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International Week from 15th - 17th June 2021: “Strengthening European-African Partnership – Challenges and Opportunities”

Gerd Müller¹; Claudia Graus²

1 Federal Minister for Economic Cooperation and Development Germany

2 Former Vice Chairwoman of UNICEF and Committee Member of the University Council

1. Greeting – Gerd Müller

Professor Hilmer, Ms. Graus, Students,

Unfortunately, COVID-19 is preventing me from coming to the wonderful town of Mittweida. The partnership between Europe and Africa means a great deal to me. I just came back from a visit to West Africa – finally, a visit, after one and a half years, in these difficult COVID times. I am very glad about this exchange between young people. Mittweida University of Applied Sciences is bringing you together for its third international week. In many places in Africa, the pandemic has become a polypandemic. Africa is going through an economic recession. Millions of jobs have been lost as a consequence of lockdowns. We must reduce the impact of the crisis and its social and economic consequences! After all, it is clear that we will either beat COVID-19 worldwide or not at all. So the vital step we jointly need to take now is to make vaccines accessible – for all! Only 2 per cent of Africa's people have been vaccinated. One-third of all developing countries have not received a single dose of vaccine. In Germany, we are working for fairer distribution. The pandemic is a wake-up call for us all – for more sustainability and protection of resources, for solidarity and more just globalization. The economic recovery must be sustainable – worldwide! So we have to invest now – in a global energy and climate transition. The European Union's Green Deal is important, but it must also be expanded to Africa. Africa can and must become the green continent of renewable energy. A world without hunger is possible on that wonderful continent. The potential is there! What is needed is the climate-smart development of the agricultural sector and local value chain development. But we all know that, above all, sustainable development requires peace and stability on the ground. And we all, Europe, Africa, have to invest in fair trade – in a new fair partnership. This is the only way to achieve development strides. The African Union and the countries of Africa have committed to a great goal, a great project: the African Continental Free Trade Area. This project offers great opportunities for new jobs for Africa's future. Europe and Africa are neighbors and partners. We should address global challenges together. The countries of Africa have their own roadmap, their own ideas for this – their Agenda 2063. We are supporting them through the Compact with Africa and, at my Ministry, through the Marshall Plan with Africa. Africa has great potential, as we all know, in many ways – but especially thanks to its young generation. This is a young continent

with the largest young generation ever. But this young continent needs a good future. This young generation needs, above all, education and jobs. That is why we are also putting a focus on digital technology and the transfer of knowledge. We regard Africa as a continent with a great future! Our best chance is a partnership between equals. I want to thank Mittweida University of Applied Sciences, but especially the person who has been pushing this project forward with great passion, idealism and commitment: Professor Ludwig Hilmer. And I wish you all every success. Thank you very much.

2. Greeting – Claudia Graus Perspectives for Africa's youth

It is my greatest pleasure to be here today and present you with a few facts, ideas and opinions on the subject of education and “Perspectives for Young People of Africa”. Through my many years of work with UNICEF, the cooperation with the HSMW and dozens of project field trips to the African continent, I was able to get a very good overview of young people and their education.

Education is a fundamental right for every human being, which has already been laid down in the Universal Declaration of Human Rights of 1948 and in Article 28 of The UN Convention on the Rights of the Child. The States thereby, undertake, among other things, to guarantee free and compulsory primary school attendance. Article 29 is about the quality of teaching. Governments should help children develop their skills and talents as much as possible. Despite all the successes so far, we are still a long way from achieving this goal.

Since the World Conference “Education for All” in Jomtien, Thailand, which took place in 1990 and the World Education Forum in Dakar, Senegal, in 2000, UNICEF has made a significant contribution to advancing the goal of “Education for All” and is still doing it today sustainably! With its educational programs, UNICEF is primarily pursuing the following goals:

1. Prepare children well for school.
2. Reduce discrimination: For example, on the basis of gender, ethnicity or the poverty of the parents.
3. Improve the quality of teaching.
4. Secure education in emergency situations.

UNICEF attaches particular importance to reaching disadvantaged and marginalized children. Basic education,

especially for girls, is also the most important investment in development. Why? Hardly any other investment has proven to have such far-reaching effects on society as a whole. Education is also the best form of contraception: Women who go to school usually marry later, have fewer children and are better able to care for them. Educated women do everything in their power to send their children to school as well.

On my many project field trips I was able to see firsthand time and again the implementation of the set of educational goals of UNICEF. And it convinced, impressed and grounded me again and again. The children want to study and go to school. They have dreams and want prospects. I experienced this very impressively on one of my last project field trips to the Ivory Coast.

1.6 million children at the Ivory Coast do not go to school. There are too few classrooms and the few that exist are often completely overcrowded with up to 100 children per class. Classrooms are missing! In addition, the Ivory Coast has a garbage problem and suffers from extreme environmental pollution. So: too much garbage and too little education! UNICEF has made an innovative project out of both problems. (Start 2018)

We get the plastic bricks for our school buildings from "Conceptos Plasticos". The Colombian company has developed a technique to convert all kinds of plastic waste (except PVC) into building bricks. Plastic waste is thus turned into durable and safe building materials. With the simple plastic bricks, a classroom can be built within a few days (like a Lego system).

I was present during the construction of a classroom and saw the first finished schools. I can only say: an ingenious invention! Not only schools are built now, but also the garbage collecting women have been integrated into this project. The women are trained by the companies and earn much more money than before - up to 10 dollars a day - until now they got 1 dollar a day. I asked some women what they will do with the regulated higher income. Almost all of them gave the same answer: I can now send my children to school, give them a better life and I am no longer dependent on my husband for school fees. And if there is anything left over, I will also buy a new dress.

Schologirl Lesline (10 years) tells: My old classroom was made of bamboo. Animals could get in, even snakes. There was dust everywhere. When it rained, we got wet. When it was windy, the ceiling flew away. The new classroom is so nice and clean. There is electricity, a blackboard, nice desks and benches, and we have latrines now. I can study well there. I love this school. The teachers are also happy in the new school.

One of UNICEF's most successful educational projects is "Schools for Africa". The schools for Africa project was founded in 2004 by UNICEF, the Nelson Mandela Foundation and the Hamburg ship owner Peter Kremer. The

aim: To provide solid basic education to as many children as possible. The "Schools for Africa" campaign now reaches 30 million children in 21 African countries. As Nelson Mandela once said: Education is the most powerful weapon you can use to change the world!

Allow me to make a few comments on the **Next Generation - Perspectives for youth in Africa**.

Africa is extremely young, almost half of all residents are under the age of 18, with 12 million young people entering the African labour market every year. Agriculture could create enough jobs, but is considered unattractive. Some see their future in agriculture, others want to leave it behind. Most seek a middle ground. They want to do their own thing, become a teacher or a doctor, owning a hairdressing salon or start a company, open businesses, trying new things out. This continent has so many innovative young people who want to shape their own futures and work very hard for it. Many are already using the digital possibilities for their own businesses.

YES! This generation is highly motivated and determined in every sense of the word... and education has never been as important as it is today in a rapidly changing world. But we must also consider the following: Corona has thwarted the future plans of many young Africans. Because of the crisis, they can no longer study in another city or take up the jobs they have already been promised. Children and young people are the losers of the pandemic. Millions of young people are affected, and as our German Development Minister Gerd Müller said last year: Europe must not underestimate the serious consequences. And.... on November 9, 2017, former Federal President, Prof. Dr. Horst Köhler, gave an impressive speech: "Africa's youth on the move: The underestimated task of humanity".

Many of you will know this speech, but allow me to quote a few sentences from it: "Giving Africa's youth prospect is one of the greatest challenges of the 21st century. Just the size of the African youth population should lead us to the conclusion that a power is growing up here that can be reckoned with, for better or for worse." He continued: "I consciously say "power" because I believe that this is exactly the right strategic category with which we should look to this global challenge.

Let us offer more young people from Africa the opportunity to come to Germany and Europe for a while, to learn, study and research! The European exchange programs should be massively expanded and the scholarship opportunities increased."

The programs of Mittweida University and this year's International Week are also contributing to this goal.

Ladies and gentlemen, I thank you for your attention and I wish you successful days with these exciting topics at International week 2021. I would like to close with my favourite African saying: "Many small people doing many small things in many small places can change the face of the world."

European-African Partnership

Lessons Learned

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Since 2017 HSMW was engaging in strategic research and training partnerships with many institutions in Sub-Saharan Africa. The objective of these partnerships is to train young African talents in an area highly relevant for Africa's transformation towards self-sustainability, namely in the area of infectious diseases, particularly malaria. The partnership was characterized by a vivid mobility exchange that came to a sudden stop with the onset of the COVID-19 pandemic. Since then, the partnerships had to shift towards virtual formats. Also, the thematic focus was extended to epidemiological modelling of the COVID-19 pandemic. Here, we describe the goals and achievements of the partnerships between HSMW and African institutions, and reflect upon the lessons learned so far.

1. Africa's transformation

The Africa Strategy of the BMBF [1] describes the continent as one with potentials and opportunities, however, also as a continent facing substantial challenges in its transformation towards economic self-sustainability. The strategy also identifies science, education, and research as a driver for social and economic development. This is of particular importance since Africa's population is projected to double by 2050 to reach 2.5 billion people.

The rapid population growth clearly comes with substantial challenges and emphasizes the demand for higher education at an international competitive level, which is indispensable to support economic growth. Africa's development has been traditionally hampered by many tropical and poverty-related infectious diseases. The consequences of a rapidly growing population on the emergence and spread of infectious diseases is not fully understood and potentially disastrous. A new generation of researchers able to cross barriers between scientific disciplines and from academia to practice in the scope of the economically most relevant infectious diseases is urgently needed. This is at the heart of the agenda of the collaborations between Hochschule Mittweida (HSMW) and African institutions in all areas of Sub-Saharan Africa.

2. Partnership between HSMW and Africa on infectious diseases

The African Institutes for Mathematical Sciences are pan-African centers providing high-level training for top African post-graduates sustained by international lecturers from all over the world. One of the most prominent endeavors in-line with the Africa Strategy of the BMBF was the engagement AIMS-Next Einstein Initiative. Mathematics was identified as a key area of importance of the BMBF's collaborations with Africa. In 2016 the DFG organized a workshop at the Next Einstein Forum in Senegal

to strengthen the collaborations between Germany and the various AIMS centers. Five targeted follow-up workshops in key areas of mathematics followed. One of these areas was mathematical modelling of infectious diseases.

2.1. HSMW's engagement in collaborations with Africa on infectious diseases

In February 2017 a DFG-organized workshop on "Mathematics against malaria: a holistic approach", hosted by the AIMS center in Cameroon, which was the beginning of the collaborations between HSMW and African partners on infectious diseases.

At this workshop a scientific agenda on various aspects of malaria research was outlined. HSMW was committed to contribute its expertise in population genetic modelling of malaria, focusing on anti-malarial drug resistance, a key challenge in the combat against malaria.

2.2. What we do?

In the aftermath of the DFG targeted workshop, HSMW was successful in applying for funds of the DAAD to sustain training activities at AIMS Cameroon by representatives of HSMW and University of Tübingen on the population genetics of malaria and dynamics of infectious diseases, which started in 2018, and marks the beginning of a sustained research and training collaboration.

The overall objective is to provide research-oriented training to young mathematicians in the Sub-Saharan African region at the interface of mathematics, biostatistics, genetics, molecular biology, epidemiology, and biomedicine in a broad spectrum of topics related to malaria and other infectious disease. This should facilitate enrollment of young talents in PhD programs in Germany (or in collaboration with German institutions) and their integration into a trans-disciplinary, highly competitive international network of collaborators, with the goal to return to their home countries as self-confident, well-

trained experts, ready to face some Africa's most important challenges.

These activities include supervision of the research phases of students at AIMS Cameroon and research visits to Germany. It also led to a double degree arrangement between AIMS Cameroon and HSMW to allow talented young researchers to complete the master program in "Applied Mathematics in Data and Network Sciences" at HSMW, to facilitate potential enrollment into PhD programs.

Since 2018 over 40 short and long-term mobility exchanges took place between Africa and Germany funded by Erasmus+ and the DAAD, with students and research visitors coming from 7 different countries in Sub-Saharan Africa (Cameroon, Ethiopia, Ghana, Malawi, Nigeria, Sudan, and Zambia). As part of a DAAD funded project "Mathematics against malaria within the AIMS network" managed by HSMW, 6 courses in population genetics and dynamical systems were taught at AIMS Cameroon by lecturers at University of Tübingen and HSMW. As a result 16 M.Sc. these were supervised at AIMS Cameroon. The results were presented at several international conferences in North America, Europe, and Africa, resulting in over 25 poster presentations with participation of AIMS Cameroon alumni and 40 oral presentations. Two AIMS Cameroon alumni received prestigious travel awards to visit the Annual conference of the American Society of Tropical Medicine and Hygiene sponsored by the Bill and Melinda Gates foundation. Moreover, over 10 peer-reviewed research articles in collaboration with partners in Africa were published in top-ranked international peer-reviewed journals, as well as several book chapters including a special issue edited by Springer.

2.3. Who are the partners?

Since the successful start of the DAAD-funded project "Mathematics against Malaria within the AIMS Network" in 2018, HSMW received several additional funds by the BMBF, ERASMUS+, DAAD, and the SMWK. These funds included a DAAD-funded Visiting-Professorship from Africa engaging in mathematical modelling of infectious diseases. The projects directly involve partners in all regions of Sub-Saharan Africa. These partners include University of Ghana in West Africa (particularly with the West African Centre of Cell Biology of Infectious Pathogens, an African center of excellence funded by the World Bank), AIMS Cameroon, University of Buea (Cameroon), and University of Yaoundé I (Cameroon) in Central Africa, Siaya County Referral Hospital (Kenya), Masinde Muliro University Of Science & Technology (Kenya) and Maseno University (Kenya) in East Africa, and University of Pretoria and University of Venda in South Africa. Furthermore, bilateral collaborations with Institute for Health Research, Epidemiological Surveillance and Training (IRESSEF) in Senegal and AIMS Rwanda are established.

The international partner network outside of Africa include the Center for Global Health at the University of New Mexico, Lehigh University in Pennsylvania, the National Institute of Tribal Health of the Indian Council of Medical Research, and the Naval Research Unit Six in Peru. Students and early career researchers are regularly engaged in video conferences with these partner institutions to secure their integration into an attractive and competitive research environment.

2.4. The worldwide pandemic and digital re-invention

The European-African partnership to which HSMW is committed depends crucially on mobility exchange, personal contacts, and capacity building measures. The COVID-19 pandemic put a sudden stop to worldwide mobility in early spring 2020. This naturally jeopardized the ongoing projects of HSMW with African partners, and hampered mobility exchange ever since.

It became evident that the ongoing activities can no longer be continued as originally planned. Hence, the involved partners made a virtue of the necessity. With a DAAD-funded visiting professorship on mathematical modelling of infectious diseases and many students being locked into a foreign country, epidemiological modelling of the COVID-19 pandemic became a cardinal cornerstone of the research activities. These were carried out via digital formats during late-night hours, because of the WiFi connections in some African countries were only stable during these hours.

Faculty from the partner institutions engaged in almost daily virtual meetings with 17 AIMS Cameroon and discovered new and innovative ways of digital collaboration. This included the use of video conferences, sharing of handwritten notes via tablets, document exchanges of clouds, live sharing of tests-editing documents and collaborative programming via live-code share in the languages R, Python, and Julia. Rather than the usual sequential student-advisor collaboration, characterized by many cycles of students preparing documents, which are corrected by the advisors, interactive channels of collaborations with real-time feedback were explored.

The concepts developed during the early months of the crisis that have been continuously refined were later supported by the International Virtual Academic Collaboration (IVAC) program of the DAAD.

2.5. COVID-19 models and media success

The focus of the COVID-19 models developed at HSMW was to provide quantitative pandemic-preparedness and decision-support tools to predict disease incidence, mortality, hospital, and ICU admissions under different epidemic management scenarios. While some models focused on specific aspects of interventions, e.g., how well vulnerable risk groups such as elderly citizens in long-term care facilities can be protected by regular COVID-19 testing employees and visitors [2], the effect

of multiple exposure to COVID-19 [3], or negative side-effects of vaccines [4], others focused on the epidemic itself [5,6].

Since the beginning of 2021 predictions by the research group centered around HSMW received media attention. The prediction of the third and fourth COVID-19 wave in Germany and the province Saxony turned out accurate. Consequently, HSMW is receiving increasing media attention for its predictions. These were featured on Germany's main public and private TV stations in various formats, radio, and some of Germany's major newspapers. The COVID-19 modelling also received media attention in Cameroon.

Furthermore, a research project of modelling the aftermath and long-term consequences of COVID-19 in collaboration with two South African institutions, University of Pretoria, and Venda University, was funded by the BMBF. Moreover, HSMW is included as a statistical consultant in a multi-million-dollar project on the clinical pathogenesis of severe COVID-19 infections in a project of the University of New Mexico funded by the National Institutes of Health (NIH). Prestigious internationally funded COVID-19 projects were also awarded to African partners.

3. The challenges

Although the collaborations between HSMW and African partners are successful, they are also characterized by numerous obstacles and challenges.

3.1. Mobility arrangements

Partnerships between Europe and Africa are more challenging than partnership within one's own country. Namely, they need to be based on personal interactions mutual sympathy, and the willingness to cross cultural borders. Personal contacts are at the heart of Europe-African partnerships. However, travel arrangements between Africa and Europe are notoriously difficult. Europeans need to receive mandatory vaccines, take a malaria prophylaxis, and have to apply for travel visa. The effort for travel arrangements and visa applications vary substantially between African countries. Likewise travel arrangements for visitors from Africa are complicated. Often mobility within an African country to the German embassy is already time-consuming. Often waiting times for visa appointments take weeks or even months in some countries. Moreover, mobility exchange needs to be supported by third-party travel funds and arranged by the German partners, causing a substantial administrative burden. While some routine develops after some time, the initial setup of partnerships is challenging.

3.2. Avoiding brain drain

Creating opportunities for young talents from the African continent always comes with the risk of creating a brain drain. On the one hand young talents should profit from abroad experience and international mobility; on the other hand, they must have an incentive to return to

their home countries after their training is completed. Research in malaria and other tropical diseases are highly relevant in Africa and internationally trained experts have many opportunities in their home countries. It is therefore important to strategically plan career paths embedded within an attractive research network that operates in many African countries.

3.3. Breaching the borders of disciplines

Africa's challenges are real and need immediate action. This requires the willingness to cross borders between scientific disciplines. While many funding schemes recognized the importance of trans-disciplinary approaches, in practice it is a difficult endeavor and a double-edged sword. Trans-disciplinary efforts require higher initial investments and training, typically at the cost of lowering the measurable scientific output in terms of scientific publications. This, however, lowers the chances of researchers to be recognized in their field and receive funding. The problem is even more pronounced for PhD students: rather than directly working on their PhD project, they must learn the fundamentals of other scientific disciplines, and hence often progress slower than their peers working on a highly specialized topic. This requires a substantial amount of intrinsic motivation that can be increased by providing a good scientific climate that reflects the advantages of trans-disciplinary approaches.

3.4. Funding schemes

Funding schemes often harbor challenges too. Budgets for mobility exchange between Germany and Africa are typically high, whereas the budgets are limited for personal costs. Hence, it is typically difficult to support PhD projects abroad. Due to long waiting times for visa applications, it typically requires additional efforts to employ African students on regular research projects.

Hence, often only short-term visits are possible, which comes with the challenge of entering a grey zone when it comes to providing guests visitors office space and infrastructure, because it is neither covered by the regular household budgets nor by third-party funds.

Short-term mobility also comes with the difficulty of organizing housing: landlords often do not want to rent out apartments for less than one year and guest visitors are usually not eligible to stay in student housing.

3.5. Short funding and no follow-ups

Partnership programs between Europe and Africa are typically limited to one funding period without follow-up funding schemes. This challenges the sustained continuation of strategic partnerships.

3.6 Different academic culture

Partnerships between Europe and Africa require intercultural competence. Africa is a diverse continent, and each country is different in its culture and mentality. This also manifests in different academic cultures across

countries in Sub-Saharan Africa. The academic culture in Europe is following the trend of North America to be less hierarchical, inclusive. Hierarchies are defined by academic achievements and students are encouraged to speak up. Academic careers are not considered to be financially attractive and driven by intrinsic motivation and idealism. In some countries in Sub-Saharan Africa the structure in academic institutions is still hierarchical and driven by seniority. Academics positions are more financially attractive and provide extrinsic motivation for an academic career. This clash of cultures often manifests in the way students and faculty interact.

The sense of punctuality, duty and devotion is different. In the tropical parts of Africa electricity supply is often interrupted by tropical storms, mobility is difficult. This results in a different concept of punctuality and reliability. Gaining a mutual understanding of each other's culture is a long learning process.

3.7. Language barriers

In addition to cultural differences, language barriers are often substantial. The German bureaucracy is not everywhere well-equipped to mitigate language barriers. While English is typically found as the mutual common ground, it is neither the mother tongues of Germans nor Africans. Even if the official language in an African country might be English, they have their own localized mother tongues.

4. Lessons learned

Partnerships between Europe and Africa require substantial devotion of all involved parties. While the activities at HSMW are successful, they are also characterized by improvisation, being sometimes chaotic, and by a willingness to be flexible. This is particularly challenging in the COVID-19 pandemic, that substantially restricts personal exchange. While virtual formats partly compensate the lack of mobility exchange, European-African partnerships must be sustained by mobility exchange in the long run.

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Integration Processes in Africa and EU-Africa Relations – Challenges and Perspectives

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Africa is currently a part of the world where regional integration is given high priority on policy makers' agendas. Recent initiatives, such as the launch of the African Continental Free Trade Area (AfCFTA), illustrate Africans' strong willingness to develop co-operations among themselves, their increasing collective determination to integrate the continent into the global economy, and a desire for their voice to be heard on the international stage. However, Africa's experience of integration has been punctuated by numerous obstacles. Its trajectories have diverged from the European model, which often serves as an example to African Regional Economic Communities (RECs). This contribution offers a timely reflection on the state of African integration, in a comparative perspective with other models of integration around the world.

Keywords: Africa, African Union, Continental integration, European Union, Regional Economic Communities, Regional integration

Regional integration is a global phenomenon which has largely been induced by economic globalisation. For the African continent, the integration of its 55 states into trade and cooperative arrangements represents a tremendous opportunity, which can boost its development, at a time when Africa finds itself at the brink of a demographic explosion. The fragmentation of the continent, sealed at the Berlin Conference of 1884-85, has been a severe handicap for its post-independence economic transformation, and partly explains Africa's struggle to deconstruct the colonial economy it inherited at independence [1]. Indeed, many borders were arbitrarily drawn by the colonial hegemons. No other continent has been so divided by politics, and no other counts as many landlocked countries. Today, trade between African countries only amounts to 18% of overall trade between the continent and the rest of the world, compared with 50% for intra-USMCA trade in Northern America, 52% for intra-Asian trade in ASEAN, and 69% intra-EU trade. Only a higher level of economic integration can generate markets with a substantial size, and the recent launch of the African Continental Free Trade Area (AfCFTA) is a clear sign of Africa's awareness of the need to overcome a legacy of divisions to empower itself and unlock its potential.

However, regional integration is a process taking place at a different pace, across Africa and around the world. In order for it to be implemented, the economic integration of a block of countries trading together requires not only the 'four freedoms', i.e., to achieve free circulation of goods, services, labour and capital, but also harmonisation of rules, standards, norms, procedures, regulatory harmonisation, and joint policies. Processes are always driven by a combination of economic and social forces. From a comparative perspective, regional integration processes in Africa are not fundamentally differ-

ent from elsewhere. They address similar needs and encounter similar obstacles. But these processes need to be strengthened.

African moves towards furthering integration can be seen as a catching up process with the rest of the world. Indeed, a vast majority of states around the globe are members of, or in the process of forming or joining regional trade facilitation structures, economic, financial, customs arrangements, or sometimes even considering political federations. There is a multitude of such groupings on all continents, with varying levels of integration binding participating states. Many of these unions have endowed themselves with symbolic attributes of statehood, albeit applied to a collective group of states. Like the EU, they have their own flag, an anthem, an emblem, and a motto. Some are committed to creating a single currency within their trade and customs boundaries, whilst others are considering the creation of a parliament elected on universal suffrage on the model of the EU. Several others have, or are planning their own free movement area, or combine security and defence goals. At first glance, this does not make Africa fundamentally different, in this respect, from other parts of the world where countries are becoming more integrated in larger unions of states. And yet, the African integration landscape and its context also appear to have distinct features.

A closer look at the African integration landscape shows that several processes are at play. First, a top-down, continental integration is taking place, albeit at a slow pace and with clear limitations, under the aegis of the African Union (AU), established in 1991 which provides the overarching conceptual bridge for continental economic integration. Second, a large number of sub-continental projects and organisations have taken shape across Africa. Eight of them, referred to as Regional Economic

Communities (RECs), such as the East African Community (EAC), the Economic Community of West African States (ECOWAS), or the Common Market for Eastern and Southern Africa (COMESA), form the building blocks of the AU. Third, the AfCFTA is a large-scale, cross-regional trade initiative which epitomises a pan-African drive towards more cohesion and unity. To add to the complexity of this integration landscape, the presence of numerous overlapping structures, well beyond the eight RECs, means that some African countries are member states of two, sometimes even three regional groupings. However, this flurry of regional or sub-regional intergovernmental organisations, rather than helping integration move forward, tends to disperse efforts and poses a challenge to integration [2]. Indeed, overlapping membership of many countries, in their hope of drawing political influence and financial advantages from sitting at various decision tables, is counterproductive, as this generates confusion and conflicts of interest, which does not contribute to advancing regional integration, but rather reinforces what Neuberger [3] referred to as the balkanisation of Africa.

Furthermore, Africa faces various constraints in its endeavours to integrate itself and its RECs. Many of those constraints are common to other parts of the world, but they tend to increase burdens. First, a lack of political and democratic involvement of public opinion. Integration remains a top-down, often technocratic exercise lacking real legitimacy. Second, institutional mechanisms are often weak, especially in developing countries, where attachment to recently acquired national sovereignty remains strong. Third, persisting regional or local border tensions are a frequent hindrance in African conflict areas as well as in the Indian sub-continent or Ukraine. Fourth, there is often a discrepancy between declared intentions and actual achievements and producing results that live up to these declared ambitions. Reality rarely matches resolutions, commitments expressed in speeches at international conferences, or the terms of treaties. Fifth, regional integration is a challenge for diplomacy. Traditionally, diplomats practise bilateral diplomacy. But diplomats then had to learn multilateral diplomacy. Today, they also need to adjust to regional diplomacy. Finally, regional integration movements have their ups and downs. This can affect Africa (e.g. with the failure of the EAC in 1977) as well as the European Union with Brexit, or any other case of trade and economic integration.

In addition to these challenges, other factors are at play at geopolitical level. Differences in size between member states means that there will usually be an elephant in the room, who may use its economic or political weight to influence decisions to its advantage. The USA in the United States-Mexico-Canada Agreement (USMCA), Brazil in South America, South Africa in Southern Africa, Nigeria in ECOWAS, Indonesia in ASEAN, China in its Belt and Road Initiative, Saudi Arabia in the Gulf Cooperation

Council, Russia in the Eurasian Economic Union, or Germany in the EU. To these internal heavy-weights, we have to add the huge influence of external elephants such as the USA in South America, China throughout Asia and beyond, or the EU and China in Africa.

Another characteristic of the global integration landscape lies in two fundamentally different approaches: on the one hand, an integration model relying heavily on the institutionalisation of processes, as is the case in Africa, but also in Latin America, the Arab world and Central Asia, which draws from the European constitutional and political culture. On the other, a more flexible Asian model where institutions are only created when they appear necessary to achieve objectives. In this model, the final purpose arises only once action has been taken. Progress is made step by step and consensus is reached as new priorities emerge.

Specificities of African integration do not merely consist of apparently unsurmountable handicaps, and some of these handicaps can also be drivers for progress. For instance, geographical distance to foreign markets can be a comparative advantage for economic integration in terms of cohesion. Or else, the fact that Africa counts the largest number of low-income countries is not per se a handicap as poverty conceals a considerable potential to raise consumption. Also, under-utilisation of agricultural production factors could mean future opportunities on a continent that hosts vast areas of arable land. Furthermore, borders inherited from colonial times are less rigid and often easier to cross than in many other parts of the world, which is of considerable importance for the informal economy. Official figures fixing intra-African trade at 18% may reflect a conservative view as these do not take African cross-border mobility into account. Another point worthy of attention concerns the legal infrastructures governing economy and business. These structures were inherited from the British, French, Portuguese or Belgian colonial administrations, and often provide common useable regional frameworks.

In this complex, fragmented African landscape, consisting of numerous land borders and overlapping intergovernmental organisations, the model of regional integration represented by the EAC represents a case worthy of attention [4]. The six participating countries of the EAC have jointly shaped a most interesting union widely regarded as the most advanced and successful regional integration scheme in Africa [5]. For politicians, policymakers and scholars alike interested in comparative regional integration studies, it may even be the most relevant model of integration in Africa to learn from. First, the EAC is one of the oldest, most established, most advanced among this multiplicity of customs unions and common markets, and ahead of other integration processes on the continent. Second, it is a relevant example of a union that experienced disintegration, only to be relaunched two decades later, this time on safer founda-

tions. Third, despite sometimes grave tensions in the region, the EAC's intra-regional relationship is now wider and deeper than ever before. It provides a rich tapestry for comparative analysis and exploratory research. Trade, development, and aid flows are only some of the multiple dimensions of intra-EAC and EAC-EU relations. Fourth, the EAC has been actively promoting initiatives at continental scale, the most important being its involvement, alongside COMESA and the Southern African Development Community (SADC), in setting up the AfCFTA. Fifth, despite regional imbalances, the East African region counts among the continent's most promising growth areas.

Moreover, the EAC bears striking resemblance with the process undergone by the EU in recent decades [6]. At various stages of its integration process, the EU provided a source of inspiration to East Africans. A customs union was launched in 2005, followed in 2010 by a common market with zero internal tariffs. Talks towards setting up a currency union with a joint East African shilling started in 2011. The EAC has its own East African Legislative Assembly (EALA), as well as an East African Court of Justice (EACJ). An East African Passport has been created to ease border crossing for EAC citizens. Establishing a sustainable economic and political bloc in the form of an East African Federation is also high on the EAC's agenda. Such federalist ambition clearly has limitations, since the EAC functions primarily as an intergovernmental body rather than as a supranational entity. However, sustained support and engagement from leading figures in EAC member states gives reasons to believe that this ambition is not in vain. Wide consensus would have to be reached between EAC partner countries to establish a balancing act between the existing intergovernmental level and a new, supranational sphere.

Whilst the EU may provide relevant insights to the EAC, it can also potentially learn from the EAC's initial troubled experience. The EAC has, indeed, a long history of integration, punctuated by several false starts and traumas that have profoundly affected its body politics. But it has nonetheless embarked on a journey towards regional integration. It is still struggling to establish its own identity, hence the need to promote cohesion, solidarity, and closeness between member states to reach its aim of an integrated, peaceful and wealthier region. But it also needs to face many obstacles. For instance, local businesses often point out the gap between the EAC's sound intentions and the work that remains to be done to eradicate hidden barriers and red tape, facilitate external trade, and attract foreign direct investments. Also, the comprehensive Economic Partnership Agreement (EPA) signed in 2014, which gives EAC countries access to the EU Single Market, remains a subject of controversy [7]. In many respects, the EAC's journey towards regional integration reflects the pathways of other RECs. They are confronted with numerous challenges. But potential benefits, to be reaped at the end of the road by

millions of Africans striving for economic prosperity, are worth achieving through such exciting collective project.

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Starting from the Past and Living at the Present to be ready for the Future

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African international students decide to move from their countries for better education facilities. Once they land in host country, they face different types of difficulties. With the great hopes about their future, they have to deal with problems while trying to adapt the new environment. As one of the destinations preferred in Turkey, students at Bandırma Onyedi Eylül University (BANU) face socio-economic problems and try to find ways to deal with them. This paper aims at looking at the lives of these African students in a detailed manner. For that purpose, a field research was conducted with students of BANU and the findings were tried to combine with researcher's observations made at different times. Students are found quite glad with their education and their lives in the city, but they have specific problems as well.

1. Introduction

Although migration for educational purposes due to numbers of factors has been popular for quite a long time, it has gained speed recently in a globalized world. With its students who constitute 10% of the mobility, doubling the world average, African countries play a big role in internationalization of education [1].

Considering the fact that each migration story has its own social dimension, it is useful to make detailed research going beyond the statistics. In other words, field research gains importance to present the realities of African students' stories. The aim of this research is to discover different dimensions of the movement. Therefore, reasons for educational mobility of African students, difficulties they face after sojourn, the level of their interaction with city life, the ways in which the problems are dealt with and the future expectations of students might be regarded as the crucial issues to be explored. The focus of this paper is to find out all these dimensions of migration in Bandırma district of Balıkesir metropolitan city, which hosts international students thanks to the newly founded Bandırma Onyedi Eylül University (BANU).

2. Mobility of African Students, Problems and Some Solutions

Increasing numbers of students are moving to other countries for educational purposes within the bounds of possibility [2]. While this trend is read as globalization of higher education, more and more people move to different destinations [3,4]. Enhanced technology and advanced transportation systems are also effective in students' mobility [5]. Playing a role as a growing industry, educational mobility is supported by countries and universities themselves since more international students mean both material and immaterial resources. Therefore, universities try to tempt more students through facilities they offer [6,7]. This effort also paves the way to formation of private sector agencies that specialize on international student mobility and students have been inclined to get professional support from these agencies [8].

The term 'international student' is an umbrella concept and those who are born in one part of the world can be an international student for any other country. In today's world, the mobility of students can be towards any direction, while it was to the West from the East in the past [9]. Despite the density of the movements, it should be kept in mind that not all the international students are treated in the same way. In various studies, it is found that Black-African students have different types of experiences as compared to the others [10]. It can be a mistake to classify all the African countries as if they have homogenous culture and life style in spite of the continent's rich diversity [11]. Nevertheless, the term is frequently used in the literature in lieu of specifying the name of the each African country and the current study uses the same language by being aware of this simplification.

There might be various reasons for African students' preference for going to different countries for education. One of them is a belief that the more developed the countries are, the more opportunities they offer in academy. Constantine et al. find students have the idea that education in United States can provide better alternatives to the students as compared to their countries [12]. In terms of technological facilities, their countries are in an inferior position and this affects the search for alternatives for qualified education [13]. The opportunity of being educated in a developed country is regarded by students of Africa as a key for job and escape from poverty, regardless of the type and the quality of the education [14,15]. Moreover, due to classes in English and internationalized education facilities, universities are getting attention among students of different countries [16]. Students of Africa also make a decision about the movement according to historically shared socio-cultural values with colonial leaders [17,18]. For instance, coming from English and French speaking countries, students of Africa prefer destination countries according to their language [19]. In addition, students search for cheaper options giving educational services as successfully as western countries [20,21].

Educational movement is also highly related to structural problems. For example, migration is characterized with inequalities in education facilities and the socio-political climate in the country of origin. Apart from war and political disturbances, international students of Africa also had to deal with poverty and these direct them to find a way for better education and life opportunities [22-24].

Going to another country is an important decision for African students considering many of them leave their countries for the first time for educational purposes [25,26]. Mobility of students can result in different feelings and experiences in each case. The journey starts with hope and expectations but, after some time, students face the reality and have to design their lives accordingly.

Difficulties related to the journey start in the country of origin and when the students land they face different types of problems both in academy and in the city. Getting a visa may be as difficult as a battle for the student [27]. Other bureaucratic issues before and after sojourn may not be any easier.

Language as a medium of interaction is another highly problematic issue for sojourners who have difficulties in understanding and actively participating lessons [28]. In addition, daily conversations in the city life depend on the ability to use the language spoken in the destination country. Although most of the mobile students can speak either English or French, few of them know only Arabic and a new language in the new environment may lead to anxiety and dreadful experiences [29].

Cultural differences and the daily life in the city can be another difficulty for sojourners. Unlike students coming from developed world such as European countries, New Zealand or Canada, those coming from Africa face neo-racial discourses and attitudes at university and in the city as "unwanted strangers" [30-32]. This kind of attitude may result in individual problems as well as troubles in adaptation to new environment [33]. Consequently, they develop relations with those having the similar background and culture [34].

Far away from their families and friends, students may feel lonely. When being active in social life necessitates money, students might fail. Going back home for special days may be impossible when the economic situation of the students is not suitable [35,36]. This leads us to mention another critical point related to the students of Africa: economic problems. At the beginning of the journey, they have to deal with the tuition fees and other expenses [37]. After arrival, housing and the daily expenses creates big burden and they have problems in allocating money to social activities [38]. Some case studies show almost all of the students interviewed depend on the parental support in financial terms [39,40]. Those who have sponsors are in a minority as opposed to self-supporting students [41].

Coming to a different country may not be bad experience all the time for the student and differences between two countries can be beneficial for both students and the local community. The city may attract students coming from crowded urban areas with lots of problems thanks to their physical characteristics like better infrastructure, less pollution and few people [42]. Although differences between native cultures can create problems for students, tasting a different cuisine, for instance, can lead richness of experience [43,44]. These students also add cultural diversity of the university and the local community through their understanding and expertise [45].

Because the most important problems are socio-economic, solutions to facilitate international students' lives should have socio-economic dimensions. When face struggling, these students trust social networks of their families and friends in Africa as well as their colleagues on campus [46]. Friendship among students sharing the similar culture helps solving the problem of loneliness [47]. Programs providing buddies for international students can be beneficial for sojourners in academy and social life in the city [48]. The accessibility of the international office staff when needed plays an important role. Social events or activities related to local culture can be other options for integrating students of Africa into local community [49]. In addition, social formations like African student groups can help them present their culture to the local community [50]. When faced serious racial discrimination, students' organized resistance through demonstrations can solve their troubles. If students' problems are financial, formal and informal solutions can be helpful. In addition to money sent by parents, they can get scholarship from governments, any institutions such as provincial administrations and ministries or associations [51]. In addition to financial aid, in kind assistance may be helpful in supporting students in socio-economic terms. Moreover, students can also work illegally to earn their own money [52].

In spite of not being questioned in most of the studies, the influence of religion may need attention in students' cultural adjustment process. It deserves attention to find out if there is any correlation between adjustment and the performance of religious rituals [53].

Another important point to be mentioned in order to study international student mobility in detail is their future projections. Students have good intentions about their lives after education, but it is not determined yet where they will be exactly in the future. Students may have different options depending on their personal desire and the attitude of the host country. They may have to leave for going back to home country as soon as they finish the school or are allowed to stay in the country. In addition, moving to the third destination can be another option for the students [54]

3. Stories of the Students at Bandırma Onyedi Eylül University

Student migration is much more than a mere movement and all the related experiences worth being investigated [55]. Although movements are towards more developed areas such as USA, Canada and some European countries, Turkey is another destination for educational mobility and population of international students has been increasing [56]. In favor of calling international students, Turkey does not apply rigid policies which results in more internationalization of higher education [57].

According to statistics of International Student Office at Bandırma Onyedi Eylül University (BANU), there are 719 international students most of whom are from African countries such as Zimbabwe, Somalia, Tanzania, Mauritania, Cameroon, Guinea, Bangladesh and Burkina Faso. They are from distinct fields and are at different stages of their higher education process. This research is conducted to understand different dimensions of the student mobility from Africa to Turkey concentrating on their past and present life as well as future expectations. Field research was carried on at BANU with 16 African students who are quite new in the country. Due to pandemic, it was not easy to find all the international students on campus and the only accessible ones were the language preparation class students. A questionnaire with open ended questions in Turkish was prepared for the research. Nevertheless, due to language problems it turned into an interview with instant translation of the questions into English and French. During the interviews, students asked further questions to the researcher to give detailed answers and talked to her comprehensively about their lives. Additionally, the researcher's observations on campus and her daily life experiences in the city were helpful to look at the issue in a broader sense.

African students prefer coming to Turkey because of their belief that it provides good education than African countries, while students of Turkey go to the West for better education. It is possible to interpret this as follows: African students consider Turkey as "Europe" of the East in terms of education. Most of the interviewees have not left their countries before and education has been the main reason for being abroad for the first time, which can be regarded as a big step for them. They are in the throes of insufficient infrastructure and negative situations in their countries such as war and poverty. Although, this is caused by uneven development of countries due to structural reasons, few students talked about socio-political problems in their countries. Only one of the students was politically conscious and stated that their continent is undeveloped, since it has been exploited for a long time. Most of the students seemed to be happy with the current situation of their countries.

Beginning of the mobility is not so difficult for the sojourners, since they have at least one relative or friend who came to Turkey before or applied to the university together. Aside

from university environment, African students are always together in their social lives. In daily experience, it is feasible to see them spending time together. If they are not in the city, they go to their African friends' house for socialization.

A positive side of city life for African students is that they did not face any discrimination from local people. The feeling of satisfaction is caused by the attitudes of local community towards African students. None of the students stated negative experiences in the city and they think people, especially old ones as specified by one, behave in a kind manner. This can be caused by historical racial profiling of the Black which is absent/not institutionalized in Turkey. As a result, they neither feel isolated or discriminated nor had adaptation problems as their colleagues in the West stated in different studies. This can also be related to the fact that Bandırma is a small city as compared to İstanbul, Ankara or İzmir and so the adaptation process takes shorter, because the whole city can be experienced easily. University also plays role in the attempt to integrate these students to the local life. In 2019, international students who participated in Gönen Shopping Festival had the opportunity of showing their cultures to visitors and interact with local people [58].

One of the most important problems of the students is language which was experienced during the field research. Since Turkish is a completely different language which is difficult to learn, they have hardship in understanding and communicating. The research was not difficult with those speaking English or French but one of the students can only speak Arabic and this may create some language barriers for her. Because of coming from colonial countries, most of the students can speak English and French, but each time it is not easy to find people speaking foreign language in Bandırma. This reality is an important barrier for students to integrate into the local community and a reason for being stuck with a small group of African students. This language barrier can create academic problems and it can be difficult for the students to understand the classes and take the exams. During previous exams, it was observed that African students enter the classroom late together with their African friends showing they are separated from other students. Furthermore, they had problems in understanding and answering some of the questions. If the content of the course is specific to Turkey, this situation gets even worse.

Besides language, one of the critical troubles that students of Africa have to tackle is financial situation. Making application and getting help from private agency requires money. Moreover, participating in city life is not easy and cheap all the time. They told compared to its quality education in Turkey is cheaper, but daily expenses create financial problems. For instance, during the interviews students were asking questions about transportation fees. University is far away from the city center and walking from home to university may not be possible each day due to the climate in Bandırma which

is too windy. They go to the university 5 days a week and pay for transportation twice a day, which is expensive for a small city like Bandırma in their opinion. One of the students asked if stated problems will be responded by the administration. With their daily concerns, they are not represented in local policies, so once their problems are ready to be listened they wanted to share all of them at once. Economic situation of African students also affect their city experiences. Almost all of them stated to be financed by their parents. Without a regular payment from government or any other institution, it may not be easy to live a happy life in a different country. This may force students to find other resources through unstable and temporary jobs. Two students at different times were seen while delivering tea and coffee to shops and it is not guaranteed that the student get money from employer all the time. In kind supports can also be another way of surviving in the city. For example, in 2021, Search and Rescue Association with the financial support of metropolitan municipality distributed 100 food packages to the African students which is an important attempt [59]. Despite these hassles, local economy is supported by these students and the more international students there are in the city, the more expenses are made in daily life during pandemy because these students were taking onsite language classes, while their native colleagues were at home thanks to online education.

Red tape is another problem stated during the interviews. According to them, application and admission processes are complicated and there were some experienced friends for helping. In addition, they had private agencies that charged students for their support in application. Pandemy has also changed the bureaucratic issues, which made the life easier for international students. They did not have to go the Provincial Directorate of Migration Management which is one hour away from Bandırma, because the university sent their documents for residence permit. However, those who have arrived late had to take these steps on their own, which is not desired by the students due to its being money and time consuming.

Students do not feel completely isolated from the city and talked about good side of their experience in Bandırma. Some of them mentioned the beauties of natural environment. According to their understanding, Bandırma is a livable city and the food is tasty. Some of them stated the nature is even better than their countries. Furthermore, electricity and internet work properly here, unlike their countries. These positive sides influence them to be glad with their new lives.

Cultural adjustment issue can be related to religion as well. The researcher was thinking about its role, but did not ask any questions in order not to direct the students. Two of them, one is Muslim and the other is Christian, gave answers about daily practices of their religion. The former touched upon mosques and easiness of the city life for praying and the latter mentioned his praying in the answer to the question about spare time.

African students were also asked about their future projections. Almost all of them stated that they hope to find a job or create their own businesses. Investing in the future through their education in Turkey, most of the students want to stay or go to more developed areas such as Canada, USA and Europe if they have a chance. Very few students indicated their desire for going back and contributing to the development of their countries. Turkey plays an important role as a bridge between Africa and the West and helps them adapting to a new culture. As a result of their expectations for better education and life, African students pause in Turkey and the next destination seems to be the West and this is possible for only those who can afford it, of course.

4. Conclusion

Growing numbers of international students move due to numbers of factors and their lives in the host country can be difficult from time to time. Policies and individual solutions can be implemented in order to cope with the problems. All these difficulties are braced for an expectation for a better future with a proper job. African students of Bandırma Onyedi Eylül University are not the exception. For a better understanding of their lives, the field research was conducted with 16 students at language class at Bandırma Onyedi Eylül University. Although it is difficult to generalize the results to the all the students or to the whole country, studies about their experiences in academy and in the city can contribute to the related literature. The findings can also alter throughout time and continuity of the research can be helpful to make more accurate interpretation about African students.

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Sustaining Ebola management by predictive modelling

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With 70-90% mortality, Ebola is one of the deadliest known viruses. Unlike SARS-CoV-2, Ebola is not an airborne but spreads by smear infection, and is most contagious in the late stage of the infections and the corps of deceased individuals are highly contagious. During the initial phase of an epidemic, when valid epidemiological data is and treatment infrastructure are yet unavailable, predictive models to evaluate the impact of potential control interventions can support decision making in crisis management. We present a predictive model to study the interactions of various interventions. We verbally describe and illustrate the compartmental-type (SEIR) model and present simulation results illustrating the effect of interventions. We found that the epidemic is controllable, thereby effectively reducing disease burden, by the combination of an effective contact tracing, case isolation, and safe burial ceremonies.

Keywords: contact tracing, isolation, intervention, ebola virus disease, model.

1. Introduction

The Ebola epidemic of 2014-2016 in three West African countries and the consecutive outbreak in Uganda and DRC illustrated the challenge of global health-emergency management. The Ebola virus is an infectious agent that causes in humans and other primates fevers, often hemorrhagic, whose historical epidemics are notable for their magnitude, severity and highly contagious particularly in the late phase of the infection.

There exists several Ebola virus species but one is the most recurrent and contagious, ZEBOV (Zaire Ebola Virus). ZEBOV causes viral hemorrhagic fever with case fatality rates from 25% to 90% on humans and non-humans primates. The recent deadliest episode that occurred in West Africa was caused by ZEBOV [3].

During the incubation period, which is generally ranged from 2 to 21 days [6], the virus infects body cells, replicates and bursts out of the infected cells, producing EBOV glycoproteins that attach to the inside of blood vessels, rendering the blood vessels to be more permeable [4]. The increased permeability causes the blood vessels to leak out blood. The virus also evades the host's natural defense system, by infecting immune cells, a channel through which it is transported to other body parts and organs, such as the liver, spleen, kidney and brain [1]. The virus can cause these organs to fail, leading to death of the infected human host. It is known that Ebola infection confers permanent natural immunity (in individuals who have recovered from the disease) against re-infection [4].

Ebola is characterized by a high case fatality ratio which was nearly 90% in a past outbreak. Ebola hemorrhagic fever is characterized also by a sudden rise in temperature, weakness, muscular pain, headache and pain in the throat during days (1-3). After appearance of vomiting and diarrhea, a cutaneous eruption, renal and hepatic insufficiency, internal and external bleeding can occur

during days (4-7). Finally, infected individuals may present with confusion and may exhibit signs of internal and/or visible bleeding, potentially progressing towards coma, shock, and death during days (7-10) [5, 7].

In lower income countries with inadequate health care centers infrastructures, during the epidemic outbreak, contact tracing and isolation strategies play a key role to curtail the disease spreading. Contact tracing strategy consists to identify, list, and monitor persons who have been exposed to infected individuals, with the goal of rapidly diagnosing and treating new cases and preventing further spread of the infection. The use of contact tracing and isolation as primary control strategy presents significant logistical and economic strain on a public health system's resource for the countries with a lower income.

Here we introduce a mathematical model to study the hypothetical effect of contact tracing and isolation during EVD epidemic during one infective period on disease mortality by an extended SEIR model (see Figure 1 for an illustration). Model parameters are chosen from the literature to reflect and adjusted such that the dynamics reflect the situation in the rural area in Africa.

2. Method

A population of N individuals is assumed, subdivided into susceptible, infected, and recovered individuals. Susceptible individual is an individual who is not yet infected. After a susceptible individual becomes infected it passes through the (i) latency period (the individual is not yet infectious), (ii) prodromal period (the individual exhibit early symptoms, but is partly infectious), (iii) fully infectious period in isolation (the individual is symptomatic and positive to Ebola test), (iv) fully infectious period in hospital (the individual is symptomatic and hospitalized but does not perform Ebola test, i.e., ignore his or her status), and fully infectious period at home (the

individual is symptomatic and stayed at home due to their traditional beliefs). After the fully infectious phase (isolation, hospital and home) individuals either they recover (and become permanently immune) or they die. Once they die, those who were in isolation will receive safe funeral (they are no longer infectious) while those who were in hospital and at home, a proportion of them will receive safe funeral (they are no longer infectious) while the remaining will receive unsafe funeral (they are still infectious) before they are buried (they are no longer infectious). The model follows the time change of the numbers of individuals being susceptible (S), latently infected (E), prodromal (P), fully infectious in isolation (I_{iso}), fully infectious in hospital (I_{Hosp}), and fully infectious at home (I_{Home}), as well as those, who are recovered (R) or died and received safe funerals (B_{iso}) or unsafe funerals before being buried (F) and buried cases (B_F). In this work we assume that deaths unrelated to EVD are ignored.

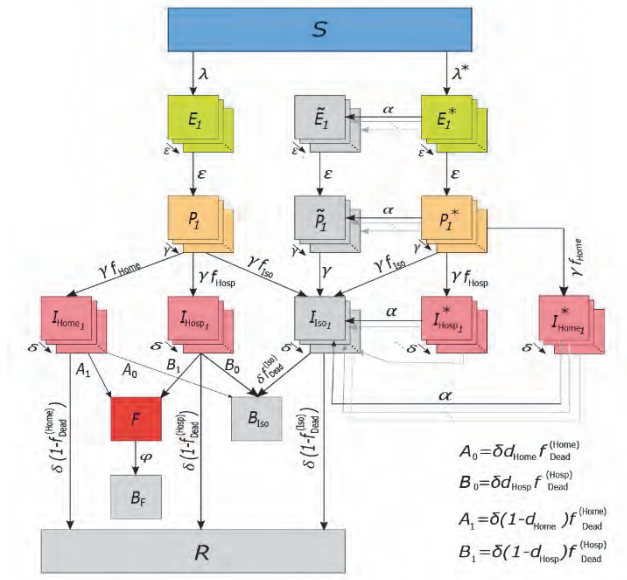


Fig. 1: Model flow diagram: The entire human population is grouped into the Susceptibles, (S), the infected which is further classified into the Latent (E), the Prodromal, (P), the fully infectious at home, (I_{Home}), the fully infectious in hospital, (I_{Hosp}), the fully infectious in isolation, (I_{iso}), another group are the transient individual which will get traced back and also those who are traced back, the rest of the group is the dead with unsafe Funeral, (F), the Buried safely cases, (B_{iso}), the Buried after funeral, (B_F) and the Recovered, (R) which are also immune. Infection flows between individuals of each compartment are explained in the text.

Prodromal individuals develop symptoms, i.e., they become fully infectious (in isolation, in hospital and at home) and they get more sicker. A fraction of fully infectious (in isolation, in hospital and at home) lead to recovery while the remaining fraction is lethal. Individuals who will never get traced back and those who are not under treatment either after being traced back or in isolation (ETU) are more likely to have higher viral load, hence to die from EVD than recovery. We therefore follow individuals who are never traced back, those will get traced

back (not yet), and those who are successfully traced back throughout all phases of the infection. The numbers of individuals who are successfully traced back in the various phases of infection are denoted by \tilde{E} , and \tilde{P} . The susceptibility to be trace back is different in the latent, prodromal, and fully infectious (at home and in hospital) phases since the symptoms are increased gradually.

Individuals that will get traced back (not yet) can still transmit the infection with the same risk of developing symptoms like those who never get traced back. If individuals is diagnosed positive to Ebola test, we start to trace all the contact that this persons had, this manifests only after a time delay ($D_T = 1/\alpha$). During this time, individuals are moved into transient compartments E^* , P^* , $I^{*,Home}$, and $I^{*,Hosp}$. As long as individuals are in the transient phases, they can end up either in isolation directly or through successful tracing back.

Susceptible individuals acquire infections through contacts with individuals in the prodromal, the fully infectious (at home or in hospital), or the funerals (Ebola deceased individuals) periods at rates βP , βI_{Home} , βI_{Hosp} , βF , respectively. Note, a fraction of those who will traced back continuous to transmit the disease before being successfully traced back and stop spread it, while the rest (those who never get trace back) transmits the infection till the disease become controllable.

3. Equations

3.1. Force of infection

The force of infection of those who are never traced back λ and those who are successfully traced back λ^* is

$$\lambda_0(t) = \beta_P f_{iso} (P_{Sum}(t) + P_{Sum}^*(t)) + \beta_{I_{Home}} I_{Sum}^{(*,Home)}(t) + \beta_{I_{Hosp}} I_{Sum}^{(*,Hosp)}(t) + \beta_{I_{Hosp}} (1 - p_{Hosp}) (1 - q(t)) (\tilde{P}_{Sum} + I_{Sum}^{iso}).$$

$$\lambda(t) = \beta_P (1 - f_{iso}) P_{Sum}(t) + \beta_{I_{Home}} I_{Sum}^{Home}(t) + \beta_{I_{Hosp}} I_{Sum}^{Hosp}(t) + \beta_F F(t) + (1 - f_{Tr} c(t)) \lambda_0(t).$$

$$\lambda^*(t) = f_{Tr} c(t) \lambda_0(t).$$

The combined force of infections by which susceptible become infected is

$$\lambda_{Tot}(t) = \lambda(t) + \lambda^*(t).$$

3.2. Differential Equation

The change in the number of susceptible individuals is given by

$$\frac{dS(t)}{dt} = -\lambda_{Tot}(t) \frac{S(t)}{N}.$$

The number of infected individuals in the latent phase change according to

$$\frac{dE_1(t)}{dt} = \lambda(t) \frac{S(t)}{N} - \epsilon E_1(t),$$

$$\frac{dE_k(t)}{dt} = \epsilon E_{k-1}(t) - \epsilon E_k(t) \text{ for } 2 \leq k \leq n_E.$$

$$\frac{dE_1^*(t)}{dt} = \lambda^*(t) \frac{S(t)}{N} - (\alpha + \varepsilon)E_1^*(t),$$

$$\frac{dE_k^*(t)}{dt} = \varepsilon E_{k-1}^*(t) - (\alpha + \varepsilon)E_k^*(t) \text{ for } 2 \leq k \leq n_E.$$

$$\frac{d\bar{E}_1(t)}{dt} = \alpha E_1^*(t) - \varepsilon \bar{E}_1(t),$$

$$\frac{d\bar{E}_k(t)}{dt} = \alpha E_k^*(t) + \varepsilon E_{k-1}(t) - \varepsilon \bar{E}_k(t) \text{ for } 2 \leq k \leq n_E.$$

The prodromal individuals change according to

$$\frac{dP_1(t)}{dt} = \varepsilon E_{n_E}(t) - \gamma P_1(t),$$

$$\frac{dP_k(t)}{dt} = \gamma P_{k-1}(t) - \gamma P_k(t) \text{ for } 2 \leq k \leq n_P.$$

$$\frac{dP_1^*(t)}{dt} = \varepsilon E_{n_E}^* - (\alpha + \gamma)P_1^*(t),$$

$$\frac{dP_k^*(t)}{dt} = \gamma P_{k-1}^*(t) - (\alpha + \gamma)P_k^*(t) \text{ for } 2 \leq k \leq n_P.$$

$$\frac{d\bar{P}_1(t)}{dt} = \alpha P_1^*(t) + \varepsilon \bar{P}_{n_E}(t) - \gamma \bar{P}_1(t),$$

$$\frac{d\bar{P}_k(t)}{dt} = \alpha P_k^*(t) - \gamma \bar{P}_{k-1}(t) - \gamma \bar{P}_k(t) \text{ for } 2 \leq k \leq n_P.$$

The fully infectious individuals at home change according to

$$\frac{dI_{Home}^1(t)}{dt} = \gamma f_{Home} P_{n_P}(t) - \delta I_{Home}^1(t),$$

$$\frac{dI_{Home}^k(t)}{dt} = \delta I_{Home}^{k-1}(t) - \delta I_{Home}^k(t) \text{ for } 2 \leq k \leq n_{I_{Home}}.$$

The fully infectious individuals in hospital change according to

$$\frac{dI_{Hosp}^1(t)}{dt} = \gamma f_{Hosp} P_{n_P}(t) - \delta I_{Hosp}^1(t),$$

$$\frac{dI_{Hosp}^k(t)}{dt} = \delta I_{Hosp}^{k-1}(t) - \delta I_{Hosp}^k(t) \text{ for } 2 \leq k \leq n_{I_{Hosp}}.$$

The fully infectious individuals in isolation change according to

$$\frac{dI_{Iso}^1(t)}{dt} = \gamma f_{Iso} (P_{n_P}(t) + P_{n_P}^*(t)) + \gamma \bar{P}_{n_P}(t) + \alpha (I_1^{(*,Home)}(t) + I_1^{(*,Hosp)}(t)) - \delta I_{Iso}^1(t),$$

$$\frac{dI_{Iso}^k(t)}{dt} = \alpha (I_k^{(*,Home)}(t) + I_k^{(*,Hosp)}(t)) + \delta I_{Iso}^{k-1}(t) - \delta I_{Iso}^k(t) \text{ for } 2 \leq k \leq n_{I_{Iso}}.$$

The fully infectious individuals at home who will get traced back change according to

$$\frac{dI_1^{(*,Home)}(t)}{dt} = \gamma f_{Home} P_{n_P}^*(t) - (\alpha + \delta)I_1^{(*,Home)}(t),$$

$$\frac{dI_k^{(*,Home)}(t)}{dt} = \delta I_{k-1}^{(*,Home)}(t) - (\alpha + \delta)I_k^{(*,Home)}(t)$$

for $2 \leq k \leq n_{I_{Home}}$,

$$\frac{dI_k^{(*,Home)}(t)}{dt} = \delta I_{k-1}^{(*,Home)}(t) - \alpha I_k^{(*,Home)}(t) \text{ for } k = n_{I_{Home}}.$$

The fully infectious individuals in hospital who will get traced back change according to

$$\frac{dI_1^{(*,Hosp)}(t)}{dt} = \gamma f_{Hosp} P_{n_P}^*(t) - (\alpha + \delta)I_1^{(*,Hosp)}(t),$$

$$\frac{dI_k^{(*,Hosp)}(t)}{dt} = \delta I_{k-1}^{(*,Hosp)}(t) - (\alpha + \delta)I_k^{(*,Hosp)}(t)$$

for $2 \leq k \leq n_{I_{Hosp}}$.

$$\frac{dI_k^{(*,Hosp)}(t)}{dt} = \delta I_{k-1}^{(*,Hosp)}(t) - \alpha I_k^{(*,Hosp)}(t) \text{ for } k = n_{I_{Hosp}}.$$

Finally, the number of recovered changes according to

$$\begin{aligned} \frac{dR(t)}{dt} = & \delta \left((1 - f_{Dead}^{(Home)}) I_{Home}^{n_{I_{Home}}}(t) \right. \\ & + \left. (1 - f_{Dead}^{(Hosp)}) I_{Hosp}^{n_{I_{Hosp}}}(t) \right. \\ & + \left. (1 - f_{Dead}^{(Iso)}) I_{Iso}^{n_{I_{Iso}}}(t) \right) \end{aligned}$$

The number of dead individuals that have not been buried but have an unsafe funeral changes according to

$$\begin{aligned} \frac{dF(t)}{dt} = & \delta \left((1 - d_{Home}) f_{Dead}^{(Home)} I_{Home}^{n_{I_{Home}}}(t) + (1 \right. \\ & \left. - d_{Hosp}) f_{Dead}^{(Hosp)} I_{Hosp}^{n_{I_{Hosp}}}(t) \right) - \varphi F(t), \end{aligned}$$

The number of dead individuals that are buried after a funeral or safely after quarantine change respectively according to

$$\begin{aligned} \frac{dB_F(t)}{dt} = & \varphi F(t), \\ \frac{dB_{Iso}(t)}{dt} = & \delta f_{Dead}^{(Iso)} I_{Iso}^{n_{I_{Iso}}}(t) \\ & + \delta \left(d_{Home} f_{Dead}^{(Home)} I_{Home}^{n_{I_{Home}}}(t) \right. \\ & \left. + d_{Hosp} f_{Dead}^{(Hosp)} I_{Hosp}^{n_{I_{Hosp}}}(t) \right). \end{aligned}$$

4. Results and Discussion

Model parameters are chosen to roughly reflect the situation in a rural area in Africa, where adapted infrastructures are insufficient. The goal is to study the effect of contact tracing and isolation on disease spreading. A population of $N = 10000$ was assumed. The basic reproduction number $R_0 = 1.7$ [2]. The average duration of the latent, prodromal, fully infectious and normal funerals stages was assumed to be $DE = 10$, $DP = 5.5$, $DI = 5$ and $DF = 2$ days, respectively.

The following figures shows that (i) everybody get infected during the epidemic, because of case isolation which started late ($t = 250$ days). In particular, infectious individuals who are never get traced cause a higher of symptomatic infections (early infectious), a proportion of them are isolated (fiso) and no longer participate (fully) in transmission.

This manifests in higher number of susceptible infections (see Figure 2A and Figure 3A).

(ii) The height of the epidemic peak is slightly reduced as infectious individuals are more likely to be isolated and do not participate in disease transmission. (iii) The number of deaths (buried safely) clearly increases with the likelihood of having symptomatic infections, because a fraction of these are lethal (see Figure 2H and Figure 3H). Isolating a higher fraction of symptomatic who are never traced back and those who will get traced back leads to slightly fewer infections and a reduced height of the epidemic peak (Figure 2B, C and Figure 3B, C).

Sustaining isolation reduce slightly the infection peak, the combination of contact tracing and isolation, delay and decrease substantially the epidemic peak and reduce notably the dead cases.

Figures

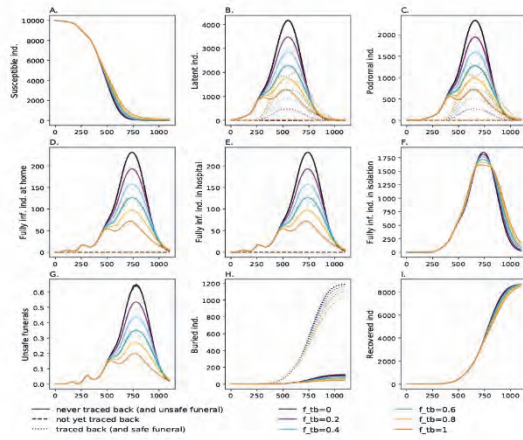


Figure 2: Proportion of infected individuals getting isolated due to tracing back. Shown are the numbers of susceptibles, latent, prodromal, fully infectious (at home, in hospital, in isolation), recovered, and buried individuals and unsafe funerals cases among all infected individuals who never get traced back and unsafely buried cases (solid lines), not yet traced back and safely buried cases (dotted lines), and trace back (in ward or not) (dashed lines). Colors are for different fractions of infected individuals that are isolated (f_{Tr} and $f_{Iso} = 0.8$).

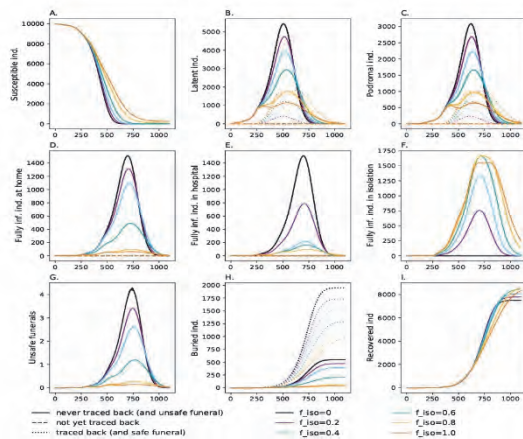


Figure 3: Proportion of infected individuals getting traced back. Shown are the numbers of susceptibles, latent, prodromal, fully infectious (at home, in hospital, and in isolation), recovered, and buried individuals and unsafe funerals cases among all infected individuals who never get traced back and unsafely buried cases (solid lines), not yet traced back and safely buried cases (dotted lines), and trace back (in ward or not) (dashed lines). Colors are for different fractions of infected individuals who get traced back (f_{Iso} and $f_{Tr} = 0.8$).

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The International Collaboration of Math Against Malaria

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The “Math Against Malaria” group is a dynamic and multicultural research group sustaining strategic partnerships between HSMW and institutions in sub-Saharan Africa. Its initiation dates back to a strategic targeted DFG-workshop hosted by African Institute for Mathematical Sciences (AIMS, Cameroon). Its outreach is to understand and monitor infectious diseases, with a focus on malaria, by supporting trans-disciplinary research endeavors with mathematical and statistical expertise. Mathematical research that facilitates to mine and interpret (epidemiological, clinical, genetic) data collected throughout disease-endemic regions (e.g. in the case of malaria sub-Saharan Africa, India, South America) has in fact real-world impact. Proper knowledge exchange between theoretical re-search and clinical practice requires an active exchange dialog that guarantees the applicability of mathematical/statistical methods. Such a dialog is made possible by the “Math Against Malaria” group through numerous international collaborations established with partners around the globe, e.g., AIMS-Cameroon, West African Centre for Cell Biology of Infectious Pathogens (WACCBIP, Ghana), Naval Medical Research Unit Six (NAMRU-6, Peru), Indian Council for Medical Research (ICMR, India), and Center for Global Health (CGH, USA). Here, we present the fruitful collaboration between the “Math Against Malaria” group and the Center for Global Health at University of New Mexico and their clinical facilities in Siaya, Kenya, one of the country’s poorest regions heavily burdened by infectious diseases.

1. Introduction

Hochschule Mittweida (HSMW) is a university with an international network of partner universities (140 partners in 53 countries) and collaborators enriching its student-exchange and international mobility programs and offering numerous cooperation opportunities. Collaborations at HSMW also extend to research endeavors as the university promotes scientific, economic, social, and cultural development in research. Partners include private-sector companies and research institutions in Europe and across the globe. HSMW is home to numerous research groups among which the “Math Against Malaria” group, a multicultural research group fostering strategic partnership between the university and institutions in sub-Saharan Africa. The group was initiated as a follow-up to a targeted DFG-workshop following the Next Einstein Forum held in 2016 in Senegal. The workshop was organized by the African Institute for Mathematical Sciences Cameroon (AIMS Cameroon) under the theme “Mathematics against Malaria: A Holistic Approach”. World-renowned experts in the field of infectious disease modelling were invited to make use of cutting-edge mathematical tools to develop innovative approaches for sustainable eradication of malaria. Malaria ranks among the most important infectious diseases causing annually 350 million infections and 0.5 million deaths worldwide. Half of the world’s population lives under the risk of infection with malaria and the disease imposes a substantial obstacle to sustained economic development in low and middle-income countries. Prof. Kristan A. Schneider of HSMW was invited to the workshop because of his long reputation in bridging the gap between fundamental research in mathematics and public health authorities. As a result, Prof. Schneider initiated the

“Math Against Malaria” group. Three years after its creation, the group is a multicultural environment for research with members from various African and European countries. The group also boasts a wide range of collaborators from around the globe, e.g., AIMS-Cameroon, West African Centre for Cell Biology of Infectious Pathogens (WACCBIP, Ghana), Naval Medical Research Unit Six (NAMRU-6, Peru), Indian Council for Medical Research (ICMR, India), and Center for Global Health (CGH, USA). Its outreach is to understand and monitor infectious diseases, with a focus on malaria and COVID-19, by supporting trans-disciplinary research endeavors with mathematical and statistical expertise. In fact, mathematical research that facilitates mining and interpreting (epidemiological, clinical, genetic) data collected throughout disease-endemic regions (e.g. in the case of malaria sub-Saharan Africa, India, South America) has real-world impact. Here, we present the fruitful collaboration between the “Math Against Malaria” group and the Center for Global Health at the University of New Mexico and their clinical facilities in Siaya, Kenya, one of the country’s poorest regions heavily burdened by infectious diseases.

2. Research environment

The “Math Against Malaria” group is a research group, dedicated to developing mathematical tools to understand and monitor infectious diseases with a focus on malaria. To sustain this agenda and achieve a real-world impact the group engages in transdisciplinary research projects. To sustain this agenda the group brings together researchers from around the globe, with different experiences and understanding of the problems tackled in the group, allowing an inclusive approach to research. The researchers are from (i) Europe, i.e., Prof. Kristan A. Schneider (Austria, Principal Investigator), Dr.

Kristina B. Helle (Germany, works on “COVID-19 and ebola”), Arlinda Sadiku (Albania, works on “Diversity measures with applications in ecology, economy, and genetics”), (ii) Africa, i.e., Henri Christian Junior Tsoungui Obama (Cameroon, works on “Differentiating between recrudescences, relapses, and re-infections in malaria”), Pierre Marie Ngougoue Ngougoue (Cameroon, works on “Hrp2/3 deletions in malaria”), Nessma Adil Mahmoud Yousif (Sudan, works on “studying Sulfadoxine-Pyrimethamine-resistance”), Aliou Bouba (Cameroon, works on “Ebola disease modelling”), Toheeb Ibrahim Babatunde (Nigeria, “Mosquitoes breeding sites modelling”), Looli Alawam Nemer (Sudan, works on “Leishmaniasis disease modelling”), Loyce Kayanula (Malawi, works on “non-parametric approaches to estimate multiplicity of infection”), Frank Sandy Ngaha (Cameroon, works on “parametric methods to estimate the number of super-infections of infectious diseases”), George Kamanga (Zambia, works on “COVID-19”), Patience Illiya Bwanu (Nigeria, works on “COVID-19”), Vincent Appiah (Ghana, works on “innovative machine-learning approaches applied to gene-expression data”), and (iii) Asia, i.e., Meraj Hashemi (Iran, works on “improving maximum-likelihood estimators to infer haplotype frequencies”). Most of the group’s activities rely on a vivid intercultural and personal mobility exchange, which was severely challenged by the ongoing COVID-19 global pandemic. In a quick response, within a few days of the first lockdowns, the group reinvented itself and utilized new channels of communication to develop pandemic preparedness tools and predictive models. So far, four COVID-19 models have been published in leading international top-ranked research journals [1, 2, 3, 4]. The work includes assessing how COVID-19 testing strategies help to protect high-risk individuals [1], different vaccination strategies could help control the pandemic [2], and how multiple exposures to the virus, when pursuing herd-immunity strategies, can lead to increased mortality [3]. The models received media attention, as the group was one of the first to predict the “third wave” in Germany very accurately and further predicted the upcoming “fourth wave”.

The group collaborates with research institutions around the globe with most of them being either located in disease-endemic areas or having remote centers in endemic areas. This allows an exchange of expertise between researchers and a deeper understanding of the diseases studied. The collaborators of the “Math Against Malaria” group are from (i) Africa, i.e., Cameroon (AIMS, University of Yaounde 1, University of Buea), South Africa (University of Pretoria, University of Venda), Rwanda (AIMS Rwanda), Ghana (WACCBIP), Kenya (Maseno University, Masinde Muliro University Of Science & Technology, Siaya County Referral Hospital), Senegal (IRESSEF), (ii) America, i.e., USA (University of New Mexico CGH, CDC), Peru (NAMRU-6), and (iii) Asia, i.e., India (ICMR).

3. Collaboration between Maths Against Malaria and the Center for Global Health

The Center for Global Health (CGH) of the University of New Mexico (UNM) - School of Medicine - in the USA is a world-leading research laboratory supervised by Prof. Douglas J. Perkins. The center’s objectives are to support and enhance global research, foster collaborative relationships for research, and provide clinical training in Tropical/Global health. The center has partner sites in malaria-endemic areas in Kenya, i.e., UNM-Kenya in Kisumu, UNM-Kenya in Siaya, and Maseno University. In those sites, some of the world’s most comprehensive clinical studies of pediatric malaria (mostly children under 5 years of age) are conducted for almost 20 years. These longitudinal cohort studies are concerned with the clinical pathogenesis of severe malarial anaemia, one of the leading causes of mortality in children in the region. In particular, the effect of poverty-related comorbidities and genetic predispositions of severe disease are studied. In this context, the “Math Against Malaria” group contributes to statistical analysis, particularly, statistical modelling, survival analysis, molecular-genetic analysis, and population-genetic/evolutionary-genetic predictions. These activities include monitoring anti-malarial drug resistance and genetic alteration in the pathogen that challenge proper malaria diagnostics. Researchers on both sides benefit from the interdisciplinary research environment and capacity building, which manifests in joint acquisition of research funding, exchange of expertise, and publications. Under the collaboration, one paper has been published in which changes in the frequencies of drug-resistant parasites are studied in children from Western Kenya [5], and a series of manuscripts on genetic factors mediating disease severity is in the process of publication. The groups further engaged in collaborations regarding severe COVID-19 episodes, which resulted in a project funded by the National Institute of Health in which HSMW is a consultant for statistical data analysis.

4. Conclusion

The international environment offered by Hochschule Mittweida allows students to have the best possible learning environment thanks to numerous co-operations and exchange programs. It also allows the students to develop personally as individuals as they learn to engage with cosmopolitan cultures. Moreover, research collaborations can evolve and produce impactful results at HSMW thanks to the international environment, as is the case for the “Math Against Malaria” group, a multicultural research group whose research contributes to policy-making in global health.

Acknowledgements

Special thanks to the 2021 international week conference organizers, who made this conference possible despite the limitations imposed on them by the COVID-19 pandemic. The “Math Against Malaria” group is sup-

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COVID-19 research at HSMW

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“Maths against Malaria” is a multinational research group - sustaining international collaborations between HSMW and partner institutions in the field of biomedicine - working in a mathematical framework to model infectious diseases dynamics and spread. The group has established many mathematical and statistical models in different topics: Ebola, visceral leishmaniasis, mosquito breeding sites, malaria pathogenesis and dynamics, and COVID-19.

1. Introduction

Since the onset of the global pandemic “Math against Malaria” research group has engaged in research on COVID-19, with a number of predictive models that have been published in competitive international research journals. In this presentation, we will discuss some of the COVID-19 models carried out by the group, which are a complex extension of the model underlying the pandemic preparedness tool CovidSim 1.1 (<http://covidsim.eu/>). The models are parameterized to reflect Germany’s situation (e.g., assuming contact reductions: curfews, social distancing, prohibition of gatherings). Our work aims to facilitate decision-making by exploring ranges of parameters rather than empirical data and preventing further economic damage from COVID-19. The predictive models can serve as an advanced decision support tool for COVID-19 management.

2. COVID-19 Models

“Maths against Malaria” research group published 3 models on COVID-19, titled “Preventing COVID-19 spread in closed facilities by regular testing of employees — An efficient intervention in long-term care facilities and prisons?”, “The impact of COVID-19 vaccination campaigns accounting for antibody-dependent enhancement”, and “Is increased mortality by multiple exposures to COVID-19 an overseen factor when aiming for herd immunity?” in the following sections, we are going to introduce a brief description of each project.

2.1. Preventing COVID-19 spread in closed facilities by regular testing of employees — An efficient intervention in long-term care facilities and prisons?

The Centers for Disease Control and Prevention (CDC) identified people aged 65 years and older and people living in a long-term care facility (LTCF) as high-risk groups.

Table 1: Test sensitivity

Test	S _E	S _P	S _I	S _L
Poor PCR	0.00	0.10	0.65	0.35
Intermediate PCR	0.03	0.30	0.75	0.50
Good PCR	0.15	0.60	0.80	0.60
Very good PCR	0.25	0.75	0.90	0.65
Excellent PCR	0.30	0.80	0.95	0.85
Antigen PCR	0.00	0.35	0.85	0.85

Hypothesis: The spread of COVID-19 inside closed facilities can be controlled by regularly testing the employees.

Compartmental model; (.) stands for Ge, St, or Ri. Some compartments are modelled by equivalent sub-states to obtain more realistic dynamics following the time change of:

- S(.) : number of susceptibles,
- Ek(.) : number of latent (not infectious) individuals,
- Pk(.) : number of infected individuals at the prodromal stage,
- Ik(.) : number of individuals at the fully infectious stage,
- Lk(.) : number of individuals at the late infectious phase,
- R(.) : number of recovered individuals,
- D(.) : number of dead individuals.

The compartmental model follows susceptibles, infected and Removed.

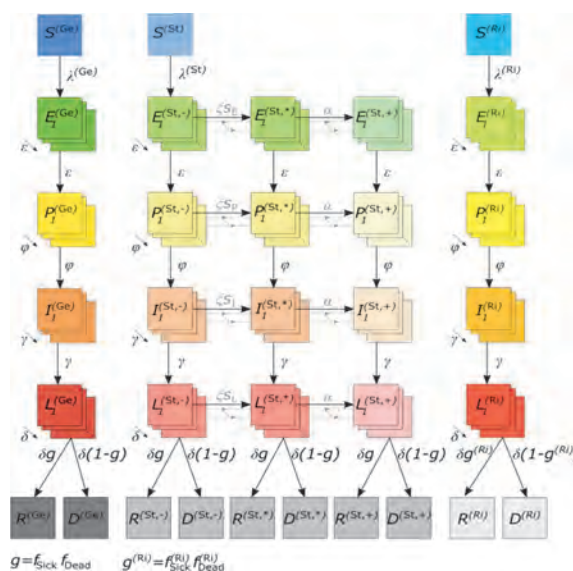
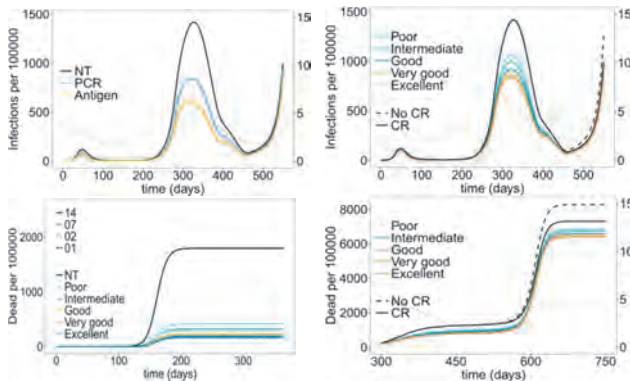


Fig. 1: Model flow chart: The infection flows between the members of the three sub-populations (Ge, St, and Ri).

Parameters values; Average duration of Latent, Prodromal, Fully infectious and Late infectious periods (days): DE = 3.7; DP = 1; DI = 5; DL = 5;

- Waiting time for test results (hours): $1/\alpha = 12; 24; 48; 72; 96;$
- Average testing rate (per day): $1/\xi = 1; 2; 5; 7; 14$ (i.e., everyday, every 2 days, every 5 days, every week, or every 2 weeks).

Results; the results below show the impact of testing intervention. The panels show the number of infected (I) and the dead (D) individuals in the risk group.



Conclusion

- Testing the staff of LTCFs and incarceration facilities is extremely efficient to decrease mortality,
- testing every 5-7 days with good quality PCR test is sufficient,
- testing intervention protects both risk group and staff,
- testing strategy relevant despite availability of vaccines.

2.2. The impact of COVID-19 vaccination campaigns accounting for antibody-dependent enhancement

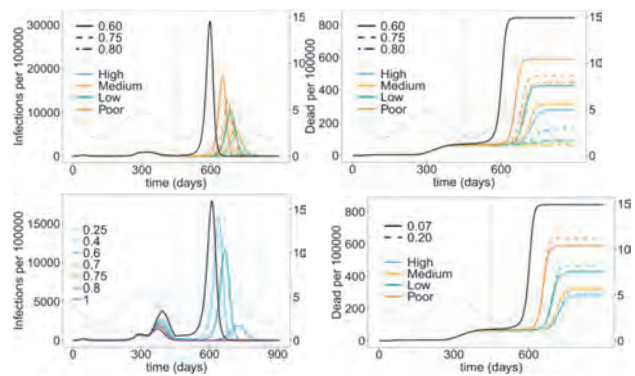
Antibody dependent enhancement (ADE) or enhanced respiratory disease is a deleterious side-effect of vaccines that can worsen the symptoms from a second infection. ADE is previously observed in SARS-CoV, MERS-CoV, Zika virus, and respiratory syncytial virus (RSV).

Hypothesis: The antibody dependent enhancement effect is too significant to be ignored when vaccinating.

Model assumptions

- The population is divided into those who are willing to get vaccinated and anti-vaxxers,
- vaccines are not assumed to immunize perfectly (either fail to immunize, immunize partially, or cause ADE),
- ADE is associated with higher case fatality upon infection, control interventions are assumed (e.g., social distancing, case isolation),
- individuals are getting vaccinated only once regardless of the manifestation of the vaccine,
- parameters values reflect the situation in Germany.

Results; the results show the impact of vaccine effectiveness. The panels show the number of infected (I), and dead (D) individuals with different levels of vaccine effectiveness, vaccination campaigns coverage, and ADE-induced death rate.



Conclusion

- Early onset of vaccination campaigns is recommended,
- the faster the population is vaccinated the better,
- necessity to immunize a sufficient part of the population by the beginning of the flu season in 2021,
- ADE effect is outweighed by the benefits of the vaccine.

2.3. Is increased mortality by multiple exposures to COVID-19 an overseen factor when aiming for herd immunity?

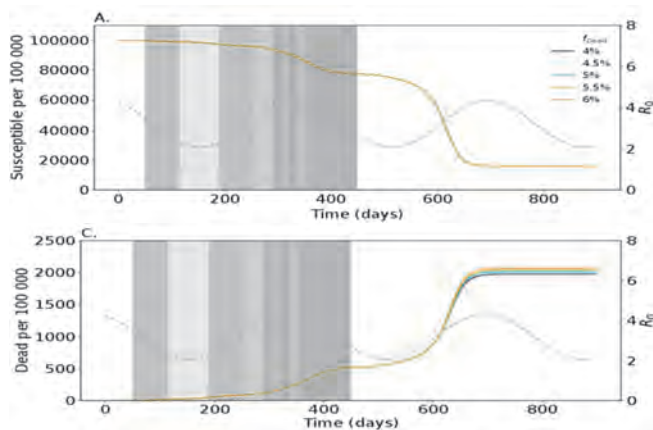
Aiming for herd immunity strategy is controversial and has been called unethical by the WHO Director-General. Without proper control measure, viral diversity increases and multiple infectious exposures become common.

Hypothesis: Multiple exposure to COVID-19 can lead to an increased mortality.

Model assumptions

- Multi-infections are either acquired by successive infective contacts during the course of one infection or by a single infective contact with a multi-infected individual,
- different disease phases have different susceptibility to multi infections,
- multi-infected individuals get isolated due to their higher morbidity,
- parameters values reflect the situation in USA.

Results; the results show the effect of multi-infections on mortality. The panels show the number of susceptible (S) and dead (D) individuals with different death rates.



Conclusion

- Overall mortality increases due to multi-infections,
- lockdowns can efficiently reduce the burden of an epidemic if sustained sufficiently long,
- increased morbidity and mortality due to multi-infections is an important but overlooked risk, particularly in the context of herd immunity.

Acknowledgements

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Access to Portuguese Higher Education through ICT courses: the case of Jean Piaget Higher School of Technology and Management

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The education and training offer of the Jean Piaget Higher School of Technology and Management is mainly focused on ICTs. The School also benefits from close relationships with the African continent due to the historical and cultural context of Portugal. This is especially so in relation to the PALOP - Portuguese Speaking African Countries, which have also been the countries of origin of the majority of the School's international students, and in which the School's founding institution - the Piaget Institute has established a number of partner universities. In the academic year of 2020-2021, 25% of the School's students came from Africa, mainly from Angola and Guinea-Bissau. It is therefore estimated that the School's future in higher education professional skills development in the field of ICTs will follow the same trend: the 2021/2022 perspectives show a clear growth of African students' interest in the School's education and training offer because they seek specific, credible and feasible academic, professional and socioeconomic opportunities through Portuguese higher education potential.

1. Introduction

The Jean Piaget Higher School of Technology and Management (*Escola Superior de Tecnologia e Gestão Jean Piaget*) is one of the three higher schools of the Jean Piaget Polytechnic Institute of the South (*Instituto Politécnico Jean Piaget do Sul*), in turn one of the Piaget Institute's higher education institutions. The School has thus inherited a history of over 40 years of the Institute's experience, translated into educational practices of renowned quality and implemented through close collaboration with the surrounding businesses and civil communities. The Piaget Institute's facilities are located in mainland Portugal – four university and academic campuses in the North, Centre and South of Portugal, as well as in the Greater Lisbon area, and overseas – five Piaget Universities in Angola, Brazil, Cape Verde, Mozambique and Guinea-Bissau. Their main activity is the provision of higher education, knowledge production and cultural development in the fields of Education, Health, ICTs, Management, Sport, Psychology and Music.

2. Jean Piaget Higher School of Technology and Management

The School is located on the University Campus of Almada, a city in the Greater Lisbon area, on the south bank of the Tagus river. Just like the School itself, the city of Almada also has a strong international component: according to the latest Portuguese Immigration and Borders Service's Report [1], there are 15.471 registered foreign inhabitants in the city, distributed into 94 different nationalities. The relationship with the African continent is obvious: three out of the five most represented nationalities are African: Cape Verdean, Angolan and San Tomean [2]. This offers favourable conditions for the development of close community

relationships through the School's extension activities, as well as for the attainment of one of its main objectives – internationalisation, which is achieved both through the inclusion of international students into the School's education and training offer and through European and international mobility programmes for students and teaching and non-teaching staff.

The Jean Piaget Higher School of Technology and Management is only three years old and is thus the most recent school of the Jean Piaget Polytechnic Institute of the South. Its strategic vision is “to contribute to human and social development through the establishment and consolidation of entities that implement projects in education, research and community intervention that are based on scientific, pedagogical and creative freedom, close relationships, fundamental human values and networking” [3]. The School's education and training offer is mainly focused on the emerging fields of ICTs and management. Currently, it runs two first cycles of studies – Computer Engineering and Oil Engineering, six higher professional technical courses - Data Analysis in Information Management; Administrative and Management Assistance; Cybersecurity, Networks and Computer Systems; Videogames and Multimedia Applications Development; Commercial Management and Sales Force; Web, and Mobile Devices and Applications Programming; and a post-graduate non-degree awarding course in Cybersecurity and Data Protection for Public Administration Services.

The School makes every effort to provide excellence in the students' outcoming professional profile, being supported by the teaching staff that consists of specialists, researchers and renowned professionals in all the different fields of its activity. It also establishes strong connections with the most important Portuguese ICT and management businesses both for the purpose

of its professional traineeships and for technical collaboration and research, thus providing the students with a close connection to, and immersion into real work environments.

2.1. African international students at the School

The premise that education opens up possibilities for a better future, together with the fact that the School's offer is focused on the currently highly employable professions makes the students coming from the Portuguese Speaking African Countries show a strong interest in its education and training offer. This is partly due to the historical ties the PALOP countries have with Portugal, but also to the opportunities for academic and social-economic development and enhanced social, professional and personal growth.

Thus, in 2019/2020, the School totalled around 110 enrolled students, out of whom 51 were international students from the PALOP countries [4]. Their origin and numbers are shown in Figure 1, where it can be observed that nearly half of them came from Angola, and more than a quarter from Cape Verde.

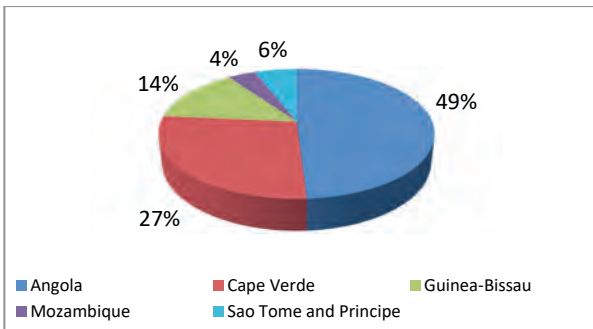


Figure 1: Origin of African students enrolled in 2019/2020

Now, Figure 2 shows the data on the course preference among African students enrolled in 2019/2020. Most of them chose the first cycle of studies in Computer Engineering (Angolans, Cape Verdeans and Guineans). The students from Angola also had a strong preference for the first cycle of studies in Oil Engineering, while Cape Verdeans also showed some interest in the higher professional technical course in Administrative and Management Assistance.

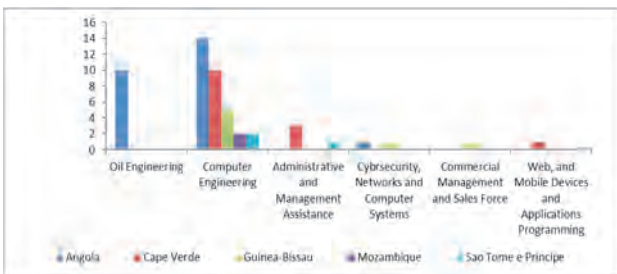


Figure 2: Course preferences among African students enrolled in 2019/2020

In 2020/2021, the Jean Piaget Higher School of Technology and Management showed a substantial growth in the number of students when compared to

the previous academic year, and thus had around 200 enrolled students. 25% of them came from the Portuguese Speaking African Countries [5]. Their countries of origin and numbers are distributed as shown in Figure 3: there was a decrease in the number of students coming from Angola and Cape Verde while the numbers of students coming from Guinea-Bissau showed an important increase.

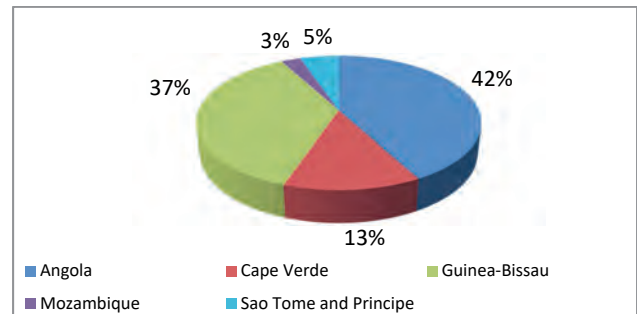


Figure 3: Origin of African students enrolled in 2020/2021

Finally, Figure 4 shows the data on the courses the School's African students chose to enroll into in 2020/2021. Overall, they continued to prefer the first cycle of studies in Computer Engineering. The strongest preference was once again shown by Angolan students, who also continued in the first cycle of studies in Oil Engineering. Besides, there was an increase in the Guinean students' preference for higher technical professional courses, namely for Cybersecurity, Networks and Computer Systems, and for Web, and Mobile Devices and Applications Programming.

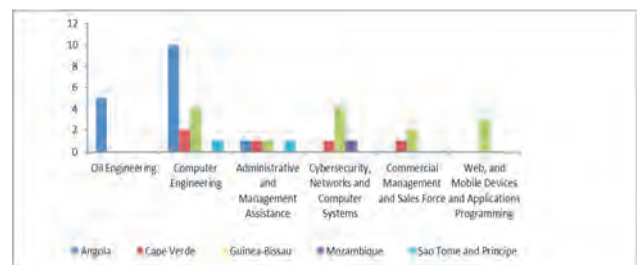


Figure 4: Course preferences among African students enrolled in 2020/2021

3. Opportunities

The existence of the Piaget universities in Angola, Cape Verde, Guinea-Bissau and Mozambique, which were built from scratch and equipped with all the resources necessary for quality higher education, makes this close relationship with the higher education in Portugal another opportunity for young Africans. This is why the Jean Piaget University of Angola appoints professionals who promote the Institute's higher education in Portugal, which justifies the strong interest and presence of Angolan students at the School.

Another example is the Jean Piaget University of Cape Verde, which gives a lot of importance to partnerships with the Jean Piaget Higher School of Technology and Management. They involve the participation of the

School's teaching staff in local higher education courses, such as the on-line lecturing in the Master's in System Engineering and Computing, as well as the University's efforts in the dissemination of the post-graduate non-degree awarding courses developed by the School. The latter was clearly shown by the marketing strategy applied to local social networks focused on the digital, which has resulted in a great interest among the University students and the general and specific public in taking part in post-graduate non-degree awarding course in Cybersecurity and Data Protection for Public Administration Services. Cybersecurity is indeed a rapidly growing field, but also a crucial one since nowadays there is a constant exposure to cyberattacks in less protected digital environments.

4. Some challenges

Receiving international students requires the implementation of a well-structured and focused logistics. Despite the existing cultural similarities with Portugal, African students may prove to have quite some difficulties in a variety of situations, such as academic and/or even standard Portuguese, social and academic insertion, financial instability, unknown or complex administrative and bureaucratic procedures, homesickness, etc. These are the challenges the Higher School of Technology and Management faces with an academic support structure that focuses on topics such as higher education functioning and procedures, studying and learning strategies, and language support for proficiency in standard and academic Portuguese, as well as on counselling for the teaching and non-teaching staff on the good practices for the reception, guidance and follow-up of African students.

5. Conclusion

Taking into account the recent history of the Jean Piaget School of Technology and Management, it may be estimated that the perspectives for the 2021/2022 academic year are good since they indicate that the number of African students is going to keep on the rise. It can also be considered that the number of partnerships among the higher education institutions of the Piaget Group will increase. As it has already been said, according to the Strategic Plan of the Piaget Institute and the Jean Piaget School of Technology and Management, they are intended "to strengthen [their] presence [...] at the international level and to reinforce the dynamics of teaching and research partnerships and exchanges both within the Group and with other international entities" [6]. These partnerships will contribute to further consolidate the School's updated and contemporary education and training potential that is offered to all its students, and especially to those coming from the African continent in search of better life perspectives through higher education opportunities. The Jean Piaget School of Technology and Management believes that it clearly focuses on the current trends in

ICT development, and makes every effort to ensure that its education activities, as well as the activities connected to businesses and the surrounding civil communities make a positive difference for the students who choose it.

Acknowledgements

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Collaborative Online International Learning (COIL): The case of DUT

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The South African Higher Education system has traditionally focused on a model of internationalisation that relies mainly on physical student and staff mobility. The vast majority of local students, however face challenges when accessing the benefits of internationalisation in higher education due to lack of funding and consequently hampering participation. In recent years, at the Durban University of Technology (DUT), the pivotal focus to address curriculum transformation is through internationalisation and decolonisation of the curriculum activities and practices. In order to increase the opportunities for students to interact with global issues and broaden their perspectives, DUT has incorporated Collaborative Online International Learning (COIL) and International Virtual Engagement (IVE) as a teaching tool.

1. Introduction

COIL is an innovative pedagogy that was developed by the State University of New York (SUNY) approximately 16 years ago. COIL is both an academic content lesson as well as an intercultural communication and collaboration experience for both students and academics residing in different countries within the context of a course.

2. COIL at the Durban University of Technology (DUT)

DUT was the first African university to implement COIL in 2016 and is widely considered the leading institution on COIL in the continent. In 2020 DUT became the first African institution to be included as a Global Network Partner in the SUNY COIL system. The university has to date successfully completed approximately 60 COIL projects.

The DUT strategic plan ENVISION2030 is strongly aligned with the concept of inclusive internationalisation. One of the objectives of ENVISION2030 is to provide a distinctive education and produce adaptive graduates. COIL plays a crucial role in accomplishing this objective. The success of COIL is such is that it offers some of the internationalisation benefits of international mobility programmes at DUT where participation is limited to a few students due to a lack of funding. COIL provides an alternative means for students to interact with global issues and broaden their perspectives. It is an innovative way of learning from leading academics and to gain knowledge about different cultures by online contact with overseas students without the need to travel. Moreover, embedding COIL into the curriculum has contributed to internationalization of the curriculum at DUT. It has enhanced the quality of the teaching programmes by bringing an international learning perspective to the classroom and developing a greater understanding of international diversity.

COIL at DUT plays a significant role in promoting internationalisation at Home by bringing the benefits of internationalisation to all DUT students and academics.

Some of the COIL activities at DUT include:

- Professional Development for Staff
- Welcome to COIL
- Getting Started with COIL
- Weekly COIL Lunch meetings
- Igniting COIL – Launch in 2020
- COIL one on one Coaching for staff
- COIL Mentoring

There have been enormous benefits of incorporating COIL at DUT for staff, students and the institution. Students that have participated in these projects have expressed that some of the benefits of being part of the projects is that it had given them the confidence to aspire to study abroad as previously they had lacked the confidence to do so. It had also improved their intercultural communication skills by meeting and interacting with students from other countries. COIL has enhanced the academic standing of the institution and has led to new partnerships and the strengthening of existing partnerships.

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Contributions from the 3rd International Week 14th – 18th June 2021

Hochschule Mittweida, Technikumplatz 17, 09648 Mittweida, Germany

Africa is the second fastest-developing region of the world and over the next 30 years its population is projected to double to 20 percent of the world's population. Africa's transformation towards self-sufficiency requires to establish sustainable economic growth that keeps up with the rapid population expansion. While ten of the fastest growing economies in the world are in Africa, more as half of the countries of the continent belong to the most fragile countries in the world weakened by various challenges like political instability, poverty, child labour, lack of education and illiteracy, food insecurity, high burdens from infectious diseases, and violence. Additionally, Africa and Europe have to tackle other common challenges such as climate change, digital transformation and sustainable development. The aim of the International Week is to reflect on the current EU-Africa partnership, especially in the field of higher education, share results and best practices and discuss challenges and future directions. Therefore, we welcome contributions covering all possible fields, e.g. governance, gender inequality, education, infrastructure (e.g. transport, energy, water, ICT), environmental sustainability and climate change, poverty reduction, peace and security, public health, intercultural dialogue, and migration.

Disruptive Innovation: Can we remove international mobility barriers with online internships? *Alejandra Vicencio, Northumbria University, UK*

"Non-traditional students have faced huge barriers to gaining work experience overseas. As educators, how can we be sure to provide equal access to resume-building, global opportunities? Is it possible that technology can offer a solution in some cases and help to internationalise an entire group of previously overlooked students? In this session, a panel of key stakeholders (a university, a student, and a provider), will explore the difficulties some students face when it comes to gaining international work experience and provide some solutions to widen access to global opportunities via online internship programs. Using student-case studies and university perspectives, the audience will gain insight into how innovative programming can create new pathways when it comes to helping those that lack funding, those that have family obligations, those that have a disability, and those that are simply unable to gain such experiences by being physically overseas. This new path provides those students with the opportunity to build skills, raise their intercultural awareness, and compete on level footing with their peers on the job market."

The role of CSOs in Strengthening European-African partnership in Higher Education for community development

Hedwig Ngwa, University of Buea, Cameroon

Higher education generates knowledge for universal consumption. The local communities in line with their occupations provide the space for experimentation and take up of the concepts and theories developed by Higher education to enhance welfare and build resilience. Local communities on their part possess indigenous knowledge that could enhance universal scholarship but lack the outlets to disseminate it. This study argues that a gap exist between Higher Education and local communities that restrict development. In similar

manner, Eurocentrism and Afrocentrism exhibit voids that constrain cohesion, inclusion, partnership and collaboration in Higher Education between the continents. Within the context of the sustainable development goals that advocate inclusion and partnership, this study seeks to examine the role of Civil society organisations (CSOs) in bridging the gap between Higher Education and local communities with the view of enhancing European-African partnership in higher education. To attain this main objective, this study seeks to answer the following specific research questions:

1. How has African European relationship in Higher education been with focus on Eurocentrism and Afrocentrism?
2. What is the role of Higher Education in community development?
3. What is the role of CSOs in community development?
4. What are the challenges in establishing collaboration between Higher Education and CSOs?

A mathematical model on the transmission of visceral leishmaniasis

Looli Nemer, African Institute for Mathematical Sciences – AIMS, Cameroon

Visceral leishmaniasis (VL) is one of the most important endemic diseases in World, Serious epidemics have claimed the lives of thousands of people. Recently, the disease has spread outside established endemic areas, and a huge number of cases occurred in regions with a previously low incidence. To helps to control and eradicate the disease, we have developed a mathematical model which to describes the transmission of the disease, using the clinical and epidemiologic features of VL. The model considers three populations: humans, reservoir animals and vector flies. The effective reproduction

number is used to study which parameters have the highest effect in the transmission of the disease.

False-negative RDTs – a hole in the ship of malaria control and eradication in Africa

Pierre M. Ngougoue Ngougoue, Hochschule Mittweida, Germany

One of the cornerstones of controlling *P. falciparum* malaria is the use of rapid diagnostic tests (RDTs), recommended to confirm infections prior to treatment with Artemisinin-based combination therapies (ACTs) as a measure of containment of antimicrobial resistance. *P. falciparum* histidine-rich proteins 2 and 3 (pfhrp2 and pfhrp3) emerged as the most appropriate and popular antigens targeted by RDTs. However, increasing prevalence of parasites with pfhrp2 and/or pfhrp3 deletions is severely challenging proper RDT-based diagnostics by yielding false-negative results, potentially leading to improper treatment and an undetected reservoir for malaria transmission. Understanding the evolutionary process underlying the origin and the spread of hrp2/3 gene deletions is urgently needed to sustain reliable and cost-efficient diagnostics. The impact of the potential evolutionary mechanisms can be studied by mathematical models tailored to the specifics of malaria transmission, characterized by the presence of genetically distinct parasite haplotypes within infections due to multiple infective contacts (multiplicity of infection, MOI). We introduce a predictive model to study the evolutionary dynamics of hrp2 or hrp3 deletions. Particularly, the interplay between transmission intensity (MOI) and the spread of deletions is explained in detail. The model shows that selection on hrp deletions originating only from delayed treatment due to false-negative RDT results on emerging haplotypes with deletions is much stronger in areas of low malaria transmission than in areas of high transmission.

The IRESSEF – an institution conducting public health research in Senegal

Ambroise D. Ahouidi, Souleymane Mboup, The Institute for Health Research, Epidemiological Surveillance and Training - IRESSEF, Senegal; Kristan A. Schneider, Hochschule Mittweida, Germany

Doing research in Africa and mainly in Sub-Saharan Africa is a really challenge. There is a limit funding opportunity and most come from international donors and sponsors. There is also a poor research policies and infrastructure and a lack of synergy for a more collaborative research. All these difficulties have led to a lack of an appropriate research system and cause often a brain drain mainly by young scientists.

To remedy this gap in research in West Africa and mainly in Senegal, Professor Souleymane Mboup on the eve of his academy retirement, thought of setting up a research and training institute of international level which will allow scientists from Senegal and elsewhere to find all they need to carry out their work.

The « Institut de Recherche en Santé, de Surveillance Épidémiologique et de Formation (IRESSEF) » or “Institute for Research in Health, Epidemiological Surveillance and Training” in English is a not for profit Public Institution based in Dakar, Senegal with US 501C3 equivalency certifications from organizations such as the Bill and Melinda Gates Foundation (BMGF) or the Ford Foundation. IRESSEF has state-of-the-art modern laboratories which have achieved International Organization for Standardization (ISO) 15189 Plus accreditation through the Public Health Agency of Canada. IRESSEF has extensive experience in International Research Collaborations and Network Coordination. We have state of the art laboratory facilities, including core facilities for molecular biology, immunology, virology, and a BSL-3 lab. We also have on-site clinical facilities for clinical studies and patient sampling. We have ongoing collaborations with clinical cohorts across Senegal and West Africa, and a biobank with validated samples of serum, plasma, and PBMC from across West Africa. The team has a extensive experience to implement surveillance strategies on several disease such as HIV, TB, Malaria etc.

IRESSEF is a government recognized non-profit institute. The institute partners with both national and international organizations under the direct supervision of the Senegalese Ministry of Health. IRESSEF within its 6-story building hosts several platforms: molecular biology, immunology, biobank, clinical trials, biochemistry, bio-security level 3, bacteriology, and virology. The institute involve mainly in global health research, disease surveillance, training, systems strengthening and capacity building programs in West Africa.

With the advent of covid-19, Iressef was one of the first labs to screen for covid in Senegal, but also to work closely with the minister of health in decision making. It also plays a primary role in research on the SARS-COV2 virus. This is how we were the first to identify a variant of SARS-COV-2 in Senegal. We also trained health workers mainly in the region of Thies in Senegal on the differents steep on how to collect (oropharyngyal and nasopharyngyal swabs) and all the steep from the pre-analytique to the post-analytique. We also organized a training module on quality control and security in lab. The institute is also carrying out various research projects on Covid-19:

- SARS-COV-2 virus sequencing
- Evaluate alternative collection methods
- Performance and intrinsic value evaluation of several rapid diagnostic tests
- SARS-CoV-2 IgG Ab prevalence among specific group (general population, first responders, person with comorbidity).

Today, our main goal on covid-19 research is to: Continue monitoring for mutants; investigate the pharmacovigilance and the efficacy of the vaccine; monitor the evolution of IgG antibody over time.

Despite the covid-19, we continue to carry out our research and training activities in other areas such as HIV, TB, malaria etc.

The vision of IRESSEF is to contribute to improving the health of populations through research, and Training and our mission is to support public health policies through research, diagnosis, surveillance, training and technical Assistance. All this is do in respect of ethics and professionalism, quality, innovation, solidarity and mutual commitment but also diversity and openness.

Diversity measures

Arlinda Sadiku, Kristan A. Schneider, Hochschule Mittweida, Germany

The African continent faces substantial obstacles in its transformation towards economic self-sustainability. These include social, income, and gender inequalities, political instabilities, climate change, rapid urbanization, and environmental changes endangering biodiversity. These challenges are unanimously considered to be of cardinal importance. Hence, attempts to properly quantify diversity, change, or inequality must be of equal importance. This can be done by diversity measures. Despite their range of applications, in practice, choosing an appropriate measure is difficult, as there are many diversity measures throughout disciplines, which are difficult to compare across studies. This is also true because many measures are simple transformations of each other, leading to numerical values at different scales. While many measures have been criticized for their drawbacks, one fact has been greatly overlooked: almost all common diversity measures (or simple transformations) fall into the same general class, subsumed by a one-parameter family of measures. By reporting a continuum of diversity measures, as a function of a tilting parameter, a more complete picture is obtained, which subsumes all advantages of competing diversity measures. Based on a solid theoretical foundation, we adapt the ecological concept of alpha-, gamma- and beta diversity, to obtain a framework that allows studying patterns of diversity among subgroups at different temporal and spatial scales. Our approach allows studying diversity patterns by a simple graphical approach. As an example, we apply this method to gender income datasets of Africa and population socio-economics and water access in Ghana.

Bioinformatics in Ghana: The WACCBIP Story

Vincent Appiah, Elizabeth Gyamfi, Angela Parry-Hanson Kunadu, Lucas Amenga-Etego, Collins M. Misita, Lydia Mosi, Francis Dzabeng, Gordon A. Awandare; University of Ghana, Ghana

The advent of high throughput technology and improvement in computing platforms has led to the generation of a plethora of biomedical datasets, particularly -omics

data (genomics, transcriptomics, proteomics etc.) These data are generated to understand various aspects of infectious diseases including the pathogenesis, symptoms, metabolic pathways, to discover new therapeutic targets, treatments and cures. To derive insight and identify hidden patterns in these datasets require specialized skills in the field of bioinformatics. This presentation will talk about how the West African Centre for Cell Biology of Infectious Pathogens (WACCBIP) is applying scientific computing to understand diseases. WACCBIP located at University of Ghana founded under the World Bank African Centers of Excellence program in 2013 and has grown into a leading center building global partnerships with world-class research institutions and funding organizations including funds by the Wellcome Trust. WACCBIP's mission seeks to improve the diagnosis, prevention, and control of tropical diseases in sub-Saharan Africa by providing advanced-level training and research excellence in cell and molecular biology. Prioritizing world-class training, we have established our short-term, medium-term, and long-term training programs, producing yearly cohorts of brilliant scientists at both master's and doctoral levels.

Complement component 5 (C5) missense mutations alter the longitudinal risk of pediatric malaria and severe malarial anemia

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Severe malarial anemia (SMA) is a leading cause of childhood morbidity and mortality in holoendemic Plasmodium falciparum transmission regions. To gain enhanced understanding of predisposing factors for SMA (Hb<5.0g/dL), we explored the relationship between complement component 5 (C5) missense mutations [rs17610 (3947C>T, Ser>Asn1310) and rs17216529 (451C>T, Val>Ile151)], malaria, and SMA in a cohort of

children (n=1,487) over 36-months of follow-up in western Kenya. C5 variants were selected based on their ability to impart amino acid substitutions that can alter the structure and function of C5. We performed bidirectional elimination stepwise log-linear regression (R glm function, family=Poisson) to explore the relationship between C5 genotypes/haplotypes and the number of malaria and SMA episodes over the 3-year follow-up period. Potential confounding risk factors such as age at enrollment, sex, HIV, bacteremia (presence/absence), sickle cell status, G6PD deficiency, and α -thalassemia were adjusted for in the model. After adjusting for multiple comparisons, longitudinal analyses revealed that inheritance of the homozygous mutant (TT) at locus 451 enhanced the risk of malaria (RR=1.144, 95%CI: 1.059-1.236, P=0.001). The CT haplotype enhanced the risk of malaria (RR=1.068, 95%CI: 1.017-1.122, P=0.009). Consistently, the TT genotype at the 451 locus that increased the risk of malaria also increased the risk of SMA (RR=1.627, 95%CI: 1.201-2.204, P=0.002). The haplotype containing both wild-type alleles (CC) decreased the longitudinal risk of SMA (RR=0.679, 95%CI: 0.542-0.850, P=0.001). Collectively, inheritance of the investigated C5 missense mutations influence the longitudinal risk of malaria and SMA in immune naïve children exposed to intense *P. falciparum* transmission.

Panel discussion: Africa's Young Future - Turning Potential into Prospects

Gunter Süß¹, Gabin Ananou², Nessma Adil Yousif¹,
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Africa is a young continent - not with regard to its history, but rather, in terms of demographic composition. In 2020 approximately, half of the population of Africa was younger than twenty years old, compared to about 21 percent in Europe (UN World Population Prospects, 2019). The challenge for African nations, but also for a mutually beneficial African-European partnership, will consist of improving prospects for young generations of Africans and Europeans. Those prospects include the economy (opportunities for gainful employment), the political system (robust democracies with opportunities for participation, especially for women), and individual identity formation processes. The urgency of the situation is intensified by the effects of climate change, health crises (HIV, malaria, etc.) and current migration movements. If the African nations are successful in improving prospects for their youth, Europe and Africa will both benefit.

Gunter Süß:

Ladies and gentlemen, my name is Gunter Süß, and I'm vice director of the IKKS, the Institute of Competence, Communication and Languages. And I'm delighted to welcome you tonight on behalf of the institute, the international office represented by my dear colleague, Dr. Julia Köhler, who will be responsible for the social media discussion tonight and quite generally Mittweida University of Applied Sciences.

The panel discussion that we are hosting tonight is part of the third international week at our university, which is entitled "Strengthening European African Partnership Challenges and Opportunities". For Tonight we will be narrowing the topic a little bit down when we talk about Africa's young future turning potential into perspectives. [...]

Africa is a young continent, not with regard to its history, but rather in terms of demographic composition. In 2020, approximately half of the population of Africa was younger than 20 years old, compared to about 21 percent in Europe. The challenge for African nations, but also for a mutually beneficial African European partnership then, will consist of improving prospects for young generations of Africans and Europeans. When Julia and I prepared this panel discussion with our guests we were often times talking about a speech that the former German head of state, the former Bundespräsident Horst Köhler gave in November 2017. Köhler was referring to giving African youth a perspective as "Die unterschätzte Menschheitsaufgabe", the underestimated task of mankind. Köhler quoted a study of the International Monetary Fund that until 2030, about 18 million jobs will have to be created in yearly Africa... yearly to absorb the number of youth entering the job market. As the Federal Minister for Economic Co-operation and Development, Gerd

Müller, stressed in his welcoming remarks this morning, Africa is now facing a severe recession.

And most African countries do not have the resources to finance the massive economic stimulus programs that the U.S. or European countries can finance. And this is only one aspect of the pandemic. As Müller also stated this morning, only two percent of Africa's population has been vaccinated. One third of all developing countries have not received a single dose of vaccine. The pandemic has been burning lands for existing inequalities and discrimination. So, when we go back to Köhler's speech the situation is even worse now. But I think that the three different realms that Köhler mentioned in his speech, where prospects are needed, are still very valid.

They include the economy, opportunities for gainful employment, the political system, robust democracies with opportunities for participation, especially for women and youth, and identity formation processes. In the discussion we had prior to this evening, we added the health care system. And it is not so much about COVID 19 here, but about malaria, an area that our graduate students specialize in and HIV, especially in southern Africa. Fifth, we could add climate change, also an area that one of our guests specializes in. And sixth educational system. If the African nations are successful in proving prospects for their youth, Europe and Africa will both benefit. I don't want to be sensationalist here, but we need to address this very clearly. If not, we will probably see violent unrest and unprecedented migration movements. Having said this, we want to focus on a constructive approach discussing both the chances and the challenges, the potential and the problems.

We have invited competent guests for this panel discussion, who I want to introduce. Our first guest is Dr. Gabin Ananou. He is Program Director at the German Aero

Space Centre in Bonn in charge of the establishment of the African Climate Competence Centres, which are a joint initiative of Federal Republic of Germany and sixteen countries in western and southern African regions responding to climate change. He was ambassador for Togo, and if I'm not mistaken, he is the youngest ambassador ever to serve in Germany. Is that record still valid?

Gabin Ananou: Yes, it is.

Gunter Süß:

It is, ok. Dr. Ananou got the Doctor Honoris Causa from the Federal University of Technology in Akure in Nigeria, for his tremendous engagement for the development of Africa and is Associate Professor for International Cooperation and Climate Diplomacy at the University of The Gambia.

On a day like this it is also important to note that one of his three sons, Frederick Ananou played for the German national team of junior players under the age of 20 and is currently under contract in the second Bundesliga with SC Paderborn. Dr. Ananou, welcome.

Gabin Ananou: Thank you very much.

Gunter Süß:

Our second speaker is Dr. Hedwig Ngwa, who holds a PhD in gender and Developmental Studies, as well as the Masters and Bachelors Degree in Geography. She is a geography teacher at Government High School, Great Soppo Buea. Furthermore, or rather at the same time she is part time lecturer of Gender and National Resource Management in the Department of Women and Gender Studies at the University of Buea and part-time lecturer of gender and local governance at the National School for Local Administration in Buea Cameroon. Hedwig is a civil rights activist who is doing a lot of work in several NGOs and associations, especially focusing on gender, environmental and developmental issues. She is the author of the book "A Gender Perspective on municipal solid waste generation and management in the city of Bamenda, Cameroon" in 2019, which shows the overlap of questions of gender and the environment. Join me in welcoming Dr. Hedwig Ngwa from Buea, Cameroon.

Our next speaker is Nessma Adil Yousif, who is a master's student at our university and a PhD candidate at Chemnitz University of Technology. Mrs. Yousif was born and raised in Sudan, but also attended AIMS, the African Institute for Mathematical Sciences in Limbe, Cameroon, which is only as I get it, a few kilometres away from Buea. Mrs. Yousif works in Mittweida in Professor Kristan A. Schneider's Group on Infectious Disease Epidemiology and Global Health. She has been awarded a scholarship by the MasterCard Foundation and DAAD and recently co-authored two papers on the COVID 19 pandemic and also presents a poster on the subject, as I heard here in the International Week. Her research interests include mathematical biology, epidemiology. Oh, that was a good one. Epidemiology. Very difficult word. And global health. Please welcome Mrs. Yousif.

Last but not least, let me introduce our fourth guest, Professor Dr. Andreas Wrobel-Leipold, who is professor of media management here at our university and dean of studies of the master's programs, media and communications science. He wrote his master's thesis on "Developmental help of the Soviet Union and China" in Africa and completed his Ph.D. in political science with a book entitled "Konflikt und Massenflucht in Tropisch Afrika", which translates roughly conflict and mass exodus in Tropical Africa, published with Peter Lang. Professor Wrobel-Leipold worked and studied numerous times in West and East Africa. And additionally, I can tell you that he's my partner in crime as we jointly teach the multiple cultural studies in the BA-program, global communication in business and culture. Welcome, Professor Wrobel-Leipold.

You know, when I talk to my students I very often refer to quote from the African American philosopher, a theologian and activist, Cornel West, who said, "whenever you talk about something, whatever this is, historicize, contextualize and pluralize". And here we are talking about Africa as if this was a very homogeneous entity or something. I wanted to start the discussion in asking Dr. Ananou. When you think about the countries you work with or also you have expertise in, what are the challenges they face? Do you agree also with Horst Köhler's observation on the most important challenges and issues?

Gabin Ananou:

Thank you very much. Thank you for inviting me to this event. I'm very delighted to be here and also to share with you my expertise and my knowledge about this wonderful continent. I am born myself in West Africa. Africa is a big, big place. It's a little bit difficult to pretend having enough skills and to talk about the whole continent. So, this is why I will limit it. I will limit my statement only on some of the countries in West Africa where I used to work and where I used to interact with people.

You know, Africa is a wonderful continent and I'm always delighted every time I get there. But the most, the biggest challenge for people is really to go to bed in the evening and to wake up in the morning. Because between the two times, they don't know what will happen in the night. There are so much challenges. There is so much risk. They are so much disasters. And managing all those challenges every day is not an easy task. In particular for families, but also, we know that women play a big role in the African society. It's not easy at all for women to manage all those risks and disasters every day.

But also, when you travel to Africa, you will gain a kind of hope because you will see a lot of movement going on. You will see a lot of people getting more excitement of what the future could bring to them, because it is a continent in movement, a continent bringing everyday changes. So, when you go tomorrow to Nigeria, you will see that 10 years ago, some of the development was not

possible. Today, you have big roads, you have clinical services, you have transportation, you have sanitations. All those changes are coming step by step, they are there. The same challenges are to notice when you travel to the southern part of the continent. So, every day people are working up, try to manage themselves. It's not easy.

But from our perspective here, we have seen a lot of hope, a lot of good changes. And this gives us more confidence to give more engagement. And to have to develop strategies at our level, but also to try to find strategies in the cooperation with our African partners to help them sustaining the situation they have or to help in developing new solutions for the continent.

Gunter Süß:

Thank you. Dr. Ngwa when you. Oh, I see there is no doctor Ngwa at the moment, so maybe Mrs. Yousif can you relate to what Dr. Ananou just said? So, the confidence, the hope for change that is coming, if you think about the countries you have lived in, Sudan and also Cameroon.

Nessma Adil Yousif:

Well, for me, I'll start with saying that I really like what you said about Africa being like we refer to it as an entity. We might not like, all the countries might not have the same culture or the same background, but we share the same struggles and we share some of the challenges.

So, for me, if you thought us of Africa as a house, then the African countries are the walls and the African people are the bricks. For me, the real challenge is everyone should know their place in building this house. Every brick should be put on top of the other. Every wall should be in a certain position in order to build a whole strong house.

So for me, I can relate to what Dr. Ananou said, because I understand that. I am coming from Sudan. It has a little, but if I can say a different culture from the African countries, because it's an Islamic conservative community. But I was very grateful actually to have seen other African countries. I've been to Cameroon for a year and a half. The people might dress differently, speak another language, but the basics are there, their challenges are there, there are people starving. The job market is not as open as you want it to be. The youth are still not certain of their future. So, yeah, the challenges are there.

The good thing is recently and I can say this confidently, because a recent event in Sudan that happened in 2019 was a start of a revolution. So, you can see that the people are becoming more aware of what they can do, more aware of where they want to go and more aware of what they want to achieve.

Gunter Süß:

Ok. Prof. Wrobel-Leipold where does Europe come into play in this equation or in this? Well, yeah, the relationship with the African continent?

Andreas Wrobel-Leipold:

Well, we are in the game for at least 150 years. And most of the time we had plenty of good advice for Africans. And as it turned out, most of our advice was not as effective as we hoped. So, I think, we should be very, very careful in telling Africans what to do and what to leave. We should analyse first, and our recommendations should be very, very decent, because I think most of the problems we are facing now are due to European deference for almost 150 years, be it problems, demographic, political, economic and what else.

Gunter Süß:

Ok, so when we talk about this, rather, if I got you correctly, Eurocentric perspective of offering help, how could it be Dr. Ananou how could it be that we do not, well, trap ourself in this, you know, like paternalistic view on Africa from a Eurocentric perspective? I mean, tell us about your work, how you on a day-to-day basis, try to really establish a mutually beneficial relationship, partnership.

Gabin Ananou:

You know, in the past it has been very simple. We have conceived the plans. We have conceived the solutions for the challenges in Africa. We went there. We had money, enough money, and we said, ok, we would like to help you, but at our conditions. So, you take it or you leave it. But today, you know, we have a lot of experts who have been capacitated in Europe or US coming from Africa, and they are going back to Africa to help their continent growing up. Those people who are also from the young generation, they have enough capacities to find a specific solution for their own problems. So, what we have changed now in our approach in the cooperation with Africa is not to design a solution for them, but to jointly design a solution with our African partners for Africa. And it is working very well.

Gunter Süß: Ok.

Gabin Ananou:

So, what we do is, for example, to express their needs, what do they need to find solutions for their problems, for their challenges. And in most of the cases, the responses are fairly simple. We need more human resources. We need more experts. We need people who are from here, from the continent, and who know about our challenges and who can help, not to find directly a solution, but to define the way to a solution. And this is what, for example, the German government is doing. This is what I'm responsible for, partly in the framework for our project. We do select young scientists in Africa and we give them the opportunity to do their Ph.D. or to do their masters by working on very, very specific solutions for their countries. And it's working very good. And the last five, six years, we have capacitated about 300 students who are now in very responsible positions in the countries in the government developing new solutions for the challenges, but also becoming at the same time ambassadors for the Federal Republic of Germany.

This is what we are doing to support the countries. We are not giving any more cheques. We are not giving any more money. We are not giving any more money to some of the organizations to go and develop solutions in Africa. So, we are putting, we are investing now in human resources, so that African partners, African young scientists are themselves in the position to develop and to find more and better solutions, specific solutions for the problems.

Gunter Süß:

How does this, if I understand correctly, your special task there is developing solutions in the realm of climate change and what this means. So how does this work? You said you work with 16 universities and there are always two people from, if I got this correctly, from the university, maybe you can elaborate a little bit more what the specific approach to climate change is there.

Gabin Ananou:

Climate change is the basic problem in the most of the West African countries. If you go to Niger, people are suffering oftentimes. They don't have water. This is the reason why they migrate from Niger, for example, to Mali. By doing this, they are occupying spaces which don't belong to them. So, when they go there the population in Mali is for example, is angry and this brings some conflicts in the region. The same happens between Niger and Burkina Faso. So, if you go down to the coast. So, where we have more water, for example, when it rains you have water everywhere [...], people have to move from a place to another one. And the part of the population suffering for this is mostly the young generation.

So, what we do is that we propose to some of the countries, joint solutions. For example, at the coastal region we know that they are suffering of coastal erosion. So, all the countries having these problematic. We put them together and we ask them to select experts who go, for example, to a specific university to get capacity building and become later experts on coastal erosion and then later develop specific solutions for the countries on the coast. If you go to Mali, we have put there a program on climate change and agriculture bringing from each of the West African countries one expert. They go there, they get a stipend from the German government for three years to do the PhD in climate change and agriculture. This helps them become an expert. And they go back after their study and help the country developing specific solutions for their country.

The most interesting part of this is that one. We in Germany, we only cooperate scientifically with the highest, really best – Japan, US, France. But now we are reversing the cooperation trained approach by also trying to work with our developing countries partners. Because when we go now for big negotiations on climate change, they are the one coming there to discuss with us. They are the ones now supporting our position because we are giving them the opportunity to be capacitated and then to understand how the world, the entire world works. So, by

doing this they are helping them to find solutions for the country.

We are producing experts for the government and for the countries, and they are in the position really to find specific solutions for their own country. By the way, because it's important to mention this. You know, for example, GIZ has been working for many years in the region, in Africa. GIZ is not having the same position now in the countries because GIZ is not more bringing only solutions. GIZ is going to Africa to work with African aspects. We were supporting the countries in that perspective.

Gunter Süß:

Thank you. Is that the approach that could help, actually? That could avoid the mistakes from the past?

Andreas Wrobel-Leipold:

Yes, indeed. It sounds very helpful and if you said we should not just cooperate with the very high-rise technology institutions. I think it's ok. We should also put into focus that there is a very high potential as far as small and medium sized enterprises are regarded. That's where the jobs can be created and that's where Africans really fit. There is a lot of initiative. There is a lot of expertise. You don't need so much high technologies. Among African craftsmen I found really geniuses. I remember a car mechanic in Ghana. We had no brake liquid and he said, no, it's no problem. There is a special kind of beer which serves as well as the officially licensed brake liquid. I don't know what kind of beer it was, but it worked. It's a lot of practical expertise and what these entrepreneurs need, it's not just money. What's also needed is the rule of law. That the bills are paid that the customers are paying, that they can rely. Well, we make a fair deal. I'll give you my services, I'll give you my goods and you give me the money. And if not, there is the law which will be enforced if you fail your obligations.

Gunter Süß: So, the basic stability, what we said as robust.

Andreas Wrobel-Leipold: The rule of law.

Gunter Süß: Yes. Rule of law. I see that Hedwig Ngwa it is now with us. Can you hear us Hedwig? Welcome.

Hedwig Ngwa

Good afternoon, everybody. I am glad to be back. I'm sorry for being in and out. Just one of Africa's problems. I'm suffering from power shading and so I'm having some shaky connections as well. Yes, I am back. I'm glad to be back. Good afternoon, everybody.

Gunter Süß:

Good afternoon. Doctor Ngwa, when you think about Cameroon and what we just discussed here in regards to two other places, is something like a robust rule of law a basic need that would serve Cameroon? At this moment in time, when we talked in preparation of this meeting, we talked about the armed conflicts that are happening in Cameroon or have been happening for the

last few years. [...] I guess we have some technical problems. [...] We were talking about a robust rule of law as something essential for developing opportunities for Africans. Can you relate to that in regard to your home country, in regard to Cameroon?

Hedwig Ngwa:

I will say that I appreciate what the former speaker already raised about Africa and African challenges. Yes, Cameroon, like most African countries, is also experiencing some of these challenges and that of the rule of law. Well, we are currently in Cameroon and at the moment in a political crisis.

There is need for us to be able to address this. Unfortunately, that is not happening. That could be attributed to the lack of situations in addressing the law and that law, which is supposed to be based on human rights, and I'm afraid we have some of those challenges and therefore we find ourselves in the insecurity in the crisis. At the moment, we have lots of insecurity. A lot of uncertainties. And we can be so certain that we can talk with conviction about what tomorrow has. So, truly we are suffering from some lack or some application or in application of the right kind of laws. I would appreciate, if you can probably refreeze or enlighten me a bit more if I got the question right or if there's something we need much more. The connections are a bit cheeky.

Gunter Süß:

Maybe you can tell our audience a little bit about the situation in Cameroon at the moment, because I don't think that everyone in Germany knows about the situation right now.

Hedwig Ngwa:

Ok. Thank you very much. Yes, about four years ago and running the regions of the north west and the south west of Cameroon have been in a crisis and this resulted from our history in one way or the other.

Cameroon is a country of bow cultures. We have descendants of the French colonial impact and we have those of the English. So, it's a country where about, with 10 regions and about eight regions of this country, have a French culture. So, we call those among the francophones and then we have the anglophones, who inherited the English culture based on the fact that the mandated nations of the United Nations given it to England and to France.

So, these two regions over time view marginalized, because of the fact that our power sharing, decision making seemed not of evil then. Also because resource distribution it's not equitable. And yes, there has been this tussle and unfortunately some four years back, actually in September 2016, the teachers and the lawyers staged a protest. This protest was asking for a readdress of the situation where they feel marginalized and the need for power to be for decision making and resources to be equitably distributed. Unfortunately, this protest was responded to by military repression. And ever since people

have been to jail and it has deteriorated from just a protest so an outright war. At this moment in the southwest and in the northwest regions of Cameroon where I belong, we are having serious challenges. It is on a day to day basis. I remember the first speaker, that said that you sleep in the night in Africa, you don't know how your morning is going to look like.

Exactly, that is what it is for us. Sometimes it's not all the sleeping in the night. I'm wondering whether you're going to see the next morning but even in the course of the day, it is still very hard for us. So that is where we are exact now. Thank you very much.

Gunter Süß:

Now, when you sketch the conflict between English speaking and French speaking ethnicities in Cameroon. Now, I was wondering about the impact. Is there still so much impact coming from colonialism or is this something we could address as neocolonialism? You were talking about resources and resource distribution and so on. What would you say? Is this a direct thing, herited from colonialism?

Hedwig Ngwa:

Ok, thank you very much. I would clarify the fact that the insecurity or the war that is currently reaching Cameroon is not between the English speaking and the French speaking. It is between the English people speaking and the government. So, I think I would like to clarify that. And as to whether it is, as a result of colonialism or it is as a result of current par dispensation. Yes, it will be a combination of both. By virtue of our history there has been this high level of dependence. Given that you still have the influence of the colonial past on the current governments. This colonial past, as we now see in new colonialism with the impact of be it French-Africa be it English-Africa, be it Sino-African relationships. All of that we still have that background there. And by virtue of the way these two cultures are one which seems to be a culture of dependence, a culture when I will put it like dependence on the past, where the colonies and the teachings at the time was more oriented towards serving the West, serving the colonial powers and not serving the indigenous. It means that even the mindset, means that even the curricula for teachings on all of that made them to be dependent. So, we can link that back to colonialism in a way. As of now, yes, we can also say that it is as a result of the current par dispensations. So, the issue of equitable distribution of resources, it remains problematic and it is necessary for Africans, for Cameroonians to be able to take that responsibility.

I'm going to shift a little from the fact that yes over the so many years we have the influence of colonial past. That is true. It has a long arm. But it is also about time that we as Cameroonians, we as Africans, also take that responsibility, which is us to do equitable distribution of resources.

I think, that if our governments did that we likely wouldn't have been where we are today. So, it is not always blaming the colonial powers, but also blaming ourselves as at today as to why we are not recognizing the needs and recognizing the importance and the values of every citizen and giving them equitable opportunities.

Gunter Süß:

Prof. Wrobel-Leipold you were heavily nodding your head, so I guess you want to remark on that.

Andreas Wrobel-Leipold:

Cameroon right now is a twofold colonial heritage. The first part is that the borders in Africa are colonial borders. As you might know, Cameroon originally was German administered. But after World War One, it was divided. The smaller part, it was administered by the British and the larger part by the French.

After independence in 1960, both parts came together. So now the other colonial heritage came into the game, and this is what I might call the colonisation of thought. It's far beyond French fantasy that there might be one state with two languages or even two different administrations. France is strictly centralized. They expected its colonies to act as the French are doing. So, it's quite logical that the Cameroon government is against any kind of autonomy in a certain region, be it justified or not. No, it's against any principle of a French way of governing.

To give you an example of how the colonization of thought works. French were very eager to educate, in inverted commas, to educate the colonial subjects as if they were French. And this was not only during the colonial times when in their history classes African kids had to learn our answers to the galls "Unsere Vorfahren – die Gallier". This took place up to the 80s. I remember a 12-year-old girl, far in the hinterland of Benin, and she was learning, she was doing her homework. She had to learn a poem by heart. And I said, oh, what are you learning here? Oh, I'm learning a poem. What kind of poem? Oh, Victor Hugos "Sur la liberté de l'ame". It's Victor Hugo "About the freedom of soul".

And I think, philosophy is a very, very nice thing. But I think that as a rural African girl, you need other capacities and abilities than learning Victor Hugo by heart.

Gunter Süß: Yes, Mr. Ananou you want to respond?

Gabin Ananou:

What I don't understand is. How the politicians are seeing the future of their own countries? We are talking about colonialism. Yes, that caused a lot of damage, but it's long known. It's long far back. Why the politician, the head of state, the ministers are not taking responsibility to do something and to develop their own country and give young people and their population a new perspective. Why are they not doing this?

If we take the case of Cameroon, it's very simple. The government is happy that the ethnics, the groups are fighting among each other. So that they can have their

peace, they can have time to take all the resources and sail to foreign countries. This is a pity, but this is what is happening. It is the case in Cameroon. It is the case in Côte d'Ivoire. It is the case in Togo where you go everywhere but we are seeing a light of hope. That the new generation coming up, will not accept that anymore. This is the reason for conflicts, in our political conflict in some of the countries. And then the change will come, if they want or they don't want.

It's time for the political leaders in Africa to take responsibility and conceive priorities, develop priorities for their own country. This is not happening. It's not accepted that the French president travels to Cameroon or travels to Côte d'Ivoire or travels to Benin to tell them what they have to do. It is not acceptable that the sign countries cannot join their force to combat the activism in their region. And we need the French army to come and occupy the country for many years to support them. But we know that Africa, the African countries, Cameroon, they have all a lot of resources, natural resources, but also financial resources to face the challenges and find solutions for the country. This is not happening.

If we want Africa, if we want the country to develop, if we want the countries to give young people good perspectives, we need to change the whole political environment. Without peace, without democracy, any change will not be possible. This is my point of it.

Andreas Wrobel-Leipold:

Well, I agree completely with you. But it's not just politicians who are unable to learn. Sometimes citizens are unable to learn as well. I remember the fact that in the early 80s, Benin had a revolutionary government and not everything a Marxist does is nonsense. But what the revolutionary government tried to do was to change the textbooks of elementary schools and secondary schools and they said the young people should learn more about agriculture, how to fight disease. They should learn more about the African reality and maybe less about French philosophy. And what the government earned was a lot of protests by teachers, by students who considered the Africanisation of textbooks as a step backwards, as a step towards underdevelopment. That means they have lost their self-confidence and they have lost the pride of being Africans. And I think that's a pity.

Gabin Ananou:

The problem here is just the time of the transition. Africa is in a phase of transition between the old world to the modernity. This is what we are, and the leaders must take time to plan and have a strategy how to do this and this is what is not coming. We need it. You know, it's not anymore. If you go to Togo. I went last time to visit my family and then I visited someone and the young doctor was hearing the music someone was playing two weeks before in Köln, in Cologne.

People are thinking at the same level, actually. We need just to see for the African countries, what are the priorities and we define them because someone who is there to the mondialisation is also able not to copy, to see what is happening elsewhere.

But how should we organize this mutation from the old world to the new world? We spoke about the laws. Africa and African society is based on laws, but archaic laws. Now, how can we move from there to the modernity, to modern laws system so that people can also feel comfortable and help developing their country? This is the biggest challenge.

Gunter Süß:

Mrs. Yousif you wanted to.

Nessma Adil Yousif:

Yes, I push back a bit the subject to colonization, because I relate to that problem in Sudan, too, because during the colonization in Sudan, we had a centralized governance. The capital, like all the politicians, if I can say, were centralized in the capital and then from there to the other, like, states. So again, this problem is still there. All the, if I can say, the change on modernization, civilization is happening in the capital, in certain regions, and the other states are marginalized and ignored.

We have a true problem of resources allocation. I mean, people don't, like, cause conflicts without reason. They're just pushed by their instinct to survive. They want to eat. They won't fight if they weren't hungry. So, again, it's resources allocation and the problem or the good thing or the hope is that the youth are becoming aware. They know what they want. They know where they want to go and they want to be part of the change.

As you mentioned, moving to modernization is a problem. But again, and as Dr. Wrobel-Leipold said, it's not just the politicians, it's a 50:50. It's like a teacher and a student. A teacher should do his job, but the student should, like, study, too. So, the politicians should do their job. But I mean, if there is no reaction from the people, then that change is not going to happen.

So, again, as I mentioned area recently, there was a revolution in Sudan like led by the youth. What you hope to see then is that finally those people are fighting for themselves and fighting for their country and fighting for the future. Nobody wanted to go to Europe or another country, African country. I mean, if you don't have a link with this place, there is no drive for you to make it better. So, the reaction of the politicians, I mean, the right one you would expect is, ok, those people now are aware, those people know what they want. Now we can work. Yeah, but the reaction is now against to oppress them, to like take them back to, if I can say their seats. And the politicians are just looking for more room to again benefit or more room to corruption or more room to just like look at themselves regardless of the other people.

So again, and there's the point you mentioned, again, some African countries are still having their curriculums

studying the history of U.S., history of Europe. Nobody's reading about their countries. How can I work for my country if I don't know anything about my country, if I don't know my identity, if I don't know why am I working for this place to get better, who I'm working for? So, yeah, it's now a kind of a copy, attitude. They just see Japan, they see Europe, and they just want to copy everything in Africa thinking this is civilization, this is the way to move forward.

But as you mentioned before and the prior discussion, I mean, the guy knew that they could put the beer and the car problem will be solved. They know their environment. They know how to make it better, and they just want to do that themselves. I think there it's time for politicians to give them that chance to express themselves rather than the politicians trying to bring experts from abroad to work in the country they know nothing about and they have no real benefit of working there.

Gunter Süß:

It's both then in a way. It's on the one hand, the kind of mindset what you mentioned Prof. Wrobel-Leipold, the colonization of the mind or of the thought and then on the other hand, the very basic, everyday knowledge in comparison to these folk processes.

Dr. Ngwa, I saw you raised your arm. I don't want to let you out of this discussion.

Hedwig Ngwa:

Thank you very much for all the input. I just want to add that, yes, today African leaders should take responsibility for that very strongly. Where Africans themselves and say, in my situation, Cameroonians themselves should be able to take a responsibility. I will still link up to the fact that Africa, Cameroon, all these are countries and continents within the global setting and within this global setting, the international organizations, be it the U.N., be it the African Union, be it the European Union and be it the independent rich countries of high levels of democracy. I think, that they still owe Africans, still owe Cameroonians and they owe them the responsibility to be able to raise their concerns to be able to call their governments to order to be able to address their problems.

I think the concern I'm having is, that the international bodies are not taking enough responsibility or not giving, in my situation, the crisis in my country, the kind of attention that I think it should deserve. So, it is not enough to say that, yes, colonialism is out of this. But we live in a global world. What happens in one country affects the other. But more so, the other countries that are stronger than others and they are members of international unions. Those unions that advocate for human rights, advocate for equal opportunities and all that should be able to give attention to the concerns of this country and particularly that of Cameroon. Thank you.

Gunter Süß:

Thank you very much. I look at the clock and I think we are at the time where we can open up the discussion to

questions from, now that we have an audience again, we can open up the discussion to the audience if there are questions from the audience. No questions? I wouldn't have thought that something like this could even happen? Kristan A. Schneider is in the house and there's no question? (laughing) Ok. Yeah.

Nessma Adil Yousif: Need a little push.

Audience (Kristan A. Schneider):

Thank you all for these very interesting contributions from all sides. Now we hear a lot of challenges. But what would be the solution? What can be done from within the country? What can one do? Like Nessma said, Mrs. Adil said it very, very picturesque. The African people are the bricks of the house. What can the brick do to make, to finish up the house and make it a palace? The question to everybody.

Gunter Süß: Ok, who wants to answer?

Nessma Adil Yousif:

Ok. I will answer. If you went back to the house, so I'll go back to the house, too. Before you build the walls, you actually dig the ground to put the basics. And actually, I think that's where we should go, the basics of the problem. For me personally, it always goes back to education. In Sudan, for example, we still have 50 percent illiterate females and 30 percent illiterate males. People still don't have the awareness of the importance of education.

I think, really, we should go back to the basics. We should have curriculums that relate to the country. We should have an oriented education. If you know that you want farmers, then that's the oriented education. You have to produce farmers. Everything should go back to the basics and like a step back to see the roots of the problem.

Gunter Süß:

And you also told me, when we discussed before, that the teaching style is something that very much concerns you. Can you elaborate a little on that? What's behind that?

Nessma Adil Yousif:

The, if I can say, educational manners, if I can't say that, it's the same. I mean, it's not in Sudan that the teachers actually have the minimum wages. So, they're not motivated to do their job. They don't have enough training to do their jobs. So, that's for me where the problem is.

Gunter Süß:

But there's also the driving force for you, if I understood you correctly? You know, become a teacher even then and to change this. So, but there is, you know?

Nessma Adil Yousif:

Yeah, basically my interest is the educational system. And so, again, as you said, like the... I'm sorry, as you mentioned, I mentioned, is that the teachers teach in the same manner: they take a book, they take a joke, they write lines, students have to copy. They say the same things, the same every year and that's how it happens like since I can remember.

I'm a master's graduate. I'm like I have a master's degree. From elementary or less at kindergarten until I got my bachelor's degree. That's eight years in elementary, three years in high school and five years in university, I was taught by many different people, but they were teaching the same way. There was no creativity. There is no extracurricular activities. No, like there's nothing, just basically academic. And the same way we have written exams, there are no other option, no oral exams, nothing. Everything is the same, strictly. I mean, it really blocks the creativity of the students, too. If the teachers are doing the same thing, then the students are doing the same thing. The parents are revising the lessons with their kids the same way. There is nothing, no room for creativity.

I think, they're kind of killing the spirits of the students that way. The kids can be very energetic, very hungry for knowledge, and then they just, like, get stuck on the system. And that's what's just what you produce. Finally, people who have no creativity, no drive like nothing.

Gunter Süß:

Actually, we have a teacher on the panel, doctor Ngwa. Can you relate to that? Of course, you are a different kind of teacher. I can really imagine that.

Hedwig Ngwa:

Oh, thank you very much. I was a teacher and I have been teaching in secondary school for over 25 years or so. I must say that teaching in my country is a bit more dynamic. And maybe as an individual, based on the experiences of a heart. I also see that teaching is a bit worrying when you don't teach at the right level. Teaching at the right level is very important because when you teach at the right level, then you're able to transmit the knowledge on to your learners in the way that they can understand.

It is important to note that the teaching, and particularly the curricula that has informed teaching in most of our institutions, has been, maybe the issue of eurocentrism comes in again, had been defined from that perspective. Increasingly Africans and Cameroonians getting what their needs are and it becomes necessary for a revision of most syllabuses or curricula. It is therefore important that we do teaching based on competencies. It is also important that we can do teaching which is 14 years hands on teaching. So that even the persons who are in the community who have been to no classroom where they learn even A, B, C can also still be to unveil the order such that the teaching is relevant.

What I'm talking about is trying to address the teaching and the education that we have in most of Africa and in Cameroon. The question is, do students have access to this education, one. Two, is that education, yes, it is available. Do they have the access? And thirdly, how relevant is the education or the curricula to the African, to her own development and to the country's development?

So, we need to revise especially our curriculum, to be able to address the local needs of the population while equally situating them within the global context. Teaching should therefore be such that it meets the minds of the 21st century mind. They should be able to do some critical thinking. They should be able to do some team building. They should be creative. They should be innovative such that the teaching can bring relevance and transform the minds and transform their economies. Teaching and education, of course, remain key. We can only insist and most insist that that teaching should be done at the right level and that teaching should be such that is relevant to the persons, to the learner and to the community.

I think, the teaching should now focus more on participatory teaching. I think that's one thing that, it's absent in some places. Like the example she gave, the teacher who come and read the book and all that, as though this candidate or the student has no prior knowledge or no mindset of her own and cannot contribute. Today, we are talking about competency based, we're talking about participatory teaching where you tickle the mind of the learner so that the learner can contribute, whatever the one is learning and you can equally value and exploit what skills the learner has which are hidden and build on them. Thank you very much.

Gabin Ananou:

I think on the teaching, sometimes we have the impression that the governments they do it at purpose because they want to keep the population in that situation. If they are better educated, they will understand more. It's not for our interests for them to reorganize, to reform the whole system, so that people are better educated.

Another point is the more important for me, it is the pre-school education and education of the children at home before they go to school. In most of the societies in Africa the rules are pretty fine: girls and boys. It's the same here, but in another way. It's so defined that women who have more responsibilities in the management of the society, they don't have this right. And girls, they don't have the right to go early to school, at the same time as boys. I think, it's, we need to do more there and explain to the populations. I know it's the job of the government to take care of this by changing the mentality.

We know that girls and women, they are supposed to the definition of the whole that's supposed to be at home and serve the whole society. It's not good, if we can change the foundation of the society by changing that rule. We see more women coming up, we see more women having the chance to have capacity building. In my program, for example, I have to go to some of the families and negotiate with the husband and with the family that the young scientists, women, female scientists can go about and get capacitated. It is incredible.

And that is something that is still happening. But it's related to the definition of the role of the woman and the

girl in the society. And this needs to change. If we don't do that, we can't change, we can't do any reform in the teaching process. We can change all the curricula at the school or at the universities. But if we don't change the foundation of the rules of the society, it will be difficult.

Nessma Adil Yousif:

Yeah. If there's an Arabic saying, saying that a mother is a school. If you taught or developed the mother, then you're reaching out for generations to come or you're teaching our generations to come. I think, that's a really important point.

Gunter Süß:

Thank you. With regard to time, I'd like to ask Julia. Are there any questions from the social media so far?

Julia Köhler:

Yes, there are two questions, and the one is actual fitting very well now, because Mr. Ananou just talked about this topic. This question was posed to Mrs. Ngwa "What are special challenges for women when looking at perspectives for Africa's youth?" [...]

Hedwig Ngwa:

The challenges for women. Ok, thank you very much. Like the professor just said, talking about women in education, it is quite an issue. When we look at gender-based violence one of them is denial of resources amongst many. And these resources can be the fact that this young girl is deprived of education. And once you're deprived of education, then what happens is that the opportunities are limited. I just share this very quickly, which are shaped everywhere, that I'm a daughter of a woman who really wanted to go to school, but was taken out of the classroom. We're talking about the 1950s here in Cameroon. She was taken back out of the classroom home and she was told "girls do not go to school". There is no future for a girl child in education and that she should go home and work so that her brothers could go to school. She was kept home and she never went to school. Years down the line, when her mother started seeing women participate in politics, participate as teachers and in the community, she started regretting. My mom said to herself, I didn't go to school, all my children will go to school. I will work so hard to make sure that they get to where they really want to kind of get.

Mainstreaming gender in education is very important. The cultures around deprived women from going to school because they expected to be home and serve the community. This same woman who do not go to school turned out to be mothers and mothers who are illiterate, and that has a very great impact on the development of the future generations. Our cultures, yes, need to be addressed and aspects of them which are repugnant to justice, like depriving them of education. It's very important for revision.

What does it mean, don't go to school? It means that the contribution to productivity is limited. It means that

women's practical needs, yes, can be met. They'll provide for them electricity at home, they'll provide for them water at home to be able to wash clothes and cook food.

But then there are strategic needs, which means that they cannot be transformed from just being caregivers to being contributors to growth. I very much by the idea and stating that there is a problem when women don't go to school. It is a problem in Africa, but I must also add that increasingly things are changing. Many years back, it was when I got to the university and for example, when I started staying around the University of Buea here when I studied in 1993, statistics will show us that at about, at the beginning, you had about 40-60 percent representation of female male in the university. And that said, today we are talking about the 50 plus women's representation and less than 50 for the men over the male.

So that changes. It also highlights the fact that we remain a gap between male and female representation in core sciences with the male in favour of the male population. However, there has been an increase, increasingly you have many more young girls daring into traditionally stipulated or traditionally perceived subject areas, like, you getting more girls, moving into science, into technology, into physics and all of that. I will at look it strongly for the fact that having to address women and the culture is very important for us to attain some level of growth. Thank you very much.

Gabin Ananou: Absolutely.

Gunter Süß: Ok. Does anyone want to respond or shall we have the second questions? Second question, please.

Julia Köhler: Ok, the second question is for Mr. Ananou. What is your wish for Africa for the future?

Gabin Ananou:

My wish for Africa is the total independence in the sense that when representatives of Africa go to international places, to international conferences, so that they are also in the position and they are also capable to articulate a message which is their own and which is important for them to show the peace of Africa in the new world.

We have gone now to most of the challenges and to get there, it would be necessary to start by reforming the society, by producing a sane environment to the populations to grow and by thinking about the redistribution of resources to the entire population or part of the population and by giving the basics, the basics for life to population, water, medical services, food, because food is the central challenge in some of the society, in some of the countries.

When people, they don't have enough to eat, there cannot be peace. If we do all those reforms step by step, by taking time to prepare the solutions jointly from Europe,

from U.S. and from Africa together. I think, I don't know if I would be here to see the results, but it would be a good step in the right direction.

Nessma Adil Yousif:

I agree and I can totally relate to what he's saying. I mean, what you want to see is, for example, back in my country, those basic needs. I mean, like water, power and electricity and the health system. I mean, if you didn't provide those things, which are the basics, the basics for development, then people always think of those basics: What will I eat tomorrow? What would I do if I got sick, my children? So, if you didn't solve those problems or if you didn't provide those basics, they're thinking we'll still be trapped in those, if I can say, like, trivial things, because this shouldn't be the focus of the Africans, everyone should again have their own room to grow and a room to achieve more than just worrying about what am I going to feed my children tomorrow.

Gunter Süß:

Dr. Ngwa, you also wanted to add something? I saw you raising your voice.

Hedwig Ngwa:

Now just going to add to what you just said about the wish for Africa. Africa being independent. It is very important for Africa to be independent. And it rests with the African leaders picking the right decision and taking up being determined to take the decision to be independent.

I was running through some southern regions and I got in it when I understood that the African Union, our structure is built by China. Yes, while it is true that you want to get your receiving aid, then it is also said that he who pays the piper dictates the tune and to understand that the African building was bocked electronically just shows how dependent Africa and African leaders are. And when it was discovered, it was just okay to say that or we are sorry, we are going to take out these connections. We are sorry, that happened. It is about time African leaders and Africans take responsibility to know what they want to receive as aid and what they don't want to receive as aid. I think that when you decide what you want to receive as aid why it may be thought, they don't know who is ready to go with your agenda or provide their aid.

And when it comes with strings and agendas of they don't know, then it becomes problematic. I go with Mr. Ananou about the fact that African leaders should take responsibility and get Africa independent.

Truly we wish and look forward to that day, even when we become ancestors. Thank you.

Gunter Süß:

Ok, these are almost closing remarks, but we have two or three more minutes. I want to ask whether there is anything else in the in the social media. No, no Social media. Are there any questions from the audience here? No more questions here? Prof. Schneider, please.

Audience (Kristan A. Schneider):

We heard now a lot about what should be done. Maybe you can comment a bit on the burden of infectious diseases and how that is challenging the economy in a way that developing a sustainable economy that actually is not further burdening the environment, a product consequence that climate change plays a role and how to deal? How can infectious diseases be there? And how much is in the African heads, that is really the number one problem and none of the politicians but on Mr and Mrs Average?

Gunter Süß:

Who wants to answer? The infectious diseases question, is this something for you?

Gabin Ananou:

The situation is very simple. If you don't have a healthy population you cannot drive the development of the country. We know that when we are sick, we don't give the same performance as we should. In some of the countries, a big part of the population is sick. People are not having drinkable water. People are not having good food. They are not healthy. They cannot perform properly. Those people are the ones who are supposed to drive the economy of the country, who are supposed to work many hours per day and bring good performance, good statistics for the country. It's not possible.

In most of the countries, you know, they don't have a politic for sanitation. They don't have politic for medical care. And what is very astonish is that big organizations like WHO they encourage, the country's in the mystic. Because the more they have a sick part of the population, the more money they get from those organizations. So, this is what we are seeing also with Covid. If you go now to Africa, some of the countries, they don't have a high level of infections, but they declare intentionally that they have more so that they can get money from abroad. This is a very, very tricky situation.

But once again, I'm going back to the point of the responsibility. If you have responsible people, responsible leaders, and this is the case in some of the countries in Africa. It is there! If we have more of those good leaders who are thinking about the population, that are thinking about the development of their country. I think that the growth of the continent will speed up, will be better and we will see frequently what is going to come. Sometimes we from Europa also doing the mistake, because we want to be present. We want to be visible on the ground. We want enter into competition with China. But I'm very sorry to say this, the pressure of the population makes the situation very, very difficult for the government. They are ready to accept any kind of aids to solve and to feed their population. And we enter in this competition with them. We are not anymore seeing the development of the countries of the population. We are only seeing our own interests. It's in the move, it's changing because our partners on the ground they don't accept those kinds of behaviours anymore.

But it will take time. But we need to do more in that sense and this will be great for the development of the continent. If we don't do that, we must be ready to receive the immigrants coming every year to the Mediterranean and they will arrive.

We cannot stop them. We will do everything to do that. And we will do everything to stop it. But we cannot, we cannot hold them back in Africa. Once they have crossed the Sahara. They are already there. They are close to us.

Gunter Süß:

Okay. Thank you.

Nessma Adil Yousif:

I will just add. The thing about Africa is that the infectious diseases prevalent there are actually the poverty related diseases, malaria, HIV, tuberculosis. So, yes, again, the solution, again, the leaders should take responsibility and I think that, again, takes us back to education. Because an educated person, I mean, like when you know, well how can I say it? Better are taking care of themselves, they're better, like, thinking straight, then like find names and then just go to achieve them.

For me, of course the solution to poverty is education. The solution, of course, to illiteracy is education. The solution to have an economic development is, again, education.

Gunter Süß:

Ok. Thank you very much. I think we almost come to close. Another question? Yes, sir, please.

Audience (name unknown):

My question will center around political instability and corruption. I want to ask that. Is there a way in which partnership between Europe and Africa can end a political instability and corruption without a kind of second colonialism?

Gunter Süß:

Ok, who wants to answer that? How could the fight against corruption and democracy not get into a second form of colonialism?

Andreas Wrobel-Leipold:

It's a very, very deep-rooted problem, because you should know the politicians, they are corrupt because of selfishness, of course. But corruption also stems from the fact that if you are the man in power, your relatives, your friends, everybody is expecting that you are giving something to them because they in turn, gave you something before. It's a give and take. If you as an African politician would say, no, I won't take any bribes, I will be absolutely not corrupt. I think your relatives will turn against you and they will tell you, well, we financed your studies, we gave you the money that you could go to America or somewhere else. We made you a big man. Now you are so ungrateful. Shame on you. If you turn your back to your relatives in Africa, it's comparable to an European whose ends all his insurances who drops

out of social insurance. Who stands on his own. And that's impossible.

If you want to end corruption, you have to alter the social structure into what family's doing in Africa, is done in Europe by bureaucracies, by insurance companies and so on. What do you want? Do you want the family system that works that is helpful, but is through solidarity or do you prefer anonymous bureaucracy?

Gunter Süß: Ok.

Gabin Ananou:

I think, because of the issue the youth in Africa has the possibility through elections to put the sanction. If you are young, you can vote and you know that your political leaders are not corrupt. You have to use your vote during the election to put a sanction.

This is the only option I can see to solve the issue by keeping the great familial ties. But also putting a system in place which will help to change the system by eliminating partly corruption.

I totally agree with the definition. In Africa, what we call corruption is not automatically corruption there because of the societal ties, but accepting resources illegally or selling the natural resources of the country illegally and keep the money on his own pocket or in an account abroad. This is what will not happen anymore. And young people in the countries, they have the opportunity to election just to show the red card.

Gunter Süß:

Okay, thank you very much. I think we come to the end of our panel discussion. And if I think about it, there were two concepts that were reappearing again and again. One was 'relevance' in regard to which kind of education to that African countries should see what is relevant for them in the first place when we talked about agriculture or whatever, you know. And the second one was 'responsibility'. Responsibility on all levels of society, not only in politicians, but also in families with mothers and fathers as you said, you know, like the first part of the education, the first school is your mother or something like that.

So, those were the two concepts appearing and reappearing again. And I'd like to thank you all. I'd like to thank Dr. Ngwa from Cameroon, Mrs. Yousif, Prof. Wrobel-Leipold and also Gabin Ananou. Thank you very much.

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