in the total workforce and results in underestimation of the informal sector. As a consequence, the use of GDP as an indicator for economic development is, for instance, not always accurate in providing a picture of the situation in the country (Charmes, 2002).

Household surveys or mixed surveys were recommended as best suited to describe economic activities in the informal economy most accurately (Flodman, 2004). The surveys are carried out based on the new 1993 ICLS definition in which sample of households is identified and the specific criteria and classification of employees are used to identify those considered to belong to the informal economy.

According to estimates, 34% of all households in Tanzania mainland are participating in activities considered to be situated in the informal economy. In urban areas such as Dar es Salaam, the number is higher, with 55% of households estimated to be participating in activities situated in the informal economy. However, as mentioned above, it is difficult to strictly apply the concept of informal sector, as surveys do not generally include questions on the economic unit in which the employee works. Comparisons then have to be made with data on establishments or enterprises (surveys or administrative records). The degree of approximation will depend on the quality of the sources used (Flodman, 2004: 15). On average, an informal enterprise is operating 8 months per year. One third of all informal personnel are employers. Trade, restaurants and hotels constitute the highest proportion of the overall informal work force in Tanzania. This differs, though, from region to region.

According to the Small and Medium Enterprise Development Policy (Ministry of Industry and Trade, 2002), the first socio-economic study of the informal economy in Tanzania was carried out in 1991 as a response to international donors and the Government's interest in further developing and specifically addressing barriers to the informal economy. In this first comprehensive survey, the informal economy was profiled as consisting of about 1.7 million enterprises with 60% located in rural areas. The findings of the survey revealed that most of the employees were not formally skilled (80%) or trained in the job (10%) with skilled artisans making up to 5% only. The training in the enterprises was usually provided for paid and sometimes unpaid employees.

More work has been produced on the informal sector in Tanzania since that first survey. An important policy document was the National Policy for Informal Sector Promotion (The United Republic of Tanzania, 1994). This document addresses key constraints and offers specific strategies for the reform of the informal sector. It also differentiates between "micro-enterprise" and "subsistence" as two different categories. The former captures those enterprises that demonstrate the capability to expand and create wealth, while the latter covers those enterprises whose operations are purely strategies to survive, which make up the majority of the sector. The policy document pointed to the importance of structural change in order to facilitate operations and expansion opportunities for the enterprises. Access to loans, to new technologies and marketing capabilities as well as the importance of education and training was also stressed out.

Tanzania has tried to eradicate informal economy activities through specific policies since the beginning of the 1970s. The ideological view during the seventies was the vision of a classless society and the understanding of informal activities being corrupt since they operated outside

the legal system. The severe economic challenges that followed during the 1980s and strong pressure from international donors forced politicians to reconsider this part of the Tanzanian economy and instead consider the socio-economic potential that the informal economy offers. Since then, a number of studies and Policy documents have been produced by national and international agencies as well as the government with the overall aim to provide assistance and incentives for informal economy entrepreneurs and enterprises to increase their production and further develop their businesses. However, the attempts and policy actions during the 1980s failed to tackle the informal economy challenges in a more nuanced way and did not separate established enterprises from unemployed persons with criminal activities. Furthermore, it had proved difficult to identify relevant client groups due to lack of coordination in the public sector along with lack of reliable data (Kahama et al., 1986). The rapid growth of informal economic activities in rural and urban areas during the 1980s was not the government's intention. It was the result of survival strategies of many people, as sufficient commodities were not offered to all those in need, including the very poor, but were offered to those businesses operating in the formal economy (Kahama, 1986; Maliyamkono and Bagachwa, 1990).

This situation remained the same during the 1990s partly due to a continuous decline of formal sector wages together with an increasing number of unemployed young people. Even formal economy employees were forced to seek additional income through informal economic activities. It has been estimated that more than 70% of publicly employed persons may be involved in one or more activities in the informal economy. Since the late 1980s and 1990s, though, a number of studies have investigated the potential of the informal sector in terms of income generation as well as employment (Kent and Mushi, 1995). Researchers on Tanzania informal economy (Bagachwa and Ndulu, 1975; Aboagye, 1985; Tripp, 1989; Komba, 1989; Wagao, 1989; Katabaruki, 1990; Maliyamkono and Bagachwa, 1990; ILO, 1991) argue that the semi-organized and unregulated activities undertaken largely by the self-employed persons, which constitutes the informal economy provides latitude and flexibility for a broad range of decisions in terms of personal initiative and innovation, the size of the enterprise, the choice of technique and the utilization of income. Once opportunities and incentives exist, this potential base may rapidly expand. These different studies consistently find that the sector is relatively more labour-intensive, efficient, profitable and saves more on skilled labour and foreign exchange and can generate more jobs with smaller capital outlays than large scale formal sector activities. It also reduces its vulnerability to external shocks compared with the levels faced by the formal sector. Moreover, there is also considerable evidence that entrepreneurs can mobilize their own savings. Despite these benefits and the assumed potential of the informal economy, there is also a long list of constraints such as lack of capital for financing

informal sector enterprises either to start operating, or to encourage growth; lack of infrastructure such as business, premises with the appropriate utilities (water and electricity) and marketing; scarcity of raw materials; lack of encouragement from the local government, which inhibits expansion and lack of implicating the potential of the sector to absorb unproductive labour; limited access to formal technical and vocational training, which makes it difficult for most of the entrepreneurs to obtain the required skills, both technical and managerial; and lack of relevant knowledge and skills like technical knowledge, as the majority of informal sector operators have primary-level education. Many of these constraints could be addressed if the University institutions were to play a supporting role when engaging in interactions with informal sector agents, specifically by providing machines and knowledge to the informal businesses (Szogs, 2010).

3.5 Concluding Remarks

Tanzania is the largest country in Eastern Africa with a surface area of 886,100 km² and a population of 44,928,923 inhabitants. After a socialist state controlled economy that existed after independence, the second half of the 1980s saw economic reforms that put the macro-economic frame back on track. The economy has been transformed from state controlled to market based. Over the last decade a number of reforms and initiatives have been made in order to further improve the investment climate, promote growth and improve livelihoods. The economy is characteristically developing, which is supported by agriculture where 80% of the population is employed. There are, however, emerging sectors like mining and tourism that show an increasing contribution to the economy. The performance of these sectors has contributed to an impressive macro-economic growth at an average GDP growth of between 6.6 to 7.1%. The GDP growth is expected to increase consistently due to the government's effort in promoting the sectors of minerals, tourism, energy, and agriculture. For this to happen sustainably, a new national STI policy has recently been drafted. R&D is one important aspect, the increasing higher education's performance is also of critical importance. At present, the performance of higher education and research organizations is not satisfactory and their potential not fully exploited. The results of our analysis showed that there is an overall increase of the number of public universities from 5 in 2000 to 11 in 2012 whereas the number of other research organizations remained almost constant. The performance of these research organizations in terms of publications and registration of patents showed an increasing trend for the period covering year 2000 to 2008. However, indicators such as KI (knowledge index) and KAM (Knowledge Assessment Methodology) were decreasing. The KAM index for Tanzania dropped by 1.06, from 2.85 in year 1995 down to 1.79 in 2012. These indicators show the contribution of science, technology and innovation to the socio economic development of a

country, hence the low KAM score is a dwindling performance of the research and development system in Tanzania. We think and propose that this challenge can be addressed by the government if the higher learning institutions and research organizations were positioned to play their role in developing and intermediating technology development in the country.

Part 1 of our case study – which follows below – is therefore paying specific attention to the way how three representative Tanzanian universities are interacting with external social actors in the national innovation system as well as with international research collaborators or other actors (in particular donors) in order to understand their pattern of interaction and the channels for their knowledge flows as well as identify possible hinder in the full realization of their potential.

4. PART 1: FINDINGS ON MAPPING INTERACTIONS AT THREE UNIVERSITIES

This chapter presents the findings of our questionnaire and interviews conducted for the first part of this research. The chapter is structured as follows: each university is first briefly described, presenting an overall picture of the vision and mission, enrolment statistics as well as a short analysis of their policies with respect to our overall research interest on the interactions of the university with external stakeholders. This is then followed by a presentation of the results of our questionnaires covering specific matters on interactions, the specific channels through which they interact, which outputs that have been achieved as a result of interaction as well as a focus on benefits and obstacles to interact with external partners. We start with Sokoine University of Agriculture (SUA), continue with the University of Dar es Salaam (UDSM) and end with Muhimbili University of Health and Allied Sciences (MUHAS).

As shown in the organizational structures of each university, the College Principals/Deans/Directors are answerable to the top university management in all matters pertaining to administrative and financial issues. At a college level, they are autonomous to design for example their research work and academic programs. However, these must usually be blessed by management structures and later be forwarded to the top university bodies like senate and councils for approval. This applies to all three universities.

It is important to note that these are government universities and that the autonomy is limited within the organized way. Moreover, even the financial expenditures are limited and controlled centrally. Any potential additional expenditure by of a college principal must be approved by the relevant University bodies.

4.1 Sokoine University of Agriculture (SUA)

The history of Sokoine University of Agriculture (SUA) dates back to 1965 when it started as an Agricultural College that offered diploma training in the discipline of agriculture. With the dissolution of the University of East Africa and the consequent establishment of the university of Dar es Salaam (UDSM) in July 1970, the College was transformed into a Faculty of Agriculture of the UDSM and thereby started offering Bachelor of Science in Agriculture. In 1974, the Division of Forestry was established and hence the faculty was named Faculty of Agriculture and Forestry. The introduction of Bachelor of Veterinary Science in 1976 and the establishment of the Division of Veterinary Science, the Faculty was re-named "Faculty of Agriculture, Forestry and Veterinary Sciences". The Faculty was on the 1st of July 1984 transformed, through Parliamentary Act No. 6 of 1984, into a full-fledged University and became known as Sokoine University of Agriculture (SUA) with the Faculty of Agriculture, Faculty of Forestry and Faculty of Veterinary Medicine.

Table 11 provides an overview over the different academic and research units at SUA which is followed by a box that lists the various departments belonging to the different faculties.

Table 11: SUA academic and research units

SNO	NAME OF RESEARCH CENTRES	NAME OF ACADEMIC UNITS /FACULTY	CAMPUS
1		Faculty of Agriculture (FoA)	
2		Faculty of Forestry and Nature Conservation (FoF & NC)	
3	Pest management centre	Faculty of Veterinary Medicine, Faculty of Sciences and Pest Management Centre (FVM)	
4		Faculty of Science (FoS)	
5		Institute of Continuing Education (ICE)	
6		Development Studies Institute (DSI)	Main campus
7	Computer centre	Computer Centre (CC)	Main campus
8	SUA centre for Sustainable Rural Agriculture	SUA Centre for Sustainable Rural Development (SCSRD)	Main campus
9		Sokoine National Agriculture Library (SNAL)	

Source: Sokoine University of Agriculture Prospectus 2012/2013

The Computer Centre and the SUA Centre for Sustainable Rural Development are independent units, like faculties.

Box 1: SUA ACADEMIC DEPARTMENTS

1) FACULTY OF AGRICULTURE
Animal Science and Production
Food Science and Technology
Agricultural Education and Extension
Agricultural Engineering and Land Planning
Crop Science and Production
Soil Science
Agricultural Economics and Agribusiness

2) FACULTY OF FORESTRY AND NATURE CONSERVATION
Forest Biology
Forest Engineering
Forest Economics
Forest Mensuration and Management
Wood Utilization
Wildlife Management

3) FACULTY OF VETERINARY MEDICINE
Veterinary Medicine and Public Health
Veterinary Surgery and Theriogenology
Veterinary Microbiology and Parasitology
Veterinary Physiology
Veterinary Pathology
Veterinary Anatomy

4) FACULTY OF SCIENCE
Physical Sciences
Social Sciences
Biological Sciences
Mathematics and Biometry
Informatics
Education

SUA is offering 30 undergraduate and 45 postgraduate degree programs. It also offers non-degree programs including certificates and diplomas. The university has a total of 7,228 student population of which 1,553 are postgraduates, 5,475 are undergraduates, 152 are diploma and 48 are certificates students. It has a total of 1,343 employees, 503 are academic members of staff of whom 58% are PhD holders and 835 are administrative staff of whom 36% are female. To date, SUA is the only university in Tanzania that offers degree programs in the broad field of agriculture.

SUA's main campus is located in Morogoro municipality where it owns 3,350 hectares of land for training, research and production. In addition to this, there are also 840 hectares of forest land in Arusha region, 320 hectares of virgin forest for research in the Usambara mountains belonging to Tanga region, and 500 hectares of miombo woodlands in Kitulanghalo within Morogoro region.

The other three SUA campuses are Solomon Mahlangu Campus (SMC) in Morogoro municipality, SUA Training Forest (SUATF) Olmotonyi in Arusha region, and Mazumbai Forestry Reserve in Tanga region. The University also has one Constituent College, the Moshi University College of Cooperatives and Business Studies (MUCCoBS) which is located at the foot of Mount Kilimanjaro in Moshi municipality. The MUCCoBS offers non-degree, Bachelor and postgraduate programmes in the disciplines of cooperative and business studies. These campuses are strategically located to provide agricultural intervention in the specific geographical locations. This is because each location has different soil characteristics, which grows its typical agricultural produce. In this respect the kind of interaction required is also specific.

4.1.1 SUA Vision and Mission

The vision and mission of SUA are “to become a centre of excellence and a valued member of the global academic community in agriculture, natural resources, rural development and other related fields with emphasis on implementing practical skills, entrepreneurship, research and integration of basic and applied knowledge in an environmentally friendly manner”. (SUA Charter, 2007: 3). The mission of the university is “to promote development through training, research, provision of services to the public and private sector in an environmentally friendly manner” (ibid). It further sets out to conduct research for sustainable development of Tanzania with the goal to eradicate poverty, to conserve the nature and environment and improve livelihoods, good governance and empowerment of the people.

Thus, by aiming to become part of the global academic community the university explicitly spells out its ambition to link up and connect with external partners in their specific field of expertise. The concrete mechanisms proposed in the policies to achieve this are for instance the encouragement of staff and students to “affiliate with other institutions” and “to accept periods of study and the examinations passed by students of the University at other Universities or places of learning” (SUA Charter, 2007: 11). Also joint collaborations with national as well as international institutions are explicitly spelled out with the intended goal of “mutual benefits of the cooperating institutions and the United Republic” (ibid, 12-13). In addition to its research and teaching function the role of consultancy and advisory services of the university to the government and any other “person or organization of Tanzania or from abroad” (ibid) is stressed as significant. This statement clearly reveals the ambition of this university to serve not only as supplier of trained human resources per se but also as provider of other crucial functions and as embedded in a potential web of different types of national and international linkages.

4.1.2 Review of SUA Policies

In the context of this research, a number of SUA policies were reviewed (see separate section after our reference list on primary documents for the analyzed policies). We found that the higher degrees regulations aim to encourage research by inspiring PhD students to publish their thesis results and present their findings to the scientific community through journal papers. In this context the university output is increased through research and its visibility in the scientific community, as opposed to the monograph format which by its very nature would have limited dissemination opportunities. This may lay the ground for potential further interactions, based on the visibility of the research findings that reach out in the academic community.

The policy documents spell out that SUA aims to provide excellent research for sustainable development in Tanzania. The promotion of inclusive development for research undertakings at SUA is expressed in the policy statement for instance by explicitly including the goal to improve livelihoods and the empowerment of people and links up this goal to the MKUKUTA and Vision 2025 policies and the MDGs. In general, SUA's research policy is to provide leadership in basic and applied research in order to generate new knowledge and innovations that respond to contemporary and emerging needs. SUA thus emphasizes that research needs to be linked to development and societal issues. Furthermore, the university also aims to "create a sense of public responsibility for rural development and the educated" (SUA Charter, 2007:11).

Research, outreach and consultancy services are driven by trained scientists, natural comprised of 452 academic staff, out of whom 50% have Ph.D. qualifications. The research capacity at SUA is further enhanced through collaborative research projects, which are supported by more than 50 memoranda of understanding. That these are in fact taking place is evident from the large variety of past and on-going research projects in these areas. The following list aims to illustrate this point; it is a list of ongoing projects under the "Enhancing Pro-poor Innovation in Natural Resources and Agricultural Value Chains (EPINAV) Programme at SUA". An extensive list of all large research projects at SUA can be found in Appendix 2.

Enhancing Pro-poor Innovation in Natural Resources and Agricultural Value Chains (EPINAV) Programme at SUA:

- Application of Value Chain and Innovation Systems Approaches for Up-scaling and Out-scaling Technologies for Enhancing Integrated Dairy Production System in Njombe District

- Up-scaling of pro-poor innovative dairy goat technologies for improved livelihood security and human capacity in selected highland areas
- Enhancing sunflower production for poverty alleviation in Mvomero and Kilosa districts, Morogoro region.
- Increased Market Access of Beef and Milk From Pastoral System Through Innovative Value Chain Approaches in Breeding, Feeding and Health
- Optimizing production and utilization of lesser known and lesser utilized indigenous agro-forestry timber species
- Increasing market share of locally produced beef through improved cattle husbandry, slaughter operations and meat handling Improving the productivity of NileTilapia (Oreochromisniloticus) through selective breeding and mass production of fingerlings
- Enhancing the revival of Home gardens for Improved Utility and Productivity through the use of Proven Agroforestry Technologies in the Northern Highlands of Tanzania
- Establishing livestock based coping strategies for improved resilience of pastoral and agro-pastoral communities to impact of climate change in Northern Tanzania
- A gendered analysis of climate change impacts and adaptation in semi-arid area farming systems and natural resources management
- Integrated livelihood and natural resource management to adapt dry land communities to climate change
- Supply chain analysis of agricultural inputs under the national agricultural voucher scheme in Tanzania
- Institutional evolutions at macro and micro levels in the management of water catchments and their influences on local community livelihoods under a climate change scenario in Tanzania
- The role of mobile phones towards improving coverage of agricultural extension services: a case study of maize value chain
- Innovative communication pathways in dissemination of agricultural technologies and improving market information in Tanzania: A case of tomato value chains

Source: http://www.erails.net/TZ/sua/sua-/ongoing-research-projects/projects-under-epinav/

In recognition of the importance of information and communication technology (ICT) in the scientific and research community, SUA established its Computer Centre in year 1993 under the Act. No. 6 of 1984 and order made under section 18 (3). This Centre was charged to be the arm of the university responsible for teaching, research and consultancy in areas related to applications of computer technology. The target areas include fields of agriculture (including livestock production), veterinary medicine, forestry and nature conservation, allied science and

other land resource management sectors, with special reference to problems affecting the development of these sectors in Tanzania.

The ICT policy was therefore put in place for coping with the rapid development and expansion in global information technology, and to strengthen coordination, and thus ensure the contribution of ICT within the mandate of Sokoine University of Agriculture.

4.1.3 Enrollment Statistics

For the past seven years the Sokoine University of Agriculture has grown from 2,260 to 5,960 students. This has happened mostly because of the broad newly introduced degree programmes and their perceived relevance in the Tanzania community. Table 12 below shows the trend of students' population by gender.

Table 12: SUA student population by gender

YEAR	MALE	FEMALE	SUB TOTAL	TOTAL*
2000/01	1,372	458	1,830	
2001/02	1,531	520	2,051	
2002/03	1,733	513	2,246	
2003/04	1,630	661	2,291	
2004/05	1,712	734	2,446	
2005/06	1,626	634	2,260	
2006/07	1,718	654	2,372	2,393
2007/08	1,571	670	2,241	3,204
2008/09	2,122	803	2,925	3,575
2009/10	1,026	2,846	3,872	4,767
2010/11	4,036	1,527	5,563	6,744
2011/12	3,899	1,664	5,563	5,960

*Include postgraduates

Source: National Bureau of Statistics, 2012; Tanzania Commission for Universities, 2013

4.1.4 Academic Staff Profile

The academic members of staff are required to attain the highest possible qualifications to enhance their skills to transmit knowledge and also conduct research and consultancy. The majority of the SUA academic staff members have been trained to the level of Ph.D. and masters. This is shown in Table 13 below. The increased staff profile through recruitment and specialized training has resulted in increased student to staff ratio from 8.3 in year 2000 to 11 in 2012. The recruitment is government controlled. All researchers/lecturers are under the central

government payroll. All recruitments need to be requested for approval by the government. The increasing trend of student to staff ratio is detailed in Table 14.

Table 13: SUA academic staff profile

YEAR	PROFESSORS			ASSOCIATE PROFESSORS			SENIOR LECTURERS			LECTURERS			ASSISTANT LECTURERS			TUTORIAL ASSISTANTS			TOTAL
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	
2000/01	23	0	23	42	2	44	68	7	75	46	3	49	23	0	23	11	0	11	225
2001/02	26	0	26	44	3	47	63	5	68	39	7	46	28	0	28	7	0	7	222
2002/03	30	3	33	45	2	47	65	12	77	31	8	39	34	4	38	7	2	9	243
2003/04	30	3	33	53	4	57	55	11	66	43	7	50	46	6	52	10	1	11	269
2004/05	34	4	38	55	4	59	53	11	64	39	7	46	48	7	55	10	0	10	272
2005/06	43	4	47	54	2	56	61	14	75	37	9	46	43	7	50	13	0	13	287
2006/07	49	3	52	60	5	65	46	14	60	56	10	66	39	8	47	18	2	20	310
2007/08	50	5	55	61	7	68	51	11	62	62	7	69	48	11	59	12	6	18	331
2008/09	60	4	64	53	6	59	51	10	61	62	16	78	77	25	102	71	21	92	456
2009/10	65	4	69	51	7	58	52	11	63	63	14	77	79	31	110	70	19	89	466
2010/11	63	5	68	53	8	61	54	12	66	69	17	86	125	44	169	29	8	37	487
2011/12	68	6	74	64	9	73	61	11	72	75	26	101	123	32	155	24	9	33	508

Source: SUA Facts and Figures, 2013

Table 14: Undergraduate student ratio

YEAR	NUMBER OF		STUDENTS STAFF RATIO
	STUDENTS	ACADEMIC STAFF	
2000/01	1866	225	8.3
2001/02	2051	222	9.2
2002/03	2246	243	9.2
2003/04	2291	269	8.5
2004/05	2446	272	9.0
2005/06	2260	287	7.9
2006/07	2372	310	7.7
2007/08	2238	331	6.8
2008/09	2925	456	6.4
2009/10	3872	466	8.3
2010/11	5563	484	11.5
2011/12	5563	508	11.0

Source: SUA Facts and Figures, 2013

4.1.5 Publications Statistics and Patents

As a result of research undertaking at SUA coupled with the efforts of disseminating them, the recent publication in international accredited journals and nationally accredited journals, respectively, stands at 448 and 41 articles. This is detailed in Table 15. Even though this number is quite high we would not interpret this in the direction of drawing on conclusions about a higher emphasis given to publications rather than interaction with external partners, which also appears as a priority point both in the policies as well as in the participation of actual research projects with the international community as well as domestic partners.

Table 15: SUA academic publications

SNO	PUBLICATION	NUMBER OF PUBLICATIONS
1	Internationally accredited journals	448
2	Nationally accredited journals	41

Source: own draft

SUA has filed in total 14 patent applications out of which 8 have been awarded. All patents are domestic and none of them are licensed.

4.1.6 Research Undertaken Recently (Past 3 Years)

As shown in Table 16 and Appendix 2 the research projects funded over the last three years were largely funded by international donors. Frequently occurring funding organizations are from the Scandinavian countries, the Norwegian NUFU and the Danish DANIDA and University of Copenhagen. Other European Funds are granted by for instance the German Research Society and the Volkswagen Foundation (also German). Bodies and universities from the US and Canada are also represented (for instance the University of Toronto and IDRC), as well as some United Nations Organizations such as for instance UNICEF and USAID. Other funding like national university funding portfolio was marginally attracted. Consequently, the majority of the research projects were responsive to international competitive open funding.

Table 16: Research funding at SUA

SNO	TYPE OF FUNDING	NUMBER OF PROJECTS	APPROXIMATE TOTAL FUNDING (T. SHS.)
1	National University funds	9	644,393,752
2	International donor funds	175	38,761,286,293

Source: own draft

Most of the research conducted at SUA is applied research (98%) while only a small proportion (2%) is on basic or product development research. Of the total research projects, about 24% of them are related to livestock/dairy production and management, followed by forestry and natural resources (19%), socio-economic and extension (17%) and crop production and horticulture (11%). The rest of the studies are spread out amongst other disciplines like animal health, human nutrition, food science and technology, soil fertility and management.

4.1.7 Mechanisms that Promote Interactions with External Actors

The responses at SUA on the mechanisms that promote interaction of researchers and academicians with external social actors were mainly those associated with professional and nonprofessional forums and newsletters. Tangible tailored mechanisms from local government or even international communities were insignificant. This is shown in Table 17.

Overall, the university supports those who do interact in different forms, such as for instance:

1) Administratively, for instance if such an interaction requires high profile lobbing or clearance from the government or local government, the University management will

always be there for instance to provide supporting letters that the motive behind such a collaboration is either purely academic and that it has the vested benefits to the community. In other cases where necessary the management may be invited to meet for example the district or regional commissioners while introducing the interaction (project) or during the implementation.

2) Usually all the physical infrastructures like buildings, space and the whole manpower of the university is available to support such an interaction (project). This means that students can be involved, laboratories, other staff from other faculties are also eligible for supporting the interactions.

Concerning the set up for collaborations with communities the scenario can vary: the collaborations may start from different projects – they can be university funded, donor supported, government based/funded. Importantly, such interaction can also come from the communities themselves who approach the university for a concrete requirement/assistance. Hence, the setup is quite diverse and does not follow the same procedure for all collaborations.

Important to note is that such collaborations are usually effected by funding since there is a cost to each and every undertaking. So even when for instance the community approaches a university with a concrete request the university has to look for ways to finance it within its funding portfolio or linking to a major funded project, etc.

The academicians that participate in collaboration are usually chosen following general inquiries from the communities/public/donors to the university. These inquiries go directly to the management (VC/Dean/Principal). Upon reviewing the intended intervention the management knows directly which department is responsible and hence the head of department is directed to form a team to respond. The head will definitely know competencies amongst the staff who he/she will task directly. The interaction/project then takes off from there. The academicians involved in such interactions have to find time to deliver the assigned or contracted project. It is possible that they will be exempted from teaching duties during the period of an ongoing project. This fact also explains why some are interacting while others are not because some think that they are already loaded with academic teaching undertakings and feel limited resources in terms of time to engage in additional activities.

Thus, those who are very successful in delivering are those who know how to manage themselves to undertake such interactions by making use of the existing university infrastructure and its manpower by including for instance assistants.

SUA, as an example of how an agricultural university is organized to work with farmers, has different extension mechanisms: they go out and work with farmers, place students to work on farms and bring farmers on to university land. The setup of these universities has a flexible and large capacity to have some model laboratories or fields for demonstration. So depending on the set up of the project/interaction, the project team members are free to bring the farmers to the university for laboratory or class works and later on go to the fields for actual work. Lecturers do go out to the farmers either to explore the problems or to demonstrate how the intervention works or to demonstrate the technology they are disseminating.

Table 17: Mechanisms that promote interactions at SUA

SNO.	MECHANISM	YES	NO
1	Performance management system that rewards interaction or engagement		✓
2	Awards for research		✓
3	Awards for innovation		✓
4	Awards for engaged activity		✓
5	Promotion criteria that rewards interaction or engagement		
6	Open days for external actors	✓	
7	Community forum	✓	
8	Newsletter that promotes interaction or engagement	✓	
9	Specialised funds for promoting research		✓
10	Specialised funds for promoting innovation		✓
11	Specialised funds for promoting interaction with communities		✓
12	Specialised funds for promoting interaction with firms		✓
13	Other – specify		

Source: own draft

4.1.8 Time Distribution of the Academic Functions

Being the core function, teaching at SUA is said to occupy about 60% of the academicians' time. The next in importance is research (20%) followed by interaction with external actors. Administrative roles and other private activities shared each 5% of the time. Table 18 details the time distribution of the academic functions within the researchers at SUA. It should be noted that 20% of the professional time for research is also considerable given the robust research being undertaken at the university.

Table 18: Time distribution of academic functions at SUA

SNO	ACADEMIC FUNCTION CATEGORY	% TIME
1	Teaching	60
2	Research	20
3	Private activities for individual gain	5
4	Interaction with external actors	10
5	Administration	5

Source: own draft

4.1.9 External Social Partners

SUA's main research objective is to provide leadership in basic and applied research in order to generate knowledge and innovations that respond to contemporary and emerging needs of our local and global society. Currently, the university is undertaking more than 130 research projects in various disciplines related to agricultural, natural resource and environment management sciences as well as in socio-economic and human studies. SUA has 9 different focus areas for their research and these are further divided into several sub- areas. Interactions with external partners in these research projects belonging to the various focus areas and sub-fields range from partners at collaborating international universities to domestic collaborators including non-academic partners, hence representing a high number and diversity of interactions.

The quantity of the Weighted Average Index for the SUA (Table 19) sample revealed that the top six (with decreasing order of importance) external social collaborators to be:

a) National universities
b) Individuals and households
c) International universities
d) African universities
e) National government departments
f) Funding agencies

With the highest WAI of 3.42 it is an indication that the national university is partners on a moderate to wide scale with external social actors. However, the university's research activities are inclusive in characteristics. This is because individuals and households including small-scale farmers are among the most important external collaborators. It should be noted that Tanzania agriculture is small holder and that over 75% of the country population is rural. Consequently, most of the research at the university is highly linked to improve the condition of the majority rural community.

Table 19: SUA external social partners

SUA		TOTAL SAMPLE						
	External social actors	Frequencies of selection						
		No of Response	**1**	**2**	**3**	**4**	Total W	WAI
1	Individuals and households	83	4	8	20	51	284	3.42
2	National universities	85	2	10	28	45	286	3.36
3	Small-scale farmers (non-commercial)	83	5	14	16	48	273	3.29
4	Funding agencies	82	3	17	32	30	253	3.09
5	A specific local community	85	8	11	32	34	262	3.08
6	Local government agencies	88	5	19	36	28	263	2.99
8	National government departments	84	3	19	39	23	250	2.98
9	International universities	87	4	24	30	29	258	2.97
10	African universities	85	7	23	29	26	244	2.87
11	Non-governmental agencies (NGOs)	86	11	28	24	23	231	2.69
12	Community organizations	82	12	22	32	16	216	2.63
13	Development agencies	81	13	24	24	20	213	2.63
14	National regulatory and advisory agencies	83	12	28	25	18	215	2.59
15	Provincial/regional government departments or agencies	86	13	25	35	13	220	2.56
16	Science councils	83	12	28	31	12	209	2.52
17	Religious organizations	83	24	21	18	20	200	2.41
18	Small, medium and micro enterprises	84	14	31	31	8	201	2.39
20	Commercial farmers	82	15	30	31	6	192	2.34
21	Schools	85	19	31	25	10	196	2.31
22	Sectoral organisations	82	20	36	19	7	177	2.16
23	Large national firms	84	21	38	18	7	179	2.13
24	Clinics and health centers	83	25	33	17	8	174	2.10
25	Other	15	7	1	6	1	31	2.07
26	Multi-national companies	82	27	35	9	11	168	2.05
27	Welfare agencies	82	29	35	11	7	160	1.95
28	Civic associations	81	31	30	15	5	156	1.93
29	Trade unions	84	39	29	12	4	149	1.77
30	Social movements	82	45	22	11	4	138	1.68
31a	Political organizations	84	50	23	11	0	129	1.54

4.1.10 Types of Relationship

After analyzing the type of relationships at SUA it shows that community-based research projects and research consultancy ranked with the highest WAI values were of 3.21 and 3.13, respectively. As shown above, these consultancies and research works were largely funded by the donor community and to a much lesser extent by the government. It is also expected that the different individual collaborators are contracting the university in ad-hoc consultancies to solve typical agricultural-based problems or to advice on some best practices such as for instance improved species or adaptation to climate change.

In descending order of frequency as shown in Table 20 below there is a wide range of activities that may take primarily engaged forms depending on the channels of interaction and the nature of partners. The top relationship types are:

g) Community-based research projects Research consultancy Collaborative R&D projects Participatory research networks Education of students so that they are socially responsiveContinuing education or professional development Monitoring, evaluation and needs assessment

We here analyzed by aggregating the most frequent. These findings are consistent with marginal differences within the university if we would disaggregate and investigate for the different faculties.

Table 20: Types of relationship at SUA

		TOTAL SAMPLE						
	Types of relationship	Frequencies of selection						
		No of Responses	**1**	**2**	**3**	**4**	Total W	WAI
1	Community-based research projects	85	3	14	30	38	273	3.21
2	Research consultancy	83	4	16	28	35	260	3.13
3	Collaborative R&D projects	85	5	16	33	31	260	3.06
4	Participatory research networks	84	5	17	32	30	255	3.04
5	Education of students so that they are socially responsive	82	9	11	32	30	247	3.01
6	Continuing education or professional development	84	6	19	35	24	245	2.92
7	Monitoring, evaluation and needs assessment	84	8	18	31	27	245	2.92

8	Technology transfer	84	6	23	28	27	244	2.90
11	Customised training and short courses	87	6	21	39	21	249	2.86
12	Work-integrated learning	82	11	17	39	15	222	2.71
13	Design and testing of new interventions or protocols	84	14	20	32	18	222	2.64
14	Collaborative curriculum design	83	12	25	28	18	218	2.63
15	Design, prototyping and testing of new technologies	82	13	21	34	14	213	2.60
17	Service learning	78	14	18	35	11	199	2.55
18	Contract research	84	16	28	18	22	214	2.55
19	Policy research, analysis and advice	82	16	28	25	13	199	2.43
21	Alternative modes of delivery to accommodate non-traditional students	81	23	25	24	9	181	2.23
22	Student voluntary outreach programmes	81	23	27	23	8	178	2.20
23	Expert testimony	81	26	31	15	9	169	2.09
24	Joint commercialization of a new product	81	46	19	9	7	139	1.72
25	Clinical services and patient or client care	84	49	19	8	8	143	1.70
26a	Other	13	10	0	3	0	19	1.46

4.1.11 Channels of Information

As SUA's major objective is teaching from the predominant types of relationships, 'students' were reported on a moderate to wide scale as academicians' main channel of knowledge and information exchange with external social partners. Nonetheless, the WAI of 3.74 for "public conferences and seminars" is very close to that of "students". "Training and capacity development or workshops" (WAI 3.54), "informal information exchange" (WAI 3.33), "popular publications" (WAI 3.14), and reports and policy briefings (WAI 2.88) were the next important channels of information, Table 21.

The least frequency of selection with WAI < 2 were reported to be "technology incubators or innovation hubs", "software development or adaptation for social uses", "spin-off companies and patents", "spin-off firms from the university (commercial or not for profit)", and "patent applications and registration". These that are knowledge intensive are yet to be common channels of information for SUA.

It should be noted that publications in international forums like conferences and peer reviewed Journals are among the channels of dissemination of SUA result. This was also evident from the number of publications in the past three years as described in earlier sections.

Table 21: Channels of information at SUA

		TOTAL SAMPLE						
	Channels of information	Frequencies of selection						
		No of Response	**1**	**2**	**3**	**4**	Total W	WAI
1	Public conferences, seminars or workshops	87	0	4	15	68	325	3.74
2	Students	84	2	7	19	56	297	3.54
3	Training and capacity development or workshops	83	2	5	28	48	288	3.47
4	Informal information exchange	85	2	9	33	41	283	3.33
5	Popular publications	83	4	19	21	39	261	3.14
6	Participatory or action research projects	86	5	16	36	29	261	3.03
7	Reports and policy briefings	86	6	21	32	27	252	2.93
8	Demonstration projects or units	81	6	23	27	25	233	2.88
9	Oral or written testimony or advice	83	12	18	26	27	234	2.82
10	Cross-disciplinary networks with social partners	81	13	20	35	13	210	2.59
11	Interactive websites	85	19	25	23	18	210	2.47
12	Research contracts and commissions	81	18	23	25	15	199	2.46
13	Intervention and development programmes	80	16	30	26	8	186	2.33
14	Radio, television or newspapers	84	21	33	24	6	183	2.18
15	Technology development and application networks	83	27	27	23	6	174	2.10
16	Technology incubators or innovation hubs	83	34	23	19	7	165	1.99
17	Software development or adaptation for social uses	80	52	8	11	9	137	1.71
19	Spin-off firms from the university (commercial or not for profit)	78	50	16	6	6	124	1.59
20	Patent applications and registration	81	56	15	6	4	120	1.48
21a	Other	13	11	1	1	0	16	1.23

4.1.12 Outputs

SUA`s research, outreach and consultancy services are driven by a trained agricultural and natural resource manpower base that comprises more than 460 academic staff, out of which 50% have PhD qualifications.

The analysis of the WAI whose finding is listed in Table 22 suggested that the most frequently reported outputs were the “graduates with relevant skills and values” (WAI 3.67), “academic publications” (WAI 3.67), and “dissertations” (WAI 3.65). These three forms the core function of the University. Other important outputs were mentioned to be “academic collaboration” (WAI 3.30); “reports, policy documents and popular publications” (WAI 3.15); and “new or improved processes” (WAI 2.37). Usually all consultancy works are submitted to the Clients through reports, which were also among the highly responded due to the high level of consultancy activities at the University.

On the other hand, “spin off companies” (WAI 1.58) was among the least responded outputs. This item was also among the least responded in the channels of information at SUA (WAI 1.59). One of the commonly utilized techniques in spin off companies is through technology incubators. Technology incubation is a missing link in Tanzania since most local universities and research centres are lacking this important component. For instance, at SUA we have not observed technology incubators.

Table 22: SUA outputs

		TOTAL SAMPLE						
	Outputs	Frequencies of selection						
		No of Respons e	**1**	**2**	**3**	**4**	Total W	WAI
1	Graduates with relevant skills and values	87	2	2	19	64	319	3.67
2	Academic publications	88	2	2	19	65	323	3.67
3	Dissertations	88	2	3	19	64	321	3.65
4	Academic collaboration	86	4	8	32	42	284	3.30
5	Reports, policy documents and popular publications	86	3	13	38	32	271	3.15
6	New or improved processes	83	22	21	27	13	197	2.37
7	New or improved products	83	27	18	25	13	190	2.29
8	Community infrastructure and facilities	84	20	29	26	9	192	2.29

9	Scientific discoveries	80	19	32	19	10	180	2.25
10	Cultural artefacts	83	42	19	16	6	152	1.83
12	Other	13	8	2	2	1	22	1.69
13a	Spin-off companies	80	46	24	8	2	126	1.58

4.1.13 Outcomes and Benefits

SUA's research focus areas are selected with due consideration to the national development effort. According to the national development vision 2025 and other related policies, the focus is on achieving eradication of poverty, food security, environmental sustainability, good governance and empowerment.

Analysis of the WAI on outcomes and benefits suggested that the most frequently reported outputs were “improved teaching and learning”, “academic and institutional reputation”, “public awareness and advocacy”, “relevant research focus and new research projects”, “training and skills development”, “improved livelihoods for individuals and communities” and “theoretical and methodological development in an academic field”. These seven outcomes and benefits had a relatively equal and high score with WAI above 3. The next in importance outcomes and benefits were mentioned to be improved quality of life for individuals and communities (WAI 3.00), cross-disciplinary knowledge production to deal with multi-faceted social problems (WAI 2,93), and “participatory curriculum development, new academic programmes and materials” (WAI 2.90).

Looking at these outcomes and benefits for SUA mentioned above and as detailed in Table 23, most of the highly ranked outcomes and benefits (with WAI about 3 and above) are academic oriented. The exception is “public awareness and advocacy” and “improved livelihoods for individuals and communities” that are inclusive in nature. It can be inferred that research programs at SUA are oriented to serve the general public to include individual rural households (farmers), which are mostly marginalized. This shows inclusiveness of the research undertaking at SUA.

Table 23: Outcomes and benefits to SUA

		TOTAL SAMPLE						
	Outcomes and benefits	Frequencies of selection						
		No of Response	**1**	**2**	**3**	**4**	Total W	WAI
1	Improved teaching and learning	88	2	6	36	44	298	3.39
2	Academic and institutional reputation	84	2	5	40	37	280	3.33
3	Public awareness and advocacy	85	5	10	30	40	275	3.24
4	Relevant research focus and new research projects	87	2	12	38	35	280	3.22
5	Training and skills development	85	5	12	28	40	273	3.21
6	Improved livelihoods for individuals and communities	83	1	13	42	27	261	3.14
7	Theoretical and methodological development in an academic field	84	6	11	34	33	262	3.12
8	Improved quality of life for individuals and communities	84	2	18	42	22	252	3.00
9	Cross-disciplinary knowledge production to deal with multi-faceted social problems	82	7	18	31	26	240	2.93
10	Participatory curriculum development, new academic programmes and materials	84	8	19	30	27	244	2.90
11	Incorporation of indigenous knowledge	84	9	28	26	21	227	2.70
12	Intervention plans and guidelines	82	14	22	27	19	215	2.62
13	Community-based campaigns	81	13	22	29	17	212	2.62
14	Community empowerment and agency	81	17	19	32	13	203	2.51
15	Community employment generation	82	14	29	27	12	201	2.45
16	Novel uses of technology	81	16	27	25	13	197	2.43
17	Policy interventions	85	14	34	25	12	205	2.41
18	Regional development	84	15	30	30	9	201	2.39
19	Firm productivity and competitiveness	80	27	26	17	10	170	2.13
20	Firm employment generation	80	31	23	18	8	163	2.04
21a	Other	10	8	1	0	1	14	1.40

4.1.14 Obstacles and Challenges

While interacting with external social partners, there are various obstacles and challenges that limit the process. At SUA the most important obstacles and challenges that scored WAI above 3 (Table 24) were mentioned to be:

a) Limited financial resource for competing university priorities (WAI 3.87)

b) Sustainable external funding (WAI 3.46)
c) Competing priorities on time (WAI 3.15)
d) Institutional recognition systems do not reward academic interaction activities sufficiently (WAI 3.08)

The two most important obstacles that are associated with funding from both the government and external funding (particularly donors) are linked to the same problem. The government is usually disbursing insufficient fund to run the universities and that what suffers most is research and extension services since the little available fund is quickly channeled to solve pertinent imminent university problems. On the other hand, donor funding is ad-hoc and has never been consistent because usually it is not aimed at solving the university or national problems but rather to address issues that are important to the donor. Consequently, sustainability of donor funding has never been consistent.

As evident from the review of policies and internal reward systems within the university, there are no apparent and structured reward mechanisms to researchers who engage and interact with external social partners. For the scientists who engage through funded projects, there are personal incentives that accrue from the project activities themselves. However, this is not consistent since the rewards are project oriented and they are not structured into the university channels. The response shows that interaction supporting structures are not coherent in these universities. However, the scientists are interacting with the community from (donor funded) projects. Thus the motive is highly on the personal income and benefits from the project. Terms of reference of the funding agency is therefore decisive on the nature of engagement. The university is not keeping track on those highly interacting for e.g. special reward or recognition.
Thus:

- The personal benefits (rewards) are different from project to project
- The level of participation and motivation to participate or interact is different
- And so is the level of participation

This again has consequences for the benefits to the community and may suggest an inconsistent way for stable, long-term and sustainable inclusive development.

Table 24: Obstacles and challenges for interaction at SUA

		TOTAL SAMPLE						
	Obstacles and challenges	Frequencies of selection						
		No of Response	**1**	**2**	**3**	**4**	Total W	WAI
1	Limited financial resources for competing university priorities	85	1	2	4	78	329	3.87
2	Sustainable external funding	84	4	7	19	54	291	3.46
3	Competing priorities on time	81	6	13	25	37	255	3.15
4	Institutional recognition systems do not reward academic Interaction activities sufficiently	84	7	15	26	36	259	3.08
5	Too few academic staff	84	11	16	19	38	252	3.00
6	Negotiating access and establishing a dialogue with external social partners	85	12	21	31	21	231	2.72
7	Unequal power relations and capabilities in relation to external social partners	81	8	30	24	19	216	2.67
8	Lack of mutual knowledge about partners' needs and priorities	85	16	22	22	25	226	2.66
9	Lack of clear university policy and structures to promote Interaction	85	21	16	30	18	215	2.53
10	University administration and bureaucracy does not support academic Interaction with external social partners	85	32	15	18	20	196	2.31
11	Tensions between traditional and new academic paradigms and methodologies	85	34	23	13	15	179	2.11
12	Legal problems	83	31	27	15	10	170	2.05
13	Risks of student involvement in Interaction with external social partners	81	38	22	15	6	151	1.86
14a	Other	14	9	3	0	2	23	1.64

4.1.15 Reasons for no Interaction

All researchers at SUA that we interviewed are interacting with external social partners. Consequently, this section is not relevant. We think that this response is representative and expect an insignificant difference if we invest more to interview all.

4.2 University of Dar es Salaam (UDSM)

The University of Dar es salaam is the oldest and biggest public university in Tanzania. It is situated on the western side of the city of Dar es salaam, occupying 1,625 acres on the observation hill, and 13 kilometers from the city centre. It was established on 1st July 1970 through Parliament Act number 12 of 1970 and all the enabling legal instruments of the constituent colleges. Prior to 1970, the then University College of Dar es Salaam had started on 1st July 1961 as an affiliate College of the University of London. It had only one faculty, the Faculty of Law, with 14 students only.

In 1963 it became a constituent College of the University of East Africa together with Makerere University College in Uganda and Nairobi University College in Kenya. Since 1961, the University of Dar es Salaam has grown in terms of student intake, academic units and academic programmes. Table 25 details UDSM historical establishment.

Table 25: UDSM establishment

SNO	NAME OF UNIVERSITY/ CAMPUS/INSTITUTE	YEAR ESTABLISHED	LOCATION
1	University of Dar es Salaam (UDSM)	1961	Dar es Salaam
2	Mwalimu Nyerere Mlimani Campus	1961	Dar es Salaam
3	Institute of Marine Sciences	1978	Zanzibar
4	School of Journalism and Mass Communication	2003	Dar es Salaam
5	Dar es Salaam University College of Education	2005	Dar es Salaam
6	Mkwawa university College of Education	2005	Iringa
7	College of Information and Communication Technology	2011	Dar es Salaam

4.2.1 Academic and Research Units

The University of Dar es Salaam has seven academic and research units at the Mwalimu Nyerere Mlimani Campus. These are shown in Table 26.

Table 26: Research centres and units at the UDSM

SNO.	RESEARCH CENTRES UNIT	ACADEMIC UNITS	CAMPUS
1	Centre for Climate Change Studies (CCCS)	IRD	Mwalimu Nyerere Mlimani Campus
2	Centre for Research and Professional Development (CERPD)	UDSoE	Mwalimu Nyerere Mlimani Campus
3	Centre for studies of Forced Migration (CSFM)	UDSoL	Mwalimu Nyerere Mlimani Campus
4	Technology Development and Transfer Centre (TDTC)	CoET	Mwalimu Nyerere Mlimani Campus
5	Tanzania German Centre for Eastern African Legal Studies (TGCL)	UDSoL	Mwalimu Nyerere Mlimani Campus
6	University of Dar es Salaam Entrepreneurship	UDBS	Mwalimu Nyerere Mlimani Campus
7	Research and education for Democracy in Tanzania (REDET)	CASS	Mwalimu Nyerere Mlimani Campus

Source: own draft

UDSM has a large number of different departments. These are listed in the box below:

Box 2: UDSM ACADEMIC DEPARTMENTS

1) COLLEGE OF ENGINEERING AND TECHNOLOGY (CoET)
Department of Transportation and Geotechnical Engineering
Department of Water Resources Engineering
Department of Structural and Construction Engineering
Department of Electrical Engineering
Department of Mechanical and Industrial Engineering, and
Department of Chemical and Mining Engineering

2) COLLEGE OF SOCIAL SCIENCE (CoSS)
Economics
Geography
Political Science and Public Administration
Sociology
Statistics

3) COLLEGE OF HUMANITIES (CoHU)
Foreign Languages and Linguistics
Literature
Fine and Performing Arts
History
Archaeology and Heritage
Philosophy and Religious Studies

4) COLLEGE OF NATURAL AND APPLIED SCIENCES (CoNAS)
Botany
Chemistry
Geology

Mathematics
Physics
Zoology and Wildlife Conservation
Molecular Biology and Biotechnology
Aquatic Sciences and Fisheries

5) COLLEGE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (CoICT)
Computer Science and Engineering (CSE)
Electronics and Telecommunications Engineering (ETE)

6) CONSTITUENT COLLEGES
Dar es Salaam University College of Education (DUCE)
Mkwawa University College of Education (MUCE)

7) SCHOOL OF EDUCATION
Department of Educational Psychology and Curriculum Studies (EPCS)
Department of Educational Foundations, Management and Lifelong Learning (EFMLL)

8) SCHOOL OF JOURNALISM AND MASS COMMUNICATION (SJMC)

9) UNIVERSITY OF DAR ES SALAAM BUSINESS SCHOOL (UDBS)
Accounting
Finance
Marketing
General Management

10) UNIVERSITY OF DAR ES SALAAM SCHOOL OF LAW
Public Law
Private Law
Economic Law

4.2.2 Vision and Mission

The vision, mission, values and guiding theme of UDSM centres are enhanced quality outputs in teaching, research and public service. The university reiterate that research relevance bases on ensuring that research undertaken addresses relevant national or societal problems for attainment of equitable and sustainable socio-economic development of Tanzania and the rest of Africa. UDSM aims to become “a reputable world-class university that is responsive to national, regional and global development needs through engagement in dynamic knowledge creation and application” (https://udsm.ac.tz/?q=mission-vision-and-values). As compared to SUA we see here a less specific focus on interactions even though of course any `dynamic knowledge creation` implies an interactive process between different stakeholders – but this is not explicitly spelled out.

Specific values and mechanisms that are identified to achieve its mission and vision are formulated on the UDSM homepage and presented in the textbox below:

- Academic excellence by ensuring that the pursuit of academic excellence in teaching, research and service to the public is well recognized and forms an important part of the academic and organizational life of the institution.
- Academic integrity by ensuring that all the academic outputs are produced in line with international standards of academic integrity.
- Academic freedom by upholding the spirit of free and critical thought and enquiry, through the tolerance of a diversity of beliefs and understanding, as well as fostering open exchange of ideas and knowledge amongst the staff and/or students.
- "Unrelenting pursuit of scholarly and strategic research, education, training and public service directed at the attainment of equitable and sustainable socio-economic development of Tanzania and the rest of Africa."
- Internationalization through participation in the regional and global world of scholarship, by being receptive and responsive to issues within the international environment, as well as enrolling an increasing number of international students.
- Professional and ethical standards by upholding the highest professional standards and ethical behavior, and through openness, honesty, tolerance and respect for the individual in all disciplines.
- Social responsibility by promoting an awareness of, and providing leadership to respond to, the issues and problems facing society with a view to ultimately solving and alleviating them.
- Developmental responsibility by ensuring that most of the research conducted has an immediate or long-term impact.
- Teaching and learning by creating a holistic teaching and learning environment which is student centred, providing students with social, cultural and recreational opportunities that will facilitate the full realization of their potential for academic and personal growth.
- Institutional autonomy characterized by self-governing structures guided by the University's Council and greater independence of action, while being responsive to societal and development needs or to what is prescribed by the relevant legal instruments.
- Public accountability by ensuring transparent decision making and open review, as well as the full participation of stakeholders in the development of the institution and in major policy shifts.
- Equity and social justice by ensuring equal opportunity and non-discrimination on the basis of personal, ethnic, religious, gender or other social characteristics.
- Strategic planning culture by inculcating it at all levels in the University.
- Research relevance by ensuring that research addresses relevant national or societal problems.
- ICT use of ICT by application of ICT in the enhancement of academic delivery and management.

Source: content adopted from https://udsm.ac.tz/?q=mission-vision-and-values

4.2.3 Review of UDSM Policies

With relevance to the universities and inclusive development, two policies were reviewed: The University of Dar es Salaam Intellectual Property Policy (2008) and the University of Dar es Salaam Research Ethics Policy and Operational Procedures (2010). These policy documents emphasize the importance of carrying out research for purpose of addressing problems and needs of the society.

The University of Dar es Salaam Intellectual Property Policy (2008) states that one of the primary objectives of the University of Dar es Salaam is to carry out research for purposes of addressing problems and needs of the society. UDSM recognizes the impact that research outputs may have in addressing the critical societal needs. The research findings may include new scientific findings and technologies, technological innovations, publications, technical information and data. If properly tapped, the research findings may contribute immensely to the national economy and support the growing private sector. The large pool of resources, in terms of competent researchers in various fields and the technical capabilities of various departments of UDSMrepresent a huge potential for forging links with the private sector in a manner that will steer economic and social development in Tanzania.

The Intellectual Property Policy document addresses all the pertinent issues raised in a manner that is in conformity with the national and international intellectual property regulatory frameworks. The university management strongly believes that researchers, research collaborators, funding agencies, and industries will take into account and abide by this policy in dealing with UDSM The policy is in line with UDSM's Institutional Transformation Programme (2008) that aims at creating an enabling environment for adding or creating value to research through innovation. In the long run, the implementation of this policy is aimed at operating as a stimulus to further research and the creation of sound and mutually beneficial linkages between UDSMon the one hand and stakeholders on the other hand. Ultimately, the effective harnessing of value from the intellectual property assets at UDSM will lead to technological and economic development which will benefit the general public in Tanzania.

On the other hand, UDSM`s Research Ethics Policy and Operational Procedures (2010) policy guidelines highlights the main action points and responsibilities of the relevant organs contemplated under the policy. The guidelines aim at facilitating the smooth operation and the realization of the vision and mission of the university. The policy statements are to guide the general conduct of research within UDSM. The specific policy interventions are operationalized by relevant offices within the university.

4.2.4 Student Enrollment at UDSM

Undergraduate Enrollment

The undergraduate student's enrollment at UDSM has constantly been increasing during the past five years as shown in Table 27 below. The departure of Muhimbili University College of Health Sciences (MUCHS), and the University College of Lands and Architectural Studies (UCLAS) into full-fledged universities have had an insignificant effect on overall undergraduate

enrolment. The enrollment increase ranged from 12,492 in 2003/04 to 17,098 in 2007/08. During the same timeframe the proportion of female students increased from 31% to 37%.

Table 27: Undergraduate student enrolment at UDSM

CAMPUS	NATIONALITY	GENDER	2003/04	2004/05	2005/06	2006/07	2007/08
Main Campus	Tanzania	Female	3168	3990	4380	4348	4064
		Male	6797	7282	7451	6992	6914
		Subtotal	9965	11272	11831	11340	10978
	Others	Female	34	40	47	107	466
		Male	32	31	69	65	655
		Subtotal	66	71	116	172	1121
MUCHS	Tanzania	Female	517	625	616	529	N/A
		Male	987	1191	1322	1233	N/A
		Subtotal	1504	1816	1938	1762	N/A
	Others	Female	8	18	0	5	N/A
		Male	16	16	0	12	N/A
		Subtotal	24	34	0	17	N/A
UCLAS	Tanzania	Female	124	162	167	203	N/A
		Male	789	870	920	1041	N/A
		Subtotal	913	1032	1087	1244	N/A
	Others	Female	5	2	1	1	N/A
		Male	15	27	19	16	N/A
		Subtotal	20	29	20	17	N/A
DUCE	Tanzania	Female			248	886	1378
		Male			284	1216	1985
		Subtotal	0	0	532	2102	3363
	Others	Female					0
		Male					0
		Subtotal	0	0	0	0	0
MUCE	Tanzania	Female				297	491
		Male				618	1145
		Subtotal	0	0	0	915	1636
	Others	Female					0
		Male					0
		Subtotal	0	0	0	0	0
Total	Tanzania	Female	3809	4777	5411	6263	5933
		Male	8573	9343	9977	11100	10044
		Subtotal	12,382	14,120	15,388	17,363	15977

CAMPUS	NATIONALITY	GENDER	2003/04	2004/05	2005/06	2006/07	2007/08
	Others	Female	47	60	48	113	466
		Male	63	74	88	93	655
		Subtotal	110	134	136	206	1121
Grand total			12,492	14,254	15,524	17,569	17098
% Female			31%	34%	35%	36%	37%

Source: University of Dar es Salaam Facts and Figures, (2013)

Postgraduate Enrollment

There were 2552 postgraduate students registered at the university in the academic year 2007/08. The proportion of female students has remained relatively stable for past three years at 27 to 28%. Admission of postgraduate students is a continuous process and therefore their actual numbers vary all the time. Table 28 shows the postgraduate admission profile.

Table 28: Postgraduate student enrolment at UDSM

COLLEGES	**NATIONALITY**	**GENDER**	**2003/04**	**2004/05**	**2005/06**	**2006/07**	**2007/08**
Main Campus	Tanzania	Female	240	465	652	770	710
		Male	615	1162	1857	2085	1833
		Subtotal	**855**	**1627**	**2509**	**2855**	**2543**
	Others	Female	21	39	31	10	2
		Male	28	67	36	25	7
		Subtotal	**49**	**106**	**67**	**35**	**9**
MUCHS	Tanzania	Female	37	37	50	58	N/A
		Male	21	30	86	68	N/A
		Subtotal	**58**	**67**	**136**	**126**	**N/A**
	Others	Female	49	62	1	1	N/A
		Male	0	0	1	1	N/A
		Subtotal	**49**	**62**	**2**	**2**	**N/A**
UCLAS	Tanzania	Female	7	10	19	18	N/A
		Male	33	39	58	66	N/A
		Subtotal	**40**	**49**	**77**	**84**	**N/A**
	Others	Female	0	0	0	2	N/A
		Male	0	0	6	21	N/A
		Subtotal	**0**	**0**	**6**	**23**	**N/A**
TOTAL	Tanzania	Female	284	512	721	846	710
		Male	669	1231	2001	2219	1833
		Subtotal	**953**	**1743**	**2722**	**3065**	**2543**

COLLEGES	NATIONALITY	GENDER	2003/04	2004/05	2005/06	2006/07	2007/08
	Others	Female	70	101	32	13	2
		Male	28	67	43	47	7
		Subtotal	**98**	**168**	**75**	**60**	**9**
GRAND TOTAL			**1051**	**1911**	**2797**	**3125**	**2552**
%WOMEN			34%	32%	27%	27%	28%

Source: University of Dar es Salaam Facts and Figures, (2013)

The current overall enrollment of students, both undergraduate and postgraduate, is shown in Figure 3. The Figure shows increasing trend in both the two regions of before and after academic year 2007/2008, when MUCHS and UCLAS parted off.

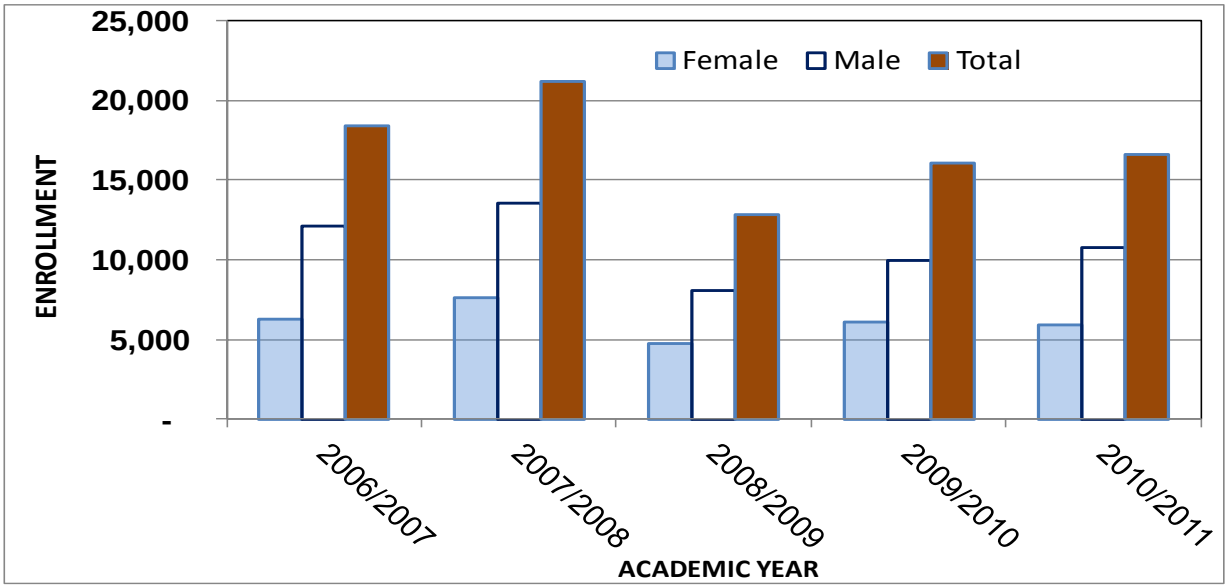

Figure 3: Enrollment at the UDSM

Source: University of Dar es Salaam Facts and Figures, (2013); Tanzania Commission for Universities, 2013

4.2.5 Academic Staff Profile

The University of Dar es Salaam staff categories include academic staff, administrative staff and technical staff (Table 29). In the academic year 2007/08, UDSM as a whole had 1127 academic staff, 1023 administrative staff and 443 technical staff and hence a total of 2593 staff members. Of these 822 are female staff members accounting for 31.7% of the total workforce.

Table 29: The overall number of UDSM staff members

YEAR	ACADEMIC STAFF			ADMINISTRATIVE STAFF			TECHNICAL STAFF			GRAND TOTAL		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
2003/04	783	120	903	460	358	818	328	167	495	1571	806	2377
2004/05	793	123	916	460	358	818	330	170	500	1583	811	2394
2005/06	828	201	1029	697	403	1100	363	95	458	1888	699	2587
2006/07	1058	282	1340	583	527	1110	406	156	562	2047	965	3012
2007/08	898	229	1127	542	481	1023	331	112	443	1771	822	2593

Source: University of Dar es Salaam Facts and Figures, (2013)

4.2.6 Publications Statistics and Patents

The details provided in Table 30 shows that for the past three years total publications in international accredited Journals, national accredited Journals, and institutional Journals for UDSMamounts to six hundred sixty one.

Table 30: Academic publications statistics for the UDSM

PUBLICATION	NUMBER
Internationally accredited journals	661
Nationally accredited journals	
Institutional journals	

Source: own draft

Among the three different universities of our research, UDSM is the only university that has one patent application abroad. It has furthermore 4 domestic patent applications. Two have been awarded and there is 1 licensed patent.

4.2.7 Research Undertaken Recently (Past 3 Years)

For the last three years, a total of seventeen projects were executed at UDSMwith a total value of U. S. $ nineteen million five hundred thousand. As observed in Table 31, the National funding to the research project was not accounted for; usually it is perceived to be marginal.

Table 31: Research projects funded over last three years

NAME	NUMBER OF PROJECTS	APPROXIMATE TOTAL FUNDING
National University funds		
International donor Funds	17	19.5 Million US Dollars

Source: Own draft

4.2.8 Mechanisms that Promote Interactions

Apparently, there are no tangible mechanisms in promoting interactions at UDSM Efforts in promoting interactions through special awards and recognition, promotion-based, or specialized funding are not put in place. The response shown in Table 32 indicate that existing mechanisms bases on “open days for external actors”, “community forum”, and “newsletter that promotes interaction or engagement”. These mechanisms are not effective since they are open and not enforced.

Table 32: Mechanisms that promote interactions at the UDSM

MECHANISM DETAILS	YES	NO
Performance management system that rewards interaction or engagement		✓
Awards for research		✓
Awards for innovation		✓
Awards for engaged activity		✓
Promotion criteria that rewards interaction or engagement		
Open days for external actors	✓	
Community forum	✓	
Newsletter that promotes interaction or engagement	✓	
Specialised funds for promoting research		✓
Specialised funds for promoting innovation		✓
Specialised funds for promoting interaction with communities		✓
Specialised funds for promoting interaction with firms		✓
Other – specify		✓

Source: own draft

4.2.9 Time Distribution of the Academic Functions

Being academic institution, about 75 percent of the time is spent on teaching activities whereas about 35 percent is for research undertaking. The remaining 5 percent is shared for interaction with external actors and for other administrative activities. This is detailed in Table 33.

Table 33: Time distribution of the academic functions at UDSM

SNO	ACTIVITY DESCRIPTION	% TIME
1	Teaching	75
2	Research	20
3	Private activities for individual gain	0
4	Interaction with external actors	5
5	Administration	

Source: own draft

4.2.10 External Social Partners

Measurement of the Weighted Average Index (WAI) for the UDSM sample revealed strong trend since the highest WAI of 3.35, is an indication that the university is partners on a moderate to wide scale with external social actors.

By considering that those with a WAI above 2, which means that they are engaged with in isolated to moderate instances, the partners are, in rank order: national universities, individuals and households, african universities, national government departments, development agencies, non-governmental agencies (NGOs), national regulatory and advisory agencies, schools, small, medium and micro enterprises, a specific local community, a specific local community, science councils, large national firms, community organizations, religious organizations, and sectoral organizations.

These details presented in Table 34 are the strong trends aggregating across the sample for this university. But some of the factors revealed that there are certain partners that have a low WAI, that are strongly associated with specialized knowledge fields, such as clinics or trade unions. It is not expected that they would be common partners across a wide range of academic fields, so a low WAI does not necessarily mean low engagement with these partners. In a similar manner, it is also worth to mention that small-scale farmers (non-commercial) scored a low WAI of 1.87. For a non-agricultural biased university like UDSM it is not possible that majority of the academicians will interact with this marginalized community. Strong interactions with this community were observed in technology Colleges like the College of Engineering and Technology (CoET).

Table 34: External social partners for UDSM

EXTERNAL SOCIAL ACTORS	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
National universities	83	2	10	28	43	278	3.35
Individuals and households	82	11	15	29	27	236	2.88
International universities	82	8	19	34	21	232	2.83
African universities	83	8	19	37	19	233	2.81
National government departments	82	8	18	38	18	230	2.80
Funding agencies	74	9	21	23	21	204	2.76
Development agencies	81	11	19	34	17	219	2.70
Non-governmental agencies (NGOs)	82	9	26	29	18	220	2.68
National regulatory and advisory agencies	83	14	24	28	17	214	2.58
Schools	80	17	21	23	19	204	2.55
Local government agencies	83	19	19	36	9	201	2.42
Small, medium and micro enterprises	81	25	19	19	18	192	2.37
A specific local community	82	23	24	20	15	191	2.33
Provincial/regional government departments or agencies	83	18	27	32	6	192	2.31
Science councils	83	24	22	30	7	186	2.24
Large national firms	82	24	24	27	7	181	2.21
Community organizations	82	23	28	23	8	180	2.20
Religious organizations	82	35	16	13	18	178	2.17
Sectoral organizations	79	32	17	23	7	163	2.06
Clinics and health centers	81	38	18	16	9	158	1.95
Welfare agencies	81	34	22	20	5	158	1.95
Multi-national companies	80	29	31	15	5	156	1.95
Small-scale farmers (non-commercial)	78	36	22	14	6	146	1.87
Commercial farmers	80	40	20	18	2	142	1.78
Trade unions	81	45	20	13	3	136	1.68
Other	21	14	3	1	3	35	1.67
Civic associations	81	47	19	14	1	131	1.62
Social movements	81	47	22	11	1	128	1.58
Political organizations	82	55	21	5	1	116	1.41

Source: Own survey data

4.2.11 Types of Relationship

Analysis of the WAI of the type of relationship for the UDSM sample revealed that the most frequently reported relationship is one of an engaged activity especial on “research consultancy” (WAI 3.01), which is the only one relationship with WAI above 3. The response presented in

Table 35 below shows that even the next three relationships namely, “continuing education or professional development” (WAI 2.95), “customized training and short courses” (WAI 2.78), and “monitoring, evaluation and needs assessment” (WAI 2.72) are all related to “research consultancy”. The WAI values were higher for “research consultancy”. In descending order of frequency as shown below there is a wide range of activities that may take primarily engaged forms depending on the channels of interaction and the nature of partners. The cut off value to assess the types of relationships that exist on an isolated to moderate scale was set as 2.05. Consequently, the least frequently reported are scored below 2 which are “clinical services and patient or client care” (WAI 1.59), and “joint commercialization of a new product” (WAI 1.56).

Indeed, “joint commercialization of a new product” (WAI 1.56) has featured the lowest at no coincidence. The linkages between Tanzanian researchers and research institutions, and companies, even those that are domestically based, historically have been weak. Consequently, researchers in health, agriculture, and technologies are facing difficulties in commercializing their indigenous outputs (Singer et al., 2008; Nanyaro and Mwingira, 1999). The National Research and Development Policy document of Tanzania (2010) and Wangwe (1995) attributes to the lack of inadequate mechanisms for technology transfer and commercialization of research results.

Table 35: Types of relationship for UDSM

TYPES OF RELATIONSHIP	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Research consultancy	83	3	24	25	31	250	3.01
Continuing education or professional development	83	6	20	29	28	245	2.95
Customized training and short courses	82	8	24	28	22	228	2.78
Monitoring, evaluation and needs assessment	81	12	17	34	18	220	2.72
Collaborative R&D projects	83	15	20	24	24	223	2.69
Education of students so that they are socially responsive	83	15	20	26	22	221	2.66
Participatory research networks	83	14	29	24	16	208	2.51
Collaborative curriculum design	82	14	30	22	16	204	2.49
Technology transfer	82	22	15	29	16	203	2.48
Contract research	83	16	27	27	13	203	2.45
Community-based research projects	83	18	29	17	19	203	2.45
Policy research, analysis and advice	80	22	17	25	16	195	2.44
Work-integrated learning	81	16	24	31	10	197	2.43

Service learning	82	22	23	26	11	190	2.32
Student voluntary outreach programmes	83	25	26	18	14	187	2.25
Design, prototyping and testing of new technologies	82	28	23	18	13	180	2.20
Expert testimony	80	25	24	24	7	173	2.16
Alternative modes of delivery to accommodate non-traditional students	82	30	21	21	10	175	2.13
Design and testing of new interventions or protocols	82	28	30	16	8	168	2.05
Clinical services and patient or client care	81	52	14	11	4	129	1.59
Joint commercialization of a new product	78	49	18	7	4	122	1.56

Source: Own survey data

4.2.12 Channels of Information

The University of Dar es Salaam is like other universities all over the world, it is meant to be an institution where people are trained at the highest level for clear and independent thinking, analysis and problem solving. Therefore, UDSM has a definite important role to play in developing the community it has been established to serve. As may be expected from the predominant types of relationships, 'students' were highly reported (WAI 3.62) to constitute most important channel of communication. Looking at Table 36, the next important channels with WAI above 3 were "public conferences, seminars or workshops" (WAI 3.48), "training and capacity development or workshops" (WAI 3.12), and "informal information exchange" (WAI 3.07). Furthermore, it is noted that "popular publications" also scored a relatively high WAI value of 2.82. This can also be acknowledged from the high number of publications in the past three years, which were noted to be 661.

Table 36: Channels of information for UDSM

CHANNELS OF INFORMATION	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Students	84	1	3	23	57	304	3.62
Public conferences, seminars or workshops	84	1	10	21	52	292	3.48
Training and capacity development or workshops	83	4	13	35	31	259	3.12
Informal information exchange	83	3	16	36	28	255	3.07
Popular publications	83	18	9	26	30	234	2.82
Oral or written testimony or advice	82	14	20	33	15	213	2.60
Reports and policy briefings	80	17	25	24	14	195	2.44
Demonstration projects or units	81	25	18	23	15	190	2.35

Research contracts and commissions	81	21	26	19	15	190	2.35
Interactive websites	82	25	23	20	14	187	2.28
Participatory or action research projects	82	24	22	28	8	184	2.24
Cross-disciplinary networks with social partners	81	28	22	21	10	175	2.16
Radio, television or newspapers	83	29	26	20	8	173	2.08
Intervention and development programmes	81	35	16	24	6	163	2.01
Technology development and application networks	81	42	19	11	9	149	1.84
Technology incubators or innovation hubs	78	44	14	10	10	142	1.82
Spin-off firms from the university (commercial or not for profit)	78	49	12	9	8	132	1.69
Software development or adaptation for social uses	80	61	13	5	1	106	1.33
Patent applications and registration	80	65	11	3	1	100	1.25

Source: Own survey data

4.2.13 Outputs

Analysis of the WAI suggested that the most important reported outputs were academic-oriented in terms of “graduates with relevant skills and values”, “academic publications” and “dissertations”. The three outputs showed strong correlation (with WAI above 3) by scoring the highest WAI values of 3.65, 3.37, and 3.37, respectively.

As listed in Table 37, close to the important academic outputs were “academic collaboration” (WAI 2.95) “reports, policy documents and popular publications” (WAI 2.90). It is apparent that discoveries and inventions of products and processes are spatially featuring since “New or improved processes” (WAI 2.09), “new or improved products” (WAI 2.00) and “scientific discoveries” (WAI 1.91) scored marginal WAI values of about 2 and below.

Table 37: UDSM outputs

OUTPUTS	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Graduates with relevant skills and values	84	1	4	18	61	307	3.65
Academic publications	83	4	9	22	48	280	3.37
Dissertations	84	3	13	18	50	283	3.37
Academic collaboration	82	8	16	30	28	242	2.95
Reports, policy documents and popular publications	83	7	19	32	25	241	2.90
New or improved processes	82	31	20	24	7	171	2.09
New or improved products	81	36	17	20	8	162	2.00

Community infrastructure and facilities	81	33	25	14	9	161	1.99
Scientific discoveries	80	39	15	20	6	153	1.91
Cultural artifacts	80	42	20	10	8	144	1.80
Spin-off companies	77	48	13	13	3	125	1.62

Source: Own survey data

4.2.14 Outcomes and Benefits

With a vision set by UDSM to become a reputable world-class university responsive to national, regional and global development needs, the university's mission is positioned towards "unrelenting pursuit of scholarly and strategic research, education, teaching and public service directed at attainment of equitable and sustainable socio-economic development of Tanzania and the rest of Africa" (University of Dar es Salaam, 2008). Thus, the most important reported outcomes in Table 38 that have scored high WAI index above 3 include: "improved teaching and learning" (WAI 3.60), "academic and institutional reputation" (WAI 3.31), "public awareness and advocacy" (WAI 3.18) and "training and skills development" (WAI 3.11). Community empowerment and agency were amongst the least frequent outcomes and benefits.

Inclusive outcomes and benefits are also evident at the UDSM since they scored WAI above 2.5, which show some strong correlation. This is listed under outcomes such as "improved livelihoods for individuals and communities" (WAI 2.62), "improved quality of life for individuals and communities" (WAI 2.57), and "cross-disciplinary knowledge production to deal with multi-faceted social problems" (WAI 2.54). These outcomes have scores WAI indices close to the most important academic ones.

Table 38: UDSM outcomes

OUTCOMES AND BENEFITS	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Improved teaching and learning	83	1	4	22	56	299	3.60
Academic and institutional reputation	83	1	14	26	42	275	3.31
Public awareness and advocacy	83	4	16	24	39	264	3.18
Training and skills development	82	4	16	29	33	255	3.11
Relevant research focus and new research projects	81	10	16	29	26	233	2.88
Theoretical and methodological development in an	82	9	20	26	27	235	2.87

academic field							
Participatory curriculum development, new academic programmes and materials	78	9	20	26	23	219	2.81
Improved livelihoods for individuals and communities	82	13	23	28	18	215	2.62
Improved quality of life for individuals and communities	81	15	22	27	17	208	2.57
Cross-disciplinary knowledge production to deal with multi-faceted social problems	80	12	25	31	12	203	2.54
Community-based campaigns	82	21	22	25	14	196	2.39
Incorporation of indigenous knowledge	76	18	22	27	9	179	2.36
Intervention plans and guidelines	80	19	27	23	11	186	2.33
Community employment generation	80	26	21	21	12	179	2.24
Policy interventions	80	22	28	20	10	178	2.23
Novel uses of technology	80	32	19	18	11	168	2.10
Regional development	82	27	27	22	6	171	2.09
Firm productivity and competitiveness	78	30	22	18	8	160	2.05
Firm employment generation	78	35	14	21	8	158	2.03
Community empowerment and agency	80	38	17	18	7	154	1.93

Source: Own survey data

4.2.15 Obstacles and Challenges

The Tanzania government has deployed a series of strategies to ensure the adequate and more concerted development of both higher education and the technical and vocational education and training (TVET) subsectors for supplying the economy with the increasing number of skilled and knowledgeable professionals it needs to sustain its growth. The Tanzania Commission for Universities (TCU) has been strengthened to comply with quality assurance requirements. Various mechanisms have been implemented or are under consideration to improve equity and access, including: (i) a streamlined admissions procedure and centralized admissions system; (ii) an extended national qualifications framework, building bridges between vocational and university education; (iii) cost-sharing policies; and (iv) student loans, providing to 81 percent of all higher education students via the Higher Education Students' Loan Board (HESLB).

Despite these efforts, there are still pertinent problems that negatively affect the performance of the higher education system in Tanzania. Looking at the responses presented in Table 39 for UDSM it is apparent that the lack of sustainable funding and absence of a reward system are the core obstacles. In a decreasing order of importance, the four obstacles that were rated as important to very important, with WAI scores above 3, and all related to resources of time and money were: "limited financial resources for competing university priorities", (WAI 3.76), "sustainable external funding" (WAI 3.31), (institutional recognition systems do not reward

academic interaction activities sufficiently" (WAI 3.01) and "competing priorities on time" (WAI 3.00). To show the criticalness of the meager resources' problem, the WAI value of 3.76 is the highest ever recorded at the UDSM. On the other hand, legal problems were the least important, being the only item with WAI rated below 2.

Table 39: Obstacles and challenges for UDSM

OBSTACLES AND CHALLENGES	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Limited financial resources for competing university priorities	82	0	6	8	68	308	3.76
Sustainable external funding	83	4	9	27	43	275	3.31
Institutional recognition systems do not reward academic interaction activities sufficiently	81	11	14	19	37	244	3.01
Competing priorities on time	81	4	18	33	26	243	3.00
Too few academic staff	78	14	15	21	28	219	2.81
Lack of clear university policy and structures to promote Interaction	80	12	16	31	21	221	2.76
Negotiating access and establishing a dialogue with external social partners	79	12	20	26	21	214	2.71
Unequal power relations and capabilities in relation to external social partners	78	14	17	28	19	208	2.67
Lack of mutual knowledge about partners' needs and priorities	81	14	25	24	18	208	2.57
University administration and bureaucracy does not support academic Interaction with external social partners	80	21	17	21	21	202	2.53
Tensions between traditional and new academic paradigms and methodologies	80	22	24	19	15	187	2.34
Risks of student involvement in interaction with external social partners	80	27	28	20	5	163	2.04
Legal problems	79	34	24	9	12	157	1.99

Source: own survey data

4.2.16 Reasons for no Interaction

Out of the 88 questionnaires collected from UDSM, only 4 researchers were not interacting. However, all the reasons for no interaction were not so strong since they attracted very low WAI value of about 2 and below. Given the low number of no interaction, this means that almost all reasons were very personal. The relatively highest WAI score was for "pressures of teaching

and research on my time are too great' (WAI 2.5). Other relatively important reasons were mentioned to be "lack of social partners' knowledge about research activities and priorities in universities' (WAI 2.00) and "interaction is not central to my academic role" (WAI 2.00). They are related to internal institutional processes but are intertwined with reputational issues, such as recognition of valid forms of scholarship and understanding of the university as a knowledge-based institution.

The third significant trend evident from the survey result shown in Table 40 is thus that those who do not engage are likely to be motivated by a lack of fit with their academic identity, and/or by a lack of institutional support and recognition for engaged activities – as reported under the reason "my department or faculty does not promote Interaction" (WAI 1.5).

Table 40: Reasons for no interaction at UDSM

REASON FOR NO INTERACTION	TOTAL SAMPLE						
	Frequencies of selection					TOTAL W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Pressures of teaching and research on my time are too great	4	1	0	3	0	10	2.50
Lack of social partners' knowledge about research activities and priorities in universities	4	2	0	2	0	8	2.00
Interaction is not central to my academic role	4	2	0	2	0	8	2.00
My department or faculty does not promote Interaction	4	3	0	1	0	6	1.50
University administration systems do not support Interaction	4	3	0	1	0	6	1.50
Lack of recognition of Interaction as a valid type of scholarship in my university	4	2	0	1	1	5	1.25
Institutional recognition systems do not reward Interaction activities sufficiently	4	2	0	1	1	5	1.25
Lack of clarity on the concept of external interaction in my university	4	2	0	1	1	5	1.25
Lack of clear university structures to promote Interaction activities	4	2	0	1	1	5	1.25
Interaction is not appropriate given the nature of my academic field or discipline	4	2	0	1	1	5	1.25
Limited financial resources are available	4	2	1	0	1	4	1.00
Lack of clear university policy on Interaction	4	3	0	0	1	3	0.75
Differences between university and social partner priorities and needs are too great	4	2	0	0	2	2	0.50

Source: own survey data

4.3 Muhimbili University of Health and Allied Sciences (MUHAS)

The Muhimbili University of Health and Allied Sciences (MUHAS) originated from the Dar es Salaam School of Medicine, which was established in 1963 by the Ministry of Health with the primary aim of training clinical health staff. In 1968, the Dar es Salaam School of Medicine was upgraded to a Faculty of Medicine of the Dar es Salaam University College of the University of East Africa. In 1976 the Faculty of Medicine was incorporated into Muhimbili Hospital to form the Muhimbili Medical Centre (MMC).

In 1991, the then Faculty of Medicine was developed into a constituent College of the University of Dar es Salaam, with the aim of nurturing it to a full-fledged University. In 2000 the Government by Act of Parliament disestablished the MMC and created two closely linked but autonomous public institutions; namely the Muhimbili University College of Health Sciences and the Muhimbili National Hospital (MNH). Over the years MUCHS made significant achievements in terms of increased student enrollment and development of several new academic programmes. The Parliament Act No 9 of 1991 that established MUCHS was repealed in 2005. Subsequently, in the year 2007, MUHAS was established by Article 1 of the Charter of Incorporation, in line with the recommendations of the Tanzania Commission of Universities (TCU).

4.3.1 Academic and Research Units

MUHAS has seven academic units, namely School of Medicine; School of Dentistry; School of Pharmacy; School of Nursing; School of Public Health and Social Sciences; Institute of Allied Health Sciences; and Institute of Traditional Medicine.

MUHAS academic departments that belong to these different units are listed below:

Box 3: MUHAS ACADEMIC DEPARTMENTS

1) SCHOOL OF MEDICINE
Anaethesiology
Anatomy and Histology
Biochemistry
Clinical Pharmacology
Haematology and Blood Transfusion
Pathology
Internal Medicine
Microbiology and Immunology
Obstetrics and Gynecology
Ophthalmology
Orthopaedics and Traumatology

Otorhinolaryngology
Paediatrics and Child Health
Psychiatry
Radiology
Clinical Oncology
Physiology
Surgery

2) SCHOOL OF DENTISTRY
Oral Surgery and Oral Pathology
Preventive and Community Dentistry
Restorative Dentistry

3) SCHOOL OF PHARMACY
Medicinal Chemistry
Pharmacognosy
Pharmaceutical Microbiology
Pharmaceutics

4) SCHOOL OF NURSING
Community Health Nursing
Nursing Management
Clinical Nursing

5) SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCES
Environmental and Occupational Health
Epidemiology And Biostatistics
Natural Products Development and Formulation
Parasitology And Medical Entomology
Community Health
Behavioral Sciences

6) INSTITUTE OF ALLIED HEALTH SCIENCES

7) INSTITUTE OF TRADITIONAL MEDICINE
Medical Botany, Plant Breeding and Agronomy
Natural Products Development and Formulation
Biological and Preclinical Studies

4.3.2 Vision and Mission of MUHAS

Based on the MUHAS Five Year Rolling Strategic Plan 2009/10 to 2013/2014, the university's mission, vision and values are concentrated upon becoming a centre of excellence on health related issues and a conducive environment for both learning and working. The generation of sustainable resources is also expressed in the vision. In order to achieve this, the mission is described as seeking "for quality health through education, training, research and health services for attainment of equitable socio-economic development" (www.muhas.ac.tz).

4.3.3 The Values and Functions

In order to realize the vision and fulfill its mission, MUHAS is guided by the following values:

a) Social responsibility, accountability and leadership in responding to issues and expectations of the society
b) Public accountability through transparent decision-making, open review, responsible and efficient use of resources
c) Institutional autonomy through self-governing structures and greater independence in action while being responsive to societal needs
d) Professional and ethical standards of the highest order, practiced through openness, honesty, tolerance and respect for the individual
e) Equity and social justice with regard to gender, religion, ethnicity and other social characteristics
f) Academic freedom in critical thought and enquiry as well as the open exchange of ideas and knowledge
g) Academic integrity and professional excellence in teaching, research and service provision
h) Nationalism and internationalism in scholarly activities of national and global concerns
i) Productivity, innovation and entrepreneurship in all activities of the University underpinned by a dedication to quality, efficiency and effectiveness
j) Human Resource of the highest quality capable of enhancing the realization of the vision and mission of the University
k) The right to enjoy intellectual, social, cultural and recreational opportunities, for students and staff

Source: http://www.muhas.ac.tz/index.php/about-muhas/vision-and-mission

While this list is kept rather general a number of more concrete mechanisms and activities of the university are proposed and guided by the components of the mission as stipulated in the charter that established MUHAS. For instance, with respect to capacity building (i.e. supply of human resources) it is here specified that students are trained in “regular and professional courses in the fields of health and allied health Sciences for degrees, diplomas, certificates and other awards of the Muhimbili University of Health and Allied Sciences” (http://www.muhas.ac.tz/index.php/about-muhas/vision-and-mission). It further specifically considers itself as “main producer of key policy makers, experts and personnel in the health sector” (ibid). In addition to this, MUHAS aims to be a source of competence in the health sector that goes beyond the education of students by acting as a trusted organization that may

catalyze reforms in the health sector through informed research. It also intends to educate the general public on health issues. The expressed focus here does not explicitly address interactions with other national or international stakeholders. Interactions with external social actors were however found in some policy documents as summarized below.

4.3.4 Review of MUHAS Policies

A policy review for MUHAS came out with three documents that promote engagement of researchers with external social actors. They include: Research Policy Guidelines (2011), Scheme of Service for Academic Staff (2013), and Academic Staff Performance Assessment Guidelines (2009). In line with the National Research and Development Policy (2010), the National Health Policy (2003), National Strategy for Growth and Reduction of Poverty (NSGRP) or "MKUKUTA", Millennium Development Goals (MDGs) and Vision 2025, the MUHAS Research Policy Guidelines aim at inculcating a research culture among staff and students by:

a) Providing a mechanism of ensuring that research conducted in the University:
    i. Is in line with national health priorities
    ii. Addresses local, regional and global health problems of public importance
    iii. Aims at solving scientific questions identified in different branches of the health sciences at the University and nationally
b) Providing attractive terms and conditions of service for researchers so as to motivate research and reward productivity
c) Strengthening the research infrastructure in the University by placing due emphasis on institutional development and improving logistical and technical support to research operations
d) Identifying, promoting and developing special talents among its members of staff and students with a view to developing a critical mass of Research Scientists in the University
e) Encouraging collaborative research between scientists within MUHAS and researchers in other institutions within and outside the country, to promote a multidisciplinary approach
f) Improving the linkage between research and the application of research results in guiding policy and action in the health sector.
g) Encouraging and rewarding individual initiatives in securing research funds.
h) Establishing research quality assurance system
i) Facilitating repackaging of research information to ensure dissemination of user friendly research findings within and outside MUHAS

In order to promote engagement in research, the research policy insists on proper remuneration to all investigators and to reward research performance at individual, academic unit and research teams each year. Further, the policy advocates that research output constitute a major criterion in the promotion of academic staff. Besides the use of academic materials/works such as thesis, conference papers, technical notes, published books, journal articles, case reports, and teaching effectiveness, the University also accepts research reports, consultancy reports, and grant awards as part of criteria for promotion. Each of the materials is reviewed by assessors and is graded according to the respective guidelines and criteria. The inclusion of research outputs in the criteria as stipulated in the Scheme of Service for Academic Staff (2013) and the Academic Staff Performance Assessment Guidelines (2009) promotes engagement amongst the scientists.

We did not find any rewards that would be given for initiating interactions with external social actors – nor that this plays a role for promotion. This might be a useful mechanism for the university to consider. Interestingly though, individual initiatives to secure research funds are not only encouraged but also rewarded as the above activity list shows, thus giving an incentive to initiate collaborative research projects which again can serve as crucial catalyst for linkages that the university engages in.

4.3.5 Student Enrollment at MUHAS

The information presented in Table 41 and Figure 4 on enrollment at MUHAS for the recent years shows a fluctuating trend for both female and male students.

Table 41: Students' enrollment at MUHAS

YEAR	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011
Female	944	374	415	631	519
Male	1,586	1,057	1,260	411	1,319
Total	**2,530**	**1,431**	**1,675**	**1,042**	**1,838**

Source: National Bureau of Statistics, 2012; Tanzania Commission for Universities, 2013

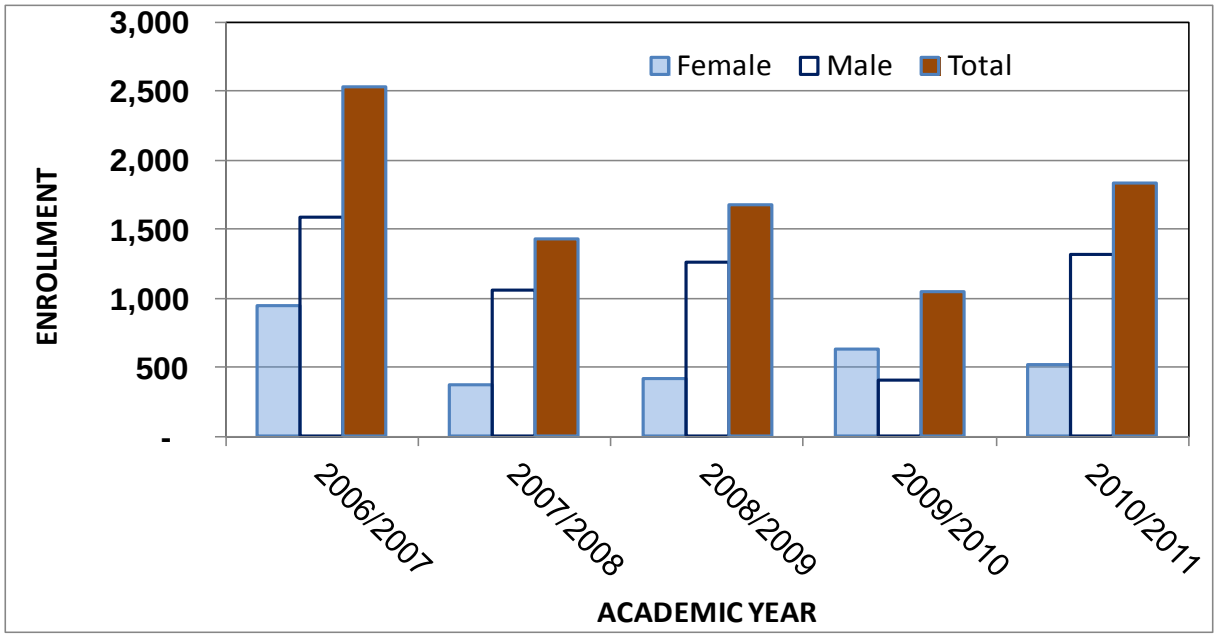

Figure 4: Students' enrollment at MUHAS

Source: National Bureau of Statistics, 2012; Tanzania Commission for Universities, 2013

4.3.6 Academic Staff Profile for Year 2010/2011

With a total staff list of 243 academic staff members at MUHAS, there are 112 members who are Ph.D. owners. This is detailed in Table 42. The current student to staff ratio at MUHAS is 8.5.

Table 42: Academic staff profile for MUHAS

	FACULTY NAME	NUMBER WITH Ph.D.	TOTAL
1	School of Medicine	35	117
2	School of Dentistry	14	20
3	School of Pharmacy	18	28
4	School of Public Health	28	47
5	School of Nursing	7	12
6	Institute of Traditional Medicine	9	11
7	Directorate of Library Service	1	4
8	ICT	0	2
TOTAL		**112**	**243**

Source: own draft

4.3.7 Publications Statistics and Patents

For the past three years, MUHAS has published 481 papers in internationally accredited Journals and 120 papers in nationally accredited journals. This is detailed in Table 43.

Table 43: MUHAS publications

PUBLICATION	NUMBER
Internationally accredited journals	481
Nationally accredited journals	120
Institutional journals	

Source: own draft

As regards patents, MUHAS is scoring less high than the other two universities, showing also here different mechanisms that have been chosen. MUHAS has 2 awarded patents and both are licensed (as a reminder UDSM has 14 applications and 8 awarded patents). Thus UDSM may show a greater inventive potential or the core priority of the other two universities is not in protecting their (potential) inventions or it may not be necessary for the type and nature of certain inventions of incremental innovations given the procedure towards a patent as well as the type of use.

4.3.8 Research Undertaken Recently (Past 3 Years)

In the past three years, MUHAS has implemented 103 research projects worth 39 billion Tanzania Shillings. The information detailed in Table 44 shows almost no contribution by government funding to the research. The trend is common to all the three surveyed Universities. According to the MUHAS Operational Policy and Procedures for Income Generation and Cost Containment Policy (2012), the government funding in research has been decreasing year after year. However, the government contribution has been mainly in terms of provision of monthly salaries for researchers, and research space.

Table 44: Research statistics for MUHAS

NAME	NUMBER OF PROJECTS	APPROXIMATE TOTAL FUNDING, T. Shs.
National University funds		
International donor funds	103	39,000,000,000

Source: own draft

On the other hand, in order to assure that trained human resources in the field of health can be tackled by MUHAS the university collaborates with other organizations from around the world to support the university to train enough health care work force.
MUHAS therefore strives to maintain and strengthen these links and makes concerted effort to promote international, regional and local links.

4.3.9 Mechanisms that Promote Interactions

Table 45 shows that literally there are no effective mechanisms that promote interaction of MUHAS academicians with external social actors. The researchers' perception has it that the only mechanism is through "open days for external actors".

Table 45: Mechanisms that promote interactions at MUHAS

MECHANISM	YES	NO
Performance management system that rewards interaction or engagement		✓
Awards for research		✓
Awards for innovation		✓
Awards for engaged activity		✓
Promotion criteria that rewards interaction or engagement		✓
Open days for external actors	✓	
Community forum		✓
Newsletter that promotes interaction or engagement		✓
Specialised funds for promoting research		✓
Specialised funds for promoting innovation		✓
Specialised funds for promoting interaction with communities		✓
Specialised funds for promoting interaction with firms		✓
Other – specify		

Source: own survey data

4.3.10 Time Distribution of the Academic Functions

As shown in Table 46, about 70% of the academicians' time is spent in teaching and research. The remaining time is equally spent in public service, interaction with external actors, and administration matters.

Table 46: Time distribution of the academic functions at MUHAS

SNO	ACADEMIC FUNCTION	**% TIME**
1	Teaching	35
2	Research	35
3	Public service	10
4	Interaction with external actors	10
5	Administration	10

Source: own draft

4.3.11 External Social Partners

MUHAS has always had links with various partners locally and internationally. The links involve international organizations in which collaborative research and consultancies are prominent. Other links include universities, with whom collaborations involve activities such as collaborative research, student and staff exchange, exchange of external examiners and joint (Sandwich) training programs. International links have grown faster than local linkages.

The weighted average index for the MUHAS sample revealed that the most important external social actor are the individuals and households (WAI 3.30). This is the strongest WAI index showing the highest correlation of ongoing medical research to individuals and households. Next in importance partners, scoring high WAI index as listed in Table 47 includes “national universities” (WAI 3.30), “African Universities” (WAI 3.00) and “a specific local community” (WAI 2.8).

Table 47: MUHAS external social partners

EXTERNAL SOCIAL ACTORS	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of responses	**1**	**2**	**3**	**4**		
Individuals and households	10	0	1	5	4	33	3.30
National universities	10	0	3	2	5	32	3.20
African universities	9	1	1	4	3	27	3.00
A specific local community	10	1	2	5	2	28	2.80
Funding agencies	9	1	2	4	2	25	2.78
National regulatory and advisory agencies	12	0	4	7	1	33	2.75
Non-governmental agencies (NGOs)	11	2	2	4	3	30	2.73
National government departments	11	1	3	6	1	29	2.64
Clinics and health centers	11	2	3	3	3	29	2.64
International universities	11	1	3	6	1	29	2.64
Science councils	11	1	3	6	1	29	2.64
Local government agencies	11	2	2	7	0	27	2.45
Provincial/regional government departments or agencies	11	3	2	5	1	26	2.36
Schools	11	3	3	4	1	25	2.27
Welfare agencies	11	4	1	6	0	24	2.18
Sectoral organizations	9	3	3	2	1	19	2.11
Development agencies	10	2	6	2	0	20	2.00
Other	4	2	0	2	0	8	2.00

Community organizations	11	3	7	0	1	21	1.91
Multi-national companies	11	5	2	4	0	21	1.91
Trade unions	10	4	4	2	0	18	1.80
Civic associations	10	5	3	2	0	17	1.70
Small, medium and micro enterprises	11	5	5	1	0	18	1.64
Large national firms	10	5	4	1	0	16	1.60
Small-scale farmers (non-commercial)	10	6	3	0	1	16	1.60
Commercial farmers	10	6	2	2	0	16	1.60
Social movements	11	6	5	0	0	16	1.45
Religious organizations	11	7	3	1	0	16	1.45
Political organizations	11	9	1	0	1	15	1.36

Source: own survey data

4.3.12 Types of Relationship

Research is one of the core functions of a University aiming at generation and advancement of knowledge. MUHAS is one of the major institutions undertaking health research in the country and the research results generated have provided valuable evidence-based information for guiding the management, control and prevention of major diseases. Currently, there are 37 major research links at MUHAS that involve bilateral collaborations. The research policy of the - university targets major community health issues including: HIV and AIDS, Malaria, reproductive health, health systems research and traditional medicine. Research at MUHAS is undertaken by staff and students, particularly those pursuing postgraduate training.

The active research environment at MUHAS has brought a diverse and strong type of relationships listed in Table 48. Among the three Universities participating in this research, MUHAS has shown the highest number of relationships with WAI above 3. They include “research consultancy” (WAI 3.18), “participatory research networks” (WAI 3.10), “education of students so that they are socially responsive” (WAI 3.09), “community-based research projects” (WAI 3.09), “continuing education or professional development” (WAI 3.00) and “customized training and short courses” (WAI 3.00). Again, the least scored WAI index amongst the relationships was “joint commercialization of a new product” (WAI 1.36). Lack of commercialization of research outputs is a persistent chronic problem in all the three surveyed Universities.

Table 48: Types of relationship for MUHAS

TYPES OF RELATIONSHIP	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No Response	**1**	**2**	**3**	**4**		
Research consultancy	11	0	3	3	5	35	3.18
Participatory research networks	10	0	3	3	4	31	3.10
Education of students so that they are socially responsive	11	2	0	4	5	34	3.09
Community-based research projects	11	1	2	3	5	34	3.09
Continuing education or professional development	9	1	1	4	3	27	3.00
Customized training and short courses	10	1	1	5	3	30	3.00
Work-integrated learning	9	2	1	3	3	25	2.78
Monitoring, evaluation and needs assessment	11	2	3	3	3	29	2.64
Collaborative R&D projects	11	2	3	3	3	29	2.64
Service learning	8	2	1	3	2	21	2.63
Design and testing of new interventions or protocols	12	2	3	5	2	31	2.58
Collaborative curriculum design	11	2	4	2	3	28	2.55
Technology transfer	11	2	4	2	3	28	2.55
Contract research	10	3	2	3	2	24	2.40
Policy research, analysis and advice	10	4	2	2	2	22	2.20
Student voluntary outreach programs	11	3	4	3	1	24	2.18
Design, prototyping and testing of new technologies	11	3	5	2	1	23	2.09
Clinical services and patient or client care	11	6	2	2	1	20	1.82
Expert testimony	9	4	3	2	0	16	1.78
Alternative modes of delivery to accommodate non-traditional students	10	5	3	2	0	17	1.70
Joint commercialization of a new product	11	8	2	1	0	15	1.36

Source: own survey data

4.3.13 Channels of Information

As may be expected that the predominant types of relationships will be, ‘students’ but the WAI show that “public conferences, seminars or workshops” (WAI 3.27), “popular publications” (WAI 3.27) and “informal information exchange” (WAI 3.25) were reported on a moderate to wide scale as the core academics’ main channel of information. The ‘students’ followed with a relatively weaker WAI of 2.91. This is detailed in Table 49.

Table 49: Channels of information

CHANNELS OF INFORMATION	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of Responses	**1**	**2**	**3**	**4**		
Public conferences, seminars or workshops	11	1	0	5	5	36	3.27
Popular publications	11	0	2	4	5	36	3.27
Informal information exchange	12	0	2	5	5	39	3.25
Students	11	3	0	3	5	32	2.91
Training and capacity development or workshops	11	1	5	2	3	29	2.64
Reports and policy briefings	11	2	4	4	1	26	2.36
Cross-disciplinary networks with social partners	11	3	3	3	2	26	2.36
Participatory or action research projects	12	3	4	5	0	26	2.17
Oral or written testimony or advice	10	2	5	3	0	21	2.10
Research contracts and commissions	10	4	2	3	1	21	2.10
Interactive websites	11	4	4	2	1	22	2.00
Intervention and development programs	10	5	2	2	1	19	1.90
Demonstration projects or units	10	6	1	3	0	17	1.70
Radio, television or newspapers	11	7	2	1	1	18	1.64
Technology incubators or innovation hubs	10	9	0	1	0	12	1.20
Technology development and application networks	10	9	0	1	0	12	1.20
Spin-off firms from the university (commercial or not for profit)	11	10	1	0	0	12	1.09
Software development or adaptation for social uses	11	11	0	0	0	11	1.00
Patent applications and registration	10	10	0	0	0	10	1.00

Source: own survey data

4.3.14 Outputs

Teaching and learning is one of the main core functions of a University and requires major investment in terms of human and financial resources in order to effectively meet the expectation of the stakeholders. Investigation of the WAI for MUHAS outputs shown in Table 50 suggested that the most important reported outputs were academic in terms of “academic publications” (WAI 3.33), “graduates with relevant skills and values” (WAI 3.11). Other important outputs were mentioned to be “academic collaboration” (WAI 2.82), “reports, policy documents and popular publications” (WAI 2.73), and “dissertations” (WAI 2.67). The remaining outputs like “new or improved processes”, “community infrastructure and facilities”, “scientific discoveries”, “cultural artifacts” and “spin-off companies” were amongst the unpopular outputs with least scored WAI of below 2.

Table 50: MUHAS outputs

OUTPUTS	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of Responses	**1**	**2**	**3**	**4**		
Academic publications	12	0	1	6	5	40	3.33
Graduates with relevant skills and values	9	1	2	1	5	28	3.11
Academic collaboration	11	1	3	4	3	31	2.82
Reports, policy documents and popular publications	11	2	2	4	3	30	2.73
Dissertations	12	2	3	4	3	32	2.67
New or improved processes	11	7	2	1	1	18	1.64
Community infrastructure and facilities	10	6	2	2	0	16	1.60
New or improved products	11	8	1	2	0	16	1.45
Scientific discoveries	11	8	1	2	0	16	1.45
Cultural artifacts	10	7	3	0	0	13	1.30
Spin-off companies	11	11	0	0	0	11	1.00

Source: own survey data

4.3.15 Outcomes and Benefits

The university academic programs are central to its core functions and reflect its professional and technical output. The university offers semesterized diploma, undergraduate and postgraduate programs in different disciplines. The number of academic progress at MUHAS has been increasing consistently over the past five years from 23 in the year 2002/03 to the current 65 programmes in the year 2011/12. The objective of developing the new programmes was dual and dictated by the higher education policy requirement of meeting the national needs for specialized skilled personnel and expanded student enrollment programme. The increased number of programmes and expanded student enrolment entails parallel increase in both human and non-human resources.

The WAI assessment results presented in Table 51 suggested five most frequently reported and highly correlated outputs. They include “improved teaching and learning” (WAI 3.36), “training and skills development” (WAI 3.33), “theoretical and methodological development in an academic field” (WAI 3.09), “participatory curriculum development, new academic programmes and materials” (WAI 3.00) and “relevant research focus and new research projects” (WAI 3.00). Also amongst the least frequent outcomes and benefits that scored WAI less than 2.00 were “community-based campaigns”, “policy interventions”, “community empowerment and agency”, “novel uses of technology”, “firm employment generation”, “regional development”, “community employment generation” and “firm productivity and competitiveness”.

Table 51: Outcomes and benefits for MUHAS

OUTCOMES AND BENEFITS	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of Responses	**1**	**2**	**3**	**4**		
Improved teaching and learning	11	0	1	5	5	37	3.36
Training and skills development	12	0	0	8	4	40	3.33
Theoretical and methodological development in an academic field	11	0	4	2	5	34	3.09
Participatory curriculum development, new academic programmes and materials	11	1	2	4	4	33	3.00
Relevant research focus and new research projects	12	0	3	6	3	36	3.00
Academic and institutional reputation	12	1	3	4	4	35	2.92
Cross-disciplinary knowledge production to deal with multi-faceted social problems	11	1	4	3	3	30	2.73
Public awareness and advocacy	11	3	3	1	4	28	2.55
Improved quality of life for individuals and communities	11	2	4	4	1	26	2.36
Incorporation of indigenous knowledge	11	3	4	1	3	26	2.36
Intervention plans and guidelines	11	5	3	1	2	22	2.00
Improved livelihoods for individuals and communities	10	4	2	4	0	20	2.00
Community-based campaigns	11	4	6	0	1	20	1.82
Policy interventions	11	5	4	1	1	20	1.82
Community empowerment and agency	11	5	4	2	0	19	1.73
Novel uses of technology	10	7	1	2	0	15	1.50
Firm employment generation	11	10	0	0	1	14	1.27
Regional development	11	9	1	1	0	14	1.27
Community employment generation	10	9	0	1	0	12	1.20
Firm productivity and competitiveness	11	10	0	1	0	13	1.18

Source: own survey data

4.3.16 Obstacles and Challenges

MUHAS as a public institution of higher learning has largely depended on government funding in order to carry out its core functions. However the funding from the government is inadequate and diminishing. Consequently, the execution of the institutional operating activities is compromised.

Thus as listed in Table 52, “limited financial resources for competing university priorities” (WAI 3.75) became the critical challenge, which is the highest WAI ever scored under this study at

MUHAS. Furthermore, “competing priorities on time” (WAI 3.08), and “too few academic staff” (WAI 3.46), “sustainable external funding” (WAI 3.38), “competing priorities on time” (WAI 3.08), and “negotiating access and establishing a dialogue with external social partners” (WAI 3.08) were reported to be among the critical obstacles.

Unique to the response from other two universities is the fact that MUHAS is facing a problem on “too few academic staff”. At a national level, there are efforts in mitigating this obstacle. For instance there is a deliberate effort in prioritizing medical fields in entry facilitation full loans from the Higher Education Students’ Loan Board (HESLB). Furthermore, as opposed to other fields, all medical students are assured of employment by the government. However, an increased number of medical universities will also have an overall impact in this regard.

Table 52: Obstacles and challenges for MUHAS

OBSTACLES AND CHALLENGES	TOTAL SAMPLE						
	Frequencies of selection					Total W	WAI
	No. of Responses	**1**	**2**	**3**	**4**		
Limited financial resources for competing university priorities	12	1	0	0	11	45	3.75
Too few academic staff	13	1	2	0	10	45	3.46
Sustainable external funding	13	1	1	3	8	44	3.38
Competing priorities on time	13	2	1	4	6	40	3.08
Negotiating access and establishing a dialogue with external social partners	12	2	0	5	5	37	3.08
Institutional recognition systems do not reward academic Interaction activities sufficiently	11	3	1	3	4	30	2.73
Lack of clear university policy and structures to promote Interaction	13	4	0	6	3	34	2.62
Lack of mutual knowledge about partners’ needs and priorities	12	2	3	5	2	31	2.58
University administration and bureaucracy does not support academic Interaction with external social partners	12	6	2	2	2	24	2.00
Unequal power relations and capabilities in relation to external social partners	12	3	4	3	2	28	2.33
Legal problems	12	4	4	2	2	26	2.17
Risks of student involvement in Interaction with external social partners	11	5	0	4	2	25	2.27
Tensions between traditional and new academic paradigms and methodologies	12	6	2	2	2	24	2.00

Source: own survey data

4.3.17 Reasons for no Interaction

Given that teaching and learning are one of the main core functions of MUHAS and require major investment in terms of human and financial resources in order to effectively meet the expectationsthis does also have an impact on interactions with external partners. Hence, the response of reasons for no interaction (6 researchers were not interacting) as shown in Table 53 included “pressures of teaching and research on my time are too great” (WAI 2.00), “my department or faculty does not promote interaction” (WAI 2.00), and “lack of recognition of interaction as a valid type of scholarship in my University” (WAI 2.00) were identified as the major reasons. However, these reasons were not so strong due to the low ranking WAI of about 2 and below.

We have noted earlier that at MUHAS the Research Policy Guidelines (2011), Scheme of Service for Academic Staff (2013), and Academic Staff Performance Assessment Guidelines (2009) are promoting academic interactions with social external actors. However, with the reasons for no interaction listed in this section it shows that the implementation and impact of these guidelines is far from being appreciated.

Table 53: Reasons for no interaction

REASON FOR NO INTERACTION	TOTAL SAMPLE						
	Frequencies of selection					TOTAL W	WAI
	No. of Responses	**1**	**2**	**3**	4		
Pressures of teaching and research on my time are too great	6	0	0	4	2	12	2.00
My department or faculty does not promote interaction	6	1	4	1	0	12	2.00
Lack of recognition of interaction as a valid type of scholarship in my university	5	2	1	2	0	10	2.00
Institutional recognition systems do not reward Interaction activities sufficiently	6	1	2	2	1	11	1.83
Lack of social partners’ knowledge about research activities and priorities in universities	6	0	2	2	2	10	1.67
Differences between university and social partner priorities and needs are too great	6	1	3	1	1	10	1.67
Limited financial resources are available	6	1	1	2	2	9	1.50

University administration systems do not support Interaction	6	5	0	1	0	8	1.33
Lack of clear university policy on Interaction	6	3	1	1	1	8	1.33
Lack of clarity on the concept of external interaction in my university	6	2	3	0	1	8	1.33
Lack of clear university structures to promote Interaction activities	5	2	0	1	2	5	1.00
Interaction is not central to my academic role	5	2	0	1	2	5	1.00
Interaction is not appropriate given the nature of my academic field or discipline	6	2	2	0	2	6	1.00

Source: own survey data

4.4 Comparative Summary of the Three Universities and Conclusions

Three public universities in Tanzania were successfully surveyed concerning their interactions with external social actors and a range of other issues in connection with this. namely Sokoine University of Agriculture (SUA), the University of Dar es Salaam (UDSM), and the Muhimbili University of Health Sciences (MUHAS). The study revealed important findings on the complex and multiple intersecting roles of the Tanzanian universities in relation to innovation oriented towards inclusion and social development. For instance, we realized through the research project profiles and funders that international donors to a large extent set and shape the research agenda in Tanzania. This was also stressed during interviews with senior management. A different interesting finding is the role of students in linking with informal stakeholders in the transfer of technologies and capability building in rural areas. Other important findings are on the policy environment, universities performance, and institutional profiles where in some instances limitations of the implementations of policies could be observed.

As the enrollment statistics at the three universities showed we find a trend of growth. This trend may suggest an increasingly important role of the university in the emerging national system of innovation in Tanzania, given its capacity to supply trained human resources per se but also with respect to the different functions for instance as supplier of crucial consultancy services.

The University of Dar es Salaam has the highest number of academic staff. However, the same University has the highest number of student to staff ration of 19 compared to 11 and 8.5 for SUA and MUHAS, respectively. The student to staff ratio is an indicator of the load of the staff which may impact on quality of teaching and learning. The ratio is also used to measure the level of utilization of the academic human resource at the institution and this difference indicates higher propensity to engage with external social partners.

In the past three years Sokoine University of agriculture (SUA) published 489 articles whereas University of Dar es Salaam (UDSM) and Muhimbili University of Health and Allied Sciences (MUHAS), respectively published 661 and 601 articles. By considering the individual number of researchers per University, MUHAS published more articles (2.47 articles per researcher) followed by SUA (0.96 articles per researcher) and lastly UDSM (0.59 articles per researcher). Thus MUHAS appears to have used publications as a channel for interaction and visibility to the international community prior to other mechanisms.

4.4.1 Re- visiting University Policies

The existing universities' policies are supportive to researchers' interaction with social external actors. Particularly all the three Universities have put in place research policies, which have established overall plans and acceptable procedures as well as conditions to guide and determine present and future decisions on research undertakings. Furthermore, researchers' engagement in terms of individual research outputs forms part of assessment criteria for promotion, which can be seen as an incentive to participate in such research. This was evident in some scheme of service for academic staff and academic staff performance assessment guidelines. However, the operationalization of the policy statements into daily research undertakings was an issue that emerged to be problematic since the interviewed researchers perceived them to be ineffective. We can therefore conclude that the university could improve their mechanisms for actually promoting and supporting interaction with external social partners in the course of that research.

4.4.2 The Role of Research projects (Past 3 Years)

Research projects showed to play a crucial role for interactions with external social partners, in particular for SUA where this was also referred to in the interviews. SUA executed 184 projects in collaboration with national University funds and international donor funds whereas UDSM and MUHAS executed 17 and 103 projects, respectively. In monetary terms these projects were worth Tanzania Shillings 39.41, 31.20, and 39.00 billion, respectively. While the research projects do cover a large variety of highly relevant issues to address the socio-economic needs of Tanzania and contribute to inclusive innovation it is striking that most of the large research projects are funded by international agencies. Thus, donors set the research agenda to a large extent. Interview data revealed furthermore, that Tanzania as a country is generally not very open towards research, with regulations to follow that are not necessarily encouraging or providing incentives.

4.4.3 Mechanisms that Promote Interactions with External Actors

All the three Universities mentioned “Open days for external actors” as the main mechanism that promote interaction with external social actors. Open days are special days that are earmarked at either a national level like “Nane Nane” pavilions where different organs including government, private businesses, or academicians demonstrate what they have developed for agricultural support in the country. It maybe technology, process, or even some technique. This is used as a promotional platforms that will enhance the engagement from the incoming enquiries. There are also localized open days like at a university, etc

In addition both UDSM and SUA added two more mechanisms namely, “community forum” and “newsletter that promotes interaction or engagement”. It is therefore evident that tangible tailored mechanisms from local government or even international communities were insignificant. This was also evident from the research funding portfolio in which local funding was marginal.

Moreover, examples of mechanisms that promote interactions with external actors are the extension units and farms at SUA and the teaching hospital at MUHAS.

4.4.4 Time Distribution of the Academic Functions

On the average, the distribution of academicians’ time for teaching and research was 56.67 and 25%, respectively. This makes a total of 81.67% for the core functions of teaching and research. Time for other functions like private activities for individual gain, interaction with external actors, and administration averaged 5, 7.5%, and 5.83%, respectively. This leaves a social considerable time for interacting with external actors. They may interact in the course of academic research or even teaching if it is service learning/workshop learning like in farms or in hospitals.

4.4.5 External Social Partners

The overall most important external social partners that scored WAI above 3 were “national Universities” (WAI 3.35) and “individuals and households” (WAI 3.16). Other important social partners were “funding agencies” (WAI 2.92) “international Universities” (WAI 2.88), “national government departments” (WAI 2.88), and “African Universities” (WAI 2.85).

The emerging important partners are generally clustered into three groups namely, academicians (national niversities and african universities); individuals and households; research collaborators (funding agencies and government department). The first group is

important for academic discourse whereas the second group is the main target of research because most of the research done at the universities is highly linked to improve the condition of the majority rural community. The third group is ultimate important with respect to facilitating these interactions through funded research and consultancies.

4.4.6 Types of Relationship

It was noted that “research consultancy” (WAI 3.40) was the most frequently reported type of relationship with WAI above 3. Research consultancy projects as funded by local agencies and international communities are important since they facilitate the perceived interaction with the social external actors. These can be students who go out in the field, but also firms, farms or patients who function as a “mediator” between the university and social external actors and therefore play a crucial role in assisting in the realization of some of the stated visions and missions of the universities. By performing this role these actors are thereby also playing a central role in the emerging innovation system, by linking different actors to each other and thereby facilitating interactive learning processes that can lead to innovation. We may therefore also place these actors at the center of analysis in investigations of formal – informal interactions.

Other types of relationship that was perceived important but with less (WAI below 3) frequency were mentioned to be “continuing education or professional development” (WAI 2.94), “collaborative R&D projects (WAI 2.86), “education of students so that they are socially responsive (WAI 2.85), “community-based research projects” (WAI 2.85), “customized training and short courses” (WAI 2.83), and “monitoring, evaluation and needs assessment” (WAI 2.81).

Indeed, “joint commercialization of a new product” (WAI 1.62) has scored the lowest at no coincidence. Lack of commercialization of research outputs is a persistent chronic problem in all the three surveyed Universities. This is because the linkages between Tanzanian researchers and research institutions, and companies, even those that are domestically based, historically have been weak (e.g. Wangwe, 1993). Consequently, researchers in health, agriculture, and technologies are facing difficulties in commercializing their indigenous outputs. This is attributed to the lack of inadequate local mechanisms for technology transfer and commercialization of research results as stressed in several of our management interviews. This being the case, private entrepreneurs, regulatory and financing institutions become key stakeholders in the development and transfer of commercializable technologies and the R&D process needs to link them and involve them at different stages of the technology development and diffusion process. Consequently, the public sector should take a different role towards supporting and regulating the private sector (Pineiro, 2007). This would include a concern and awareness around assuring

that potential technologies generated from R&D reach the potential end-users. Thus, this addresses issues that are of importance when strengthening and further developing the emerging innovation system in which the university is embedded.

4.4.7 Channels of Information

The three Universities had a common perception on the highly utilized channels of information for their academic and engagement activities. These channels of information were most frequently cited in the three Universities. They include “public conferences, seminars or workshops” (WAI 3.59), “students” (WAI 3.54), “training and capacity development or workshops” (WAI 3.25), “informal information exchange” (WAI 3.20), and “popular publications” (WAI 3.00). Thus, we find a number of very typical academic channels here.

Indeed, “public conferences, seminars or workshops” and “popular publications” as the main channels of information is also evident from the observed high number of publications in conferences and Journals. On the other hand, “students” and “training and capacity development or workshops” are also featuring frequently because training is the core mission of the Universities.

4.4.8 Outputs

It was observed under this study that the most important outputs (with WAI above 3) from these universities were academic oriented to include “graduates with relevant skills and values” (WAI 3.63) “academic publications” (WAI 3.51) “dissertations” (WAI 3.46) “academic collaboration” (WAI 3.11) “reports, policy documents and popular publications” (WAI 3.01)

On the other hand, “community infrastructure and facilities” and “new or improved process/products” scored marginally with WAI about 2 whereas technology transfer outputs in terms of “spin-off companies” attracted a poor response with WAI below 2.0. These low-ranked outputs in spin-offs are inherent in the core problem of low research output commercialization capacities in Tanzania. Since technology incubation is a missing link in most Tanzanian universities and research centres, lack of technology transfer is bound to be a persistent problem.

4.4.9 Outcomes and Benefits

Academic outputs and benefits were frequently acknowledged by the interviewed researchers. These benefits include “improved teaching and learning” (WAI 3.48), “academic and institutional reputation” (WAI 3.30), “training and skills development” (WAI 3.17), “public awareness and

advocacy" (WAI 3.17), "relevant research focus and new research projects" (WAI 3.05), and "theoretical and methodological development in an academic field" (WAI 3.00).

Inclusiveness of the research conducted by the interviewed academicians was apparent since they perceived communal benefits as next important outcomes and benefits alongside the academic ones. Thus the next in importance outcomes and benefits included "improved livelihoods for individuals and communities" (WAI 2.83), "improved quality of life for individuals and communities" (WAI 2.76), "cross-disciplinary knowledge production to deal with multi-faceted social problems" (WAI 2.73), and "incorporation of indigenous knowledge" (WAI 2.53).

4.4.10 Obstacles and Challenges

The similarity of obstacles and challenges amongst the three universities was indicated by the fact that the most critical obstacle on "limited financial resources for competing university priorities" (WAI 3.81) scored the highest WAI ever responded when the three universities are considered. This obstacle goes in parallel with the second critical obstacle "sustainable external funding" (WAI 3.39). It was reported that the government is usually disbursing insufficient fund to run the Universities and that what suffers most is research and extension services since the little available fund is quickly channeled to solve pertinent imminent university problems. On the other hand, donor funding is ad-hoc and has never been consistent because usually it is not aimed at solving the university or national problems but rather to address issues that are important to the donor. Consequently, sustainability of donor funding has never been consistent.

Other obstacles and challenges were mentioned to be "competing priorities on time" (WAI 3.07), "institutional recognition systems do not reward academic interaction activities sufficiently" (WAI 3.03), and "too few academic staff" (WAI 2.95).

Though reviews of universities' policies emphasize the need of putting in place reward systems, there are no apparent and structured reward mechanisms to researchers who engage and interact with external social partners. Existing mechanisms are either insufficient or ineffective, or implementation and impact of these guidelines is far from being appreciated. For the scientists who engage through funded projects, there are personal incentives that accrue from the research consultancy activities themselves. However, this is not consistent since the rewards are project oriented and they are not structured into the university channels.

4.4.11 Reasons for no Interaction

All interviewed academicians at the Sokoine University of Agriculture (SUA) were interacting with social external actors. Four out of 88 interviewed academicians from the University of Dar

es Salaam (UDSM) were not interacting whereas six academicians from the Muhimbili University of Health and Allied Sciences (MUHAS) were also not interacting. Reasons for not interacting were noted to be “pressures of teaching and research on my time are too great” (WAI 2.20), “my department or faculty does not promote interaction” (WAI 1.80), “lack of social partners’ knowledge about research activities and priorities in Universities” (WAI 1.80), “lack of recognition of interaction as a valid type of scholarship in my University” (WAI 1.67), and “institutional recognition systems do not reward interaction activities sufficiently” (WAI 1.60).

However, all the reasons for no interaction were not so strong since they attracted very low WAI value of about 2 and below. Given the low number of no interaction, this is most likely that almost all reasons were personal. However, the reasons are related to internal institutional processes but are intertwined with reputational issues, such as recognition of valid forms of scholarship and understanding of the university as a knowledge-based institution.

4.5 Final Reflections

The analysis of our case material showed different types of national and international interactions with different types of external actors the three universities engage in. Given the new emphasis on the role of universities in inclusive socio-economic development and innovations for marginalized groups, it appears crucial to further strengthen and stabilize some of these interactions. It has been a typical feature of the Tanzanian NSI that linkages are often of rather sporadic nature. This was also evident from the research projects, where linkages exist during the duration of a project. Long-term mechanisms and follow ups off established contacts could specifically be addressed in policies. We realized the crucial “linking-task” that a certain group of actors played – these were firms and farmers and students, enrolled at the university or linked to it through consultancies. These appear to fulfill an interesting mediating function between marginalized groups and problems and the capacity and competence available at the university. It would be interesting to further fine tune the specific roles that these different types of external actors may play for the university and in the emerging NSI.

The following part 2 of this study provides some in-depth insights into and analysis of the interactions taking place in three selected case studies of innovation for inclusive development. We are here thus examiningin more detail the role that university employees can play in linking with marginalized groups of people with the overall aim of increased livelihoods and inclusive development.

5. FINDINGS ON CASE STUDIES OF LIVELIHOODS

5.1 Case 1: Development and Dissemination of a Small-Scale Stone Crusher Technology in Tanzania

This case study presents the interactions between the university researchers and a womens group involved in hard labour of manually crushing quarry stones to produce small sized stones (aggregates). The produced aggregates are then sold to the builders of houses and civil structures for income generation. The case demonstrates the importance of technology interface in improving the working environment, easing hard labour, improving productivity, and increasing income generation.

This project on the development and dissemination of a small-scale stone crusher was implemented at the university of Dar es Salaam under the College of Engineering and Technology (CoET) at the Department of Chemical and Process Engineering. While researchers from CoET were involved in the process of design and manufacturing of the prototype including testing in the field, the workshop within the Technology Development and Transfer Centre (TDTG) at CoET was utilized for manufacturing the crusher. Implementing researchers were from the Department of Chemical and Process Engineering.

The social partner is a women group of stone crushers known as Umoja ni Nguvu. The women group is located in the city peripheral at the Kunduchi Mtongani quarry in Temeke District of Dar es Salaam where we interviewed them.

> *… I remember that our colleague at the Department of Chemical and Process Engineering was approached by two women who introduced themselves as representatives of a group of stone crushers from Kunduchi Mtongani quarry. Their interest was to be assisted with a simple manual stone crusher for easing their quarrying work. At the time we had no such funding that can be utilized in building a crusher for them. Our promise to them was that we shall look for possibilities of assisting them through funding that may come from government or donors. Six months later we came to know about possible funding from the Tanzania National Roads Agency (TANROAD) through the Labour*

Base Technologies project. We therefore approached TANROAD and after an iterative process the funding was obtained[1]*. ….*

5.1.1 The Livelihood Problem

The Tanzania construction industry is among the booming industries in Tanzania. The construction industry is also booming in support of the developing economy, which is currently recording a growth rate of 6.8% per annum. About 24% of the Gross Domestic Product (GDP) is contributed by the construction and industry sectors (National Bureau of Statistics, 2012). As a result of the economic growth, construction of buildings and other civil infrastructures is growing. The growing of building and construction activities is simultaneously creating a demand for aggregates beyond what could be supplied by existing large-scale quarries. This prompted the development of a new vocation of informal miners, mostly individual women, who use manual tools like pick axe, crow-bars, and sledge hammers to mine and process limestone or granite rocks to feed the booming construction industry. Although these miners earn their livelihood, through sale of the aggregates, the occupation is undertaken under adverse conditions, which are characterized by:

i. Low productivity as it takes a man 3 weeks and a woman 4 weeks to produce a 7 ton lorry of limestone aggregates worth U. S. $ 80 less production costs
ii. Health risks and safety hazards that cause bodily injury of fingers by sledge hammers, eye injury from flying stone chips, and respiratory ailments due to dust inhalation
iii. Drudgery and hardship involving over 10 hours per day of toiling on hot sunshine
iv. Marginal income from hard labour and drudgery

While typical quarrying is shown in Figure 5, the common hand tools used in the process are detailed in Table 54. From Table 54 it can be observed that in this business men do the heavier work of stones excavation and pre-crushing whereas women do the crushing and sorting to final sized of aggregates.

[1] Project Leader

(a) Stone crushing

(b) Aggregate sizing

Figure 5: Stone quarrying

Table 54: Tools used in artisanal quarrying

STEP	PROCESS	TOOL	PURPOSE	PARTY
1	Demarcation	Pickaxe and spade	Marking the area to be excavated	Mostly men
2	Excavation	Pickaxe and crowbar	Excavate large rock boulders up to 1 meter in diameter	Men
3	Pre-crushing	10 kg sledge hammer	Reduces large boulders to ¼-½ meter diameter stones, which can be carried by carts or buckets	Both
4	Transportation	Buckets and trolleys	Carrying stones to crushing or selling point	Women
5	Crushing	2-5 kg sledge hammers	Crushing stones to final sizes- ½", ¾" or 1" diameter	Women
6	Sieving	Metal screen, fork, and shovel	Removing unwanted dust and undersize (fines) from product	Women

Source: Elisante et al., 2005

Generally, these artisanal miners are poor with virtually no other means of better income. They therefore depend on scavenging the limestone to make a living. In fact, the products from these vendors are very attractive even to formal builders and contractors when they require small amounts of aggregates, say one or more 20 litre buckets (the unit measure), otherwise it becomes expensive and unnecessary to procure the whole standard 7 ton truck of aggregates. Although there are larger trucks that can carry higher tonnage, the 7 ton truck is the common unit measure for a truck of about four cubic meter capacity.

… When we started crushing the stones to produce aggregates using hand tools we were very poor without better alternatives to make life. It was a really toiling work as we worked full time in sunny days and as a result our skins darkened not the way we shinny today. Our skins and lips were dry. Even with this hard work, we could only produce two bucket (20 litres) full aggregates each selling at T. Shs. 100 to 150 (U. S. $ 0.10 to 0.15)[2]. … Look at my fingers; they are not straight as a result of hard work and frequent knocking with hammer or the stones themselves[3].

5.1.2 Actors

The main actors and their role to this project are shown in Figure 6 below and are:

i. The government of the United Republic of Tanzania
ii. The University of Dar es Salaam (UDSM)
iii. College of Engineering and Technology (CoET) scientists
iv. Tanzania National Roads Agency (TANROADS)
v. The Kunduchi Mtongani local government
vi. Umoja ni Nguvu Women Group

The government is responsible for setting up policies and their implementation. Therefore, in this case the government has put in place social policies in gender empowerment in which women are given priorities to access support from government agencies and from financial institutions. In Tanzania, there are Savings and Credit Cooperatives (SACCOs) and microfinances that have been primarily established to increase women access to training and funding. The TANROADS being a government agencyhas implemented the policy by supporting women who are engaged in quarrying, which is an important sector in their construction industry.

The scientists used their intellectual knowledge to teach and provide solutions to societal problems through projects and contracted research. Thus, as part of producing a solution to easing the workload and improve productivity of artisanal quarrying, researchers from the College of Engineering and Technology (CoET) of the University of Dar es Salaam prepared a project proposal for funding by the Tanzania National Roads Agency (TANROADS).

[2] Women Group Leader cum crusher and Group Members
[3] Women Group Leader cum crusher

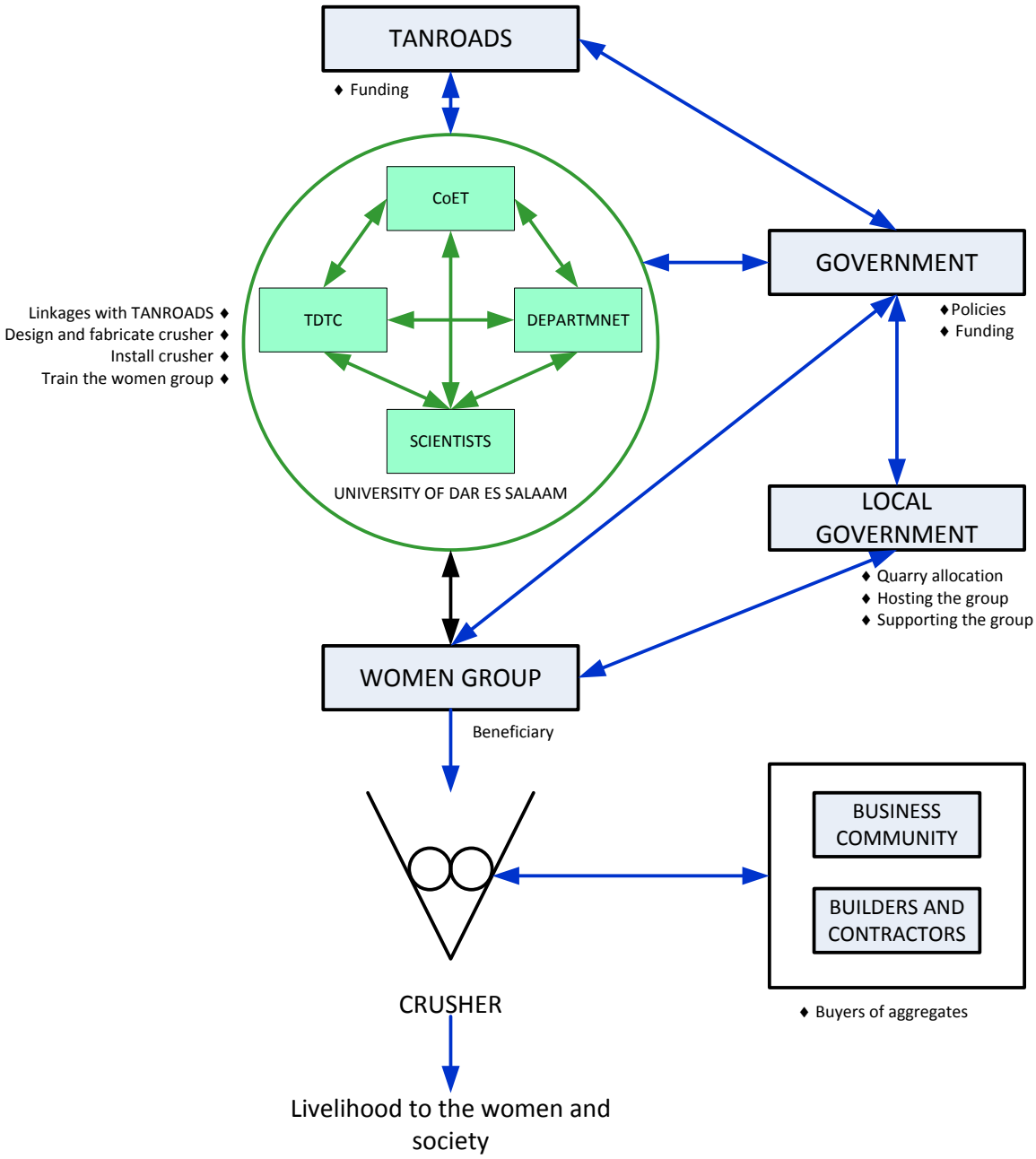

Figure 6: Main actors and their roles to CIMA crusher project

The funding was received in year 2004 and the project on designing the crusher was implemented using the facilities at the Technology Development and Transfer Centre (TDTC), at CoET. TDTC is an external interface structure for the university. The objectives of the project were to:

i. Improve productivity and income of small-scale stone quarries
ii. Reduce hardships, drudgery and hazards of artisanal quarry vendors
iii. Increase employment generation

Thus the local government and the women group were the direct beneficiary of the project. The women group belongs to the Mtoni Mtongani local government, which in turn supported them. Some of the support given to the group is for their recognition as a legal entity and also by allocating them part of the quarry area where they operated.

In Tanzania artisanal aggregate quarrying activities can be seen almost everywhere in small towns and big cities like Dar es Salaam, Mwanza and Arusha where men, women and children work round the clock in quarry sites. In Dar es Salaam they scavenge limestone rocks left behind by large -scale miners in open pit mines located in Kunduchi Mtongani, Boko and Salasala areas. In other areas of Dar es Salaam city like Masaki, the artisanal quarries are also found along the roadside as they scavenge limestone left behind in existing construction works.

5.1.3 Drivers of Interaction

While the CoET researchers under this project were interested in excelling in their professions, the development of such tools and machinery like crushers is among the core objectives of establishing TDTC. TDTC plays a key role in coordinating technology development and transfer activities at CoET. The Centre has a multipurpose workshop with technical staff of different engineering cadres. The Objective of the Centre is to develop and disseminate technologies that have direct relevance to the Tanzanian community and which will directly impact on the development of SMEs and thereby improving the lives of the general public. Following were the main objectives of establishing TDTC:

i. Development of indigenous and adopted technologies
ii. Accelerating promotion and commercialization of technologies
iii. Initiation, coordination, and supervision of product/production innovation projects
iv. Facilitating technology procurement from within and outside the country
v. Provision of technical service to the industry

The motivation for the women to interact with CoET scientists was highly linked to their objectives of forming the group from which they will engage in income generation activities for alleviating their poverty. They formed the group in order to consolidate efforts and put themselves in a position that they can be supported by financial institutions and other organizations. Because an effective contribution to a community can be easily be done by supporting a group rather than an individual. Fortunately, this became the case in which CoET could support them as a group.

5.1.4 Organizational Arrangement

During implementation, the researchers from CoET visited the group of artisanal miners for gathering initial design data for the mechanical stone crusher. In comparison to the utilized traditional tools mentioned in Table 1, the individual artisans could not afford to own such an expensive crusher in their own. Consequently, the already existing vendors' group known as Umoja ni Nguvu Women Group at the Kunduchi Mtongani quarry was organized through their leaders under the project. The group was an informal cooperative that consisted of existing artisanal quarry vendors who operated within the Mtongani quarry. The group constituted 30 women. All communications to and from the group were channeled through existing leaders.

The Umoja ni Nguvu Women Group was an informal cooperative that organized all artisan women miners at the quarry. Usually there is one such group at a quarry and it is led by a formally elected chairperson and an assistant. There could be other positions like an accountant, depending on the specific group structure. The group leaders are responsible for managing all administrative issues and especially to solve emerging problems. They also become responsible for interacting with different government organs including the local government.

> *… Looking at the poor artisans we even thought of what kind of mechanical crusher could be designed for them. Crusher size and capacity out to be small but the issues was on the means of powering it. Different options were discussed like hand pedals, foot pedals, etc. We had to avoid powering by electrical due to remoteness of the quarries and cost too. Engine driven was also avoided for cost reasons. Lastly, foot/bicycle pedaling was chosen. Indeed, this did cut down the initial and running cost of the crusher*[4] *…*

5.1.5 Artisan Vendors Participation

The artisanal quarry vendors were highly consulted during the choice of technology to be developed. The basic design data as utilized by TDTC engineers including other important quarrying information were gathered from the Umoja ni Nguvu Women Group. Such information like type of tools and techniques used by artisanal quarry vendors, aggregate size, and nominal throughput of the crusher were therefore gathered as a result of interaction with the vendors.

[4] Project Team Leader

However, the choice of technology was also influenced by a matrix of other socio-economic and technical factors like:

i. Gender non-displacement due to introduction of new technology
ii. Feed size of 3-6 inches consistent with existing techniques and tools used by artisan vendors
iii. Aggregate product size range of ½ to 1 inch as consumed by the local construction industry
iv. A throughput that is economical in terms of time and investment
v. Wide applicability to crush different rocks from softer materials like gypsum and dolomite to hard and abrasive ones like quartz, limestone and granite
vi. Purchasing power of the women group to buy the new crusher, initial investment

The testing and evaluation of the developed CIMA crusher was done by the TDTC engineers under the close participation of the women group. About 100 tons of aggregates were produced during the test period. During a three months evaluation phase, these project beneficiaries were trained with respect of operating and taking care of the crusher during its service. After acquiring these skills the women group continued to produce the aggregates with the CIMA crusher.

The TDTC engineers collected useful CIMA crusher's performance characteristics during the training and while undertaking the test runs. More information was exchanged from the women who operated the crusher. Thus as part of these recommendations collected from the field test runs of the CIMA crusher, following improvements were done to the CIMA crusher suggested by the vendors and were implemented by the TDTC engineers:

i. Adaptation of a feed hopper
ii. Incorporation of sieving mechanism
iii. Installation of additional safety guards
iv. Installation of a clutch to decouple the crusher from engine motion when a jam occurs

5.1.6 Innovation

Technological Innovation

Different types of innovation were the result of this project. With the development and introduction of the new machinery for crushing the stones (in detail described in the following section) we have a clear technological product innovation. This was, however, accompanied by the development of new skills and procedues in the process of stone crushing. Thus, the result

was also a process innovation given that the artisanal quarry vendors were now dealing with a mechanical crusher in stead of hand tools that were originally used in crushing and sieving the aggregates. New skills were acquired through training on how to operate the new mechanical crusher. A further change for the group was its organizationinto a formalized group for managing the process. The training was provided by the team that constituted of TDTC implementing engineers and technicians. The engineers who designed the machine were responsible for developing and supervising the training program. They also utilized this training period for receiving feedbacks from the end users, the women group. The feedback was useful in finding areas of improving the machine with respect to end users and machine performance. The engineers provided in-class theoretical training to the women. On the other hand, the technicians were responsible for demonstrating the actual running of the machine for training its operations to the women group. This training was done directly to all members of the group. Detailed training on servicing the machine was done to two men who were appointed by the women group for this specific technical part. Thus, new organizational structures and new skills were introduced simultaneously.

> *… This crusher was heavy, what we did was to request a service of two men who used to tow it to different other locations. The two men were also responsible for taking care of the mechanical systems while the remaining work of collecting stones, filling, and packing was our responsibility[5]. …*

The Developed Technology

The developed crusher was known as Construction Industry and Mining Accessory (CIMA). Initially, the CIMA was designed to operate through a bicycle pedal (Figure 7). The bicycle pedaling mechanism was perceived necessary for reducing the overall crusher initial investment cost and running cost of commercial energy like electrical or petroleum. However, this demanded a backbreaking effort to paddle, so the bicycle idea was abandoned and instead a 3.6 kW diesel engine was installed as shown in Figure 8. Hence, ongoing interaction and adaptation of the new technology introduced to the conditions was required.

> *… After completing the fabrication of the bicycle pedaled crusher, we had to let them operate for some time. After visiting them several times, we saw that though there was an increment of productivity, pedaling the*

[5] Women Group Leader cum crusher

crusher was an issue to think about. We even noticed that women themselves were avoiding pedaling the crusher. Instead they had to invite men for the work. Men also had to toil a lot to make and effective pedaling. This actually killed the whole concept of assisting the women in easing their work and the powering mechanism had to be changed[6] *…*

Figure 7: Bicycle pedaled crusher

Figure 8: Diesel engine operated crusher

Source: Elisante, 2006

The diesel crusher presented in Figure 3 is an air cooled diesel engine model Z170F made in China by Yuyao Power Machinery Works. The horizontal single cylinder four-stroke, engine has a rated speed of 2600 revolutions per minute giving a nominal power of 2.94 kW and a maximum power of 3.23 kW. With a net weight of 40 kg, the engine satisfies versatility requirement as the whole crusher unit weighs roughly 150 kg hence it was possible to mount it on a mobile unit that could be towed by two people within the quarry perimeter.

5.1.7 Outcomes and Benefits

Field tests and continued performance of the CIMA crusher revealed its positive results with respect to improved working condition and increased aggregates productivity. These improved features were important for ensuring that the project did contribute to improving the livelihood of the marginalized artisan women quarry vendors.

The field performance evaluation tests indicated that one 7 tons lorry took 5 to 6 hours, which is faster compared to a period of 3 to 4 weeks required to get the same quantity using traditional manual crushing by the artisanal quarry vendors. From the projected 2009 profit-and-loss account summary using actual 2006 field testing data as analyzed by the researcher and

[6] Project Team Leader

presented in Table 55, the CIMA crusher increased profitability to the artisanal quarry vendors. Furthermore, based on a new crusher investment of T. Shs. 3,500,000, using a ten hour working day, a monthly net profit of T. Shs. 2,400,000 was realized. This means that if there is no major breakdown and market conditions were favorable, the project had a payback period of two months only. This means that the initial investment to buy this CIMA crusher is recovered by a buyer after gathering revenue from operating it in a period of two months for the machinery. This analysis shows that investment in buying such a CIMA crusher by any artisan miner is a profitable venture. Individual miners could even approach financial institutions for loans that can be repaid in a period of two months only. It therefore provided an opportunity for poverty alleviation to the miners and any other interested individual or a commercial entity.

> *… It was unbelievable that we managed to improve our productivity tremendously! Though the operation was dusty, we could crush stones and sell two trucks (each 7 tons) full of aggregates per day*[7]*. …*

Table 55: Performance characteristics of the CIMA crusher

SNO	DESCRIPTION	AMOUNT PER DAY, T. Shs.	AMOUNT PER MONTH (25 DAYS), T. Shs.
1	Sales revenue (Aggregates 130,000/= per 7 tons)	259,000	6,475,000
2	Variable costs (stones, diesel, lubricants, maintenance and servicing, operator wages, plus 5% overheads)	125,980	3,022,250
3	Fixed costs (license, technician wages, security)	6,500	195,000
4	Total operating costs	132,480	3,217,250
5	**Gross profit**	**126,520**	**3,257,750**
6	Depreciation (12% per annum on equipment)	1,151	28,767
7	Income tax (25% of gross-profit)	31,342	807,246
8	**Net profit**	**94,027**	**2,421,737**

Source: Elisante, 2009

Indeed the CIMA crusher was capable to improve the living conditions of the marginalized quarry vendors by increasing profitability and the rate of profitability. Through the improved crushing efficiency, the vendors had enough time to do other economic and social activities like taking care of their families. Furthermore, the improved profitability was an economic gain as they could be able to afford medical and to pay school fees to their children.

[7] Women Group Leader cum crusher and Group Members

… All what you see around me is the benefit from that CIMA crusher. It uplifted my income and slowly I managed to invest appropriately as follows[8]:

i. *I educated my daughter to college level and now she is married. I wonder if one could marry her given the poor situation we had before*
ii. *I have built two houses and bought an extra plot*
iii. *I own two more businesses, a grocery and I also run a charcoal store … see this (showing the Team both the house and a pile of about twenty each 30 kg bags of charcoal)*

… At the time we were crushing manually, my kid was at FK primary school. It was even difficult and painful when it came a period for paying fees and school contributions. Immediately when the CIMA crusher came it was really easy and I could not think about it. My son has now joined the University education[9]. …

5.1.8 Knowledge flows

The artisanal aggregate vendors did provide useful information to the researchers with respect to the design parameter for the CIMA crusher. Such information like capacity, and the product aggregate size was not known in the market. The basic socio economic data as applicable in the aggregate artisanal miners were also provided by themselves. This information was instrumental for designing and for understanding the viability of the product to be developed.

The overall flow of knowledge was from the researchers at the university to the artisanal aggregate vendors. The vendors had to be trained on the operation and maintenance of the CIMA crusher. It is thus a clear case of a formal technology transfer structure that can be identified here, with a mandate for working with SMEs and livelihood related to the nature of the engineering discipline.

[8] Women Group Leader cum crusher
[9] Group Member

5.1.9 Enabling Factors

Three main enabling success factors to the CIMA crusher project can be identified. These are a) financial, b) the existence of supportive infrastructure at TDTC, and c) the women group was able to organize itself and became a successful project recipient.

The financial support to the project as extended by TANROADS was important to the success of the projectas the development of the CIMA crusher required capital input in terms of procuring materials for its manufacture. Secondly, the role of the university of Dar es Salaam through the academicians and available physical infrastructure for machinery development at TDTC is acknowledged as another success factor. TDTC engineers designed the CIMA crusher and produced a prototype, which was used by the women group. TDTC also provided the initial seed money while developing the project proposal. On the other hand, the Umoja ni Nguvu Women Group at the Kunduchi Mtongani quarry was supportive to provide the necessary input during CIMA crusher design, testing and further as an organized recipient of the technology.

5.1.10 Constraints

A number of constraints did exist. Some related to problems with interactionfor such engineering technological support to the marginalized communities. For instance, the women group could not manage to undertake technical servicing and repairs to the CIMA crusher. Instead two men had to be trained for being able to undertake the servicing and maintenance. However, it was reported that they still could not do a proper servicing/maintenance. .

Further, other management problems are obvious in this project. The transfer of this technology could not realize the importance of the social and cultural dimensions of the women group. For instance, the project developers expected that the successful operation of the CIMA crusher prototype could receive a multiplication effect. This was not the case due to several factors that include the negative aspects of a 100% donor funded project. The recipient women group could not ensure a long time life of the crusher since even the first major overhaul of the diesel engine could not be afforded. The group could not set aside some of the profit for meeting incidentals like machine breakdown. This was also attributed to the poor business and financial management aspects within the women group.

Due to its simplicity and potential, the crusher attracted considerable attention from the local population and from neighboring countries like, Kenya, Somalia, Cameroon and South Africa. However, it could not receive a widespread adoption due to the fact that only one CIMA crusher

was developed and demonstrated in Dar es Salaam only. With such a single prototype it thus received limited demonstration to potential beneficiaries. A sustainable dissemination of the product could be achieved through:

i. Promoting the widespread dissemination of the innovation through mass media, seminars, workshops, trade fairs and exhibitions;
ii. Technology transfer through platforms such as incubators for facilitating its mass production.

Though TDTC participated in such promotional events and trade fairs, workshops and seminars there was an apparent problem in commercializing the CIMA crusher. Other instruments for technology transfer and commercialization may therefore be needed to overcome these problems of scaling up. Furthermore, alternative funding sources should be arranged to maintain such important projects that significantly contribute to livelihoods in informal settings.

The CIMA crusher was later transferred to a businessman who had a similar aggregate enterprise in the northern part of Tanzania. The crusher was transferred to the businessman after the woman group acknowledged to have no capacity to manage it further.

5.2 Case 2: Development of Sustainable Production and Distribution System of Clean, True Type Banana Planting Materials in Tanzania

This project was implemented by the Department of Crop Science and Production of the Sokoine University of Agriculture (SUA). The project team leader, assistant team leader and 4 other researchers were from SUA, and two researchers from Agricultural Research Institute (ARI), Uyole Mbeya Tanzania, and 2 more collaborating researchers from the Norwegian Institute for Agricultural and Environmental Research (Bioforsk), Norway. The project was funded by the Norwegian government through the Norwegian Embassy. Even though the department of Crop Science implemented the project in the period of 2001 – 2008, the extension service is going on todate through advisory services and research. The main aim of the project was to improve farmer's income by disseminating disease free plantlets and training.

The project was implemented in eight villages of Tanzania that were drawn from three regions namely, Mbeya (2 villages), Morogoro (4 villages) and Coast (2 villages). Every village nominated 20 banana farmers to form a group for implementing the project and the villages were simultaneously served in the same project period. In general, the project has made it possible for more than 3,200 farmers to benefit by accessing the disseminated superior disease free plantlets. The trained farmers were able to train farmers within their village and region

including those from other regions and neighbouring country, Malawi. Figure 9 show the respective location of the three participating regions.

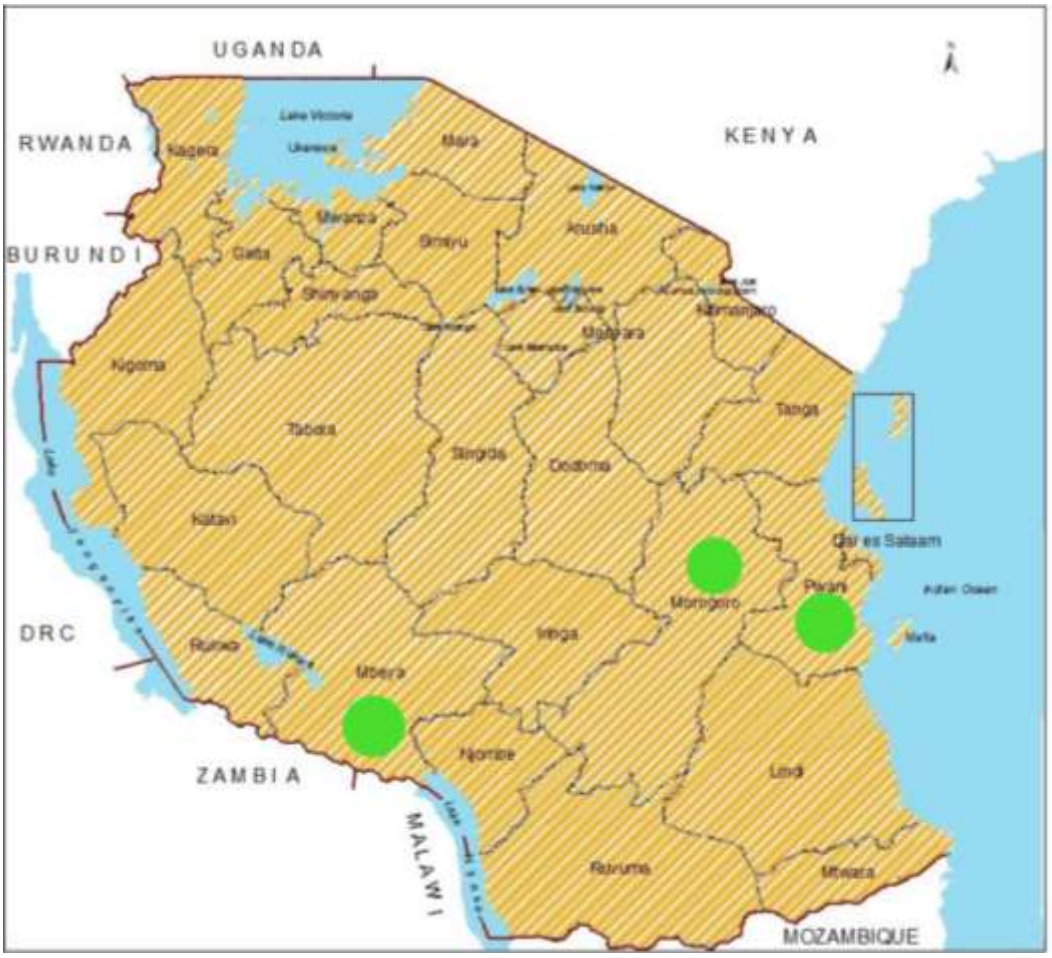

Figure 9: Location of banana project participating regions (green dot)

This case illustrated the process of increasing the banana productivity and improved banana farming techniques as a result of solving identified banana production constraints. The success of this demand driven research project went beyond the participating villages and regions. This success was brought by many factorsincluding the high level of beneficiaries participation and that a bigger network of researchers were involved. The participation of the project beneficiaries started from early stages when they were asked to list pertinent problems that were responsible for lowering their banana productivity. Besides the fact that poor farm management practices were among the existing problems, other frequently mentioned problems were attributed to pests attack and diseases. The project was therefore designed to use the tissue culture technology for solving the disease problem and pests attack whereas the farmers were taught better techniques of farming. Tissue culture is a propagation technique used to clone a single cell or plant materials in culture medium under strict hygienic conditions. In the case of banana,

corm suckers and sword suckers are used as starting materials. The tissue culture method consists of four steps namely, initiation, multiplication, rooting and acclimatization. This method is commonly used in rapid production of superior banana cultivars.

Both the tissue culture and better farming techniques were transferred to the farmers theoretically and this was done practically at an identified model farm. A high level of participation was assured at all stages of this training. Thus before planting the cultured disease free bananas in the model farm, the farmers were asked to select the preferred banana species to be planted. Alongside the preferred species, the researchers introduced new species too. The new species were designed to match the local preferences and also to meet the disease free characteristic. Five newly introduced species were FHIA 17, FHIA 23, Yangambi, SH-34469 and Pelipita whereas the common traditional species were Kambani, Jamaica, Mtwike, Bukoba, Uganda, Itoke Sege, Ngego Kapale, Sege, and Malindi Ndefu. Both the newly introduced species and traditional ones were planted in the model farms by the farmers themselves under a strong supervision of the scientists. The supervision ensured to train practically for adopting the better banana farming techniques. After sometime, the products from the model farm were appreciated by the farmers in terms of yield and productivity from both traditional and new species. The new species were then tasted by eating, which was important in increasing the preferential selection of the farmers themselves. After appreciating the results from the model farm, the individual farmers were then free to plant the preferred banana species in their own farms. At this stage, the farmers themselves were able to apply the tissue culture techniques themselves for transferring the banana species from the model farm to their own farms.

5.2.1 The Livelihood Problem

Bananas (*Musa* spp.) are some of the earliest crop plants having been domesticated by humans. Bananas are consumed as ripe fruit, whereas plantains, which remain starchy even when fully ripe, need cooking for palatability and consumption. Originally crops from humid tropics but have acclimatized to a broad range of climatic conditions. While bananas have come to occupy the status of a high value, commercial crop, plantains have remained a staple food of many ethnic groups.

Besides banana, other main food crops grown in Tanzania are maize, sorghum, millet, cassava, sweet potatoes, pulses, paddy and wheat. According to the national sample census of agriculture (United Republic of Tanzania, 2012), banana is the second most important planted perennial (permanent) crops with total area of 289,496 ha second to cashew crops whose planted area is 531,526 ha. Banana occupies a distinct place in the national as well as in the

household economy of Tanzania. Nutritionally, banana stands out among other fruits because of its richness in carbohydrates, vitamins and minerals. Despite the importance of bananas in rural livelihoods, there have been minimal efforts to develop the marketing of bananas and their products in Tanzania.

Marketing of bananas is one of the major factors that determine the existence of banana fields and types of bananas cultivated by farmers. This is because the demand created under marketing strategies is directly influential on the supply side that makes farmers produce more preferred species.

Expansion of banana cultivation to marginal areas is limited due to the low value of bananas. In traditional Tanzania banana farms, its production is declining due to increasing pressure of pests and diseases, low soil fertility and other socio-economic limitations, including poor marketing systems. Socio-economic factors, including low marketing, have directly or indirectly contributed to the decline of banana production since some banana farms are converted to commercial crops like coffee. This is among the factors that limit the expansion of banana cultivation into marginal areas. In this situation, the communities that relies on banana crop as a cash crop and for nutritional purposes are facing the vicious circle of poverty. The poverty becomes critical to such rural communities that their capacity to access nutritional food and necessary social services like health and education is severely hampered. A number of efforts to increase banana productivity are in place. These include soil fertility improvement, good crop husbandry, and control of banana diseases and pests. One of the projects that were implemented by Sokoine University of Agriculture targeted to address the problem of low banana productivity was by introducing clean, true type banana planting materials through tissue culture technology and by training farmers in integrated crop and pest management (ICPM) through mulching, using big plantation hole, controlling banana weevils and appropriate use of fertilizers. Tissue culture technique involves a systematic banana stem's cuttings that are subsequently treated to produce disease-free planting materials.

> *… The project was initiated as a result of frequent enquiries by Morogoro region farmers at SUA. The farmers were interested in having a permanent cure to existing banana diseases that diminished productivity and income. In an attempting to solve these problems, SUA researchers developed a project proposal, which was submitted to the University management for funding. Through the broader project which*

was funded by Norway. An initial funding of T. Shs. 1.5 million was received for developing a full proposal[10].

5.2.2 Actors

Different actors shown in Figure 5 interacted with the beneficiary villagers from the three regions Coast (Mkuranga), Mbeya and Morogoro. They included researchers from the Sokoine University of Agriculture (SUA), Agricultural Research Institute (ARI) from Uyole Mbeya, and from the Norwegian Institute for Agricultural and Environmental Research (Bioforsk). Another important actor was the Norway government. The Norway government supported the project by providing the funding to the activities whereas the researchers were responsible for transferring the tissue culture technology to the participating farmers and also they trained them on integrated crop and pest management. The government of Tanzania also provided funding to the project through salaries to the local scientists and through the existing research infrastructure at the local participating Universities.

The local governments provided administrative support to the project. This was an important link between the researchers and the participating villagers. Other important actors were the business community, which bought the banana products for resale to the larger community. The business community also was also responsible for providing the farm inputs like fertilizers. On the other hand, the villagers themselves were engaged through their local group leaders.

[10] Assistant Team Leader

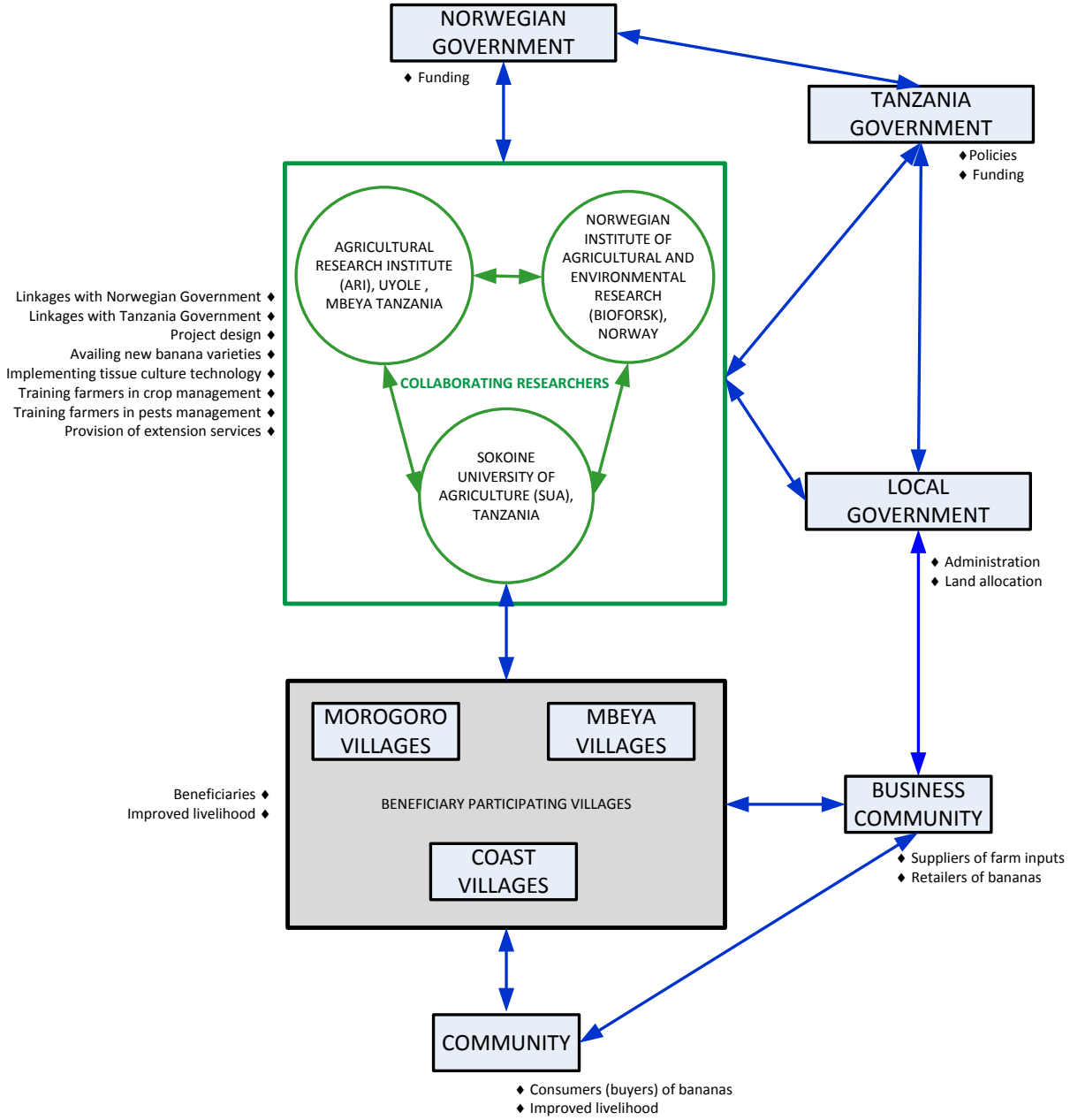

Figure 10: Actors to the banana project

5.2.3 Drivers of Interaction

SUA's main research objective is to provide leadership in basic and applied research in order to generate new knowledge and innovations that respond to contemporary and emerging needs. SUA thus emphasizes that research becomes linked to development and societal issues. . The banana project was developed to increase livelihoods of farmers and for yielding other important capacity building benefits in terms of supporting postgraduate studies. The

participating researcherswere motivated by practicing their intellectual knowledge while at the same time having a financial gain in terms of accrued professional fees. Thus, both sides, university and community benefited from this project and motivated their respective interaction.

The main driver for the participating communities were to alleviate their poverty through improving the yield of bananas. The banana yield improvement was sought through solving banana plantation problems like pests and diseases.

5.2.4 Organizational Arrangement

The role played by the Sokoine University of Agriculture was mainly to provide technological knowledge and to deliver extension service and training to the villagers. The SUA researchers linked researchers from the other participating institutions (ARI Uyole and Bioforsk) to deliver the agricultural support to the villagers. Furthermore, SUA utilized the improved banana varieties from its banana genebank for disseminating them to the beneficiary villagers. While the three institutions were responsible for designing the project and its intervention, the SUA researchers transferred the tissue culture technology and provided the daily extension and training to the participating villagers.

Participatory approaches were used by SUA researchers to implement the project using the farmers' field schools model as technology uptake path, where farmers learn by doing, discovering and comparing. It nurtures a non-hierarchical relationship between farmers and trainers.

5.2.5 Community Participation

Community participation was one of the main attributes of this project's design, implementation and monitoring. After identifying the project beneficiaries in each village, the villagers were asked to list pertinent problems that were responsible for lowering their banana productivity. Besides the fact that poor farm management practices were among the existing problems, other main problems were mentioned to be attributed to pests attack and diseases.

> *… The SUA Professors visited our village for discussion together with our leaders on the proposed improved banana project. After discussing with the villagers and after visiting our banana farms they observed many problems that were responsible for low productivity. They proposed a field visit to SUA University where my friend and I were*

> *selected to represent others. It was an eye opening as the difference between our farms and the bananas themselves were not comparable. Ours were very poor. This fact did encourage us to join the program without hesitating![11] …*

The project was therefore designed to use the tissue culture technology for solving the disease problem and pests attack and additionally the farmers were taught better techniques of farming. Thus, both the tissue culture and improved farming techniques were transferred to the farmers at an identified model farm (field school). A high level of participation was assured at all stages of this training. Before planting the cultured disease free bananas in the model farm, the farmers were asked to select the preferred banana species to be planted. Alongside the preferred species, the researchers introduced new species too. The new species were designed to match the local preferences and also to meet the disease free characteristic. Five newly introduced species were FHIA 17, FHIA 23, Yangambi, SH-34469 and Pelipita whereas the common traditional species were Kambani, Jamaica, Mtwike, Bukoba, Uganda, Itoke Sege, Ngego Kapale, Sege, and Malindi Ndefu. Both the newly introduced species and traditional ones were planted in the model farms by the farmers themselves under a strong supervision of the scientists. The supervision ensured to train practically for adopting the better banana farming techniques.

> *... We asked the participating farmers to choose the preferred species within their locality and simultaneously we introduced new ones. While the banana grew, in one of the village they wanted to uproot one of our specie for the reason that it resembled one of their unfavourable. However, we persuaded them to leave them to maturity where they can confirm by eating. It was interesting that this specie "bokoboko" became one of their favourite new specie![12] …*

After sometime, the products from the model farm were appreciated by the farmers in terms of yield and productivity from both traditional and new species. The new species were then tasted which was important in increasing the preferential selection of the farmers themselves. After appreciating the results from the model farm and particularly after becoming conversant with the tissue culture and farming techniques, the individual farmers were free to plant the preferred banana species in their own farms. At this stage, the farmers themselves were able to apply the

[11] Mwalusembe (Mkuranga , Coast) successful banana farmer
[12] Assistant Team Leader

tissue culture techniquesfor transferring the banana species from the model farm to their own farms.

> *… This is the model farm was donated by our secretary it is from where we were trained practically on the tissue culture technology and also to take care of the farms. The SUA Professors did teach us how to prepare disease free plantlets, which we then planted in our own fields. We can now practice ourselves. After preparing the plantlets, we were also taught to prepare the appropriate size of holes for planting bananas, how to apply manure, how to maintain the number of banana plants per single location and to take care of the farm. This practice eliminated diseases and the banana quality and yield increased*[13]*. …*

Furthermore, the project dealt with solving the banana weevil problem. The weevils were attacking the banana stems leading to die off and low productivity. The technique used to solve the problem was either by treating the stem with chemicals, uprooting the affected plants, also by attracting the weevils to the surface where they were subsequently killed physically. The banana weevil for this purposed were obtained by treating the selected species' banana roots.

> *… I personally started with 36 species of bananas because I was eager to choose the best. Currently I am only maintaining with five species namely Ngego kapale 105, FHIA 17, FHIA 23, Mbondia, and Jamaica. I also maintain Mtwike and Mzuzu traditional bananas species. The Mzuzu specie is resistant to disease whereas the Mtwike is easily affected*[14]*. …*

After two years of consequent bumper harvest, the farmers in Turiani Morogoro requested more services like the possibility of introducing a modern banana ripening procedure. This was a necessary entry point to the potential market since after harvesting enough green bananas, the ripening technology is utilized to process the whole harvested batch. Thus, plentiful ripe (value added) bananas are sold at a time. The technology increased income to the group compared to the traditional method where the bananas are ripening naturally, which takes longer time. This technology was also transferred by the SUA researchers.

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[13] Hembeti (Turiani, Morogoro region) beneficiary and group Chairman
[14] Mwalusembe village (Mkuranga, Cost region) successful banana farmer

5.2.6 Innovation

The development of new tissue culture technology has been the foundation of high quality, disease free planting material production at a mass scale. Particularly new banana varieties were developed and disseminated in the villages, as described above..These varieties were targeted to be resistant to existing diseases while at the same time increasing yield per acre. The following 5 new banana varieties were introduced:

i. FHIA 17
ii. FHIA 23
iii. Yangambi
iv. SH-34469
v. Pelipita

While new banana varieties were developed and disseminated care was taken to include local varieties. The local varieties were also treated with the tissue culture technology to produce disease free plantlets. Some of the local varieties are strongly linked to the indigenous traditions of cuisine and culture. Table 56 shows that a total of 9 indigenous banana varieties were also tested and disseminated in the villages.

Table 56: The disseminated indigenous banana varieties

SNO	BANANA VARIETY	PLACE TESTED
1	Kambani	Morogoro and Mkuranga
2	Jamaica	Rungwe and Mkuranga
3	Mtwike	Rungwe
4	Bukoba	Mkuranga
5	Uganda	Mkuranga
6	Itoke Sege	Morogoro and Mkuranga
7	Ngego Kapale	Morogoro and Mkuranga
8	Sege	Morogoro and Mkuranga
9	Malindi Ndefu	Morogoro and Mkuranga

The existing technology was upgraded where the farmer were trained to control banana weevil. By using tissue culture, it was possible to develop planting material which is free from sucker borne diseases and pests. The healthy planting material complemented with integrated pest management program was key to the success of the project. New farm management skills such as mulching, big plantation hole, control banana weevils and use of fertilizers were introduced to the farmers. Thus, what we see here are – in addition to the new products in terms of the

specific new types of banana and the adotion of the banana tissue technology – a set of accompanying organizational and managerial innovations on the farm, such as pest and farm management techniques, and the banana ripening technique.

The participating villagers were fully convinced of the benefit of these innovations to their community:

i. The availability of large quantities of clean and superior planting material enabling them to reclaim their old banana orchards
ii. Substantial reduction in losses from pests and diseases
iii. Increased productivity per acre
iv. Shorter maturing period
v. Uniformity of bunch sizes resulting in increased and easy marketing of the banana
vi. Uniform and simultaneous ripening of the produced bananas

5.2.7 Outcomes and Benefits

There are several positive outcomes and benefits of the project. Firstly, there are benefits for the university and SUA researchers which has made impact to the university and public awareness on utilizing the capacity existing at SUA.

Research students were involved in this project and produced 1 Ph.D. and 3 Master theses. The candidates pursued their studies while at the same time assisting with the project activities. The mission of the university was fulfilled with respect to teaching and provision of the needy extension services to the community. Project results were shared with the international community through publications. A total of 10 journal publications, 5 conference papers and 1 banana booklet were produced. As a result of this kind of undertakings, SUA is publishing a minimum of 70 papers in peer reviewed scientific journals annually. The publications are promoting SUA beyond Tanzania borders and increasing the competence of the university and researchers themselves. Further to these benefits, the University provides continued extension services which forms part of the continued research work at the university. In June 2014 the university was remodeling a building at Hembeti village in Turiani Morogoro region. The building will serve as a field class for the university. This class shall support the banana growers through a continued and closer extension service.

Secondly, there are large benefits also for the farmers which relate to the training they received from SUA researchers in the whole process from planting to harvesting diverse banana types,

along with improved pest and farm management techniques as well as to the increase in income generation. The impact of tissue culture banana technology helped to recover from the banana farming setback by increasing yield of the bananas. The additional income or increased access to one of the staple foods to small scale farm families contributed to improving the food security, nutritional levels and economic status.

Thirdly, apart from the additional income that accrued to the participating families, the implementation of this project revived the banana economy and resulted in a multiplier economic impact to the communities, i.e. spread further and was not limited to individual farmers but moved to the community level. Still, farmers in the project focal areas have been the primary beneficiaries. Yield losses caused by pests and diseases at farm level decreased substantially. The technology has made it possible for more than 3,200 subsistence farmers to access large quantities of superior disease free plantlets with early maturity traits (12 – 16 months compared to the conventional banana of 2 – 3 years), bigger bunch weights (30 – 45 kg compared to the 10 – 15 kg from conventional bunches) and higher annual yield per unit of land (40 – 60 tons per hectare against 15 – 20 tons previously realized with conventional farming). Figure 11 shows a comparative banana plantation between traditional and the improved one.

(a)

(b)

Figure 11: Turiani village banana plantation (a) traditional and (b) improved

One of the conspicuous performance indicators of the project is the extent to which the livelihoods of the community have been upgraded. Household incomes of participating farmers have been uplifted from subsistence to adequate capacity to procure services like education for children, modernized houses, and expanded economic base through diversification into other crops. Simultaneously, the increased yield has also translated to enhanced food security and improved health of the households and the consuming community at large. Additional outcomes forthe rest of Tanzania's economy was by providing employment and business opportunities to villagers, wholesalers, urban retailers, transporters, laborers in wholesale markets, manufacturers of packaging materials and agricultural labour households.

> *… The project has not only empowered the poor families but also it has promoted our village into a very reputable one and we are all proud of this. In year 2005 to 2007 our village represented the District in nane nane exhibitions (national agriculture exhibition) through the banana from one of the project beneficiary from our village. The farmer is now economically powerful from a mere local person before the banana*

project. He is now having more income as he diversified into other crops like pineapples, cashew nuts, and oranges[15] *….*

… Let me inform you that at the time of joining this project I was nothing. Affording one meal per day was a big issue! Now I am not even thinking about this as I rather choose a meal. I had a bicycle, now a motorcycle[16] *…*

... It is true that the banana farming has uplifted me economically. My lowest income per day, in in years with adequate rainfall used to be above T. Shs. 40,000 up to 2,000,000 (U. S. $ 32 up to 1,500)… of course not every day! ... Due to the economic power I gained from the banana farming I was able to achieve the following important issues:

i. *I have acquired 28 acres of land from 2 acres only. Here, 5 acres are dedicated to bananas whereas the rest are for cashew nuts, coconuts, oranges, and pineapples*
ii. *I am a famous teacher with respect to banana farming*
iii. *I am now married and our family constitute of 8 children*
iv. *I have moved out of grass thatched house that had wooden-mud walling to a modern cement brick walled iron roofed one*
v. *My first born is attending a University in Sudan whereas another one is at a Tanzanian University in Iringa*
vi. *Other younger kids are attending modern primary schools …*

... Though I joined the program late, some of the benefits I gained from the banana farming are[17]*:*

i. *I managed to educate my children*
ii. *I have a modern iron roofed house*
iii. *Now I have bought more farms, 2 acres planted with pineapple on top of the 3 acres of banana. I started with 1 acre of banana.*

…. This looks like a well-kept and successful banana farm. It is not what it is supposed to be. I could be having three times or more this size with even better bananas. However, I appreciate that this farm rescued me

[15] Mwalusembe village (Mkuranga, Coast region) Chairman
[16] Mwalusembe (Mkuranga, Coast region) successful banana farmer
[17] Mwalusembe village (Mkuranga, Coast region) banana farmer

from the serious disease I had for the past two years. My family harvested the bananas and sold them for buying medicines and for taking care of me as I was incapable of doing anything[18]. …

The following benefit of the tissue culture banana project were reflected by the participating families and the community:

i. Preferable varieties were identified according to farmers' criteria including new one
ii. Expansion in farms, increased income and improved livelihoods (build houses bought motor cycle and paid school fees)
iii. Spillover effects when inquisitive neighbouring villagers and those beyond the District wanted to adopt the innovations from the participating farmers
iv. Some farmers became main suppliers of banana plantlets despite selling bananas. This provided an additional continuous income to the farmers
v. A higher income has allowed the families to improve quality of life indicators by way of payment of secondary school fees for the children, improved housing, and diversification of income through taking up of other supplementary enterprises like poultry
vi. Many families from banana sales have acquired assets such as mobile phones, bicycles and consumer durables for the family
vii. Banana production has provided a cash-income security to poor banana growing farmers because it provides almost continuous income flow throughout the year, even under low input regimes. Besides, banana suckers and leaves are used as animal feed, especially during dry seasons when other sources of fodder are scarce
viii. An increase in banana production at the farm level has increased food security at the household level. Some farm families who have adopted banana tissue culture did not require food aid for the first time in their lives when there was prolonged drought that necessitated food aid to be supplied in the area
ix. Malnutrition among members of the banana growing households was reduced owing to the increased staple food and fruit and additional income from banana sale that was used for purchasing other foodstuffs and thus leading to diversity in diets
x. Increased fame to Mwalusembe village and Mkuranga District was obvious since it became the role model in improved banana farming. In this respect, the participating farmers are frequently invited to participate in regional and national

[18] Sembeti village (Turiani, Morogoro region) banana farmer

agricultural exhibitions. This ensures extended spillover effects of the project benefits.

5.2.8 Knowledge flows

A bi-directional knowledge flow was evident during the interaction. The participating communities were recipient of the tissue culture technology and the good practices of farming bananas. Flows of knowledge from the communities include the traditional knowledge of local species of bananas and their superiority characteristics.

5.2.9 Enabling Factors

Currently SUA holds memoranda of understanding and collaboration agreements with more than 50 institutions and agencies across the world. In respect of this capacity the university has over the years been able to attract more research grants and development support from a number of agencies. Thefundsreceived from the Norwegian government for this project were a clear enabling factor.. Furthermore, the project was a collaborative effort between SUA and two other institutes, a Norwegian institute (Bioforsk) and a local institute (ARI Uyole). This complimented the capacity of the participating institutes and contributed importantly to the success of the project

Other enabling factors include the existing SUA structure on supporting research activities. SUA is an old public university, which has built enormous capacity in agricultural research. The capacity is both in terms of available researchers and the laboratory facilities. Funding from the donor was important in sustaining the project activities like field work, transportation and materials cost.

> *… Throughout the whole project duration the SUA Professors were very keen and they used to follow up closed. One could not be able to cheat them. If you agree to do something you must do it otherwise the next time they come they clearly pin you down. They were also very responsive to our frequent requests*[19]*. …*

Enabling factors are, however, not limited to funding and scientific expertise and technological know-how of SUA researchers but can also be attributed to input from the cooperating farmers.

[19] Mwalusembe village (Mkuranga, Coast region) successful banana farmer

In fact, the cooperation from farmers. participating villages and communities was critical to the success of this project. This is because the participating villagers were responsible for implementing all project activities like preparing the holes for planting bananas, availing the manure, and a continued care to the banana plantation. This has to be done on a continuous basis. This commitment was responsible for the success of the project and for its sustainability. This characteristic has also been shown when these farmers were interviewed for this UNIID research. The Hembeti village in Turiani Morogoro region has twenty active participating villagers todate (8 women and 12 men) whereas those from Mwalusembe Coast region are only four remaining as a group of participating villagers. Both villages started by enrolling ten villagers each. Furthermore, the Hembeti group has already formalized their group into an integrated banana farming and environmental group known as *Kikundi cha Wakulima wa Migomba na Uhifadhi wa Mazingira,* meaning Banana Farming and Environmental Conservation Group. Besides banana farming, the group is already engaged into selling and distributing tree seedlings for reforestation purposes.

5.2.10 Constraints

Although many donor/government programs have produced small initial gains in improved production with small holder schemes, often such gains are lost once donor or government support is withdrawn. Furthermore, such programs are limited in time space and fail to account that farming is a long-term undertaking, which needs to be independently sustainable once a particular program or financial and technical support ceases. From this project we have observed that once the project ended, the Mwalusembe Mkuranga farmers in Coast region could not manage themselves into a growing group. Only a few members are remaining in cohesion. Even though the project was successful in the period of support, there emerge other problems like climate change that requires a systematic approach in combating them. This was evident in both interviewed villages where they mentioned that the dry spell, which results from climate change, is negatively affecting them. This necessitates the use of expensive techniques like irrigation. It is possible that well-researched banana farming will assist in availing sustainable and cheaper techniques to combat the climate change.

Subsistence smallholder and emergent banana farmer are faced with challenges much greater than those facing the commercial farmer. The banana project was not an exception to this as following emerged to be the main challenges:

i. The Tukuyu District in Mbeya region is among the highly populated areas in Tanzania. Hence, majority of the farmers that participated in the project had to uproot their old orchards and other crops to give space to the new banana plants.

This initially delayed the project implementation and also it was the main source of resistance to farmers that had marginal land

ii. Unreliable water distribution from village councils and persistent drought stress diminished the project outcomes. This was the case of Mwalusembe village in Mkuranga

iii. Interference by some village leaders inciting farmers against the credit slowed down their participation to the project

iv. Mkuranga peoples' lack of commitment to work in groups did jeopardize the project. Their participation was low hence less was imparted to them during the training

v. Low entrepreneurs skills amongst the participating villagers played a negative role. Some could not take this knowledge as an opportunity for their economic transformation

vi. Lack of sustainability of the project like additional sources of funding to support next step core activities such as integrated pest management (IPM), marketing, value addition and project evaluation

vii. Neophobic reaction on food tasting, one may not be interested in new foods due to preference of traditional ones

viii. Communities participating were quite scattered and hence effective management took more effort

ix. Lack of economies of scale, average land holding barely covers his own needs

x. Lack of land title and the ability to raise finance by offering this as security for present production.

xi. Lack of agronomic knowledge in crop production (like the value of good seed, the importance of timings, conservation tillage methods and soil fertility.

… The past three years were not favourable for banana farming due to prolonged drought. This has degraded our farms leading to diminished incomes. Unfortunately we cannot easily attract support for acquiring expensive irrigation systems and farm implements as this could solve our problems all together[20]*.*

… Particularly the Mwalusembe women showed less support and commitment to the banana program. Majority of the remaining people here showed to be more donor dependent rather than being hard worker

[20] Mwalusembe villagers (Mkuranga, Coast region)

and commit themselves to the improved farming. Indeed for one to be successful in this farming it requires commitment in terms of time, effort and financial too[21]*. …*

Our case material did not provide insights into how the university tried to overcome or address such constraints as the donor dependence, which appears to be a major problem for many research projects and cases in Tanzania.

5.3 Case 3: Zanzibar Seaweed Cluster Initiative (ZaSCI)

The Zanzibar seaweed case is particularly interesting to re-examine with respect to the interactions between university and community given its long-term sustainability. Interestingly, the Zanzibar seaweed case shows an initiative that originated from a research conducted by a professor at the University of Dar es Salaam (UDSM) back in the 1970s and early 1980s. This was followed later by commercial cultivation started by private entrepreneurs in 1989. So this case has its origin from the community rather than top down approaches from donor initiatives. After this the structure has further developed and there exist now local groups who process and sell the various seaweed value added products that result from seaweed (and they do have application in different sectors ranging from food, pharmaceutical and cosmetic to textile industries). Important to stress again is that seaweed farming is now competing with the tourism industry in terms of foreign exchange earnings for Zanzibar. The farming contributes over 90 per cent of Zanzibar's marine exports and in the period between 1990 and 1993, seaweed production increased from 808 to 1,768 metric tons whereas the production in year 2009 increased to 11,000 metric tons.

The issue of adding value was implemented by the Zanzibar Seaweed Cluster Initiative in 2008. This Cluster initiative is one of the Cluster programmes under the College of Engineering and Technology (CoET) of the University of Dar es Salaam outreach. CoET implemented the program in collaboration with the Institute of Marine Sciences (IMS). While the IMS is assisting and responsible for all matters related to the planting and growing of the seaweed, the CoET team continuously assists in further developing different types of seaweed value added products. It is important to stress though that despite of this expertise the methods used are typically village level recipes that are affordable for farmers. Importantly, and with respect to the

[21] Mwalusembe village (Mkuranga, Coast region) farmer

issue of livelihoods, the seaweed processing plant has contributed to increasing the income through exporting semi-processed seaweed of Zanzibar communities.

5.3.1 Livelihood Problem

Seaweed is farmed in rural coastal areas where some families solely depend on fishing as their main income generating activity. In other areas, agriculture is not flourishing. Though seaweed farming is a family business, it has been established that over 90 percent of the farmers are women. As a result, this farming has been effective in economic empowerment to the coastal women since traditionally they are not participating in fishing, which is dominated by men. Also traditionally, men are dominating family income from other economic activities like agriculture. Some of the participating women are widows, meaning that the emerging seaweed farming became the savior to the mother. As the women dominate the seaweed farming, it implies that they are vested to dominate other seaweed connected incomes like those from value added products.

Though seaweed is a naturally occurring feedstock for food, pharmaceutical and cosmetic to textile industries, its commercial farming in Zanzibar was introduced in 1970s and early 1980's by researchers from the University of Dar es Salaam through the Institute of Marine Sciences (IMS), which is located in Zanzibar. Recent works in seaweed farming through the Zanzibar Seaweed Cluster Initiative (ZaSCI) are attributed by researchers from the College of Engineering and Technology (CoET) and from the IMS. The ZaSCI was part of the major Innovation Systems and Clusters Programme in Tanzania (ISCP-Tz) which was implemented in year 2006 through funding received from the Swedish International Development Cooperation Agency (Sida). The funding was received as part of a research cooperation proposals submitted by the Pan African Competitiveness Forum (PACF) to Sida. These proposals were funded to address specific problems in the PACF member countries. Particularly, PACF intervention was to increase income generation to the majority rural and urban population working with small scale businesses.

The common seaweed farming used in Zanzibar is known as peg and line (off-bottom), which is suitable in shallow intertidal (Figure 12). In this method, farmers tie seaweed to nylon ropes that are then stretched between two wooden pegs. Farmers usually tie 100 gram branches to these lines using thin nylon ropes called "tie-tie", each at about 20 cm interval. These small branches are then allowed to grow for six weeks after which they are ready for harvesting. After planting, farmers need to take care of the farms by working at every low tide. Low tides occur two times a month and each low tide takes 7 days, thus farmers work for 14 days per month. Low tides last

about 4 hours. Seaweed farm management involves shaking the seaweed lines to remove sand and debris, removing entangling and fouling (wild) seaweeds, re-tying empty branches, and re-fixing unstable pegs. Seaweed harvesting involves removing the grown branches for sun drying for 2 to 7 days after which they are sold to vendors. Small seaweed branches are then re-tied for the next harvest.

Figure 12: Seaweed farm

Seaweed is the main source of high quality carrageenan, agar, and alginates. These are gelling substances, stabilizers and emulsifiers that find their niche use in food, pharmaceutical, cosmetic, and textile industries. Seaweed farming is now competing with the tourism industry in terms of foreign exchange earnings for Zanzibar. The farming contributes over 90 per cent of Zanzibar's marine exports and in the period between 1990 and 1993, seaweed production increased from 808 to 1,768 metric tons whereas the production in year 2009 increased to 11,000 metric tons.

In year 2006 the Zanzibar Seaweed Cluster Initiative Started with on firm that constituted of twenty members located in 1 village in Zanzibar. In 2014 the initiative have 16 cluster firms located in 10 villages in Zanzibar four villages in Pemba, and one village in mainland Tanzania (Bagamoyo). Figure 13 shows the participating villages in Zanzibar.

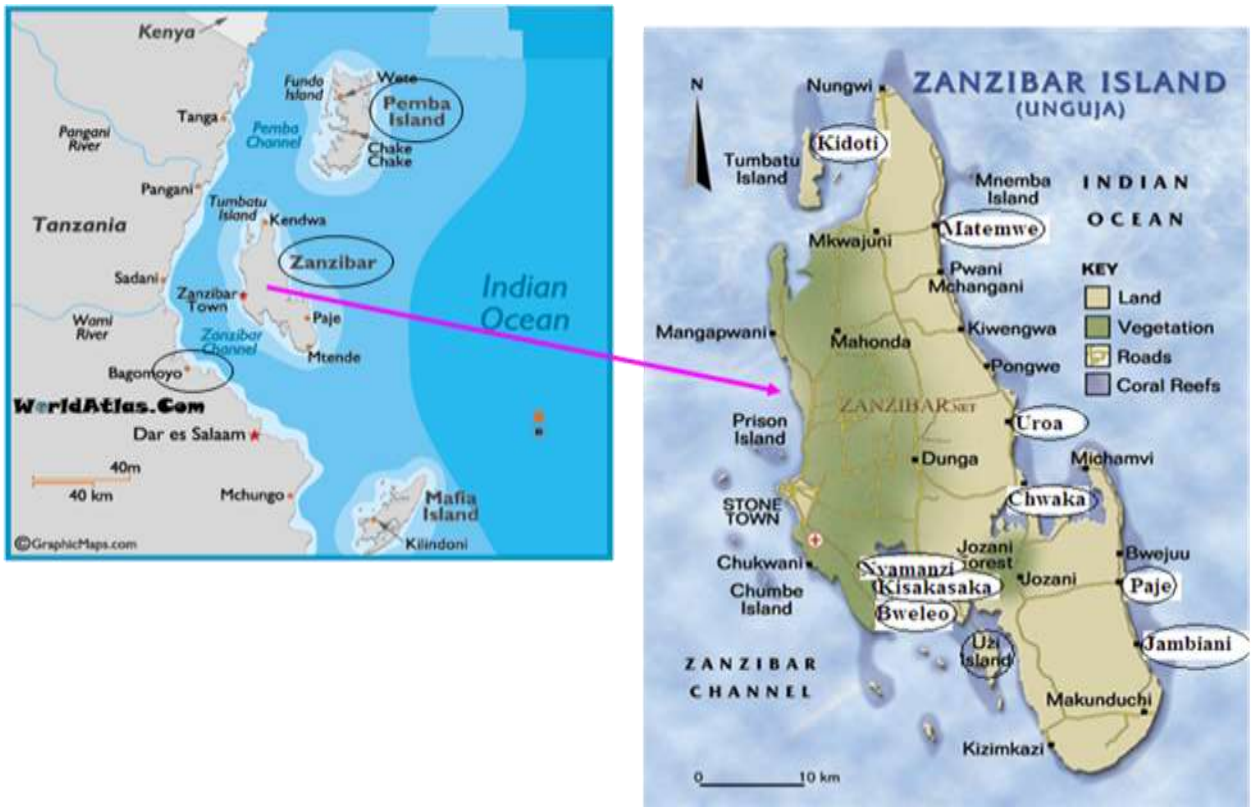

Figure 13: Zanzibar cluster initiative villages

5.3.2 Actors

Since its establishment in 2006, the seaweed farming in Zanzibar has received contributing attention from different actors. Early works by university professors was supported by a collaborative research with the Hawaii University. Under this work, the seaweed potential for Tanzania was established. This gave the necessary information for potential developers of the seaweed farming. In the period between 1995 and 1996, the Finnish funded a project known as Rural Integrated Project Support (RIPS) programme that supported establishment of seaweed farming in the southern Tanzania, in Mtwara and Lindi regions. When the seaweed farming developed diseases and die-off problem, actors that collaborated with the Institute of Marine Science (IMS) to solve the problem included USAID, Western Indian Ocean Marine Science Association (WIOMSA), the University of Rhode Island-Coastal Resources Centre (URI-CRC), and the Zanzibar Seaweed Cluster Initiative (ZaSCI). The ZaSCI, which is the main collaborator narrated in this case, was formed under the year 1996 Innovation Systems and Clusters Programme in Tanzania (ISCP-Tz). The ISCP-Tz was coordinated by the College of Engineering and Technology (CoET) of the University of Dar es Salaam and was funded by the Swedish International Development Cooperation Agency, Sida/SAREC. Under the ZaSCI researchers at IMS and CoET introduced new seaweed farming techniques and they introduced

value addition chain to the harvested seaweed. The value addition chain is described in the coming chapters.

Besides the funding agency (Swedish Development Cooperation Agency, Sida), the main actors that supported the ZaSCI worked were academicians, government authorities, and the business communities interact to of the innovation. The government authorities that participated were the Department of Fisheries, Ministry of Agriculture, Ministry of Tourism and Trade, and the Zanzibar Chamber of Commerce, Industry and Agriculture. These authorities supported the initiative by enforcing the government policies in agriculture and fisheries; by funding project activities to support extension services, training, and research; and by facilitating linkages to the government and other stakeholders. On the other hand, the academia (collaborating researchers) supported the cluster initiative by facilitating and coordinating advisory services through training. The academicians trained the seaweed farming techniques, and they also introduced and trained the deep seaweed farming technique for combating seaweed die off. Other important training delivered to the seaweed farming was the value addition to the raw seaweed for producing seaweed powder, seaweed gel, food products, cosmetics, and medicals. At the same time, the academicians were utilizing this platform to fulfil their mission in undertaking research and development. Thus, the machines that were introduced to the seaweed farmers were part of their research and development outputs.

The business community was an important actor in the seaweed cluster initiative. Their main role was to supply the farming inputs like tie ropes and they were also responsible for trading the produced seaweed. They bought the raw seaweed and the value added products. Included in this group were the seaweed buyers and resellers, different commodity traders, and exporters. Figure 14 summarizes these actors and their respective roles.

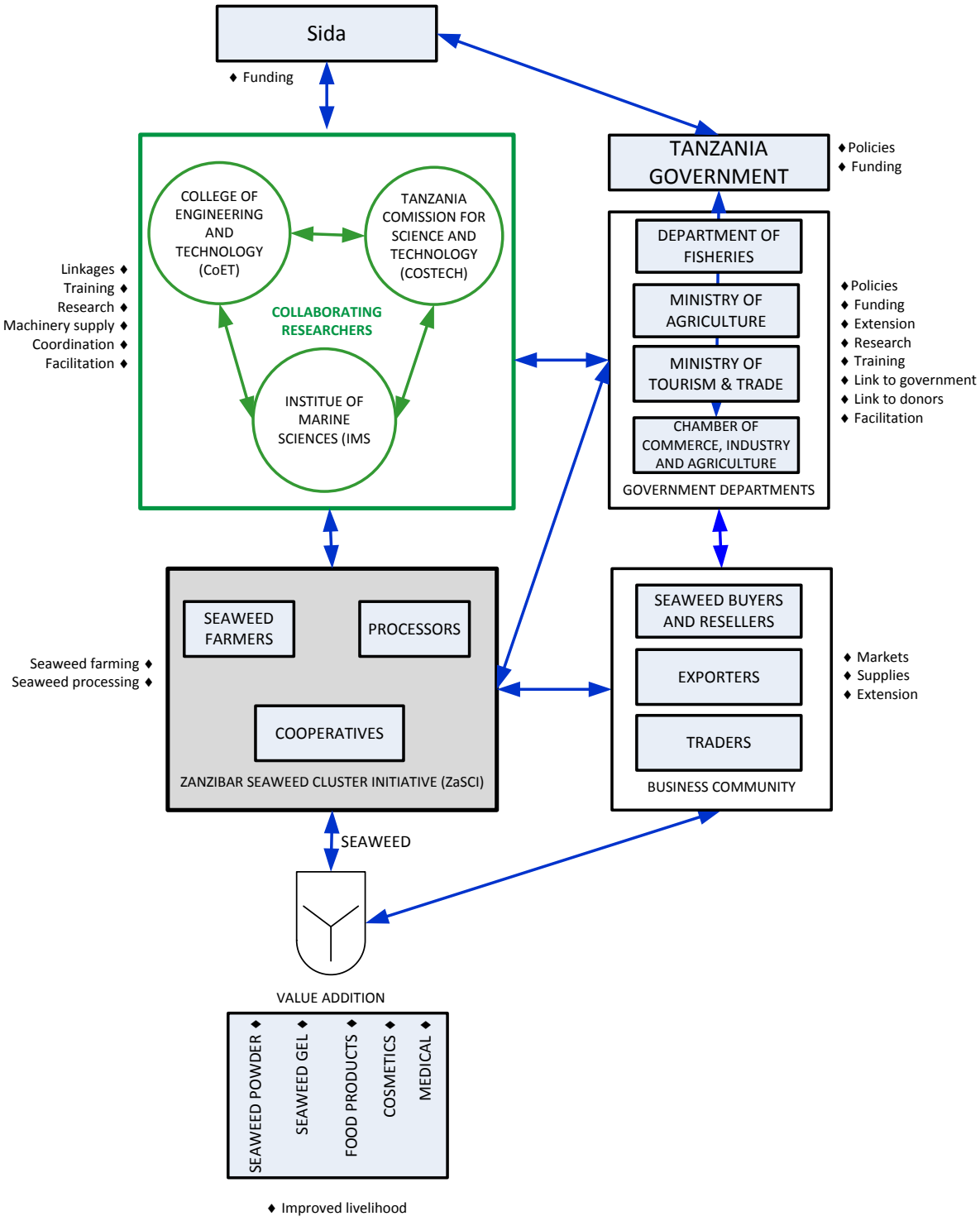

Figure 14: Actors involved in the seaweed project

5.3.3 Drivers of Interaction

Through the Pan African Competitiveness Forum, CoET and IMS were interested in contributing to poverty alleviation by increasing income generation to the Zanzibar coastal community and particularly the women. Through this initiative it was the interest of these institutes to excel their mandate to teach, conduct research and, develop and transfer technologies to the community. Furthermore, the individual researchers anticipated to benefit from accrued research results that include publications, which was one of the key objectives in establishing the cluster initiative.

5.3.4 Organizational Arrangement

The Zanzibar Seaweed Cluster Initiative was part of eight clusters that were established under Sida/SAREC ISCP-Tz to include:

i. Bagamoyo cultural heritage tourism cluster
ii. Eastern region mushroom cluster
iii. Morogoro metal works and fabrication cluster
iv. Morogoro small scale fruit and vegetables food processors cluster
v. Arusha seeds and seedlings cluster
vi. Sisal cluster
vii. Zanzibar seaweed cluster, and
viii. Nutraceuticals cluster

The Seaweed Cluster initiative drew members that were engaged in common activities of seaweed farming and making value-added products. The cluster activities were centered in six villages in Zanzibar namely, Bweleo, Kidoti, Paje, Nyamanzi, Chwaka, and Kisakasaka. In year 2006 the ZaSCI started at one village that had 20 members and by year 2011 grew to 14 villages and over 3,000 members and there were already 17 new enterprises dealing with value addition to the seaweed.

The clusters initiative worked under the triple helix model, which assumes that real and sustainable development in developing countries can only be achieved when innovation and technological development is domestic and locally driven. Thus the engagement of government (focus on social and economic development on general level), academia (focus on knowledge development with social relevance) and private sector entrepreneurs (focus on economic stability and progress on individual level) is imperative for a long-term development. The government was therefore represented by Department of Fisheries and Marine Resources (DFMR), Ministry of Agriculture, Livestock and Environment (MALE), and the Ministry of

Tourism, Trade and Investment (MTTI). On the other hand, the Institute of Marine Sciences and CoET were the academia and the business community constituted of the farmers and seaweed buyers. Tanzania seaweed is an export cash crop with main byers in the USA, France, Denmark, and Spain. These foreign buyers have established their networks of local buyers who are responsible for buying the seaweed from individual farmers.

Thus the ZaSCI program activities were driven by interested researchers from the IMS and CoET including other research organization. Through the central coordination at CoET the researchers therefore became facilitators to the cluster and took part in various pre-arranged trainings. The facilitators therefore comprised of the local business representatives, government representatives from relevant departments, and the researchers.

5.3.5 Seaweed Farmers/Entrepreneurs Participation

The seaweed farming cluster was highly participative. . The facilitators of the university introduced the new techniques of growing seaweed and in suggested product development and assisted in solving emerging problems. Participation of the seaweed farmers and entrepreneurs was in the following areas:

i. Setting up of the group and its management
ii. Selection of farming locations and farming
iii. Water side techniques like how to access the seaweed farms safely
iv. Tide related aspects and thus seasoning the farming
v. Selection of value added products like soap and confectionaries that are highly demanded in the area

5.3.6 Innovation

Three broad innovations were realized under the seaweed cluster program, these are: the introduction of improved farming methods, new seaweed species, and the development of seaweed value added products.

The IMS researchers introduced the deep water floating lines seaweed planting method as for solving the prevailing seaweed die-off problem. The die-off problem reduces harvest to farmers and was responsible for diminishing incomes. As opposed to the conventional shallow water farming method, the deep water allows farming seaweed in water depths of between 2.5 to 6 m. The floatation is facilitated by plastic buoys, which avoid cutting down green mangrove trees for making wooden pegs (poles) used in the traditional method. It therefore cleans the environment

from the nuisance of used plastics and at the same time the coastal mangrove tree cover is protected. Simultaneously, the deep water method allowed farmers to cultivate Kappaphycus alvarezii (cottonii) seaweed specie. The cottonii specie is the higher price earning variety but it is prone to diseases and die-off when grown in shallow waters. Another advantage of using the deep water method is that seaweed farmers (women) deploys dema traps alongside the floating line plots to harvest fish and thereby increase family's nutrition and income upon selling some.

Besides the innovations in farming techniques, the value addition chain of the harvested seaweed, shown in Figure 15, was the next important innovation. In this respect, the farmers were trained to produce semi-processed products like seaweed powder and gel. Thereafter they were trained to produce high value finished products in food, cosmetics and medical, see Figure 16.

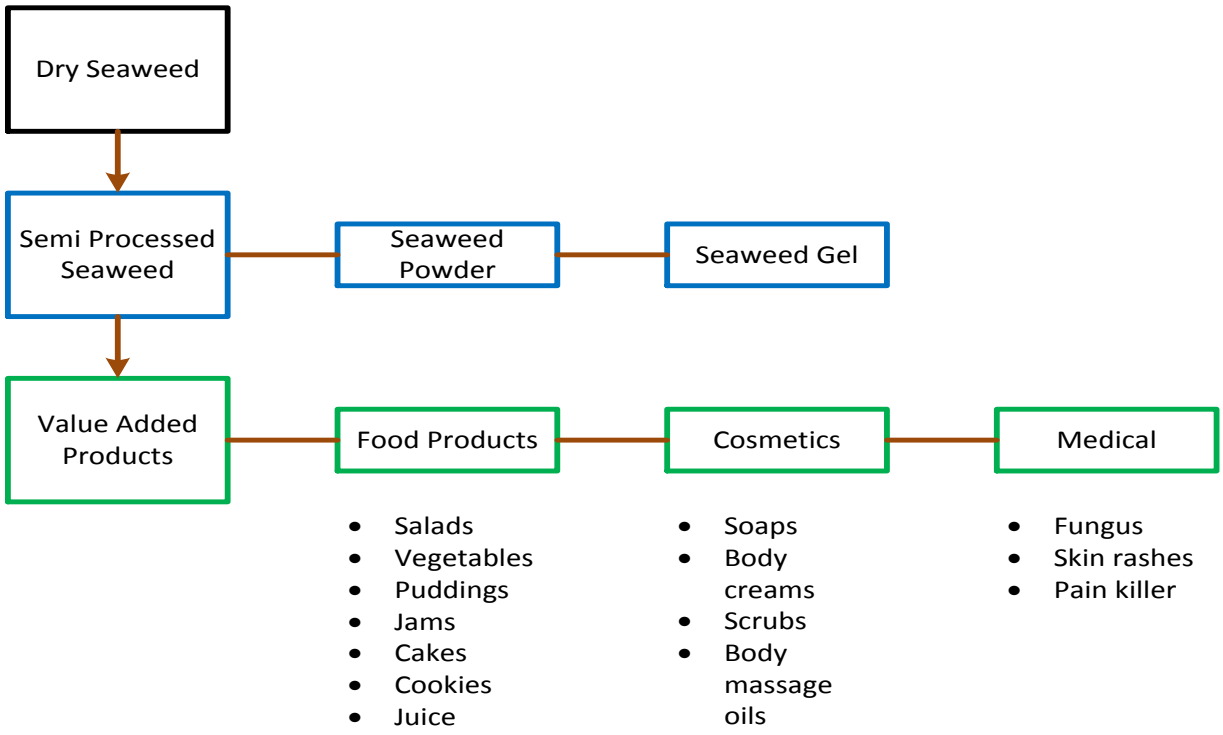

Figure 15: Seaweed value addition chain

PRODUCT DESCRIPTION	PIC
(a): Food	 
(b): Soaps	
(c): Cream and oil	 

Figure 16 (a – c): Seaweed value added products

Technology transfer was therefore linked to the following process and product innovations:

i. Better seaweed farming techniques and how to take care of the farms
ii. Planting better seaweed specie, cottonii
iii. Semi processing harvested seaweed into powder and gel
iv. Production of value added products in food, confectionery and pharmaceuticals

5.3.7 Outcomes and Benefits

The result of the seaweed farming support through the cluster initiative has been tremendous in terms of seaweed productivity and with respect to the businesses that evolved from its processing and value addition. Some of the direct economic benefits of the seaweed cluster initiative were the following:

i. Sale of seaweed and its value added products has been the main source of income and has increased purchasing power of women. Seaweed farmers can harvest over 100 kg per month and allows them to earn about U. S. $ 160. For a case of value addition, a group of women known as “Tusife Moyo” sold soap worth over U. S. $ 2, 000 per year. There are also seaweed middlemen who earn incomes by linking farmers to buyers

ii. The increased purchasing power allowed them to afford important services such as educating children, acquiring medical services, improving the houses in which they live, and purchasing clothes and food to meet their daily needs

iii. The introduction of floating line method produces 0.35 kg more dried cottonii per meter line than the traditional method

iv. Employment generation through a chain of shops (like those at Bweleo and Kidoti townships) that are dedicated to sale seaweed farming materials and value-added products

v. Fish trapped in the deep water system supported nutrition and became a secondary source of income after selling

> *… Amina Khamis Makame is a woman seaweed farmer from Bweleo village in Zanzibar, Tanzania. Born in 1964 she is divorced and has 2 children. Amina studied up to Form III (three years of secondary school), the typical education system in Zanzibar if one is not selected to go to Form IV and then high school. She started a small business of pottery in 1990 and sold in a shop. She used the money for food and hospital bills for the children. In 1992 she started farming seaweed. She owned 1 plot (containing 50 lines of 4m long each) and later she expanded to 16 plots with 800 lines. She sells about 100 kg of dry seaweed per month earning about an equivalent of U.S. $ 160. Her family (children and brother) help her with the farming when it is appropriate. They helped in planting, harvesting, carrying the wet seaweed home from the sea, drying, and sorting. She used to spend her money from seaweed farming to send the children to school.*

Amina spends 4 hours in the sea every day when harvesting and replanting seaweed, leaves at around 7:00 in the morning and coming back at noon. When the children were small, she used to leave them with her mother but later she took them to a nursery school. When she comes back, she collects her children herself or asks her mother to bring them back. In the evenings the children attended evening classes (commonly called "tuition classes"). Besides the seaweed farming, she also practiced small business of making and selling washing soap, poultry, and bee-keeping. She is a member of a soap making group called "Bado tupo Bweleo" meaning "We are still at Bweleo", with a total of 14 members.

In 2006 she joined the Zanzibar Seaweed Cluster Initiative (ZaSCI) in a group of 10 members. Under the ZaSCI she participated in trainings, meetings, workshops, and conferences and thus became exposed to a number of business opportunities. Later in 2007 she realized that in her village, Bweleo, which sells seaweed to 3 Companies, some farmers stayed longer before they were able to sell their seaweed to existing buyers. She saw that these people would need money but they were not able to sell in time. Thus she decided to look for a company in Zanzibar town which will buy from her as a middleman. This was successful and she started to buy seaweed from villagers who needed money and sold to the company at a profit. She sold the seaweed to a company called Zanzibar Shell. She bought at T. Shs. 160 per kg and sold at T. Shs. 200 per kg thus getting a profit of T. Shs. 40 for each kg that she sold. In one year she sold 40 to 50 tons of seaweed worth about U.S. $ 6,000 earning her between U.S. $ 140 and 150 per month.

Amina explained that seaweed farming has helped her a lot in educating her children and buying food and clothes. "Seaweed farming has enabled me to buy school uniforms, books, and pay fees for my children. I can now buy my own clothes and food at home. With seaweed selling business I made strong door frames for my house, I do not want to

spend any other money on my house except from seaweed business so I can see the results of my efforts" she explained[22]*. …*

5.3.8 Knowledge flows

The indigenous knowledge on the sea and its characteristics was influential for the successful interaction between the coastal communities and the university. The coastal people are aware of the sea tides occurrence and their behaviours. Furthermore, the communities already had experience in seaweed farming prior to the cluster program. Hence, this knowledge was passed to the researchers for the cluster initiative project. The researchers could therefore utilize the already existing indigenous knowledge for designing better seaweed farming techniques. Zanzibar island has a long history of being the native land for spices. Hence the local cuisine is rich in spices. The indigenous knowledge and passion in spices was an important input towards the evolvement and designof value addition in seaweed products.

5.3.9 Enabling Factors

The critical enabling factor was the financial support from Sida/SAREC for funding the cluster initiative activities through the PACF. Secondly, the expertise and extension service offered by IMS and other facilitators to the seaweed farmers was a further significant enabling factor. In addition to these, a few more enabling factors were identified:

i. Excellency available at the IMS in terms of competent and experienced researchers and the availability of research facilities
ii. Supportive policy environment from government that advocates supporting the socio-economic development of the communities
iii. Availability of sea space for farming the seaweeds
iv. Strong leadership within the beneficiary village communities

5.3.10 Constraints

Besides the success in the seaweed cluster, the following constraints were noted:

i. The limited funding could not allow for a wider interaction and coverage of communities and within the communities

[22] ZaSCI Project Leader, In: Aquaculture Compendium. Wallingford, UK: CAB International, 2010

ii. Global warming and its consequences in climate change affected weed harvest and quality. This had a negative impact on some participants who were affected seriously
iii. Deep seas seaweed farming technique is capital intensive. Hence its adoption was limited
iv. Social conflicts emerged in some families as the mother spent more time in seaweed farming rather than taking care of the family (husband)

5.4 Concluding Section: Comparing the Three Cases of Livelihoods

Our three cases provided in-depth insights into the dynamics and interactions resulting into innovation focused on livelihoods in informal settings in Tanzania, centered on the role of the university in each case. Two of the cases were located at the University of Dar es Salaam (UDSM) and one at the Sokoine University of Agriculture (SUA). While the cases do have some similarities they also reveal their own unique characteristics in terms of the interactions they engaged in and the type of knowledge flows in these interactions, showing that there is not one single role model of the university in such interaction with marginalized communities. .

5.4.1 Stone crusher case

The stone crusher project was conducted under the College of Engineering and Technology (CoET) outreach programme and is a typical mandate of technology transfer as laid down in the university policy. The financial input in this specific case was provided from the Tanzania National Roads Agency (TANROADS) and did not belong to the support provided by the university, even though initial seed money was provided by the university. The role of the university was on the side of providing a supportive infrastructure and knowledge that was able to respond to and implement the requests and needs of the Umoja ni Nguvu women group at the Kunduchi Mtongani quarry in the community. Thus, the role of the university was related to developing appropriate technology as requested by those in need of that very technology and can thus be understood as a response to a bottom-up request. The receiving group in the community was in no way passive recipients. The know-how of the academicians and the engineers who designed the crusher at the Technology Development and Transfer Centre (TDTC) of CoET could use the available infrastructure at the university for developing the technology (CIMA crusher). This case showed lively interactions between the women group who provided necessary input during several stages of the CIMA crusher prototype design and also in the field testing phase. The result was a well-developed prototype produced by TDTC which was used by the women group. However, besides the benefits accrued from the CIMA crusher

the women group could not sustain the technology. This happened due to the lack of management and business skills within the group. Further, the engineering technology was beyond their technical knowledge since they had to hire men for servicing and maintenance of the crusher which finally jeopardized its service life. At the university level, it was observed that there was no further diffusion of the prototype to the whole construction industry and community. This was due to insufficient infrastructures for technology transfer. In the absence of infrastructures like incubators that are specifically engaged in technology transfer, the academicians are not investing extra time beyond their primary role of teaching, unless they are part of a research project that pays them.

Thus, with respect to innovation per se this is an interesting bottom-up approach case where the community could make effective use of the expertise available at the university. When it comes to scaling – up of these innovations to other locations this case has not been successful. Related to the sustainability problem of this specific case has also been the lack of long term funding. As described above, a maintenance problem finally ended this project and not a problem related to aspects of technology transfer. In this respect it could be reflected about mechanisms at the university that could be established to overcome this type of problems which most probably are not a unique case. These could be incorporated into the outreach programme. There might be possibilities for technology transfer offices that also try to assist in attracting long term funding or incubators might be established more widely with new and adopted concepts so as to integrate community cases and projects such as this one. The university could thus expand and strengthen its role if the management process of such projects could be expanded and the coordination strengthened. Thus, if follow-up of these community engagement projects could be assured similar to the extension services in agriculture. The observed problems are associated with insufficient long-term management of the initiated interactions by the community. It would be interesting to compare this further with other similar cases in order to see whether this is a typical problem for such “empowerment-oriented” types of projects that are driven by small holder persons or farmers and where lack of funding for maintenance issues can end the whole project.

5.4.2 Banana Case

The banana case interestingly illustrated the process of increasing the banana productivity and improved banana farming techniques as a result of solving identified banana production constraints. We saw that the success of this demand driven research project continued beyond the project duration and went beyond the project boundaries. This success was brought by

many factors, which includes the high level of beneficiaries participation and that a bigger network of researchers were involved.

The participation of the project beneficiaries started at early stages when they were asked to list pertinent problems that were responsible for lowering their banana productivity. Besides the fact that poor farm management practices were among the existing problems, other frequently mentioned problems were attributed to pests attack and diseases. The project was therefore designed to use the tissue culture technology for solving the disease problem and pests attack whereas the farmers were taught better techniques of farming. Both the tissue culture and better farming techniques were transferred to the farmers theoretically and this was done practically at an identified model farm. A high level of participation was assured at all stages of this training. Thus, before planting the cultured disease free bananas in the model farm, the farmers were asked to select the preferred banana species to be planted. Alongside the preferred species, the researchers introduced new species too. The new species were designed to match the local preferences and also to meet the disease free characteristic. The five newly introduced species were FHIA 17, FHIA 23, Yangambi, SH-34469 and Pelipita whereas the common traditional species were Kambani, Jamaica, Mtwike, Bukoba, Uganda, Itoke Sege, Ngego Kapale, Sege, and Malindi Ndefu. Both the newly introduced species and traditional ones were planted in the model farms by the farmers themselves under a strong supervision of the scientists. The supervision ensured practical training for adopting improved banana farming techniques. After sometime, the products from the model farm were appreciated by the farmers in terms of yield and productivity from both traditional and new species. The new species were then tasted by eating, which was important in increasing the preferential selection of the farmers themselves. After appreciating the results from the model farm, the individual farmers were then free to plant the preferred banana species in their own farms. At this stage, the farmers themselves were able to apply the tissue culture techniques themselves for transferring the banana species from the model farm to their own farms.

Besides the obvious academic benefits to the university, the overall benefits to the community were in terms of the availability of large quantities of clean and superior planting material enabling them to reclaim their old banana orchards, substantial reduction in losses from pests and diseases, increased productivity per acre, shorter maturing period, and uniformity of bunch sizes resulting in increased and easy marketing of the banana.

By considering that the participating villages are the marginalized rural communities, the positive project's benefits were directly linked to improving their livelihood. The banana production has provided a cash-income security to poor banana growing farmers because it provides almost continuous income flow throughout the year, even under low input regimes. Furthermore, the increase in banana production at the farm level has increased food security to the participating households and the community at large. The observed spillover effects of this project exported these benefits beyond the project boundaries. This is because the farmers are able to train amongst themselves.

5.4.3 Zanzibar Seaweed Case

The Zanzibar seaweed case was particularly interesting to re-examine with respect to the interactions between university and community given its long-term sustainability. Interestingly, the Zanzibar seaweed case shows an initiative that was initiated through research conducted by a professor at the University of Dar es Salaam (UDSM) back in the 1970s and early 1980s. This was followed later by commercial cultivation started by private entrepreneurs in 1989. So this case has its original origin – contrary to the other two cases – by interest of a university employee who saw the potential. After this the structure has further developed and there exist now local groups who process and sell the various seaweed value added products that result from seaweed (and they do have application in different sectors ranging from food, pharmaceutical and cosmetic to textile industries). Important to stress again is that seaweed farming is now competing with the tourism industry in terms of foreign exchange earnings for Zanzibar. The farming contributes over 90 per cent of Zanzibar's marine exports and in the period between 1990 and 1993, seaweed production increased from 808 to 1,768 metric tons whereas the production in year 2009 increased to 11,000 metric tons.

The issue of adding value was implemented by the Zanzibar Seaweed Cluster Initiative in 2008, This Cluster initiative is one of the Cluster programmes under the CoET outreach programme – as was the stone crusher project, but here in the particular group of clusters. While the Marine Institute is assisting and responsible for any matters related to the planting and growing of the seaweed, the CoET team continuously assists in further developing different types of products. It is important to stress though that despite of this expertise the methods used are typically village level recipes that are affordable for farmers. Importantly, and with respect to the issue of livelihoods, the seaweed processing plant has contributed to increasing the income through exporting semi-processed seaweed of Zanzibar communities.

An overall finding is that those cases that really served the community were mostly initiated locally rather than the by donor driven research agendas at universities. A typical problem with donor driven cases/projects has been the mismatch and lack of benefit to the community. The university has thus an important role to play in its responsiveness towards bottom-up approaches initiated by communities – or as in the seaweed case – domestic university staff.

This also shows, as a general conclusion, for ensuring success of such interactions the dynamics in informal settings could be taken more seriously on board and on the agenda of university policies. Further, the innovation policies in the country should ensure to put in place a conducive environment and infrastructure for supporting such initiatives that include and address socio-economic, livelihood related challenges of marginalized communities to foster inclusive innovation activities.

6. CONCLUSIONS

This Tanzanian study on understanding universities´ linkages with external social actors and marginalized communities and case studies on livelihood in informal settings, as part of the African UNIID project, seeked to address the limited attention that has been given to understanding the role of universities in contributing to innovation for inclusive development and particularly innovation activities in marginalized areas, or marginalized groups of people. Thus, with this focus the Tanzanian study aimed to bridge a gap as far as our academic understanding of this role is concerned, where only recently a focus on inclusive innovation and inclusive development has emerged.

By conducting this research we made innovation activitites taking place in marginalized communities more visible and assessed the contribution of universities to these activities in terms of their technical expertise in all three cases and responsive, problem solving attitutes towards solving challenges that were faced by the communities. The universities that were part of this study showed to play a crucial role in linking formal and informal actors and activities in the innovation system. The research was conducted at three public universities namely, the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), and the Muhimbili University of Health Sciences (MUHAS). The research was conducted in two phases, the first one involved the mapping of interaction of the researchers and scientists with social external actors, the communities. It paved a way to identify case studies whose detailed assessment was carried out in the second phase. The second phase in-depth exploration of

innovation in informal settings allowed us to interrogate critically the policy options and interventions typically proposed in the innovation systems literature.

Findings of the mapping exercise were interesting as they showed that existing universities' policies are supportive to researchers' interaction with external social actors. Particularly all the three universities have put in place research policies, which have established overall plans and acceptable procedures as well as conditions to guide and determine present and future decisions on research undertakings. Furthermore, researchers' engagement in terms of individual research outputs form part of assessment criteria for promotion, which can be seen as an incentive to participate in research and hence to interact with social external actors. However, one challenge on meager research funding from the central government remained evident and so the implementation of these policies are risking against implementing research agenda of external funding agencies. Looking at the research project profiles particularly at SUA one sees clearly that international rather than national funded research projects are highly dominating. Another important challenge was the fact that the universities have no apparent and structured reward mechanisms to researchers who engage and interact with external social partners. Existing mechanisms are either insufficient or ineffective, or implementation and impact of these guidelines is far from being appreciated. For the scientists who engage through funded projects, there are personal incentives that accrue from the research consultancy activities themselves. However, this is not consistent since these rewards are project oriented and they are not structured into the university channels.

The mapping also revealed profound academic outputs in terms of producing graduates, academic publications, reports, policy documents and popular publications. Other noticed outputs were community infrastructure and facilities; and new or improved process/products. Outputs in terms of "spin-off companies" were marginal. The low output in spin-offs is inherent in the core problem of low research output commercialization capacities in Tanzania. Since technology incubation is a missing link at most Tanzania universities and research centres, and also the lack of technology transfer is bound to be a persistent problem.

Our research findings on the in-depth analysis of the three selected cases of livelihood are supportive of the contribution of Tanzania higher learning institutions in poverty alleviation and particularly, for inclusive development. They have provided a strong evidence base that can be used for promoting a policy agenda intended to strengthen the complex and multiple intersecting roles of african universities as drivers of innovation and inclusive development. Two cases were on agriculture (banana culture, and seaweed farming) while the third one was technology oriented (development of CIMA crusher for informal quarry vendors). The banana

culture and CIMA crusher cases were a response by the universities to a bottom-up request from neighbouring communities whereas the seaweed case had a meso-levelnature, as it had its very origin from a domestic university researcher and formed later part of the Scandinavian funded Cluster Programme at UDSM, hence at that stage part of top-down and foreign funding, but not in its very initiative stage as such. The researchers introduced the banana culture technique to solve the low yield of banana crops, which were attacked by pests and diseases. The CIMA crusher was introduced for assisting artisanal quarry vendors (women group) to improve productivity and income while at the same time reducing the huddle of hard labour and risky working environment. On the other hand, the seaweed case was introduced by researchers who saw its potential in alleviating poverty to coastal women. All the three cases were, to a larger extent, financially supported by agents outside the universities and mostly also outside the country.

The CIMA crusher case showed lively interactions between the women group who provided necessary input during several stages of the CIMA crusher prototype design and also in the field testing phase. The result was a well-developed CIMA crusher prototype which was used by the women group for producing and selling the stone aggregates for use in construction work. However, besides the benefits accrued from the CIMA crusher the women group could not sustain the technology. This happened due to the lack of management and business skills within the group. Further, the engineering technology was beyond their technical knowledge since they had to hire men for servicing and maintenance of the crusher which finally jeopardized its service life. At the university level, it was observed that there was no further diffusion of the prototype to the whole construction industry and community. One of the major constraints and reasons being the insufficient infrastructures for technology transfer in Tanzania. In the absence of such infrastructures like technology tramsfer offices or to some extent also incubators, the academicians will not invest extra time beyond their primary role of teaching. Thus, with respect to innovation per se this is an interesting case where the community could make effective use of the expertise available at the university. When it comes to scaling up this inclusive innovation, , this case has not been successful. Related to the sustainability problem of this specific case has also been the lack of long term funding. As described above, a maintenance problem finally ended this project and not a problem related to aspects of technology transfer. In this respect, it could be reflected about mechanisms at the university that could be established to overcome this type of problems to re-occur. These could for instance be incorporated into the outreach programme. There might be possibilities for technology transfer offices that also try to assist in attracting long term funding or incubators might be established more widely with new and adopted concepts so as to integrate community cases and projects such as this one. The university thus could expand and strengthen its role if

the management process of such projects could be expanded and the coordination strengthened, in a similar way to the extension services in agriculture.

The banana case interestingly illustrated the process of increasing the banana productivity as a result of solving identified banana production constraints. We saw that the success of this demand driven research project went beyond the project boundary up to a neighbouring country, Malawi. This success was due to many factors such as the high level of beneficiaries' participation and the involvement of a bigger network of researchers. The participation of the project beneficiaries started from early stages when they were asked to list pertinent problems that were responsible for lowering their banana productivity. Besides the fact that poor farm management practices were among the existing problems, other frequently mentioned problems were attributed to pests attack and diseases. The project was therefore designed to use the tissue culture technology for solving the disease problem and pests attack whereas the farmers were taught better techniques of farming. Both the tissue culture and better farming techniques were transferred to the farmers theoretically and this was done practically at an identified model farm. Before planting the cultured disease free bananas in the model farm, the farmers were asked to select the preferred banana species to be planted. Alongside the preferred species, the researchers introduced five new species too. The new species were designed to match the local preferences and also to meet the disease-free characteristic. Both the newly introduced species and traditional ones were planted in the model farm by the farmers themselves under a strong supervision of the scientists. The supervision ensured to train farmers for adopting the new banana farming techniques. The products from the model farm were appreciated by the farmers in terms of yield and productivity from both traditional and new species. The new species were then tasted, which was important in increasing the preferential selection of the farmers themselves. The individual farmers were then free to plant the preferred banana species in their own farms. At this stage, the farmers themselves were able to apply the tissue culture technique themselves for transferring the banana species from the model farm to their own farms. The overall benefits to the community were in terms of the availability of large quantities of clean and superior planting material enabling them to reclaim their old banana orchards, substantial reduction in losses from pests and diseases, increased productivity per acre, shorter maturing period, and uniformity of bunch sizes resulting in increased and easy marketing of the banana. The increased banana production provided a cash-income security to poor banana growing farmers because it provides an almost continuous income flow throughout the year, even under low input regimes. Furthermore, the increase in banana production at the farm level has increased food security to the participating households and the community at large.

The Zanzibar seaweed case is peculiar when re-examined with respect to the interactions between university and community given its long-term sustainability, since the 1970s and early 1980s. The initial interaction by researchers and the coastal community introduced seaweed farming, which was responded by commercial cultivation by private entrepreneurs from year 1989. After this the structure has further developed and there exist now local groups who process and sell the various seaweed value added products that result from seaweed (and they do have application in different sectors ranging from food, pharmaceutical and cosmetics to textile industries). The issue of adding value to the seaweed was implemented by the Zanzibar Seaweed Cluster Initiative in 2008. The researchers were assisting the seaweed farmers in better seaweed planting and growing techniques some of which combated the seaweed die off problems. Furthermore, the researchers collaborated with the farmers to develop different seaweed value added products. It is important to stress though that despite of this expertise the methods used are typically village level recipes that are affordable for farmers. Importantly, and with respect to the issue of livelihoods, the seaweed processing plant has contributed to increasing the income through exporting semi-processed seaweed of Zanzibar communities. As a result of this long-term interaction, the seaweed farming is now competing with the tourism industry in terms of foreign exchange earnings for Zanzibar. The farming contributes over 90 %of Zanzibar's marine exports and in the period between 1990 and 1993, seaweed production increased from 808 to 1,768 metric tons whereas the production in year 2009 increased to 11,000 metric tons.

An overall finding is that those cases that really served the community were mostly initiated locally rather than the donor driven research agendas at universities. A typical problem with donor driven cases/projects has been the mismatch and lack of benefit to the community. The university has thus an important role to play in its responsiveness towards bottom-up approaches initiated by communities – or as in the seaweed case – university staff. This also shows, as a general conclusion, for ensuring success of such interactions the dynamics in informal settings could be taken more seriously on board and on the agenda of university policies. Further, the innovation policies in the country should ensure to put in place a conducive environment and infrastructure for supporting such initiatives.

Together, the mapping of university practice and the in-depth exploration of innovation in informal settings allows us to interrogate critically the policy options and interventions typically proposed in the innovation systems literature. The research ultimately aims to inform better targeted policy adaptation and formulation in universities. In this respect, there was a clear need to develop more incentive mechanisms to support interaction with external social actors.

On a more general, national level of STI policy making universities may be considered and treated as crucial actors in innovation systems to enable and support innovations for inclusive development. Importantly, while the concept has its origins in India, its social dimension us highly important in countries like Tanzania and sectors such as agriculture with its high levels of informal self- employments and subsistence farming. DUI-modes of interacting are here particularly important and students play a central role in transferring knowledge from the universities to the communities and vice verca and hence perform an essential “linking” or “intermediating” task in these emerging innovation systems.

While the innovation system concept was adopted from the North and its suitability and applicability tested and adopted in the South, the concept of inclusive innovation and inclusive development has its very origin in catching-up countries. Socio-economic development in a country like Tanzania that is highly dependent on agriculture based on susbsistence farming will certainly need to follow an inclusive development path if profound and sustainable changes are to be reached. For this to happen, universities and their role in innovation for inclusive development should have a clear place in inclusive innovation policies of the country. We have in this report pointed to both contributions and constraints as regards the role of the universities which could be followed up and taken on board in future national STI policies.

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SUA Policies:

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Information and Communication Technology Policy and Guidelines (2007)

UDSM Policies:

The University of Dar es Salaam Intellectual Property Policy (2008)

University of Dar es Salaam Research Ethics Policy and Operational Procedures (2010)

MUHAS Policies:

Research Policy Guidelines (2011)

Scheme of Service for Academic Staff (2013)

Academic Staff Performance Assessment Guidelines (2009)

National Research and Development Policy (2010)

National Health Policy (2003)

APPENDICES

Appendix 1: Instruments for Mapping Academic Interactions

Appendix 1.1: University Information Schedule

Use this schedule once for each university.

You may get the information beforehand from university documents or websites, or you may ask senior management to point you to someone who can help you with the information (for example, on student numbers).

This gives you key background information on the university.

For question 9: there may be official policy, but if not, use the interviews to complete this section.

For question 10: This information is likely to come from your interviews. It provides a useful checklist when you are interviewing, relating to question 2 of Template C.

For question 11: This is likely to come from your interviews. It provides a good checklist for question 4 of Template C.

_____**UNIVERSITY** *(add institution name)*

Our study attempts to map the nature of interaction between universities and external actors that contributes to innovation for inclusive development in African countries. There is general agreement globally that universities should become more responsive to their global, national and local contexts. One of the key ways is for the university – as a knowledge producer – to interact with knowledge users – firms, government, communities, farmers, civil society. This interaction may take a wide range of forms related to the teaching, research and community engagement or service activities of the university.

We would like to understand the pattern of different forms of interaction between academics at your university and the range of external partners, whether locally, nationally or globally situated. Our particular interest is individuals, communities and their organizations.

Thank you for agreeing to participate. We would like some core background information on the university, to contextualize the patterns that we do find. Please assist with data for 2012 or as recent as possible.

1. **Please list all the campuses of your university, and indicate the year in which the campuses or institutes were established and their location.**

	Year established	**Location**
Name of university:		
Campus/institute:		
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

2. **Please provide total enrolments per faculty for the most recent year available, distinguishing between under-graduate and post-graduate students. Please indicate the year for which you have supplied data.**

Year	2012/13

ENROLMENT		
Faculty name	**Under-graduate (BA and Licentiatura)**	**Post-graduate (Masters and Doctorates)**

Total		

3. **Please provide the total number of academic staff and indicate the number of staff with PhDs for the same year, per faculty**.

ACADEMIC STAFF		
Faculty name	**Number with PhD**	**Total**

Total		

4. **Please list all of the research centres and units in your university, indicating their location and size.**

NB: Centres eg for Marine (UDSM), pesticides (SUA), TDTC (CoET)

NAME	FACULTY	CAMPUS	STAFF SIZE

5. **Please list all of the outreach units in your university, indicating their location and size.**

NB: Outreach units re technology dissemination units, like TDTC at CoET

NAME	FACULTY	CAMPUS	STAFF SIZE

6. **Please indicate the number of research projects funded *over the last three years 2010 – 12***

	Number of projects	Approximate Total Funding
National university funds		
International donor funds		

NB: Consider programs as projects eg SIDA at UDSM

7. **Please indicate the number of academic publications at your university *over the last three years. 2010 – 12***

Publications	**Number**
Internationally accredited journals	
Nationally accredited journals	
Institutional journals	

8. **Please indicate the number of patents awarded to your institution *to date*** (ALL)

Patents	**Domestic**	**Abroad**
Number of patent applications		
Number of patents awarded		
Number of licensed patents		

9. **How do you expect staff to distribute their working time among the following academic functions?**

In most cases there are no policies
Teaching is said to be paramount
Research is not featuring “directly”, it is inferred only!
However, publication that comes from research is taking over 90% of evaluation for promotion!
There is a maximum number of hrs (contact hrs) per class of teachers eg TAs, seniors, etc
Prepare a questionnaire for 30 people and include the % time into current and “wishing” – From Sr. Lecturers to Professors 10 interviewees per strata – 40 questionnnaires

	% TIME
Teaching	
Research	
Private activities for individual gain	
Interaction with external actors (outreach - related)	
Administration	

10. **Does your university have any of the following policies and structures? Please supply copies of each of the formal policy documents that you do have**.

	Yes	**No**
Annual reports		
Research policy		
Intellectual Property Rights (IPR) policy		
Strategic institutional policy		
Teaching and learning policy		
‘’Community engagement’’ policy		
Research office		
Contracts office		
Technology transfer office		
Commercialisation office		
Innovation office		
Extension office		
Community engagement office		
Science park		
Small business incubator		
Experimental farm or agricultural centre		
Specialised outreach campus		
Delivery site based in communities		
Cultural sites		
Other – specify		

11. **Does your university have any of the following incentive mechanisms that promote interaction?**

Comments:

a) There are always complaints on incentives to those eg who devote their time too much to teaching/research/projects
b) Those reviewing programs
c) Administrations

	Yes	No
Performance management system that rewards interaction or engagement		
Awards for research		
Awards for innovation		
Awards for engaged activity		
Promotion criteria that rewards interaction or engagement		
Open days for external actors		
Community forum		
Newsletter that promotes interaction or engagement		
Specialised funds for promoting research		
Specialised funds for promoting innovation		
Specialised funds for promoting interaction with communities		
Specialised funds for promoting interaction with firms		
Other – specify		

Appendix 1.2: Interview Schedule for Senior Management and Leadership

This instrument is intended for the use of the interviewer primarily. It can also be sent to the person you are interviewing beforehand, as some people prefer to be prepared for the interview.

There are seven main questions, and possible prompts. It is a semi-structured interview, so use these as a guide to cover the seven areas.

You can use the introduction below as a way to introduce the project.

> This project aims to make visible the involvement of academics and universities in the kinds of innovation that typically remain below the radar. In particular, we are interested in identifying and mapping the kinds of interactions between academics and communities, small scale farmers, cooperatives and local actors – but in the context of the general orientation of your university to teaching, research, innovation and interaction with any actors, such as firms or government or NGOs.
>
> That is, we are interested in finding out how your university is organised to be more accountable to social needs, particularly in the local environment, and how academics extend their knowledge to the benefit of inclusive social and economic development.

1. How does interaction with external social partners fit into the main **mission**s of your university?
    - What is the intended balance between teaching and learning, research and innovation, and outreach?
    - How do you expect academics to address these?

2. What are the main **types** of interaction that take place in your university?

3. Have you put in place any **institutional policies** to support interaction to the mutual benefit of external social actors?
    - What are these policies?
    - What are the main concepts used to describe interaction? (eg community engagement, service, extension, technology transfer)
    - To what extent are these policies **coordinated** with your strategic thrust?

4. What are the **institutional structures and processes** you have tried to put in place to promote interaction with external social actors, particularly communities and local actors?
    - Internal interface mechanisms (e.g. research and innovation office, engagement office)
    - External interface mechanisms (e.g. technology transfer office, extension office, community forum)
    - Decision making structures (e.g. senate, deans, special committees)

5. What are the specific **incentive mechanisms** you have put in place to promote interaction with external social actors, particularly communities and local actors?
    - Internal mechanisms (e.g. performance criteria, special awards)

- External mechanism (e.g. newsletters, special funds)

6. What are your successes in terms of the **outcomes** of interactive activities? In what ways has interaction resulted in inclusive development?

7. Where have you encountered **bottlenecks**? What are the main **obstacles** to interaction and innovation with communities particularly?

Appendix 1.3: Individual Academic Interaction Instrument

The first step is to establish whether the academic has any form of interaction with any form of partner. If yes, use this template. If no, use Template F.

This instrument can be used to yield two complementary kinds of data

- numerical trends on the most common types of partners, types of relationship etc. (questions 1-6)
- qualitative data on the most significant case of interaction with which the academic is involved (question 7)

It can also be used in practice in different ways:

- You may print it out and give it to the academic to complete themselves, while you are talking and explaining
- You may ask the academic the main question for each section, and then complete the schedule yourself, based on their answers

Please make use of the ''Other'' category, as there are likely to be many more context specific options that are not included.

Basic descriptors of the academic are important to distinguish which academics tend to interact in particular ways.

Introduce the discussion to the academic as follows:

I am going to ask you six sets of questions, focused on the ways in which you interacted with external social actors through your academic work **over the last two years 11/12 to 12/13**

Each question will have a number of options that cover the experience of different academic disciplines, and they may not all apply to your own field.

Please rate ***EACH*** of them on the same scale

(where 1= not at all, 2 = in isolated instances, 3 = on a moderate scale and 4 = on a wide scale).

NB: Each institution choose 3 academic institutions that are posed to bring case study areas eg:

MUHS: - Medicine, Traditional, Public Health - min of 30 interviewees per unit and a total of 100 per University

SUA – min of 30 interviewees per unit and a total of 100 per University

UDSM: min of 30 interviewees per unit and a total of 100 per University

Name of department:

Academic rank:

Disciplinary field:

Highest qualification:

1. To what extent do you interact through your academic scholarship with any of these **external social actors**?

	External social actors	**Not at all**	**Isolated instance**	**On a moderate scale**	**On a wide scale**
		1	**2**	**3**	**4**
1	Local government agencies	☐	☐	☐	☐
2	Provincial/regional government departments or agencies	☐	☐	☐	☐
3	National government departments	☐	☐	☐	☐
4	Clinics and health centers	☐	☐	☐	☐
5	Schools	☐	☐	☐	☐
6	National regulatory and advisory agencies	☐	☐	☐	☐
8	Individuals and households	☐	☐	☐	☐
9	A specific local community	☐	☐	☐	☐
10	Welfare agencies	☐	☐	☐	☐
11	Non-governmental agencies (NGOs)	☐	☐	☐	☐
12	Development agencies	☐	☐	☐	☐
13	Trade unions	☐	☐	☐	☐
14	Civic associations	☐	☐	☐	☐
15	Community organizations	☐	☐	☐	☐
16	Social movements	☐	☐	☐	☐
17	Political organizations	☐	☐	☐	☐
18	Religious organizations	☐	☐	☐	☐
20	Large national firms	☐	☐	☐	☐
21	Small, medium and micro enterprises	☐	☐	☐	☐
22	Multi-national companies	☐	☐	☐	☐
23	Small-scale farmers (non-commercial)	☐	☐	☐	☐
24	Commercial farmers	☐	☐	☐	☐
25	Sectoral organizations	☐	☐	☐	☐
26	National universities	☐	☐	☐	☐
27	African universities	☐	☐	☐	☐
28	International universities	☐	☐	☐	☐
29	Science councils	☐	☐	☐	☐
30	Funding agencies	☐	☐	☐	☐
31a	Other	☐	☐	☐	☐
31b	Specify				

2. To what extent does your academic scholarship involve these **types of relationship** with external social actors?

	Types of relationship	**Not at all**	**Isolated instances**	**On a moderate scale**	**On a wide scale**
		1	**2**	**3**	**4**
1	Alternative modes of delivery to accommodate non-traditional students	☐	☐	☐	☐
2	Work-integrated learning	☐	☐	☐	☐
3	Education of students so that they are socially responsive	☐	☐	☐	☐
4	Service learning	☐	☐	☐	☐
5	Student voluntary outreach programmes	☐	☐	☐	☐
6	Collaborative curriculum design	☐	☐	☐	☐
7	Continuing education or professional development	☐	☐	☐	☐
8	Customised training and short courses	☐	☐	☐	☐
11	Policy research, analysis and advice	☐	☐	☐	☐
12	Expert testimony	☐	☐	☐	☐
13	Clinical services and patient or client care	☐	☐	☐	☐
14	Design and testing of new interventions or protocols	☐	☐	☐	☐
15	Design, prototyping and testing of new technologies	☐	☐	☐	☐
17	Monitoring, evaluation and needs assessment	☐	☐	☐	☐
18	Research consultancy	☐	☐	☐	☐
19	Technology transfer	☐	☐	☐	☐
21	Contract research	☐	☐	☐	☐
22	Collaborative R&D projects	☐	☐	☐	☐
23	Community-based research projects	☐	☐	☐	☐
24	Participatory research networks	☐	☐	☐	☐
25	Joint commercialization of a new product	☐	☐	☐	☐
26a	Other	☐	☐	☐	☐
26b	Specify				

3. To what extent have you used each of the following **channels of information** to transfer your knowledge to external social actors?

	Channels of information	**Not at all**	**Isolated instances**	**On a moderate scale**	**On a wide scale**
		1	**2**	**3**	**4**
1	Public conferences, seminars or workshops	☐	☐	☐	☐
2	Informal information exchange	☐	☐	☐	☐
3	Radio, television or newspapers	☐	☐	☐	☐
4	Popular publications	☐	☐	☐	☐
5	Interactive websites	☐	☐	☐	☐
6	Students	☐	☐	☐	☐
7	Reports and policy briefings	☐	☐	☐	☐
8	Oral or written testimony or advice	☐	☐	☐	☐
9	Training and capacity development or workshops	☐	☐	☐	☐
10	Demonstration projects or units	☐	☐	☐	☐
11	Research contracts and commissions	☐	☐	☐	☐
12	Technology incubators or innovation hubs	☐	☐	☐	☐
13	Intervention and development programmes	☐	☐	☐	☐
14	Software development or adaptation for social uses	☐	☐	☐	☐
15	Participatory or action research projects	☐	☐	☐	☐
16	Cross-disciplinary networks with social partners	☐	☐	☐	☐
17	Technology development and application networks	☐	☐	☐	☐
19	Patent applications and registration	☐	☐	☐	☐
20	Spin-off firms from the university (commercial or not for profit)	☐	☐	☐	☐
21a	Other	☐	☐	☐	☐
21b	Specify				

4. To what extent has your academic Interaction with external social actors had the following **outputs?**

	Outputs	**Not at all**	**Isolated instances**	**On a moderate scale**	**On a wide scale**
		1	**2**	**3**	**4**
1	Graduates with relevant skills and values	☐	☐	☐	☐
2	Academic publications	☐	☐	☐	☐
3	Dissertations	☐	☐	☐	☐
4	Reports, policy documents and popular publications	☐	☐	☐	☐
5	Cultural artifacts	☐	☐	☐	☐
6	Academic collaboration	☐	☐	☐	☐
7	Spin-off companies	☐	☐	☐	☐
8	Community infrastructure and facilities	☐	☐	☐	☐
9	New or improved products	☐	☐	☐	☐
10	New or improved processes	☐	☐	☐	☐
12	Scientific discoveries	☐	☐	☐	☐
13a	Other	☐	☐	☐	☐
13b	Specify				

5. To what extent has your academic Interaction had the following **outcomes or benefits**?

	Outcomes and benefits	**Not at all**	**Isolated instances**	**On a moderate scale**	**On a wide scale**	**Database variable name**
		1	**2**	**3**	**4**	
1	Public awareness and advocacy	☐	☐	☐	☐	q51
2	Improved teaching and learning	☐	☐	☐	☐	q52
3	Community-based campaigns	☐	☐	☐	☐	q53
4	Policy interventions	☐	☐	☐	☐	q54
5	Intervention plans and guidelines	☐	☐	☐	☐	q55
6	Training and skills development	☐	☐	☐	☐	q56
7	Community employment generation	☐	☐	☐	☐	q57
8	Firm employment generation	☐	☐	☐	☐	q58
9	Firm productivity and competitiveness	☐	☐	☐	☐	q59
10	Novel uses of technology	☐	☐	☐	☐	q510
11	Improved livelihoods for individuals and communities	☐	☐	☐	☐	Q511
12	Improved quality of life for individuals and communities	☐	☐	☐	☐	q512
13	Regional development	☐	☐	☐	☐	q513
14	Community empowerment and agency	☐	☐	☐	☐	q514
15	Incorporation of indigenous knowledge	☐	☐	☐	☐	q515
16	Participatory curriculum development, new academic programmes and materials	☐	☐	☐	☐	q516
17	Relevant research focus and new research projects	☐	☐	☐	☐	q517
18	Academic and institutional reputation	☐	☐	☐	☐	q518
19	Theoretical and methodological development in an academic field	☐	☐	☐	☐	q519
20	Cross-disciplinary knowledge production to deal with multi-faceted social problems	☐	☐	☐	☐	q520
21a	Other	☐	☐	☐	☐	q521a
21b	Specify					q521b

6. In your experience, how important are the following **obstacles and challenges** to your academic Interaction with external social actors?

	Obstacles and challenges	**Not important**	**Slightly important**	**Moderately important**	**Very important**	**Database variable name**
		1	**2**	**3**	**4**	
1	Limited financial resources for competing university priorities	☐	☐	☐	☐	q61
2	Lack of clear university policy and structures to promote Interaction	☐	☐	☐	☐	q62
3	University administration and bureaucracy does not support academic Interaction with external social partners	☐	☐	☐	☐	q63
4	Competing priorities on time	☐	☐	☐	☐	q64
5	Too few academic staff	☐	☐	☐	☐	q65
6	Institutional recognition systems do not reward academic Interaction activities sufficiently	☐	☐	☐	☐	q66
7	Risks of student involvement in Interaction with external social partners	☐	☐	☐	☐	q67
8	Tensions between traditional and new academic paradigms and methodologies	☐	☐	☐	☐	q68
9	Sustainable external funding	☐	☐	☐	☐	q69
10	Negotiating access and establishing a dialogue with external social partners	☐	☐	☐	☐	q610
11	Unequal power relations and capabilities in relation to external social partners	☐	☐	☐	☐	q611
12	Legal problems	☐	☐	☐	☐	q612
13	Lack of mutual knowledge about partners' needs and priorities	☐	☐	☐	☐	q613
14a	Other	☐	☐	☐	☐	q614a
14b	Specify	☐	☐	☐	☐	q614b

7. Finally, can you describe the best **example** of your academic teaching, research or outreach projects in which you interacted with external social actors over the last two years? 2011 – 2012

Example of projects
• What was the main aim of the project? • What social actors were involved? • What kinds of relationship were involved? • What channels of information were used? • What were the outputs? • What were the outcomes and benefits? • What were the obstacles and challenges?

Thank you very much for your time and insights, and I wish you good luck with your future endeavors!

Appendix 1.4: Individual Academic Interaction Instrument

The first step is to establish whether the academic has any form of interaction with any form of partner. If no, use this template. If yes, use Template E.

Please make use of the ‘’Other’’ category, as there are likely to be many more context specific options that are not included.

Basic descriptors of the academic are important to distinguish which academics tend to interact in particular ways.

Introduce the discussion to the academic as follows:

You have indicated that you do not interact with external social actors through your academic work.

There are many **reasons why academics do not interact** with external social actors.

Please indicate how important ***each*** of the following is in relation to your own experience.
(where 1 = not important, 2 = slightly important, 3 = moderately important and 4 = very important).

Name of department:
Academic rank:
Disciplinary field:
Highest qualification:

	Reason for no Interaction	**Not important**	**Slightly important**	**Moderately important**	**Very important**
		1	**2**	**3**	**4**
1	Interaction is not appropriate given the nature of my academic field or discipline	☐	☐	☐	☐
2	Interaction is not central to my academic role	☐	☐	☐	☐
3	Pressures of teaching and research on my time are too great	☐	☐	☐	☐
4	My department or faculty does not promote Interaction	☐	☐	☐	☐
5	Lack of clarity on the concept of external interaction in my university	☐	☐	☐	☐

6	Institutional recognition systems do not reward Interaction activities sufficiently	☐	☐	☐	☐
7	Limited financial resources are available	☐	☐	☐	☐
8	University administration systems do not support Interaction	☐	☐	☐	☐
9	Lack of clear university policy on Interaction	☐	☐	☐	☐
10	Lack of clear university structures to promote Interaction activities	☐	☐	☐	☐
11	Lack of recognition of Interaction as a valid type of scholarship in my university	☐	☐	☐	☐
12	Differences between university and social partner priorities and needs are too great	☐	☐	☐	☐
13	Lack of social partners' knowledge about research activities and priorities in universities	☐	☐	☐	☐
14 a	Other	☐	☐	☐	☐
14 b	Specify				

Thank you very much for your time and insights, and I wish you good luck with your future endeavors!

Appendix 2: Suitability of the Case Study

This case study seems like a strong candidate for inclusion in UNIID Activity 2. It meets the selection criteria related to innovation, informality, marginalization, and livelihoods. The extent of community participation is unclear at the state, but it seems that at least a minimal level of community participation is indeed present. This will have to be further explored as part of the case study.

Innovation			
	Project 1	**Project 2**	**Project 3**
Are new products, processes or organisational structures developed?			
Are skills developed in support of this technical or organisational novelty?			
Are there links between the case study project and other actors in the innovation system?			
Social setting: livelihoods, informal settings, marginalized communities			
Is the case study set in the informal economy or within informal employment in the formal economy?			
Does the case study include the participation of marginalized households and communities?			
Does the interaction contribute towards improved livelihoods?			
Participation			

Do local communities participate in the identification of the problem that the interaction is seeking to solve?			
Do local communities provide input into possible solutions?			
Do local communities participate in processes, including proposal evaluation, setting the terms of engagement, and monitoring and evaluation?			
Do local communities contribute their knowledge in a collaborative process of knowledge production?			

Appendix 3: List of Research Projects for Case Study

Appendix 3.1: List of Research Projects SUA Funded by External Partners

S/N	Project	Project Leader	Source of Funds	Commencent Date	End Up Date	Total Grant Value	Amount received to date in TZS
1	National Research Network in Biomedical Science	Prof.D.M. Kambarage	EU-AFRICAN CARRIBEAN AND PACIFIC SCIENCE AND TECHNOLOGY PROGRAMME	Nov,2010	Oct,.2013	EURO 935,850	551,630,526.99
2	Productivity and Growth in Organic Value-	Prof.K.Sibuga	DANIDA	Jan,2011	Mar,2015	DKK 2,174,817	100,217,236.86
3	Enhancing Children Nutrition and Rural Livelihoods in Malawi Mozambique	Prof.Y Muzanila	Mcknight Foundation	Aug,2009	Sept,2013	USD 240,000	261,576,000.00
4	Bioassay technique for determination of Mercury pollution in the lake Victoria	Dr.C.Tungaraza	IUCEA	Aug,2007	Sept,2010	USD 136,000	17,454,702.00
5	Capacity Building for Sustainable Land Management	Prof.S.S.Madoffe	Eastern and Southern Partnership Program (ESAPP)	Feb,2009	Mar,2012	CHF 47,960	39,026,532.56

6	Integrated Approach for Improving Small Scale Market Oriented Dairy System	Prof. B. Kessy	International Atomic Energy Agency (IAEA)	Jan,2007	Dec,2012	Euro 30,000	45,300,275.00
7	Collaborative Programmed on Zoonosis and Environmental Toxicology	Prof. R. Kazwala	NUFU	July,2007	Dec,2011	NOKK 5,758,000	87,880,351.17
8	ECABREN (Phase II)	Dr Mamiro	ASARECA	Jan,2010	Marc,2013	Depends on Activities	48,070,149.59
9	Development of a Sustainable Tilapia Culture in Tanzania	Dr.S.W.Chen yambuga	University of Arkansas	Jan,2008	Sept,2011	USD 62,000	40,273,444.50
10	Processing for commercial Exploitation of Selected Tree fruits and Vegetable	Prof.B.Tisek wa	ASARECA	Oct,2009	June, 2011	USD 196,000	57,600,000.00
11	Participatory Forest Management for Rural Development, Forest Conservation and Good Governance in Tanzania	Prof.Y.Ngaga	ENRECA	Feb,2008	Dec,2011	DKK 2,411,254	406,319,273.81
12	Drying Fruits and Vegetable	Dr (Mrs) A.Temu	DANIDA	July,2009	June,2012	DKK 3,000,000	266,193,764.00
13	African Network	Prof	Carnegie-IAS	Oct,2008	June,2011	USD 800,000	228,059,861.25

	for Research and Training in Natural Products	R.H.Mdegela	Regional Initiative in Science and Education				
14	Molecular characterization of Theileria parva	Prof.P.Gwakisa	University of Pretoria	Jan,2009	Dec,2011	USD 150,000	20,130,000.00
15	Peri Urban Livestock Enterprises	Prof. M.M.Mtambo	DANIDA	July,2009	Dec,2012	DKK 2,996,342	339,196,636.60
16	Monitoring Climate Change	Prof. C.Tungaraza	DANIDA	July,2009	Dec,2012	DKK 3,900,000	367,701,495.76
17	Intergrated Productivity Enhancing Technology	Prof.Kanuya	ASARECA	Apr,2010	Mar,2013	USD 130,000	121,192,430.00
18	Plant Bleeding Marker Assisted Selection (MAS)	Prof,Nchimbi Msola	KIRKHOUSE TRUST	Sept,2008	August,2011	USD 188,394,866	201,082,823.21
19	Promoting Sustainable Natural resources Mgt through Effective Governance and Farmer – Mkt	Dr. D.Kimaro	ASARECA	July,2009	Dec,2011	USD 104,548	44,650,210.11
20	Advancing Soil Health in Africa	Dean, Faculty of Agriculture	Allience for Green Revolution in Africa	Jan,2010	Dec,2015	USD 1,867,497	888,879,540.00

21	Seed Disease Diagnosis	Prof. R. Mabagala	VARIOUS STAKEHOLDER	Jan,2008	Dec,2012	NO SPECIFIC BUDGET	54,538,145.10
22	Market Infastructure Improvement (Phase II)	Dr (Mrs) Anna-Temu	IFPRI-Washington	Nov,2008	Mar,2011	USD 58,000	94,192,984.32
23	Improved Utilization of Sorghum and Pearl Millet in Ease Africa	Dr. J.J.Mpagalile	INSTOMIL	July,2006	Sept,2011	USD 120,600	141,494,045.00
24	Testing and Validation of breed survey	Prof. P.Gwakisa					
	Methodology, Socio-Economic survey and		ASARECA				
	characterization of Indigenous Breeds of Cattle			Sept,2010	June,2012	USD 163,162	18,360,346.40
25	Market Development in Support of Sorghum and	Dr. E.Mbiha	Ohio State University				
	Millet Farmers in Tanzania and Zambia		Research Foundation	Sept,2007	Sept,2011	USD 51,103	54,701,460.50
26	Sustainable Land mgt. and Agriculture productivity Land aqcusition	Prof.S.Madoffe	Centre for Development and Environment (CDE)	May,2010	Dec,2011	CHF 32,000	26,673,807.14
27	Genome Sciences Centre	Prof. P.Gwakisa	Seattle Biomedical Research	Aug,2005	Dec,2010	USD 700,000	937,300,000.00

			Institute				
28	Intergrated Pest Management (IPM)	Prof.Maerere	The Ohio State University	Oct,2009	Sept,2014	USD 180,410	79,838,990.00
29	Infectious Diseases Preparedness Analysis and	Prof.Mark.Rweyemamu					
	Resources Mapping Across Human and Animal		Welcome Trust				
	Health Sectors in Southern Africa.(SACIDS)			Sept,2009	Dec,2014	GBP 5,784,079	1,937,637,870.00
29	Infectious Diseases Preparedness Analysis and	Prof.Mark.Rweyemamu					
	Resources Mapping Across Human and Animal Health Sectors in Southern Africa.(SACIDS)	u	Google Foundation	Nov,2009	Oct,2011	USD 500,000	718,500,000.00
30	Infectious Diseases Preparedness Analysis and	Prof.Mark.Rweyemamu					
	Resources Mapping Across Human and	u	Rockefeller Foundation	Oct,2008	Marc,2011	USD 399,000	538,857,000.00

	Animal Health Sectors in Southern Africa.(SACIDS)						
31	Infectious Diseases Preparedness Analysis and	Prof.Mark.Rweyemamu					
	Resources Mapping Across Human and Animal Health Sectors in Southern Africa.(SACIDS)		Rockefeller Foundation	Oct,2009	Mar,2012	USD 899,525	617,437,080.00
32	Diagnotic and control Tool and Strategies for Taenia Solium Cyticercosis	Prof. F.Lekule	ASARECA	July,2009	June, 2010	USD 85,000	35,352,016.00
33	Poverty and Sustainable Development Impacts of REDD Architecture (Phase II)	Prof.G.Kajembe	II ED		May,2013	NOKK456,950	6,127,500.00
34	Exploiting Markets for Dairy and Meat Product Quality and Safety	Prof. Kurwijila	ASARECA	Jan,2006	Dec,2011	USD 133,464	82,365,355.24
35	Improving livestock	Prof. L.Mtenga	ASARECA	Jan,2006	Dec,2011	USD 62,430	18,902,141.32

	Productivity through development of Regional Fees data base						
36 37	Rural-Urban Comlementaritie s of Poverty (RUCROP) Efficient Utilization of Available Feed Resource to Improve Livestock in East Africa	Dr. E.Lazaro Prof. A.Kimambo	DANIDA ASARECA	July,2010 Jan,2006	June,2013 Dec,2011	DKK 2,885,860 USD 59,993.15	207,261,129.90 22,736,265.00
38	IGMAFU – Meat, Income Generation Thro.	Prof. A.Kimambo	ENRECA	Mar,2009	Mar,2013	DKK 1,628,684	48,335,224.67
39	Groundwater characterization of coastal aquifer in	Dr.C.Tungara za					
	Dar-es-Salaam,Tanzani a.Mapping groundwater		VLIR				
	quality			April,2009	Mar,2012	Euro 99,101	70,164,213.63
40	Building Climate Change Adaption Capacity in the Agriculture Sector in	Prof.K.Tarim o	Rockefeller Foundation	Dec,2010	Nov,2012	USD 400,000	294,600,000.00

	Tanzania						
41	Capacity Building for Nutrional Security	Prof (Mrs) J.Kinabo	UNICEF	Jan,2007	Dec,2011	USD 40,000	46,223,179.70
42	Exploiting African Seed Treatment Technology (Eclipta alba)	Prof.R.B.Mabagala	DANIDA	Jan,2010	Dec,2012	DKK 832,460	31,194,651.35
43	Characterization of undesirable Substances in Ruminant Food chain in the Lake Victoria	Dr. R. Max	IUCEA	Jan,2007	June,2011	USD 30,678	27,321,890.10
44	SUA-WORLD Bank Project	Director, Directorate of					
		Research and	WORLD BANK				
		Postgraduate Studies		Jan,2009	Dec,2012	USD 7,5234,000	3,477,744,849.00
45	Drying of fruits and Vegetables,and development of market for poverty Alleviation.	Dr(Mrs)A. Temu	NUFU	July,2009	Dec,2012	NOKK 2,879,000	150,092,458.94
46	Carbon Sequesration Potential of Planted Fallows in Tanzania	Prof.Chamshama	University of Toronto	Jan,2010	Dec,2012	CAD 5,000	6,613,400.00

47	Enhacement of sustainable Productivity of Fish in	Prof.R.Mdegela					
	Lake Victoria through control of Pollutants with		International Atomic				
	Emphasis on Endocrine Disruptors and Microbial Pathogens		Energy Agency (IAEA)	Cct,2007	Oct,2013	USD 150,000	21,429,000.00
48	Animal Welfare Training	Prof.A.Muhairwa	World Society for Protection Animals	July,2007	July,2012	Depending on Number of Students	16,452,388.10
49	Improving of Livelihoods of the rural poor	Dr. P.Msoffe	WELLCOME TRUST	Oct,2007	Dec,2011	USD 119,329	111,357,805.60
50	Increasing Value of African Mango and	Dr. M.Watawala	DANIDA	Jan,2011	Dec,2014	USD 240,000	64,275,162.84
51	Applied Participatory forest Management	Prof. Y.Ngaga	TAFORI	July,2007	June,2011	TZS 323,595,234	323,595,234.00
52	Miombo and Savannah Vegetation change	Prof. P.Munishi	Eastern and Southern				
			Partnership Program				
			(ESAPP)	Jan,2005	Dec,2011	CHF 20,500	34,178,507.38

53	Combined Carbon and Nitrogen Isotope Signatures in the determination of effects exogenous input into Lake Victoria	Dr.C.Tungaraza	International Atomic Energy Agency (IAEA)	Aug,2007	Sept,2011	Euro 12,500	17,235,819.80
54	Genetic Characterization of the local chicken Ecotypes of Tanzania Using Micro scale lelloce DNA markers and major histocompatibility complex: Possibilities for future marker assisted	Dr. P.Msoffe	International Foundation for Science	Jan,2007	Dec,2011	USD 12,000	18,392,596.80
55	Seed Pathology Course Transfer Project	Prof.Mabagala	DANIDA	Jan,2002	Dec,2012	DKK 8,518,053	986,508,129.57
56	Valuing the Arc-Linking Science	Prof.S.Madoffe	University of Cambridge	July,2007	August,2011	GBP 96,677	197,073,249.45
57	Afro-Alpine Biodiversity	Prof.P.Munishi	UNIVERSITETET I OSLO	July,2007	Dec,2012	NOKK 2,607,000	108,106,155.00
58	Biofuels Developments,Local Resources Rights and	Prof. E.J.Luoga	Centre for International Foretry Research (	Aug,2011	Aug,2011	USD 46,378.50	51,201,864.00

	Governence in Africa and Asia		CIFOR)				
59	Assessing the Impact of forestland Tenure changes in forest Resources and Rural livelihood	Prof. G.Kajembe	NUFU	July,2007	Dec,2012	NOKK 5,379,642	294,705,518.25
60	Contribution of milk value chain to Poverty Reduction in Tanzania	Dr, F.Kilima	IDRC	July,,2010	July,2013	CAD 163,900	44,709,704.76
61	Intergrading Livelihoods and Multiple Biodiversity values in wetlands Management in	Prof.P.Munishi	NUFU	July,2007	Dec,2012	NOKK 5,423,000	239,004,270.50
62	Expanding Frontiers in Health	Prof. R.Kazwala	WELLCOME TRUST	Oct,2010	Sept,2014	GBP 362,848	31,249,135.26
63	Local Knowledge and Adaptive Capacity to Climate Change.	Prof.P.K.T.Munishi	National Science Foundation - USA	Jan,2010	Dec,2013	USD 75,520	37,269,705.00
64	Enhancement of Sustainable Productivity of Fish within Lake Victoria through	Prof. R.Mdegela	Inter Universty of East Africa (IUCEA)	Oct,2007	Oct,2013	USD 150,000	21,429,000.00

	control of Pollutants emphasis on endocrine disrupts and Microbial pathogens						
65	Securing Rural Livelihoods Through Improved Small Holder Pig Production in Mozambique and	Prof.F.P.Lekule	DANIDA	Jan,2010	June,2015	DKK 2,133,606	69,736,990.25
66	EKOSIASA	Dr, J.M.Abdallah	NUFU	July,2007	Dec,2011	NOKK 5,415,000	168,220,663.45
67	Improving Nutritional Status and CD 4 + Counts in HIV Infected Children Through Nutrition	Prof..Mosha	Michigan University	April,2010	Mar,2013	USD 287,000	102,416,760.00
68	Evaluation of the Effect of Soil Fertility and Soil Quality in Nutritive Value of Some Crops in Selected physiographic Units of Mbeya Region	Dr.Nyambilila Amuri	RUFORUM	Sept,2010	Sept,2011	USD 59,994	75,693,842.00

69	Poultry Health for Development (PHD)	Dr. P.Msoffe	Regents of the University of California Davis	Jan,2009	Dec,2011	USD 43,000	49,506,739.33
70	Conservation Agriculture fot a restored E i	Dr. D.Kimaro	VLIR	July,2009	June,2011	Euro 24,836.7	17,890,843.64
71	Managing Risk, Reducing Vulnerability and Enhancing Agricultural Productivity under changing climate	Prof.H.Mahoo	IDRC	Apr,2007	March,2011	CAD 1,626,100.00	927,601,173.40
72	Managing the Eastern Arc Mountains for Carbon Credit and Emission Trading	Prof.P.Munishi	EAMCEF	Jan,2009	Dec,2012	TZS 60,000,000	6,000,000.00
73	Antelope Conservation and Application of Molecular Forensics in Investigating Wildlife	Dr. Mdegella	NUFU	July,2007	Dec,2011	NOKK 3,493,600	195,639,881.38
74	Pulse CRSP Bean Nitrogen Fixation (BNF)	Prof (Mrs) Nchimbi Msolla	USAID	Oct,2010	Sept,2013	USD 98,741	30,340,380.00
75	Wildlife population Ecology and Human-	Prof.A.Songorwa	VLIR	Sept,2009	Aug,2013	Euro 309,789.77	128,879,099.49

	Wildlife Interactions In and Around Saadani (WIPE)						
76	Agricultural Research Documentary (Participatory Approach)	Director, Institute of Continuing Education	TANZANIA MEDIA FUNDS	Aug,2010	June,2011	TZS 199,421,787	199,421,784.00
77	Fruit fly Host Utilization	Dr.M.Mwata wallah	International Atomic Energy Agency (IAEA)	Ja,2010	Dec,2013	Euro 12,000	5,132,371.00
78	Livestock Enterprises	Prof.M.M.Mtambo	University of Copenhagen	Jan,2009	Dec,2012	DKK 3,000,000	85,239,000.00
79	PREPARE PHD	Prof. F.P. Lekule	University of Copenhagen	Aug,2008	July,2011	Euro 42,876	66,994,000.00
80	Women and Food Science:together towards national visibility	Prof.B.Chove	NUFU	July,2008	June, 2013	NOK 5,175,500	31,191,241.70
81	Spartial and Temoral Prevelence of Rodent Borne	Prof. R.Makundi	Belgian Technical				
	Zootic Disease		Cooperation	Jan,2009	Dec,2010	Euro 60,000	87,278,000.98
82	The Role of Institutions for Forest Resource and Livelihood Management in East African	Prof.G.C.Kajembe	Volkswagen Foundation	Aug,2008	Oct,2011	Euro 20,500	16,562,948.60

	Forest Landscape						
83	Strengthening Researcdh and Teaching Capacity of the department of Wildlife Management	Prof.A.Songorwa	USAID	Jan,2011	Dec,2011	USD 25,265	18,317,125.00
84	Quality Conservation Through Training	Prof.A.Songorwa	Macarthur Foundation	Jan,2009	Sept,2011	USD 300,000	195,750,000.00
85	Safe Food Fair Food	Prof. L. Kurwijila	ILRI	June,2009	June,2011	USD 25,000	20,262,010.00
86	Msc Training in Plant Bleeding and Related Fields	Dr. C.L. Rweyemamu	AGRA	Jan,2009	Dec,2011	USD 393,545.8	288,745,925.00
87	Integrated Control of Neglected *Zoonosi*s (ICONZ)	Prof.R.Kazwala	University of Edinburgh	May,2009	Apr,2014	Euro 270,000	100,742,011.82
88	Enhancement of Research Capacity to Control and Manage Bacterial Plant Diseases	Prof.Mabagala	ENRECA	Jan,2008	Dec,2011	DKK 608,000	49,931,213.72
89	Newcastle Disease	Prof.Msoffe	Welcome Trust	Jan,2007	Dec,20014	GBP 85,000	136,160,272.72
90	Global Health	Prof.M.Msoffe	University of Edinburgh	Aug,2010	Sept,2011	Euro 65,000	129,922,577.33

91	GERAFT	Prof.R.Kazwala	Germany Research Foundation	June,2009	May,2012	Euro 403,186	358,538,729.60
92	Wastewater Irrigated Agriculture as a Mean to	Dr.H.Shombe	Centre for Development				
	Alleviate Poverty		and				
			Environment,Switzerland	Jan,2009	Dec,2011	CHF 45,000	49,864,800.00
93	Neurocysticercosis in Sub-Saharan Africa	Dr. H. Ngowi	Germany Research Society	Sept,2009	Sept,2012	Euro 56,530	28,245,600.00
94	Landscape Ecological Clarification of Bubonic Plague Distribution and Outbreaks	Dr.D.Kimaro	VLIR	Oct,2008	Sept,2013	Euro 307,360.06	83,017,191.48
95	Community – Based Intergrated Rodent Mgt in Kilimanjaro	Prof.R.Makundi	VLIR	July,2009	Dec,2011	Euro 49,500	28,428,750.00
96	Establishing a Network of Field Sites for Long Term Surveillance of Zoonotic	Prof.R.Kazwala	Google	Aug,2009	July,2012	GBP 131,000	261,050,291.00
97	Promotion of Small Scale agro forestry livestock	Dr. R. Max	DFID	Oct,2009	Sept,2012	GBP60,000	30,402,796.91

	practices for improved livelihood						
98	Bean Bruchid Resistance	Dr.P.Kusolwa	Mcknight Foundation	Sept,2009	Sept,2012	USD 432,000	330,405,000.00
99	Scaling Up Minjingu Phosphate Utilization in Tanzania	Prof.J Semoka	AGRA	July,2009	June,2012	USD 424,416	217,582,638.00
100	Road-testing Innovative Surveillance Technologies for Rabies	Prof.R.Kazwala	Ifakara Health Institute	Sept,2009	Aug,2012	USD 46,000	51,077,200.00
101	Enhancing Children Nutrition and Rural Livelihoods in Malawi Mozambique	Prof.Y Muzanila	Mcknight Foundation	Aug,2009	Sept,2013	USD 240,000	80,766,000.00
102	Food Security, Adequate Care and Environmental Quality	Prof. (Mrs) J.Kinabo	IDRC	Feb,2010	Jan,2013	CAD 600,000	231,771,765.32
103	Efficacy of a low dose ferric sodium ethylene tetracetic acid (FeNaEDTA)	Prof. T. Mosha	H.J. Heinz Co.	Jan.2010	Dec,2011	USD 130,117	90,930,000.00
104	Dynamics of Miombo Woodlands	Dr.Nzunda	IFS	July,2010	Dec,2011	USD 12,000	17,220,000.00

105	Determine the Potential Global Distribution for Bactrocera Invades using Climex	Dr. M.Mwatawalah	CRI-STELLENBOSCH UNIVERSITY	Jan,2011	Dec,2012	USD 14,260	10,748,000.00
106	Development of Management Practices for Sustainable Improvement of Indigeneous Goats in	Prof.Chenyambuga	RUFORUM	Jan,2011	Dec,2012	USD 59,750	25,959,369.00
107	Legume Biomass Transfer for enhancing Producivity of maize in striga infected Farmlands.	Prof.K.Sibuga	RUFORUM	Jan,2011	Dec,2012	USD 60,000	38,887,330.00
108	Sustainable Nutrition Research for Africa in years to come (SUNRAY)	Prof.J.Kinabo	Institute of Tropical Medicine	Jan,2011	Dec,2013	Euro 117,710.70	141,374,200.00
109	PREDICT(Emerging Pandermic Threats Programe)	Prof.R.R.Kazwala	USAID	Oct,2010	Sept,2014	USD 874,000	260,893,643.28

110	Quantification, Modelling and Mapping Carbon Stocks and plant diversity in different Land covers types in Tanzania	Prof.K.Munishi (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	48,810,921.00
111	Climate change,non-timber forest and livelihood of forest dependent communities:Impacts,Vulnerability and	Dr.S.Augustino (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	37,851,583.00
112	Developing Fire reduction strategy for miombo Woodlands as a potential tool for carbon storageand sequestration	Prof.S.Madoffe (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	39,186,178.00
113	Comparative study of incentive options for forest-based emissions reduction,biodiversity conservation	Prof.K.Kulindwa (UDSM)	CCIAM Programe	Jan,2010	Dec,2014	TZS 155,100,000	26,039,279.00

	and livelihood improvement;case of Kilwa and Rufiji districts.						
114	Economic Valuation of Incremental Biomass Under PFM and its potential to serve as Management Incentives under REDD.	Dr.L.Lusambo (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	35,942,688.00
115	Establishment of Hormonized Modalities and Mechanisms for Community compensation and carbon markets:The case study of REDD pilot project in Tanzania	Dr.R.Shemdoe,(ARU)	CCIAM Programe	Jan,2010	Dec,2014	TZS 153,975,000	33,446,442.00
116	REDD Architecture in Tanzania:Assessment of REDD options for livelihood security and sustainable	Dr.A.Mwakalobo (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 152,891,000	34,935,053.00

	Development						
117	Governance,incentives and monitoring in REDDGIM-REDD	Prof.J.Kessy (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	39,730,457.00
118	Governance Challenges in REDD Implementation in Tanzania:Experiences from participatory Forest Management in Manyara and Lindi Regions	Dr.F.Magangaa (UDSM)	CCIAM Programe	Jan,2010	Dec,2014	TZS 153,990,000	35,162,815.00
119	The role of local Government in implementing REDD	Dr.J.King'ori,(UDSM)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	30,276,372.00
120	The role of indigenous knowledge in community adaptation and mitigation response to the impacts ofclimate change in Tanzania	Dr.A.Kijazi (TMA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 153,725,000	36,464,779.00

121	Implications of REDD on smallholders' Livelihoods through Access to Land in Manyara Region: Mapping and Assessment of Challenges	Dr.A.Majule (UDSM)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	31,456,760.00
122	Analysis of the impacts urban land use and climate changes on coastal forest ecosystem and	Dr.J.Lupala (ARU)	CCIAM Programe	Jan,2010	Dec,2014	TZS 154,000,000	34,738,617.00
123	Impact of climate variability on fisheries and mangrove ecosystems based mariculture along the Tanzania coast	Dr.B.Mnembuka (SUA)	CCIAM Programe	Jan,2010	Dec,2014	TZS 177,000,000	39,809,423.00
124	Genetics Diversification of Tomato for Health Production	Dr.Kusolwa	Ministry of Agriculture-ZARDEF	Oct,2010	Sept,2012	TZS 30,000,000	8,705,000.00
125	Analysis of	Prof.					

	Genes and Genetic makers associated	Chenyambuga					
	with mestitis resistance in Ingegeneous Cattle in		COSTECH				
	Tanzania			Jan,2010	Dec,2011	TZS 25,000,000	13,971,400.00
126	Turning Rural Scavenging Local Chicken into Profitable Business	Dr.S.Mbaga	COSTECH	Jan,2010	Dec,2012	TZS 43,750,230	2,411,300.00
127	Use of Indigeneous and scientific Knowledge	Dr. Nindi					
	systems on Seasonal climate Forecasting for enhancing community adaption to climate		COSTECH				
	variability in Mbinga district.			Jan,2011	Dec,2012	TZS 89,938,800	45,568,950.00
Grand /total							**22,610,422,679.43**

Source: www.suanet.ac.tz

Appendix 3.2: List of Research Projects for MUHAS

S/N	Project donor/Link	Principal Investigator Name	Project Title
1	PEPFAR	Dr. T.W Kohi	Teaching and learning about HIV/AIDS in Tanzania Schools
2	DANIDA	Prof. A. D. Kiwara	Health Insurance in Ghana and Tanzania: Addressing Equity and Accessibility.
3	Dar Dar Health studies- Receiving funds from NIH	Prof. N. Moshi	Prevalence of hearing deficits and its association with HIV seroprevalence: A cross sectional study in HIV+ adults with frequency matching to HIV- controls
4		Prof. M. Matee	Effects of Protein Calorie Supplementation on HIV disease in Breastfeeding women and women with TB
5		Prof. M. Matee	Dar Dar1.0 Vaccine Trial
6	Swedish International Development Agency (Sida)	Dr. J. R. Masalu	Research Capacity Strengthening
7		Prof. Z. Premji	Malaria Project
8		Prof. M. Bakari	HIV and TB sub-programme
9			**Project A**. Studies of cohorts for HIV vaccine trials and HIV vaccine evaluation in Tanzania
10			**Project B.** Improved Clinical Management of TB in HIV co-infected individuals in Tanzania (PI, F Mugusi)
11			**Project D.** Prevention of Mother to Child HIV Transmission (PMTCT)
12			**Project E**. HIV and Malignancies
13			**Project F.** Kagera AIDS Research Project
14		Prof. A. D. Kiwara	Health Systems Research
15		Prof. S. Massawe	Reproductive Health Projects
16		Prof. M. Moshi andDr. E.T. Lwoga	ICT and Library Support
17	EDCTP	Dr. M. Janabi	Optimization of tuberculosis and HIV co-treatment in Tanzania and Ethiopia: Pharmacokinetic and pharmacogeneticsaspects on drug-drug interactions between Rifampicin and Efavirenz
18		Prof. E. Lyamuya	TaMoVac- 02
19	Muhimbili Wellcome Programme	Dr. Sharon Cox/ Dr.Julie Mk	Vascular Function Intervention Trial in Sickle cell

		ani	
20		J. Makani, S. Cox	MWP - Neurology andneonatal conditions
21		J. Makani, S. Cox	Nutrition and nutrient gene interactions in sickle cell disease
22		J. Makani, S. Cox, E. Kaaya, SL Thein	Haematology Programme of anaemia and its therapy (PAST)
23		J Makani	The Royal Society Pfizer Award 2011
24		J Makani	Genetic determinants of clinical heterogeneity in Sickle Cell disease.
25		S Nkya	Genetic determinants of the phenotypes of Sickle Cell Disease in Tanzanians
26	University of Capetown	Dr. J. Makani, N. Mulder	H3ABioNet: a sustainable African Bioinformatics Network for H3Africa
27	Muhimbili Research Program- Wellcome Trust- UK	Dr. C. Moshiro	MUHAS/ AFRIQUE ONE PROJECT
28	Wellcome Trust	Dr. J. Mkani, Prof. E.Kaaya, Dr. S. Cox	Strategic Award
29	MUHAS- Harvard, Funds from NIH	Prof. J. Killewo	DAR cohort study
30		Prof. F. Mugusi	Effect of Vitamin A and Zinc on Placental Malaria among pregnant women attending Antenatal Clinic
31		Prof. Z. Premji	Malaria I: Prenatal Iron supplements: Safety and Efficacy in Tanzania
32		Prof. Z. Premji	Malaria 1: Exposure of Biomass during pregnancy: Possible role of Placental Damage (Cook smoke)
33		Prof. F. Mugusi	Malaria 2: malaria in pregnancy, nutrition and immunological effects
34	PEPFAR	Prof. S. Kaaya	MDH HIV/AIDS Care and Treatment Program
35		Prof. S. Kaaya	Patient Satisfaction and health care workers survey within MDH sites
36		Prof. S. Kaaya	Patient retention study
37		Prof. S. Kaaya	Evaluation of MDH patient retention quality improvement intervention
38		Prof. J. Killewo, Pangaea Global AIDS Foundation	Pathways to adolescent health and livelihoods in Tanzania (Youth Health Corp project – YHC)

		(PGAF)	
39	CDC	Prof. S. Kaaya in collaboration with HSPH	Agents of change protocol
40		Dr. G. Kwesigabo	Violence against children study: Retrospective self-reports from 13- 24 years old males and females in Tanzania, a collaborative venture between SPHSS, UNICEF and CDC
41		Dr. J.K.K. Mbwambo	Tanzania AIDS Prevention programme (TAPP)
42		Dr. Candida Moshiro	Postgraduate programme MSc Applied Epidemiology and MSc Epidemiology and Laboratory Management
43		Dr. S. Aboud	Public Health Evaluation-Resistance sub study for TOV 3
44	Family Health International	Prof. S. Kaaya	Adolescent women and Microbicide trials: Assessing the challenges and opportunities to their participation
45	National Institutes of Health (NIH) in collaboration with University of North Carolina (UNC)	Dr. J.K.K.Mbwambo/Ms S.K.Maonga	Identifying venues to prevent HIV and violence for youth in Tandale district, Dar es Salaam
46	University of Michigan- ForgartyInternational Center	Mr. Yahya Kishashu	Collaboration/Environmental and occupational Health capacity building Project – MUHAS- BARRICK
47	Norwegian Development for Higher Education (NOMA) Training Support	Prof. W. Matuja	Post graduate Programme MSc Internal Medicine(MSc Cardiology and MSc Nephrology)MMED Radiology
48		Dr. M. Mwangu	MA in Health Policy and Management
49		Dr. SebaldaLeshabari	NOMA Regional Master in Nursing
50	German Research Foundation	Prof William Matuja	Neurocysitercosis and Epilepsy in urban and rural Tanzania
51	WHO, University of Dublin, LSHTM.	Dr. I. Semali	Effects of global Health Initiatives on HIV/AIDS to the use of the health system.The case of HRH in Tanzania.
52	MUHAS- Stanford UniversityCollaborat	Dr. Larama Rongo	Child health status in relation to quality of water and sanitation in peri urban Dar esSalaam

	ion		
53	NIH/ Forgarty International Center	Prof. F. Mugusi	International Clinical, operational and Health system Research Training on AIDS and TB (ICOHRTA)
54		Prof. M Aboud	International Extramural Research Development Award
55		Prof. F. Mugusi	Forgarty International Scholars
56	International Foundation for Science	Dr. E.Innocent	E-Phytochemical Studies of mosquito
57	PREPARE Project, In- collaboration with University of Bergen: Funds from the EU	Prof. S. Kaaya	Promoting sexual and Reproductive Health amongst Adolescents in Southern and Eastern Africa
58	WHO/Future Grow	Dr. M. Fataki	An operational study on the management of acute diarrhea in Tanzania
59	University of Bergen collaboration- Funds from the Research Council of Norway	Dr. DCV Kakoko	Health Promotion Dignity and Human Rights
60	Johns Hopkins Collaboration	Dr. J. Mbwambo	Understanding and Interpretations of communication campaign messages about concurrent partnerships, acute HIV infection and sexual networks
61		Prof. J. Killewo	Morogoro Evaluation
62	European Union	Dr. E. Mbaga	African Programme for Advanced Research Epidemiology Training
63		Prof. MT Leshabari	Institutional Capacity Building through East African Postgraduate Teaching Programme
64		Prof. MT Leshabari	Quality of maternal and perinatal care: Bridging the know do gap
65	COSTECH	Prof. Z. H. Mbwambo	Formulation and standardization of herbal medicines from Garcinia and Combretumplant species growing in Tanzania for managing HIV/AIDS and related symptoms
66	MUHAS- Fred Hollows Foundation	Dr. A. Sanyiwa	Outreach Programme to provide quality practical training to Ophthalmology students

67	AIRES SUD	Dr. M. Njelekela	Air Pollution and Health Effects in Dar esSalaam, Arusha and Mwanza
68	German Research Foundation/ Munich University	Prof. W. Matuja	Palliative Care in Tanzania Exemplified by Cancer: A Hospital Based Ethnography in Dar es Salaam, Tanzania
69	EPOS	Dr. M. Mwangu	Proactive Staff Recruitment and Retention Measures Based on Experiences of Successful Implementers: Towards Improving Quality and Quantity of Skilled Health Workers in Lindi and Mtwara
70	EDCTP	Prof. F. Mugusi	Prevalence of HIV Drug Resistance in HIV Infected Patients at MNH and the Application of Bioinformatics in Prediction of Appropriate Therapy
71	USAID	Dr. J. Mbwambo	Strategic Assessment to Define a Comprehensive Response to HIV in Iringa, Tanzania
72	NIH	Prof. M. Aboud	DPRET- Dartmouth- Penn Research Ethics Training Programme
73	Centre for AIDS Research (CFAR) at UCSF	Dr. A. Mwakigonja	Tanzania Cancer Registry
74	CDC/PEPFAR Boston University School of Public Health Dartmouth Institute for Health Policy and Clinical Practice	Dr. G. Kwesigabo	Building capacity for HIV/AIDS human resources at the Muhimbili School of Public Health and Social Sciences
75	St. Lukes Midwifery College,Tokyo, Japan	Dr. S. Leshabari	Humanization of Child birth
76	University of Uppsala	Dr. J. Otieno	Post-doctoral Training
77	Future Group	Dr. J.K.K. Mbwambo	SEARCH Tanzania GBV
78	Pathfinder Int.	Dr. S. Kamazima	Master of Science Behavior Change Program
79	WHO	Prof. M. Leshabari	UNAIDS MSM project
80	United Nations Environment Programme	Prof. F. Kahabuka	Promoting the phase sown approach of dental amalgam in developing countries

81	International Foundation for Science	Dr. J. Sempombe	Search for Novel Trypanocidal Agents FromAlbizia gummifera, Asteranthe asterias,Commiphora eminii, Disosprros verucosa andKhaya nyasica medicinal Plants used inThno-Veternary Field
82	Center for Disease Dynamics, Economics & Policy	Prof. S. Aboud	Global Antibiotic Resistance Partnership, Tanzania – Phase II (GARP II – Tanzania)
83	Columbia University in the City of New York	Prof. S. Kaaya	Parent-Son Protective Factors for Improved Adolescent Health Outcomes in Tanzania
84	University of North Carolina	Lusajo Kajula	A multilevel intevention to reduce HIV Risk among networks ofmen in Tanzania
85	Boston Children's Hospital fund from Bill and Mellinda Gates Foundation	Prof. K. Manji	Biomakers of gut function and predictors of linear growth and neurodevelopment status among young Tanzanian children
86	Guttmacher Institute	Dr. P. Muganyizi	Abortion incidence in Tanzania

Source: www.muhas.ac.tz

Appendix 3.3: List of Research Projects for UDSM

College of Engineering and Technology (CoET)

RESEARCH AREAS		RESEARCH THEMES
1	Agriculture and food technology	- Food Processing and Preservation
		- Production and Utilization of Chemicals
		- Utilisation of Biomass
		- Animal Feed Production
		- Organic Fertilizer Processing
		- Agricultural Mechanization
		- Management of small-holder Irrigation Systems
		- Postharvest Storage Structures
2	Energy Systems	- Renewable Energy
		- Conventional Energy
		- Energy Efficiency
		- Energy Equipment
3	Exploitation of Natural Resources and Manufacturing	- Recovery of minerals
		- Purification Processes
		- Utilization of Marine Resources
		- Industrial Mining
		- Production and Utilization of Ceramics
4	Information and Communication Technology	- Strategic Planning in Information Technology
		- Exploitation of ICT Facilities for Sustainable Development
5	Rural and Urban Infrastructure Development	- Development of Sustainable Buildings and Transport Infrastructure
		- Construction Materials and Technology
		- Infrastructure Maintenance Systems
		- Planning and Design of Sustainable Development
6	Water Resources and Environmental Engineering	- Ecological Techniques for Purification of Wastewater
		- Development of De-fluoridation technology
		- Alternative Methods of Augmenting Water Supply in Arid Areas
		- Shallow and Small Bore Sewerage Systems
		- Air Pollution management
		- Chemical Pollution Management
		- Solid Waste Management

Appendix 4: Checklist for Case Studies Interviews

CASE STUDY INTERVIEW CHECKLIST FOR SUA BANANA PROJECT BENEFICIARIES

Tanzania Industrial Research and Development Organization (TIRDO)

P O Box 23235 Dar es Salaam

1. **CONTACT DETAILS OF THE BENEFICIARY**
    - Name:
    - Gender:
    - Age:
    - Marital status:
    - Village:
    - Mobile no:

2. **REASONS FOR JOINING THE PROJECT**
    - Motivation behind:
    - How did you come to know about the project?

3. **ECONOMIC BACKGROUND BEFORE THE PROJECT + SOCIAL SETTING?**
    - What was your economic activity?
    - What was your income level?

4. **PARTICIPATION IN THE PROJECT**
    - How many of you joined the project initially? Females/Males?
    - How many of you are still practicing? As a group or individuals?
    - What was the role of the university? Which tasks?
    - How were you being engaged?
    - Did you participate to identify problems to be solved?
    - Did you participate to design and provide solutions?
    - Did you participate in monitoring and evaluation?

5. **MENTION PROBLEMS THAT WERE IDENTIFIED**

6. **PROJECT ORGANIZATION AND INTERACTIONS**
    - How was the project organized at the village?
    - Who reported to whom?

7. LIVELIHOODNESS

- What was the outcome of the project in improving your livelihood/income? Quantify/evidence/indicators
- Narrate a case of improved livelihood

8. INNOVATION

- Were any products developed?
- New process developed?
- Introduced new product to local market?
- New skills developed?

9. PROJECT RESULTS

- Benefits to community?
- Financial results - increased e.g. income and production: by how much?
- Other benefits of the project

10. TECHNOLOGY TRANSFER

- Which technologies were transferred as a result of this project?
- Were there any bottlenecks to technology transfer?

11. BUSINESS INCUBATION/DEVELOPMENT

- Did the project produced any businesses amongst the as a result of the? Please give details

12. ENABLING FACTORS

- For the community
  - → Organization
  - → Financial
  - → The approach, etc.

13. INTERACTION CONSTRAINTS

- Challenges
- Limitations
- Social issues

14. RECOMMENDATIONS

CASE STUDY INTERVIEW CHECKLIST FOR UDSM CIMA CRUSHER PROJECT BENEFICIARIES

Tanzania Industrial Research and Development Organization (TIRDO)

P O Box 23235 Dar es Salaam

15. CONTACT DETAILS OF THE BENEFICIARY

- Name:
- Gender:
- Age:
- Marital status:
- Village:
- Mobile no:

16. REASONS FOR JOINING THE PROJECT

- Motivation behind:
- How did you come to know about the project?

17. ECONOMIC BACKGROUND BEFORE THE PROJECT + SOCIAL SETTING?

- What was your economic activity?
- What was your income level?

18. **PARTICIPATION IN THE PROJECT**

- How many of you joined the project initially? Females/Males?
- How many of you are still practicing? As a group or individuals?
- What was the role of the university? Which tasks?
- How were you being engaged?
- Did you participate to identify problems to be solved?
- Did you participate to design and provide solutions?
- Did you participate in monitoring and evaluation?

19. MENTION PROBLEMS FACED IN TRADITIONAL MANUAL STONE CRUSHING

20. PROJECT ORGANIZATION AND INTERACTIONS

- How was the project organized at the village?
- Who reported to whom?

21. LIVELIHOODNESS

- What was the outcome of the project in improving your livelihood/income? Quantify/evidence/indicators
- Narrate a case of improved livelihood

22. INNOVATION

- New process developed?
- New skills developed?

23. PROJECT RESULTS

- Benefits to community?
- Financial results - increased e.g. income and production: by how much?
- Other benefits of the project

24. TECHNOLOGY TRANSFER

- Which skills were transferred as a result of this project?
- Were there any bottlenecks to CIMA crusher technology transfer?

25. DISCUSS ON THE BICYCLE PEDALLED CRUSHER PROTOTYPE

26. DISCUSS ON THE ENGINE POWERED CRUSHER PROTOTYPE

27. ENABLING FACTORS

- For the group
  - → Organization
  - → Financial
  - → The approach, etc.

28. CONSTRAINTS

- Challenges
- Limitations
- Social issues

29. WHAT HAPPENED TO THE CIMA CRUSHER PROTOTYPE?

- Where is it?

30. RECOMMENDATIONS

CASE STUDY INTERVIEW FOR IMS/UDSM SEAWEED CLUSTER FARMER

Tanzania Industrial Research and Development Organization (TIRDO)

P O Box 23235 Dar es Salaam

31. CONTACT DETAILS OF THE FARMER

- Name:
- Gender:
- Age:
- Marital status:
- Village:
- Mobile no:

32. REASONS FOR JOINING THE SEAWEED CLUSTER INITIATIVE

- Motivation behind:
- How did you come to know about the project?

33. ECONOMIC BACKGROUND BEFORE THE PROJECT + SOCIAL SETTING?

- What was your economic activity?
- What was your income level and economic status?

34. PARTICIPATION IN THE CLUSTER INITIATIVE

- How many of you joined the group initially? Females/Males?
- The group constitute of how many members now?
- What was the role of the university/mentors? Which tasks?
- How were you being engaged?
- Did you participate to identify problems to be solved?
- Did you participate to design and provide solutions?
- Did you participate in monitoring and evaluation?

35. DESCRIBE YOUR FARM SIZE AND HOW IT DEVELOPED TO EXISTING SIZE

36. MENTION YOUR PRODUCTION CAPACITY PER DAY/MM/YR

37. WHAT IS THE CURRENT PRICE OF THE SEAWEED/KG

38. MENTION SEAWEED BUYERS IN YOUR AREA

39. SEAWEED CLUSTER INITIATIVE ACTORS

- Among the following groups, mention specific actors that interacted with you
- What was the role of each actor?
    i. Institute of Marine Science (IMS)?
    ii. College of Engineering and Technology (CoET) – UDSM
    iii. Businessmen
    iv. Government
    v. Other mentors (e.g. in business, etc.)

40. MENTION SEAWEED PROBLEMS THAT EXISTED BEFORE THE CLUSTER

41. PROJECT ORGANIZATION AND INTERACTIONS

- How was the project organized at the village?
- Who reported to whom?

42. LIVELIHOODNESS

- What was the outcome of the project in improving your livelihood/income? Quantify/evidence/indicators
- Narrate a case of improved livelihood

43. INNOVATION

- Mention innovations and skills that were transferred to you in:
    i. Seaweed farming

44. PROJECT RESULTS

- Benefits to the general community?
- Financial results - increased e.g. income and production: by how much?
- Other benefits of the project

45. TECHNOLOGY TRANSFER

- Which technologies were transferred to you? e.g. in farming, etc.

46. WHAT IS THE SELLING PRICE OF YOUR PRODUCTS? TABULATE

47. ENABLING FACTORS

- For the mentors
  - → Organization
  - → Financial
  - → The approach, etc.
- For the farmers' group
  - → Organization
  - → Attitude, etc.

48. CHALLENGES FACED WHILE FORMING THE SEAWEED CLUSTER GROUP

- Challenges
- Limitations
- Social issues

49. MENTION EXISTING CONSTRAINTS AND CHALLENGES

50. RECOMMENDATIONS