

RWESCK ANNUAL REPORT 2022

SUBMITTED TO SECTOR ADVISORY
BOARD (SAB) AND INTERNATIONAL
ADVISORY BOARD (IAB)

RWESCK MANAGEMENT

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RWESCK ANNUAL REPORT 2022

EXECUTIVE SUMMARY

As an Africa Centre of Excellence, the Regional Water and Environmental Sanitation Centre, Kumasi (RWESCK) is committed to its mission of building capacity in Ghana and the sub-region to meet the needed critical mass of human resources with expertise in water resources, water supply, climate change resilience, and environmental sanitation. In this report, the activities of RWESCK spanning January to December 2022 are presented. The report captures various sections on academics, admissions, delivery of postgraduate courses, short courses, partnership, financials, and the proposed 2023 Annual Workplan.

PARTNERSHIPS AND DEVELOPMENT IMPACT

This year, as part of the vision, to build capacity for industry and impact the community, the centre collaborated with industry partners and stakeholders in the areas of training and mutual benefit. To assess the centre's impact on students, a tracer study was carried out which indicated that 98.9% of the ninety respondents would recommend RWESCK programmes they studied. Additionally, the centre engaged communities on Global Handwashing Day to promote literacy in WASH.

ADMISSIONS AND DELIVERY OF SHORT COURSES

In the year under review, the Centre enrolled a total of seven-four students comprising forty-six master students and twenty-eight doctoral students, following which all PhD students have successfully embarked on their internships tailored to enable students to develop industry-based expertise, with only one yet to complete. Five professional short courses were successfully organized, with recorded national and international participants totalling hundred and fifty-two.

PROPOSED 2023 ANNUAL WORKPLAN AND LABORATORY COMMERCIALIZATION

The report further captures a proposed budget along with a work plan for the oncoming year of 2023. The planned activities in the work plan shall be undertaken by the Centre with the support of the Vice-Chancellor of the institution, Centre Staff and Partners. The Centre's budget for 2023 is USD \$ 904, 803, to be funded with

ACE and IGF funds.

Additionally, the second building has been completed, currently undergoing an allocation exercise under the supervision of the office's allocation committee. Meanwhile, successful commercialization of the Laboratory is underway since the operationalization of the X-ray diffractometer.

CONCLUSION

The Centre with the help of its staff has achieved its targets for the year under review. The Centre can be said to have performed well in the past year in the actualization of its vision and mandate for the year 2022. With the continual support of the Sector Advisory Board (SAB) and the International Advisory Board (IAB), the Centre will move on to greater achievements in the year 2023.

1.0 Introduction

The [Regional Water and Environmental Sanitation Centre Kumasi \(RWESCK\)](#) is a World Bank Africa Centre of Excellence project under the Department of Civil Engineering, KNUST. Phase I of the project commenced in 2013. Through the RWESCK's overarching aim of impacting Ghana and West Africa, at the call of the proposal of the World Bank in 2018, the Centre got a renewal of the project. In total, the Centre has received about 13.5 million USD from its donor. RWESCK continues to build capacity in water resources, environmental sanitation and hygiene.

Ghana and the Sub-Saharan Africa region are faced with a number of emerging environmental challenges including but not limited to freshwater scarcity, water resources management, climate change-related floods in peri-urban and urban areas and water-food-energy security, environmental sanitation and hygiene problems. It is in this light that the [Regional Water and Environmental Sanitation Centre Kumasi \(RWESCK\)](#) has tailored its programmes to equip students with skills to help curb the problems confronting Ghana and Africa at large in order to attain Sustaining Development Goals (SDGs) and Africa Union Agenda 2063.

The Centre exists to be a recognised hub in advancing knowledge and expertise in water resources, climate resilience and adaptation, water technology, waste management and environmental sanitation. [RWESCK](#) is committed to providing cutting-edge research to address challenges and a conducive environment for teaching for the industrial and socio-economic development of Ghana and Africa.

2.0 Partnerships and Development Impact DLI 2

PARTNERSHIP COLLABORATIONS

The Centre continues to collaborate with industry partners and stakeholders in the areas of training and mutual benefit. A meeting was held between RWESCK and GSA to discuss capacity building of GSA Staff, joint research collaboration and graduate internship placement at GSA's technology and innovation departments. GSA agreed

to build the capacity of their staff at the Centre, work hand in hand with RWESCK to offer laboratory commercialisation services to the general public and accept graduates from the Centre to train them to acquire needed skills for the job market. The Ghana Standards Authority again undertook training on ISO/IEC 17025:2017 to prepare and introduce technical staff to standardisation processes.

In the year under review, teams from the African Centre of Excellence for Water and Sanitation (C2EA) and the University of Abomey, Calavi, all of Benin visited the Centre for discussions. The Chief-of-staff of the Monrovia City Council, Liberia also visited the Centre. All three institutions want to partner with the Centre on capacity building, student and staff exchange and research.

TRACER STUDY REPORT

The Centre sent google forms to its past students to ascertain their impact in their various workplaces. Specifically, the Centre wanted to assess its contribution to the number of RWESCK students in the water and sanitation industry, the positions of past students as well as their experiences and their testimonials. This was aimed at improving students' experience in the future. Ninety students out of one hundred and ninety-seven students responded to the survey. It was discovered that 90% of past students are employed, 86.2% have jobs related to their field of study, 24.4% are in the water supply and resources industry while 34.3% are in education and training, 27.8% of alumni are supervisors at their places of work while 21.1% are managers, 98.9% would recommend RWESCK programmes they studied to others and 90% would choose RWESCK if they had to start all over again.

SELF-EVALUATION REPORT (SAR)

RWESCK has made good progress to realise impact. Specifically, the Centre has built strong relationships with organisations in the field and the Centre is actively working on ways to support students in creating start-ups and spin-offs. The Centre also has created a masterplan programme to create societal impact, which will likely have large impacts in the future. The Centre organises follow-ups of its activities such as internships and forums, which allows the Centre to receive feedback and keep its approach tailored to the needs of the community and students. The Centre scored four (4) out of a total of five (5).

COMMUNITY ENGAGEMENT

Global Handwashing Day

The Master of Science class of the Centre celebrated Global Handwashing Day 2022 at Ampabame in the Ejisu Municipality. The theme for 2022 was "Unite for Universal Hand Hygiene". The colourful ceremony took place at the Ampabame Basic School.

The activities held to mark the celebration included a talk, handwashing drill, games and the presentation of toiletries by the Centre. The headteachers of the Primary and Junior High Schools were grateful to the Centre for choosing their school among the many in the Municipality.



Group picture of RWESCK and pupils of Ampabame Basic School at the Global Handwashing Day celebration



Group picture of RWESCK and pupils of Ampabame Basic School at the Global Handwashing Day celebration

3.0 Enrolment of Postgraduate Students (DLI 3.1 & 3.2)

ENROLMENT IN 2022

The Regional Water and Environmental Sanitation Centre Kumasi currently has seven-four (74) students. Forty-six (46) of the students are at the master's level while twenty-eight (28) students are pursuing doctoral programmes.

Table 1: 2021/2022 Enrolment Details

Programme	2021/2022 Enrolment	Regional Students	Ghanaian Students
PhD Water Resources Management	11	3	8
PhD Environmental Sanitation and Waste Management	10	1	9
PhD Water Supply and Treatment Technologies	7	1	6
M.Sc. Water Resources Engineering and Management	22	6	16
M.Sc. Water Supply and Environmental Sanitation	24	5	19
Total	74	16	58

The Centre advertised the following programmes to attract prospective students:

- M.Sc. Disaster Prevention and Management
- M.Sc. Environmental Sanitation and Waste Management
- M.Sc. Water Engineering
- M.Sc. Water Supply Engineering and Management

FRESHMEN ORIENTATION

RWESCK held an orientation on 12th January, 2022 to welcome its freshmen from their various destinations to KNUST campus. Key personnel in the University as well as industry players were invited to welcome the students. The Centre crowned the event with visitation to the library, counselling office and the International Programmes Office.

TRAINING OF STUDENTS

As part of the Centre's partnership with the University of Bologna (UNIBO), a student from the Centre travelled to Italy for three months exchange programme. Other students have been selected to join UNIBO programmes held online.

GRADUATION RATE

For ACEs one and two, a greater number of students have graduated from both MSc and PhD programmes. The table below shows the statistical data for enrolment and graduation.

Table 2a: Graduation Rate

Programme	Year of Enrolment	Total Number Enrolled	Number graduated	%
PhD Water Resources Management/PhD Environmental Sanitation and Waste Management/ PhD Water Supply and Treatment Technology (all programmes)	2015/2016	18	18	100%
PhD Water Resources Management/PhD Environmental Sanitation and Waste Management/ PhD Water Supply and Treatment Technology (all programmes)	2016/2017	10	10	100%
PhD Water Resources Management/PhD Environmental Sanitation and Waste Management/ PhD Water Supply and Treatment Technology (all programmes)	2017/2018	16	9	56.25%
PhD Water Resources Management/PhD Environmental Sanitation and Waste Management/ PhD Water Supply and Treatment Technology (all programmes)	2018/2019	10	1	10%
PhD Water Resources Management/PhD Environmental Sanitation and Waste Management/ PhD Water Supply and Treatment Technology (all programmes)	2019/2020	20	4	20%

Table 2b: Graduation Rate

Programme	Year of Enrolment	Total Number Enrolled	Number graduated	%
MSc. Water Resources Engineering and Management/ MSc. Water Supply and Environmental Sanitation	2015/2016	25	25	100%
MSc. Water Resources Engineering and Management/ MSc. Water Supply and Environmental Sanitation	2016/2017	47	47	100%
MSc. Water Resources Engineering and Management/ MSc. Water Supply and Environmental Sanitation	2017/2018	39	38	97.43%
MSc. Water Resources Engineering and Management/ MSc. Water Supply and Environmental Sanitation	2018/2019	46	46	100%
MSc. Water Resources Engineering and Management/ MSc. Water Supply and Environmental Sanitation	2019/2020	43	35	81.39%
MSc. Water Resources Engineering and Management/ MSc. Water Supply and Environmental Sanitation	2020/2021	31	13	41.93%

For PhD students 2018/2019 and 2019/2020 have not completed their four years of study.

DOCTOR OF PHILOSOPHY (ENVIRONMENTAL SANITATION AND WASTE MANAGEMENT)

Table 3: Doctor of Philosophy Graduates

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
1.	20481313	PG7266416	ADDO, Priscilla (Miss)
2.	20527520	PG1848717	APPIAH-BREMPOG, Miriam (Mrs.)
3.	20474361	PG7266116	ASARE, Wilhemina (Mrs.)
4.	20445980	PG1849417	OSARENOTOR, Osayomwanbo

DOCTOR OF PHILOSOPHY (WATER SUPPLY AND TREATMENT TECHNOLOGY)

Table 4: Doctor of Philosophy Graduates

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
1.	20484993	PG7266916	MENSAH-AKUTTEH, Hanson

MASTER OF SCIENCE (WATER RESOURCES ENGINEERING AND MANAGEMENT)

Table 5: Master of Science Graduates

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
1.	20646271	PG9655919	AZAGONOR, Samuel
2.	20674286	PG9656219	COMMODORE, Nii Martey Isaac
3.	20669206	PG9656419	INKOOM, Emmanuel Osofo Amoah
4.	20660882	PG9656619	LARWEH, Festus Aidoo
5.	20662774	PG9656719	OBENG, Lydia (Miss)
6.	20655192	PG9656819	OBLIM, Teye Frank

MASTER OF SCIENCE (WATER SUPPLY AND ENVIRONMENTAL SANITATION)

Table 6: Master of Science Graduants

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
1.	20683329	PG9651819	ADU-BOAHENE, Francis
2.	20671339	PG9651919	ADU-DARKO, Yaa Kesewaa (Miss)
3.	20698757	PG9652319	ASIEDU, Theophilus Sagoe
4.	20670003	PG9652719	BAAKO, Samuel Yeboah
5.	20671735	PG9652819	BARNES JNR, Norman
6.	20675169	PG9653019	DANSO-APAU, Nana Ayebea (Miss)
7.	20672921	PG9653219	DZITSE, Grant Degbe
8.	20450974	PG9654619	OCHADE, Chiamaka Salome (Miss)
9.	20662954	PG9653919	OWIREDU OPOKU, Bismark
10.	20679526	PG9654119	SARFO, Cornelia Frimpomaa (Miss)

The lists below show MSc and PhD students who have submitted their theses and are awaiting graduation.

MASTER OF SCIENCE (WATER RESOURCES ENGINEERING AND MANAGEMENT)

Table 7: Master of Science Graduants

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
1.	20749253	PG5747620	ACHEAMPONG, Johnmark Nyame
2.	20760262	PG5747720	ADDAE-MENSAH, Benedict
3.	20748773	PG5747820	ANHWERE, Bernard
4.	20722437	PG5747920	APOGBA, Joseph Nzotiyine

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
5.	20761626	PG5748320	FRIMPONG, Emmanuel Asamoah
6.	20727741	PG5748820	ISSAHAKU, Sumaila Tairu
7.	20457394	PG5748420	KOON, Arthur B.
8.	20769739	PG5748920	NARVEH, Samuel
9.	20739735	PG5748520	YANKEY, Benjamin Ewuley

MASTER OF SCIENCE (WATER SUPPLY AND ENVIRONMENTAL SANITATION)

Table 8: Master of Science Graduants

S/N	STUDENT NUMBER	PG NUMBER	STUDENT NAME
1.	20747015	PG5741820	ACQUAH, Ebenezer
2.	20746131	PG5742620	COFFIE, Priscilla Badaweh (Miss)
3.	20755686	PG5741620	HAMID, Ilham Ku-Nwa (Miss)
4.	20454261	PG5742920	SONIE, Mambue J.

DOCTOR OF PHILOSOPHY

Table 9: Doctor of Philosophy Graduants

S/N	NAME
Environmental Sanitation and Waste Management	
1.	ADDAE, Gloria
2.	ASILEVI, Prince Junior
Water Resources Engineering and Management	
4.	LOGAH, Frederick Yaw
5.	AKANDI Joan Tully
6.	ZAKARIA, Nafisatu
7.	ECHETA, Odinakachukwu Chidinma
8.	OSIAKWAN, Gustav Merrit
9.	THIAM, Mbayang
10.	ABUNGBA, Joachim Ayiwe

DOCTORAL THESES

1. Frederick Yaw Logah, 2022. *Integrated Flood Risk Assessment of The Black Volta Basin*
2. Gloria Addae, 2022. *Market Waste Characterization and Resource Recovery Potential in Kumasi, Ghana*
3. Gustav Merrit Osiakwan, 2022. *Hydrogeological Assessment of Major Geological Formations in The Central Region, Ghana*
4. Hanson Mensah-Akutteh, 2022. *Determination of Optimum Coagulation Conditions for Particulate Impurities and Organic Matter Removal*
5. Joachim Ayiiwe Abungba, 2022. *Hydro-Climatological Dynamics and Estimation of Future Water Resources of The Black Volta Basin Under Different Climate Change Scenarios*
6. Joan Atulley Akandi, 2022. *Assessing the Impact of Human Disturbances and Climate Change on Catchment Hydrology, Sedimentation, And Water Allocation in the Tono and Veve Reservoirs, Ghana*
7. Mbayang Thiam, 2022. *Hydro-Climate Changes and Riverine Ecosystem Services for Water-Energy-Food Nexus within the Senegal River Basin*
8. Miriam Appiah-Brempong, 2022. *Treatment of Artisanal Tannery Wastewater Through Coagulation and Flocculation Processes*
9. Nafisatu Zakaria, 2022. *Hydrogeochemical And Isotopic Study of Groundwater Contamination in the Anayari Catchment, Ghana*
10. Odinakachukwu Chidinma Echeta, *Improving Rainfall Estimation in Data-Scarce Regions through Bias Corrections of Near-Real-Time Satellite-Based Rainfall Estimates: Using Volta Basin as a Case Study*
11. Osayomwanbo Osarenotor, 2022. *Application Of Pleurotus Ostreatus Mycelium-Colonised Sawdust for Treatment of Slaughterhouse Wastewater*
12. Prince Asilevi Junior, 2022. *Study On Atmospheric Non-Thermal Plasma Application for Degradation of Volatile Organic Compounds Towards Air Pollution Treatment and Control*
13. Priscilla Addo, 2022. *Determining The Potential Of Black Soldier Fly Larvae (*Hermetia Illucens*)_ In Valorisation of Municipal Organic Solid Waste (MOSW) Composting*
14. Wilhemina Asare, 2022. *Households Solid Waste Source Separation and Incentive Options for Improving Solid Waste Resources Recovery*

Delivery of Short Courses (DLI 3.3)

PROFESSIONAL SHORT-TERM COURSES

RWESCK remains supportive of the industry players through short-term courses for skill development and capacity building. RWESCK organised five (5) professional short courses in the year under review viz; Sustainable Integrated Municipal Solid Waste Management, Sustainable Onsite-Sanitation and Faecal Sludge Management, Drainage Master Planning and Evaluation and Water and Sanitation Master Planning, Evaluation short courses, All4Wash Summer School and ISO/IEC 17025:2017 training. The organisation of these short courses recorded a total of one hundred and fifty-two (152) national and international participants.

SUSTAINABLE INTEGRATED MUNICIPAL SOLID WASTE MANAGEMENT

The five-day training was held in collaboration with the Institute of Local Government Studies (ILGS) and the Africa Environmental Sanitation Consult (AfESC) of Jospong Group. The training took place from 16th May to 20th May, 2022 at the Kumasi Compost and Recycling Plant, Adagya. Participants were constituted from seven (7) Municipal Assemblies, fourteen (14) females and twenty-three (23) males, comprising mainly Environmental Health Officers, Planning Officers, and Community Development Specialists. The training equipped participants with skills, and competence in integrated solid waste management, solid waste infrastructure designs, and the

operation and management of integrated solid waste management systems.



Participant on a field from Sustainable Integrated Municipal Solid Waste Management at KCARP



Participant in group discussions from Sustainable Integrated Municipal Solid Waste Management

SUSTAINABLE ONSITE SANITATION AND FAECAL SLUDGE MANAGEMENT

The training on Sustainable Onsite Sanitation and Faecal Sludge Management was held from 6th June to 10th June, 2022 at RWESCK together with the Institute of Local Government Studies (ILGS) and the Africa Environmental Sanitation Consult

(AfESC). The fifteen (15) participants were drawn from (7) Municipal Assemblies being Environmental Health Officers, Planning Officers, and Community Development Specialists. Two (2) females and thirteen (13) males partook in the training. By the end of the face-to-face participatory short course, participants gained a deeper understanding of engineering designs and construction of onsite sanitation systems



Participant on field from Sustainable Onsite Sanitation and Faecal Sludge Management

WATER AND SANITATION MASTER PLANNING, MONITORING AND EVALUATION/ URBAN DRAINAGE, MONITORING AND EVALUATION SHORT COURSE

The training was held together from 20th June 2022 to 24th June, 2022. RWESCK, the Hydrological Services Department, the Institute of Local Government Studies (ILGS) and the Africa Environmental Sanitation Consult (AfESC) came together to run the training. Participants recorded were Community Water and Sanitation Agency workers and Environmental Health Officers, Planning Officers, and Community Development Specialists from seven (7) Municipal Assemblies. Ten (10) out of the fifty (50) attendees were female while forty (40) were males. The teaching and learning methods were



interactive lectures, discussions, group work, and participants' presentations. In the end, participants appreciated the importance of master planning, Monitoring & Evaluation and Understood the master planning framework and strategic planning of drainage, water, sanitation and municipal solid waste management.

ALL4WASH SUMMER SCHOOL

“North-South-Alliance for Inclusive Water, Sanitation, and Hygiene (All4WASH)” in collaboration with the Norwegian University of Science and Technology under the Norwegian Partnership Programme for Global Academic Cooperation (NORPART) 2022-2026 and six other universities organised a two-week summer school programme which was slated for 12th July to 22nd July, 2022 at the Regional Water and Environmental Sanitation Centre Kumasi, KNUST. Participants were from University of Venda (South Africa), Nelson Mandela African Institute of Technology (Tanzania), Addis Ababa University (Ethiopia), National School of Engineers Bamako (Mali) and Kampala International University (Uganda), Norwegian University of Science and Technology and Kwame Nkrumah University of Science and Technology. A total of twenty-seven (27) attendees were recorded for both participants and facilitators. The overarching aim of the Blue Circular Economy programme was for the institutions to join hands to confront some of the local and global challenges of water supply and sanitation, strengthening inclusive education and research in sustainable water supply and sanitation in NTNU and the partner Universities through co-curriculum development, student/academic staff exchange, joint research projects, and co-supervision, developing a relevant curriculum incorporating eLearning & blended learning to equip students with the transversal skills needed to be active participants in the knowledge economy of water and sanitation considering the SDGs, establish research hubs to increase the quality of research and advance knowledge in the areas of circular economy, digitalization, governance, equity & inclusion, resource recovery, health, and climate change, establishing the research hubs for Norwegian and partner University students to work on joint research projects to cross-fertilize ideas, innovate and develop solutions from different cultural perspectives, establishing long-term partnerships at the institutional and individual levels to continue to pursue these activities of mutual interest beyond the lifespan of the project.



Participants introducing themselves from ALL4WASH Summer School at RWECK



Participant in discussion from ALL4WASH Summer School at RWECK

ISO/IEC 17025:2017 TRAINING

As part of the procedures for the standardisation of the RWESCK lab, a training on the general requirement for the competence and testing of calibration laboratories ISO/IEC 17025:2017. The five day-program began from 25th July to 29th July, 2022. The training took place at the Regional Water and Environmental Sanitation Centre Kumasi, KNUST. The Centre invited technicians from various laboratories in KNUST to partake in the course. In total, twenty-one (21) people were trained, (6) females and fifteen (15) males. In ensuring that participants benefited fully from the short course, training materials in the form of soft and hard copies were shared. The training was successful.

ORGANISED SHORT COURSES IN THE YEAR 2022

Table 10: List of short courses organised by the Centre in the year 2022 with the number of participants

Short Course	Participants Female	Participants Male	Total number of Participants
Sustainable Integrated Municipal solid waste management	14	23	37
Sustainable Onsite Faecal Sludge Management	2	13	15
Water and sanitation master planning, monitoring, and evaluation	10	40	50
Urban Drainage, monitoring, and evaluation short course	2	11	13
All4wash summer school	12	4	16
Training on the general requirement for the competence and testing of calibration laboratories ISO/IEC 17025:2017	6	15	21

4.0 Quality of Education and Research (DLI 4)

The Centre in consultation with the Ghana Tertiary Education Commission has submitted four (4) programmes yet to be commenced at the Centre. This falls under Quality of Education. Payment for the accreditation has been made to the National Accreditation Board. The new programmes are found below:

- MSc Disaster Prevention and Management
- MSc Environmental Sanitation and Waste Management
- MSc Water Engineering
- MSc Water Supply Engineering and Management

RESEARCH AND PUBLICATIONS (DLI 4.2)

- The Centre has submitted thirty-one publications for the 2021/2022 academic year, which are yet to be verified.
- The Centre is undertaking joint research with Community Water and Sanitation Agency on packaged plan for water treatment.

TEACHING AND LEARNING ENVIRONMENT (DLI 4.3)

- RWESCK has secure a Fluoride Meter to support cutting-edge research and commercialisation.
- RWESCK is partnering with the Ghana Standards Authority to acquire accreditation for the laboratory.
- To support online teaching and learning, the Centre has been able to procure three (3) Wacom tablets for E-studio.

5.0 Relevance of Education and Research (DLI 5)

EXTERNALLY GENERATED FUNDS (DLI 5.1)

The Centre has won a grant of One Hundred and Fifty Thousand Ghana Cedis (GHS 150,000.00) to commence research on Econometric Cost Function and Cost Recovery Models for Solid Waste Management Services

Table 11: Externally Generated Funds

Funding Source	Amount	Purpose	PI/Co-PI
French Emabssy	€ 39,000.00	For staff and student mobility and capacity building	Prof. M. K. Essandoh/ Prof. S. Oduro-Kwarteng
French Embassy	€ 7,000.00	For staff and student mobility and capacity building	Prof. S. Oduro-Kwarteng
Jospong Group of Companies	GHS 150,000.00	Solid waste management research	Prof. S. Oduro-Kwarteng

STUDENTS INTERNSHIPS (DLI 5.2)

As has been the practice, PhD and MSc students embark on internships every year to acquire practical skills and to get exposure of the working environment. This year, all twenty-seven (27) PhD students of the Centre have successfully completed their internship. Only one (1) is yet to complete. During the industrial attachment, a team from the Centre liaised with personnel at the agencies to ensure that students were punctual and addressed their challenges.

ENTREPRENEURSHIP (DLI 5.3)

In the quest of completing this milestone, RWESCK has collaborated with the TRECK to launch another call for proposal.

6.0 Financial Management (DLI 6)

RWESCKs' financial position was presented as follows:

RECEIPTS AND PAYMENTS AS AT 30TH SEPTEMBER 2022

Table 12: Receipts and Payments as at 30th September 2022

RECEIPTS:				
YEAR	2020	2021	2022-SEPT	Y-T-D
	USD \$	USD \$	USD \$	USD \$
Funding from World Bank	687,866	1,742,350	832,528	3,262,744
TOTAL Funding from World Bank	687,866	1,742,350	832,528	3,262,744
PAYMENTS:				
REGIONAL CAPACITY TRAINING	120,463	303,281	244,839	668,583
LEARNING AND TEACHING ENVIRONMENT	117,754	910,200	758,062	1,786,016
REGIONAL RESEARCH CAPACITY BUILDING	105,502	89,861	34,803	230,166
ACADEMIC PARTNERSHIP	9,368	71,519	36,901	117,788
INDUSTRIAL PARTNERSHIP	85,048	21,598	8,750	115,396
GOVERNANCE AND ADMINISTRATION	98,478	114,378	70,552	283,408
CENTRE VISIBILITY	2,023	2,255	1,484	5,762
TOTAL PAYMENTS	538,636	1,513,092	1,155,391	3,207,119
SURPLUS (DEFICIT)	149,230	229,258	(322,863)	55,625

NOTES:

1. Total funding from World Bank for the year under review is **\$ 832,528** against year to date figure of **\$3,262,744**.
2. Total payment for the year is **\$ 1,155,391** as compared to the year to date figure of **\$3,207,119**
3. The highest payment made was **\$ 758,062** as compared to the year to date expenditure of **\$ 1,786,016**. It is high because of the building infrastructure project. Most of the payments related to Learning and Teaching Environment, Regional Capacity Training, and Governance and Administration.
4. The next highest expenditure was Regional Capacity Training with end of year figure of **\$244,839** compared to the up-to-date payment of **\$ 668,583**
5. Total grants receivable before the end of the year **\$ 340,753**

7.0 Institutional Impact (DLI 7)

The Regional Water and Environmental Sanitation Centre (RWESCK) has in the number of publications in the world's renowned peer reviewed journals indexed by Scopus, which has contributed to ranking KNUST as an institution.

INSTITUTIONAL REGIONAL STRATEGY

As part of the requisite to achieve DLI 7, a committee has been constituted by the University. The committee will see to the revision of the university-wide regional strategy which aims at increasing KNUST's capacity in attracting prospective international students. The institutional strategy will focus on student recruitment and retention, financial matters, faculty members' recruitment, students' support services and staff exchange, research collaborations, internship placements, among others. The document for this strategy has been forwarded to the academic board of the University for consideration.

INSTITUTIONAL ACCREDITATION

Committee has received feedback on gap analysis and will soon submit a revised document for all the accreditation.

8.0 Centre Management and Governance

RECRUITMENT OF A PROJECT MANAGER

RWESCK went through a competitive selection and conducted an interview for the project manager portfolio on 8th July, 2022. Mr. Prince Asilevi Junior emerged first. He is now the Centre Manager.

SECTOR ADVISORY BOARD MEETING

The 3rd Sector Advisory Board meeting was held on 12th April, 2022 at the Coconut Grove Hotel, Accra. The Chairperson of the Board, the Honourable Minister of Sanitation and Water Resources and invited guests from CWSA, CONIWAS, ESPA, ATU and WRC were present at the meeting. The Board discussed the Centre's activities, reviewed and commented on the 2021 workplan and provided inputs and strategies for sustaining the Centre.



The Minister of Sanitation and Water Resources, Hon. Mrs. Cecilia Abena Dapaah at the SAB meeting

In the year under review, the 4th Sector Advisory Board meeting is scheduled for 8th December, 2022. Key points for discussion include the RWESCK Endowment fund, 2023 Water Sanitation Sector Dialogue Series, NORPART Summer School, Laboratory certification/GSA, and RWESCK Sustainability Plan.

THE 8TH ACE IMPACT REGIONAL WORKSHOP

This year, the centre director Prof. Sampson Oduro-Kwarteng led a six-member delegation to participate in the 8th ACE Impact Regional Workshop from November 14th to 18th, 2022, on the theme “Innovation and Entrepreneurship” at the Sir Dawda Kairaba Jawara International Conference Centre in The Gambia, the Smiling coast of Africa. 53 ACE IMPACT Centers from 11 countries viz., Benin, Burkina Faso, Côte d’Ivoire, Djibouti, Gambia, Ghana, Guinea, Niger, Nigeria, Senegal, and Togo participated. The workshops are designed to continue providing the participating centers, their host institutions and governments with the requisite tools necessary to ensure timely Project effectiveness and strong



The Director (from right) and six-member delegation at the 8th ACE impact regional workshop

implementation in order to achieve a strong push toward project disbursements with a focus on increasing fund utilization of the ACEs.

9.0 Workplan, Budget and Outlook For 2022

2023 FINANCIAL BUDGET

Table 13a: Workplan, Budget and Outlook for 2022

EXPENDITURE ITEMS	EXPENDITURE (\$)	REVENUE (\$)
1.0 REGIONAL CAPACITY TRAINING		
1:1 PhD & MSc enrolment		
1:2 Batch 6 REG PhD-1 Students=1 *11,720)	11,720	
1:2 Batch 6 NAT PhD-12 Students= (12 * 2,073)	24,876	
1:3 Batch 7 REG PhD- 5 Students = ((5*11,720)*2)	117,200	
1:4 Batch 7 NAT PhD-13 Students = ((13*2,073)*2)	53,898	
1:5 Batch 7 REGIONAL MSc- (11 Students) =11 by (GHS 113.78+487.80+1,200+500+1,200)	38,517	
1:6 Batch 7 NATIONAL MSc- (30 students) =30 by (GHS 113.78.00+487.80)	18,048	
1.7 Research Fees & Transportation cost for Thesis Defence	11,585	
1:8 Regional Short course (25 participants by \$400.00)	10,000	

Table 13b: Workplan, Budget and Outlook for 2022

EXPENDITURE ITEMS	EXPENDITURE (\$)	REVENUE (\$)
1:9 National short course (50 participants at \$200)	10,000	
1:10 International Institutional Accreditation-DLI 7	60,000	
1:11 Total for Regional Capacity	355,844	
2.0 LEARNING AND TEACHING ENVIRONMENT		
2.1 Procurement of Laboratory ISO certification	160,295	
2.2 Consumables & Maintenance	60,000	
2.1 Procurement of Laboratory equipment	250,000	
2.3 Procurement of Laboratory equipment	300,000	
2.4 Laboratory Certification & Audit	60,000	
2.5 Procurement of Office Equipment	15,000	
2.6 E-Conference/ Office room	60,000	
2.7 Wirelss and Fibre Optic	30,000	
Total for Learning & Teaching Environment	685,295	
3.0 REGIONAL RESEARCH CAPACITY BUILDING		

Table 13c: Workplan, Budget and Outlook for 2022

EXPENDITURE ITEMS	EXPENDITURE (\$)	REVENUE (\$)
3.1 Partnership Capacity Building	20,000	
4.0 ACADEMIC PARTNERSHIP		
4.1 Workshop, Seminars, Staff Training on Research & Staff Development-DLI 5.3	5,000	
4.2 Regional Partners Engagement Workshop	20,000	
4.3 Total Academic Workshop	25,000	
5.0 INDUSTRIAL PARTNERSHIP		
5.1 Staff & Student Internship/ Partners Engagement Workshop	10,000	
5.2 Business Incubation and start up and Innovation Week DLI 5.3	20,000	
5.3 Engagement with Alumna	10,000	
Total for Industrial Partnership	40,000	
6.0 GOVERNANCE AND ADMINISTRATION		
6.1 Management, Board and Partnership Meetings/ACE meeting	30,000	
6.2 Fuel & Lubricants	15,000	
6.3 Repairs and Maintenance	40,000	

Table 13d: Workplan, Budget and Outlook for 2022

EXPENDITURE ITEMS	EXPENDITURE (\$)	REVENUE (\$)
6.4 Staff Remuneration, Compensation & Others	80,000	
6.5 Management, Board and partnership meetings	30,000	
6.6 Audit fees and Charges	10,000	
6.7 Office Consumables	15,000	
Total for Governance & Administration	220,000	
7.0 CENTRE VISIBILITY		
7.1 Communication & Data	15,000	
7.2 Visibility and Media- Tools & Equipment	10,000	
7.3 Community Engagement and World Day Celebrations	5,000	
7.4 Communication Equipment & Live Streaming	10,000	
Sub-Total Centre Visibility	40,000	
8.0 Grand Sub-Totals	1,386,139	
9.0 CONTIGENCIES-0.10%	13,861	

Table 13e: Workplan, Budget and Outlook for 2022

EXPENDITURE ITEMS	EXPENDITURE (\$)	REVENUE (\$)
10.0 Grand Totals for Expenditure	1,400,000	
11.0 REVENUE ITEMS:		
11.1 Development Impact of ACE		120,000
11.2 New PhD students		157,761
11.3 New Masters Students		88,838
11.4 Quality of Education & research through research publications		221,077
11.5: Relevance of Education and Research through internships and entrepreneurship		60,423
11.6 Timeliness and quality of fiduciary management		142,394
11.7 IGF-Interest from Bank		3,437
11.8 International Institutional Accreditation-DLI 7		60,000
11.9 IGF Fund		546,070
11.10 Grand Totals for Revenue		1,400,000
12.1 Surplus/(Deficit)		0

NOTE:

1. Total expenditure budget for the year amounted to **\$ 1,400,000.00**
2. Total revenue budget for the year amounted to **\$ 1,400,000.00** as same figure as total expenditure.
3. The Centre is expected to run Zero-Based budgeting for the year under review.
4. Out of this a total amount of **\$ 685,295.00** into Learning and Teaching Environment and also, **\$355,844** will go into Regional Capacity Training and **\$ 220,000** into Governance & Administration.
5. The rest of the expenditure will go into Regional Research Capacity Building, Academic Partnership, Industrial Partnership & Centre Visibility.

OUTLOOK.

1. The Centre is expected to receive a total amount of **\$ 1,400,000.00** for its operations for the year 2023.
2. These revenues are expected to come from mainly Development Impact of ACE, New PhD students & New Masters Students, Quality of Education & research through research publications, Timeliness and quality of fiduciary management, International Institutional Accreditation- DLI 7 and Internal Generated Fund,
3. The commercialization of the Laboratory has started but the greater impact will be seen in 2023 when most of the laboratory equipment might have been acquired.

10.0 RWESCK SUSTAINABILITY PLAN

ENDOWMENT FUND

The Centre intends to set an endowment fund for the following:
to support cutting-edged researches of postgraduate students,
to advance laboratory infrastructure and equipment to aid teaching and learning,
to give stipends to support students' living costs
to support any other activity the Board finds suitable

The Centre looks forward to receiving inputs from its Industry/Sector Advisory Board for the composition of Board of Trustees, kind of investment and other activities that can be supported with the interest from the fund.

RESEARCH GRANT HUNTING

As was done in the past, the Centre has discussed with its members to seek for proposals together. The members of faculty have agreed to write for grants under thematic headings. They have been admonished to explore all opportunities and commit time in order to acquire grants for students' researches and tuition fees if possible. The Centre has also pleaded with its members to apportion some funds to support student researches should they win individual grants.

ACADEMIC FEES FROM WEEKEND/ONLINE MSC PROGRAMMES

As part of measures to sustain the Centre after the World Bank funding, the Centre has introduced four new master's programmes. The programmes have been designed to attract the working class in the water and sanitation sector and will be held on weekend basis. Fees obtained will be used to pay teaching lecturers and also remunerate core Centre staff.

LABORATORY FUND

The Centre has teamed up with the Ghana Standards Authority to acquire standardisation and certification. This is aimed at commercialising the RWESCK Laboratory. As it stands, the Centre has secured state-of-the-art equipment such as Scanning Electron Microscope (SEM), X-ray Diffractometer, Spectrophotometers, Polymerase Chain Reaction (PCR), and Biogas analyser. In line with sustainability, the Centre hopes to render service to a number of individuals and corporate. The monies accrued from the commercialisation will cater for reagents and consumables which will be needed at the laboratory. Again, part of the money will also be spent on the maintenance of equipment.

FACILITY MANAGEMENT FUND

As was advised in the 3rd Sector Advisory Board meeting, the Centre has committed funds to complete the phase II of the Centre building. Management intends to furnish the office rooms and allocate to Department of Civil Engineering and other College staff supporting the activities of the Centre. Projects within the College who would like to occupy office spaces will be charged. Meeting and Seminar rooms to host all who would like to hold meetings will be charged at moderate rates. The monies generated from the occupancy of the rooms will be channelled to the maintenance of the building.

VEHICLE FUND

RWESCK has three coaster buses. In order to maintain the vehicles, the Centre has resorted to renting the vehicles to other departments and the entire University community at fixed rates. Monies accrued from the hiring of buses will cater for the maintenance of the vehicles.

ANNEX: PUBLICATIONS IN THE YEAR UNDER REVIEW

WATER RESOURCES ENGINEERING

1. Abungba, J. A., Khare, D., Pingale, S. M., Adjei, K. A., Gyamfi, C., & Odai, S. N. (2020). Assessment of hydro-climatic trends and variability over the Black Volta Basin in Ghana. *Earth Systems and Environment*, 4(4), 739-755.
2. Kwarteng, E. A., Gyamfi, C., Anyemedu, F. O. K., Adjei, K. A., & Anornu, G. K. (2021). Coupling SWAT and bathymetric data in modelling reservoir catchment hydrology. *Spatial Information Research*, 29(1), 55-69.
3. Oseke, F. I., Anornu, G. K., Adjei, K. A., & Eduvie, M. O. (2021). Assessment of water quality using GIS techniques and water quality index in reservoirs affected by water diversion. *Water-Energy Nexus*, 4, 25-34.
4. Arthur, E., Anyemedu, F. O. K., Gyamfi, C., Asantewaa-Tannor, P., Adjei, K. A., Anornu, G. K., & Odai, S. N. (2020). Potential for small hydropower development in the Lower Pra River Basin, Ghana. *Journal of Hydrology: Regional Studies*, 32, 100757.
5. Delaire, C., Peletz, R., Haji, S., Kones, J., Samuel, E., Easthope-Frazer, A., ... & Khush, R. (2020). How much will safe sanitation for all cost? Evidence from five cities. *Environmental Science & Technology*, 55(1), 767-777.
6. Schelbert, V., Meili, D., Alam, M. U., Simiyu, S., Antwi-Agyei, P., Adjei, K. A., ... & Lüthi, C. (2020). When is shared sanitation acceptable in low-income urban settlements? A user perspective on shared sanitation quality in Kumasi, Kisumu and Dhaka. *Journal of Water, Sanitation and Hygiene for Development*, 10(4), 959-968.
7. Simiyu, S. N., Kweyu, R. M., Antwi-Agyei, P., & Adjei, K. A. (2020). Barriers and opportunities for cleanliness of shared sanitation facilities in low-income settlements in Kenya. *BMC Public Health*, 20(1), 1-12.
8. Incoom, A. B. M., Adjei, K. A., & Odai, S. N. (2020). Rainfall variabilities and droughts in the Savannah zone of Ghana from 1960-2015. *Scientific African*, 10, e00571.
9. Logah, F. Y., Adjei, K. A., Obuobie, E., Gyamfi, C., & Odai, S. N. (2021). Evaluation and Comparison of Satellite Rainfall Products in the Black Volta Basin. *Environmental Processes*, 8(1), 119-137.
10. Ahmed, S. D., Agodzo, S. K., & Adjei, K. A. (2021). Designing River Diversion Constructed Wetland for Water Quality Improvement. *Inland Waters-Dynamics and Ecology*.
11. Ackom, E. K., Adjei, K. A., & Odai, S. N. (2020). Spatio-temporal rainfall trend and homogeneity analysis in flood prone area: case study of Odaw river basin-Ghana. *SN Applied Sciences*, 2(12), 1-26.
12. Meili, D., Schelbert, V., Alam, M. U., Antwi-Agyei, P., Simiyu, S., Adjei, K. A., ... & Günther, I. (2021). Indicators for Sanitation Quality in Low-Income Urban Settlements: Evidence from Kenya, Ghana, and Bangladesh. *Social Indicators Research*, 1-38.

13. Francis, O. I., Anornu, G. K., Adjei, K. A., & Martin, E. O. (2021). Development of water surface area–storage capacity relationship using empirical model for Gurara reservoir, Nigeria. *Modeling Earth Systems and Environment*, 7(3), 2047-2058.
14. Ofofu, S. A., Adjei, K. A., & Odai, S. N. (2021). Assessment of the quality of the Densu river using multicriterial analysis and water quality index. *Applied Water Science*, 11(12), 1-13.
15. Devlin, A., Pan, J., Shah, M. M., & Nuhu, A. A. (Eds.). (2021). *Inland Waters: Dynamics and Ecology*.
16. Oseke, F. I. E., Anornu, G. K., Adjei, K. A., & Eduvie, M. O. (2021). Predicting the impact of climate change and the hydrological response within the Gurara reservoir catchment, Nigeria. *Journal of Water and Land Development*.
17. Simiyu, S., Antwi-Agyei, P., Adjei, K., & Kweyu, R. (2021). Developing and Testing Strategies for Improving Cleanliness of Shared Sanitation in Low-Income Settlements of Kisumu, Kenya. *The American Journal of Tropical Medicine and Hygiene*, 105(6), 1816.
18. Oseke, I. E. F., Anornu, G. K., Adjei, K. A., & Eduvie, M. O. (2021). Integrated water resources management approach in mitigating the potential impacts of climate change on hydrology in Gurara reservoir catchment, Northwest Nigeria. *Proceedings of the International Association of Hydrological Sciences*, 384, 355-361.
19. Darko, S., Adjei, K. A., Gyamfi, C., Odai, S. N., & Osei-Wusuansa, H. (2021). Evaluation of RFE Satellite Precipitation and its Use in Streamflow Simulation in Poorly Gauged Basins. *Environmental Processes*, 8(2), 691-712.
20. Antwi-Agyei, P., Dwumfour-Asare, B., Adjei, K. A., Schelbert, V., Meili, D., & Lüthi, C. (2021). *Shared Sanitation in Low-income Urban Settlements in Ghana*. ETH Zurich.
21. Oseke, F. I., Anornu, G. K., Adjei, K. A., & Eduvie, O. M. (2020). a review of stakeholders participation importance in the development of water diversion systems in developing countries: a case from Gurara water diversion system, Nigeria. *Nigerian journal of technology*, 39(4), 1263-1275.
22. Gyimah, R. A. A., Gyamfi, C., Anornu, G. K., Karikari, A. Y., & Tsyawo, F. W. (2021). Multivariate statistical analysis of water quality of the Densu River, Ghana. *International Journal of River Basin Management*, 19(2), 189-199.
23. Gyamfi, C., Tindan, J. Z. O., & Kifanyi, G. E. (2021). Evaluation of CORDEX Africa multi-model precipitation simulations over the Pra River Basin, Ghana. *Journal of Hydrology: Regional Studies*, 35, 100815.
24. Nsiah, J. J., Gyamfi, C., Anornu, G. K., & Odai, S. N. (2021). Estimating the spatial distribution of evapotranspiration within the Pra River Basin of Ghana. *Heliyon*, 7(4), e06828.
25. Anima Gyimah, R. A., Karikari, A. Y., Gyamfi, C., Asantewaa-Tannor, P., & Anornu, G. K. (2020). Spatial evaluation of land use variability on water quality of the Densu Basin, Ghana. *Water Supply*, 20(8), 3000-3013.
26. Awotwi, A., Anornu, G. K., Quaye-Ballard, J. A., Annor, T., Nti, I. K., Odai, S. N., ... & Gyamfi, C. (2021). Impact of post-reclamation of soil by large-scale, small-scale and illegal mining on water

- balance components and sediment yield: Pra River Basin case study. Soil and Tillage Research, 211, 105026.*
27. Zakaria, N., Anornu, G., Adomako, D., Owusu-Nimo, F., & Gibrilla, A. (2021). Evolution of groundwater hydrogeochemistry and assessment of groundwater quality in the Anayari catchment. *Groundwater for Sustainable Development, 12, 100489.*
 28. Gibrilla, A., Fianko, J. R., Ganyaglo, S., Adomako, D., Anornu, G., & Zakaria, N. (2020). Nitrate contamination and source apportionment in surface and groundwater in Ghana using dual isotopes (^{15}N and $^{18}\text{O}-\text{NO}_3$) and a Bayesian isotope mixing model. *Journal of Contaminant Hydrology, 233, 103658.*
 29. Awotwi, A., Annor, T., Anornu, G. K., Quaye-Ballard, J. A., Agyekum, J., Ampadu, B., ... & Boakye, E. (2021). Climate change impact on streamflow in a tropical basin of Ghana, West Africa. *Journal of Hydrology: Regional Studies, 34, 100805.*
 30. Abdul-Wahab, D., Adomako, D., Abass, G., Adotey, D. K., Anornu, G., & Ganyaglo, S. (2021). Hydrogeochemical and isotopic assessment for characterizing groundwater quality and recharge processes in the Lower Anayari catchment of the Upper East Region, Ghana. *Environment, Development and Sustainability, 23(4), 5297-5315.*
 31. Ashaley, J., Anornu, G. K., Awotwi, A., Gyamfi, C., & Anim-Gyampo, M. (2020). Performance evaluation of Africa CORDEX regional climate models: case of Kpong irrigation scheme, Ghana. *Spatial Information Research, 28(6), 735-753.*
 32. Yankey, R. K., Anornu, G. K., Osae, S. K., & Ganyaglo, S. Y. (2021). Drastic model application to groundwater vulnerability elucidation for decision making: the case of south western coastal basin, Ghana. *Modeling Earth Systems and Environment, 7(4), 2197-2213.*
 33. Osiakwan, G. M., Appiah-Adjei, E. K., Kabo-Bah, A. T., Gibrilla, A., & Anornu, G. (2021). Assessment of groundwater quality and the controlling factors in coastal aquifers of Ghana: An integrated statistical, geostatistical and hydrogeochemical approach. *Journal of African Earth Sciences, 184, 104371.*
 34. Yankey, R. K., Anornu, G. K., Appiah-Adjei, E. K., Osae, S. K., & Ganyaglo, S. Y. (2020). Structural equation modeling and GIS application into non-carcinogenic health risk assessment of the phreatic aquifers of the south-western coastal basin-Ghana. *Modeling Earth Systems and Environment, 6(4), 2553-2564.*
 35. Egbi, C. D., Anornu, G. K., Appiah-Adjei, E., Ganyaglo, S. Y., & Dampare, S. B. (2021). Trace Metals Migration and Contamination Assessment of Groundwater in the Lower Volta River Basin, Ghana. *Exposure and Health, 13(3), 487-504.*
 36. Baddoo, T. D., Li, Z., Odai, S. N., Boni, K. R. C., Nooni, I. K., & Andam-Akorful, S. A. (2021). Comparison of missing data infilling mechanisms for recovering a real-world single station streamflow observation. *International journal of environmental research and public health, 18(16), 8375.*
 37. Nsiah, J. J., Gyamfi, C., Anornu, G. K., & Odai, S. N. (2021). Estimating the spatial distribution of evapotranspiration within the Pra River Basin of Ghana. *Heliyon, 7(4), e06828.*

38. Badmos, B. K., Villamor, G. B., Agodzo, S. K., Odai, S. N., & Badmos, O. S. (2021). Evaluating the impact of an agricultural land-use change adaptation strategy on household crop production in semi-arid Ghana. *Singapore Journal of Tropical Geography*, 42(1), 65-84.

ENVIRONMENTAL QUALITY ENGINEERING

1. Appiah-Brempong, M., Essandoh, H. M., Asiedu, N. Y., Dadzie, S. K., & Momade, F. W. Y. (2020). An insight into artisanal leather making in Ghana. *Journal of Leather Science and Engineering*, 2(1), 1-14
2. Oduro-Kwarteng, S., Addai, R., & Essandoh, H. M. (2021). Healthcare waste characteristics and management in Kumasi, Ghana. *Scientific African*, 12, e00784.
3. Kumatse, I. M., Essandoh, H. M. K., Asiedu, N. Y., & Oduro-Kwarteng, S. (2020). Evaluation of selected activated carbon filters and sand media for nutrient and pathogen removal from an anaerobic baffled reactor effluent system. *Scientific African*, 9, e00523.
4. Nsiah-Gyambibi, R., Essandoh, H. M. K., Asiedu, N. Y., & Fei-Baffoe, B. (2021). Valorization of faecal sludge stabilization via vermicomposting in microcosm enriched substrates using organic soils for vermicompost production. *Heliyon*, 7(3), e06422.
5. Nyieku, F. E., Essandoh, H. M., Armah, F. A., & Awuah, E. (2021). Environmental conditions and the performance of free water surface flow constructed wetland: a multivariate statistical approach. *Wetlands Ecology and Management*, 29(3), 381-395.
6. Dwumfour-Asare, B., Nyarko, K. B., Essandoh, H. M., & Awuah, E. (2020). Domestic greywater flows and pollutant loads: A neighbourhood study within a university campus in Ghana. *Scientific African*, 9, e00489.
7. Enyemadze, I., Momade, F. W., Oduro-Kwarteng, S., & Essandoh, H. (2021). Phosphorus recovery by struvite precipitation: a review of the impact of calcium on struvite quality. *Journal of Water, Sanitation and Hygiene for Development*, 11(5), 706-718.
8. Acquah, M. N., Essandoh, H. M. K., Oduro-Kwarteng, S., Appiah-Effah, E., & Owusu, P. A. (2021). Degradation and accumulation rates of fresh human excreta during vermicomposting by *Eisenia fetida* and *Eudrilus eugeniae*. *Journal of Environmental Management*, 293, 112817.
9. Siabi, W. K., Owusu-Ansah, E. D. J., Essandoh, H. M. K., & Asiedu, N. Y. (2021). Modelling the adsorption of iron and manganese by activated carbon from teak and shea charcoal for continuous low flow. *Water-Energy Nexus*, 4, 88-94.
10. Nyieku, F. E., Essandoh, H. M., Armah, F. A., & Awuah, E. (2020). Joint influence of hydraulic load and hydraulic retention time on oilfields wastewater contaminant removal dynamics in free water surface flow constructed wetland. *SN Applied Sciences*, 2(12), 1-12.
11. Appiah-Brempong, M., Essandoh, H. M. K., Asiedu, N. Y., Dadzie, S. K., & Momade, F. Y. (2021). Optimization of Coagulation-flocculation Process for Pre-treatment of Artisanal Tannery Wastewater Using Response Surface Methodology.
12. Osarenotor, O., Essandoh, H. M., & Tito Aighewi, I. (2021). Removal of pollutants by mycelium-

colonized sawdust. *Water Practice and Technology*, 16(3), 1036-1047.

13. Asare, W., Oduro Kwarteng, S., Donkor, E. A., & Rockson, M. A. (2020). Recovery of municipal solid waste recyclables under different incentive schemes in Tamale, Ghana. *Sustainability*, 12(23), 9869.
14. Delaire, C., Peletz, R., Haji, S., Kones, J., Samuel, E., Easthope-Frazer, A., ... & Khush, R. (2020). How much will safe sanitation for all cost? Evidence from five cities. *Environmental Science & Technology*, 55(1), 767-777.
15. Asare, W., Oduro-Kwarteng, S., Donkor, E. A., & Rockson, M. A. (2021). Incentives for improving municipal solid waste source separation behaviour: The case of Tamale Metropolis, Ghana. *SN Social Sciences*, 1(5), 1-33.
16. Nti, S. O., Buamah, R., & Atebiya, J. (2021). Polyaluminium chloride dosing effects on coagulation performance: case study, Barekese, Ghana. *Water Practice & Technology*, 16(4), 1215-1223.
17. Samuel, W., Richard, B., & Nyantakyi, J. A. (2022). Phytoremediation of heavy metals contaminated water and soils from artisanal mining enclave using *Heliconia psittacorum*. *Modeling Earth Systems and Environment*, 8(1), 591-600.
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19. Wiafe, S., Buamah, R., & Owusu, M. (2021). The effects of varying levels of heavy metals uptake by *Typha capensis* and *Heliconia psittacorum* from water and soil. *Arabian Journal of Geosciences*, 14(23), 1-10.
20. Abubakari, Z. I., Mensah, M., Buamah, R., & Abaidoo, R. C. (2019). Assessment of the electricity generation, desalination and wastewater treatment capacity of a plant microbial desalination cell (PMDC). *International Journal of Energy and Water Resources*, 3(3), 213-218.
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22. Bartels, D. A., Johnson, R., Bayor, M. T., Ainooson, G. K., Ossei, P. P., Etuafuful, R. K., & Buamah, R. (2021). Formulation of Suppositories of Alum Produced from Bauxite Waste in Ghana for the Treatment of Hemorrhoid. *The Scientific World Journal*, 2021.
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Sludge Odour Control in Dry Sanitation Toilet Facilities.

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28. Gyasi, S. F., Boamah, B., Kuffour, R. A., & Awuah, E. (2020). *Dam-induced Pollution in Ghana: Assessment of the Activities of Resettled Communities in the Vicinity of Bui Power Project on Freshwater Bodies. Journal of Energy and Natural Resource Management*, 6(1), 10-10.
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