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Aligning International Collaborative Research to Global and National Objectives: An Analysis of Research Objectives in Uganda Using Text Analysis and Natural Language Processing

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ABSTRACT

Like many developing countries, Uganda's engagement in international research collaboration has been on the increase. Evidence from this and other types of research is intended to shape policy and development outcomes for sustainable development. Uganda's development roadmap is reflected in its National Vision 2040 with its constituent five-year National Development Plans. These Plans are designed and aligned to other global development roadmaps, like the Sustainable Development Goals. Unfortunately, no research has been to track the alignment of IRC to these national and global development objectives. As a result, research is undertaken within a structural vacuum and the evidence it generates hardly influences policy. This research paper investigates the alignment of research projects conducted in Uganda between 2015 and 2020 with Sustainable Development Goals (SDGs), The National Development Plan III objectives, and NRM government Manifesto programs. By analyzing a comprehensive collection of research projects, the study aims to uncover hidden patterns, relationships, and insights, ultimately shedding light on research trends and providing guidance to policymakers and the research community.

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Several researchers have explored the alignment between research activities and specific Sustainable Development Goals (SDGs), highlighting the need for targeted efforts to address specific challenges (Smith et al., 2018; Johnson & Brown, 2020). Text mining techniques have emerged as a promising solution for analysing research literature, including identifying trends and assessing relevance to specific goals (Li et al., 2017; Chen et al., 2019). The objective of this study is to map the existing research registered in Uganda onto the NDPIII, Vision 2040 and Sustainable Development Goal Objectives to generate new evidence on the future alignment of research objectives to national development objectives. The methodology involved data acquisition and preprocessing, descriptive statistical analysis, qualitative analysis using text mining techniques, and natural language processing (NLP). The data was cleaned and analyzed using Excel and R programming. Descriptive analysis provided an overview of research distribution, while text mining identified key themes and connections between research titles and objectives. NLP was used to score and classify projects based on titles and objectives by leveraging the Ada Davinci Large Language OpenAI model. The combination of NLP and R programming allowed for efficient analysis of the data.

Analysis indicates a significant surge in registered research projects in 2017, showcasing remarkable growth, collaboration, and dedication within the scientific community. Most projects (80.37%) were collaborative, indicating a culture of international cooperation. The text mining analysis of research objectives reveals key focus areas and central concepts such as Uganda, HIV, health, care, and women. The analysis also shows a shift in key words and focus areas over time, with a reduction in research on HIV and an increased focus on Uganda. The text mining analysis of research titles aligns with the findings from the objectives, highlighting the prominence of Uganda, HIV, health, study, and evaluation. Overall, there is consistency in the focus areas before and after 2019, with a potential shift towards gender-related research and more specific study areas within Uganda. the paper also analyzed the alignment of international collaborative research with global and national objectives. The findings revealed that research projects primarily focused on Clean Water and Sanitation and Good Health and Well-being (19.4% and 18.0% respectively), while Affordable and Clean Energy and Decent Work and Economic Growth had limited representation (0.6% each). Regional Development and Tourism Development showed high alignment with NDP III objectives (27.6% and 25.6% respectively), while Governance and Security, Manufacturing, and Sustainable Urbanization and Housing had lower alignment. Collaborative research made significant contributions to delivering education and health (52.4%), ensuring justice and equity (23.5%), and protecting life and property (10.8%) in the NRM Manifesto programs. The results suggest the importance of collaborations, interdisciplinary research, and resource allocation for achieving sustainable development goals.

Introduction

Many countries have embarked on engaging in international research collaboration (IRC) over the last decade. More developing countries are increasingly pursuing joint research with partners from the global north while research teams include nationalities from more than one country. Carefully designing research objectives is critical for the identification of specific challenges, gaps, and opportunities. Such alignment also ensures that the right stakeholders can be engaged and that communities understand their needs and aspirations and how research can provide solutions to these. However, as in most developing countries, the research being undertaken is often never aligned to the strategic national objectives. With most of the research in Africa, being foreign funded, there is a likelihood of a misalignment of national

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priorities to research objectives. Aligning national and international research is crucial for advancing scientific knowledge, fostering collaboration, and addressing global challenges. Such alignment can help establish clear research priorities that reflect societal needs, scientific opportunities, and global challenges. Governments, research institutions, and funding agencies can work together to identify common research areas where collaboration can be mutually beneficial. Several reports have indicated that Uganda has significantly aligned its national development roadmap (NDP III) to other global development roadmaps, including the Sustainable Development Goals and the major political party's national development agenda, the NRM Manifesto.

The National Development Plan (III)

The National Development Plan (NDP) crafts Uganda's medium term strategic direction, development priorities and implementation strategies. The NDPIII focuses on improving household incomes and welfare using a development vehicle called the Parish Development Model (PDM). With its Program Implementation Action Plan (PIAP), implementation of the NDPIII is shaped by eighteen (18) program areas. By 2025, effective implementation of these programs is expected to lead to; average economic growth rate 7 percent, increase income per capita to USD 1,300, lower poverty rate to 15.4 percent, reduce income inequality (gini-coefficient) to 0.39; and further improve health and education outcomes of the population (NDP III). These programs incorporate the country's commitments to regional and international development frameworks and cross cutting issues. The eighteen programs include: Agro-industrialization, Mineral Development, Sustainable Development of Petroleum resources, Tourism Development, Climate Change, Natural Resources, Environment, and Water Management, Private Sector Development, Manufacturing, Integrated Transport Infrastructure and Services, Energy development, Digital Transformation, Sustainable Urbanization and Housing, Human Capital Development, Innovation, technology development and Transfer, Community Mobilization and Mindset, Governance and Security, Public Sector Transformation, Regional Development and Development Plan Implementation. Whereas these broad areas provide an insight into the key priorities expected to shape Uganda's medium term development, evidence available shows that they have limited focus. Their multi-sectorality does not facilitate ownership and partnership across different actors (EPRC, 2021).

Nevertheless, the demand to align NDPs to global development frameworks has been part of the reforms in global economic transformation. With the adoption of the 2030 Agenda there has been an increase in the number of national development plans (NDPs) adopted, accelerating a trend over the past two decades. According to Chimhowu *et al.* (2019), the number of countries with an NDP more than doubled between 2006 and 2018, from 62 to 134. The National Development Plan III objectives serve as a blueprint for the country's development agenda. The plan outlines key priority areas, targets, and strategies to achieve sustainable socio-economic transformation. Understanding the extent to which research projects align with these objectives is crucial for assessing their relevance and contribution to national development. Previous studies have examined the alignment of research with national objectives in various countries (Anderson et al., 2016; Li & Fu, 2019). In the ideal, research objectives should be shaped by imperatives arising out of this national development roadmap. De Hann *et al* (2015) note that identifying research priorities is key to innovation and economic growth, since it informs decision makers on effectively targeting issues that have the greatest potential public benefit. For developing countries, the process of setting research priorities is of pivotal importance for STI-led development. In Tanzania, research priority setting followed three major criteria: Linkage to the National Five Year Development Plan; Feasibility for implementing the research; and the possibility for

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cross-sectoral work. However, for most developing countries, aligning research objectives to national priorities remains a challenge. For instance, TFHRD (1991) notes that existing mechanisms often fail to focus attention on the key issues affecting the health of the majority of the population, especially the needs of the most vulnerable and the disadvantaged. This means that the priorities enunciated by such mechanisms tend to be narrowly constructed. Aligning research priorities to the national development roadmap provides opportunities for better alignment, smarter research funding and STI-ecosystem cohesion and coordination. … notes that such alignment provides a "strong voice" for research impact.

Plough (2018) look at this alignment from an ethical standpoint. They priority setting is shaped by values and other implicit prioritizations which provide guidance on the research topics to fund. However, some tensions continue to persist between the research priorities and how they are shaped and eventually adopted to infom national planning strategies. While such healthy tension is inevitable, within nascent research systems, clear responsibilities and processes are required to ensure that the tension does not become counterproductive. Countries like Malaysia have ensured that every investment it makes in supporting research achieves the desired results and earns a high rate of return. The allocation of resources is therefore closely aligned to its national priorities of transforming the country into a knowledge-driven economy so as to maximize economic and social returns (OECD, 2015).

The Sustainable Development Goals (Agenda 2030)

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. The 17 SDGs include: (1) no poverty; (2) zero hunger; (3) good health and well-being; (4) quality education; (5) gender equality; (6) clean water and sanitation; (7) affordable and clean energy; (8) decent work and economic growth; (9) industry, innovation and infrastructure; (10) reduced inequalities; (11) sustainable cities and communities; (12) responsible consumption and production; (13) climate action; (14) life below water; (15) life on land; (16) peace, justice, and strong institutions; and (17) partnerships for the goals. These 17 SDGs are integrated—they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. Countries have committed to prioritize progress for those who're furthest behind. The SDGs are designed to end poverty, hunger, HIV/

AIDS, and discrimination against women and girls. SDGs focus on a range of interrelated goals, comprising 169 targets and 232 indicators, from the eradication of poverty and inequality to taking action on climate change. The creativity, knowhow, technology and financial resources from all of society is necessary to achieve the SDGs in every context. Collaboration has become a critical ingredient in sustainable development research and in strategies for meeting the SDGs.

Numerous studies have been conducted to examine the alignment of research projects with Sustainable Development Goals (SDGs) and national objectives in various contexts. Smith et al. (2018) explored the alignment of research activities with specific SDGs by conducting a comprehensive analysis of research publications. They employed a systematic review approach, categorizing the research papers based on their relevance to each SDG and assessing the extent to which the research addressed the goals. Johnson and Brown (2020) focused on mapping the alignment of education research with the SDGs. They reviewed publications from 2016 to 2018, analyzing the research content and identifying the SDGs addressed in each study. The researchers employed a content analysis method to assess the alignment between research and the SDGs. In the context of national objectives, Li and Fu (2019) conducted a bibliometric analysis of environmental research in China to identify the alignment of

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research projects with the country's National Development Plan objectives. They used bibliometric indicators, such as keywords and research areas, to assess the relevance of research projects to the plan's goals. Anderson et al. (2016) investigated the alignment of youth development research with national objectives by examining data from the International Youth Development Study. They employed a mixed-methods approach, combining quantitative analysis of survey data with qualitative interviews, to assess how research activities aligned with national youth development strategies. Work by Fourie (2018) concluded that sustainable development depends on coherence between the development policies of recipients and the providers of development assistance. They developed five guidelines to ensure proper alignment: Prioritizing political buy-in; Safeguarding country ownership of development priorities; Using and improving existing institutional structures and processes; Stimulating cooperation across government departments by using an issue-based approach; and, Including a long-term and transnational perspective when considering policy impacts.

Using co-authorship of Sustainable Development Goal-related publications over a 20-year span (1999–2018), Payumo et al (2021) showed that publication output on the SDGs grew at a compound annual growth rate (CAGR) of 19%. These findings confirm similar findings that collaboration was also on the rise, with more authors and institutions collaborating over time, indicating that collaboration is becoming a mainstream approach for SDG research (Sustainability Science (2015); Nakamura et al. (2019). Moreover, since most research undertaken in developing countries is foreign-funded, research budgets tend to be skewed to those SDGs which are pertinent to the funders. Several researchers have explored the alignment between research activities and specific SDGs, highlighting the need for targeted efforts to address specific challenges (Smith et al., 2018; Johnson & Brown, 2020).

The NRM Manifesto

The National Resistance Movement (NRM) is the ruling party in Uganda. The NRM manifesto provides a comprehensive blueprint of the policies, which the party will follow and implement over the next five years (2021- 2026) for socioeconomic transformation. The NRM Manifesto proioritises five strategic areas: (1) Creating Jobs and Wealth; (2) Delivering Education and Health; (3) Ensuing Justice and Equity (4) Protecting Life and Property; (5) Achieving Political and Economic Integration. There is however limited evidence as to how research is shaping the delivery of these imperatives under the NRM manifesto.

Text Mining Techniques for Research Analysis

Research endeavors play a crucial role in addressing global challenges and advancing societal development. The alignment of research projects with global and national objectives has gained significant attention to maximize the impact of scientific efforts. This research paper focuses on examining the alignment of research projects conducted in Uganda between 2015 and 2020 with Sustainable Development Goals (SDGs), The National Development Plan III objectives, and NRM government Manifesto programs. Efficient comprehension and extraction of meaningful insights from vast amounts of text data on research titles and objectives are essential for researchers, scholars, and research policy makers. Traditional manual methods for analyzing research titles and objectives are time-consuming and impractical for large datasets. Advanced text mining techniques have emerged as a promising solution to overcome these challenges.

Text mining encompasses various computational methods and statistical algorithms that can automatically extract valuable information from unstructured text documents (Manning et al., 2008). Research titles and objectives provide concise representations of the study's scope and purpose, making

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them crucial components of research work. To explore the composition of these elements, advanced text mining techniques have emerged as a promising solution. Text mining encompasses a range of computational methods and statistical algorithms that extract valuable information from unstructured text documents. Researchers have applied text mining techniques to analyze research literature in different domains, including identifying research trends, detecting emerging topics, and assessing the relevance of research to specific goals or objectives. For instance, Cheerkoot (2021) employed text mining methods to analyze research publications and identify emerging trends in sustainable agriculture. Another study by Chen et al. (2019) used text mining techniques to assess the alignment of research projects with the United Nations' SDGs. These studies demonstrate the efficacy of text mining in uncovering hidden patterns and relationships within research literature. The identification of prevalent keywords, themes, and word networks will provide valuable insights into the overall research landscape. By leveraging these insights, policymakers and funding agencies can make informed decisions regarding research funding allocation, ensuring that resources are allocated to projects that align with national priorities and have the potential for meaningful impact. According to Waegel (2006), text mining uses non trivial extraction of previously unverified but useful information from a large volume of textual data. Using techniques like data mining, text-analysis can help reveal useful patterns within the data that provide strategic insights into marketing, demographic behavior, system analysis and health care outcomes. Over the years, text mining research has become a major methodological approach for determining underlying patterns and trends between phenomena. Developing a text mining mainframe involves cleaning up the text (removing certain common words, like “is” or “and”), tokenization, normalization, and -then stemming. Other approaches may include creating a term-document matrix (Lee *et al,* 2023), which comprises the frequencies of specific terms for each document (Feinerer *et al.*, 2008). Some studies have used this method to investigate research topics of academic publications via content analysis. The application of text-mining methods enables us to visualize trends in research objectives and map them onto the national and global development objectives.

This study analyses trends in research objectives over a five year period from 2015 to 2019 and uses text-mining techniques to evaluate the R&D trends and research concentration. The aim to provide researchers and policy makers with a comprehensive and systematic understanding of how to realign research to effectively respond to these national objectives through policy reform. Although the alignment of research projects with global and national objectives is gaining attention, there is a lack of comprehensive studies on the topic in the context of Uganda. This research paper aims to bridge this gap by conducting a thorough analysis of research projects conducted in Uganda between 2015 and 2020. By applying text mining techniques to a dataset comprising research titles and objectives, the study intends to uncover patterns, themes, and insights that shed light on the alignment of research projects with SDGs, the National Development Plan III objectives, and NRM government Manifesto programs. The outcomes of this research paper will contribute to the understanding of the extent to which research projects in Uganda align with broader societal goals. The identification of prevalent keywords, themes, and word networks will provide valuable insights into the overall research landscape, enabling policymakers and funding agencies to make informed decisions regarding research funding allocation. By ensuring that resources are directed towards projects that align with national priorities, this research can facilitate the meaningful impact of scientific efforts in Uganda.

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Methods

Data Acquisition and Preprocessing

The research projects' dataset used in this study was acquired from the registration database of the Uganda National Council of Science and Technology. The dataset consists of information on various researchers' characteristics, project details including their title and objectives of research registered between 2015 and 2020, Before conducting the analysis, the dataset underwent preprocessing to ensure data quality and consistency. This involved data cleaning, removing duplicates, handling missing values, coding, and standardizing and subsetting necessary variables for this study. This was done using Excel spreadsheet and R programming utilizing the package of "tidyr", "dplyr", "tidytext" and "tm".

Descriptive Statistical Analysis

Descriptive statistical analysis was performed to gain insights into the distribution and characteristics of the selected variables. This analysis involved calculating measures such as frequencies and percentages and using bar, doughnut, and line charts. It provided an overview of research distribution over the years and by collaborative status.

Qualitative Analysis - Text Mining

Text mining techniques were employed to extract meaningful information from the research project titles and objectives. The text mining packages in R programing of "tm", "tidytext", "arules" and "quantenda" and text processing were utilized to clean and transform the tittles and objectives to an analyzable format and perform feature extraction and association rule mining. These identified key themes, keyword trends, and connections between research project titles and objectives compositions.

Word-frequency, word co-occurrences and word connections analysis were conducted separately for title and objectives. The analysis was done overall, and in comparison, between time interval of year of research registration, that is before 2019 and during 2019 onwards to examine keyword changes and trends over time. This analysis allowed the identification of keywords and tracked their occurrence and popularity over time. The associations and patterns discovered were visualized using bar graphs, word clouds and network enabling a better understanding of the connections among different research titles and objectives.

To interpret the results from a word cloud, a visual inspection is performed following the rule that "the size of each word corresponds to its frequency of appearance in the text; *The more frequently a word appears in the objectives, the larger and more prominent it appears in the word cloud."* It offers a visual snapshot of the most frequently occurring words and concepts.

This word association/ network graph similarly gives a visual representation that illustrates the connections between words based on their co-occurrence and semantic associations within the research objectives. Can be interpreted by inspect basing the rule that *"Nodes/words that are more closely connected and frequently co-occur together will be positioned closer to each other in the chart, while words with weaker associations will be farther apart."*

Natural Language Processing for National and broader Objectives

Natural language processing (NLP) techniques were utilized to score and classify research projects based on their alignment with specific Sustainable Development Goals, National development Plan III objectives and NRM government programs. The Ada Davinci OpenAI Large Language Model was employed via an API integration in the R programming language, allowing for advanced language

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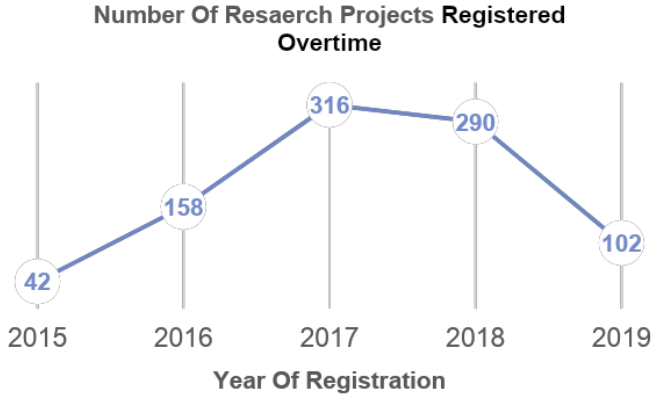
processing capabilities. By leveraging the model's deep learning capabilities, the titles and objectives of research projects were utilized to score and classify the research projects to their aligned policy objectives. The model's sophisticated language understanding capabilities enabled to capture nuanced semantic information and context-specific patterns within the text. This powerful combination of advanced AI in the R programming language offered a seamless and efficient workflow.

Findings

Descriptive Statistical Analysis Results

As shown in the chart, between the years 2015 and 2019, the sampled studies have been increasing since 2015. The findings indicate that the majority (80.37%) of the researcher projects were collaborative (international collaborative), as only 19.63% pursued non-collaborative endeavors. The substantial percentage of research projects engaged in international collaboration suggests a prevailing culture of teamwork, knowledge sharing, and interdisciplinary cooperation across countries.



Text Mining Results for Research Objectives

Research Objectives Overall Text Mining

a. Ten Most Used Words in Research Objectives

The top ten most frequent words reveal insights into the critical focus areas. Topping the list, "Uganda" appears 294 times, highlighting the central geographical context of the research. Following closely, "HIV" emerges at 226, "Health" appears 197 times, "Care" at 162 times. Furthermore, "women" and "factors" share the fifth position, both at 116, emphasizing the attention given to gender-specific considerations and influencing elements. "Use" is next at 114, indicating a focus on utilization patterns or behaviors.

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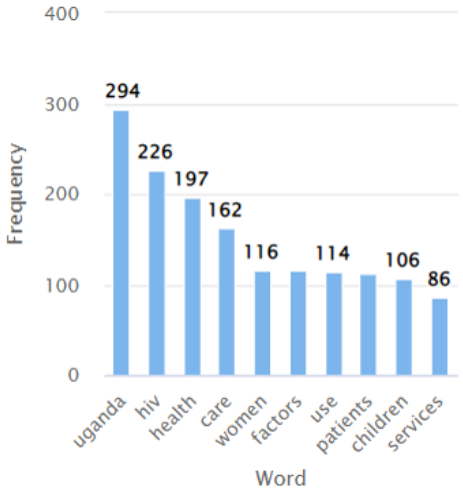
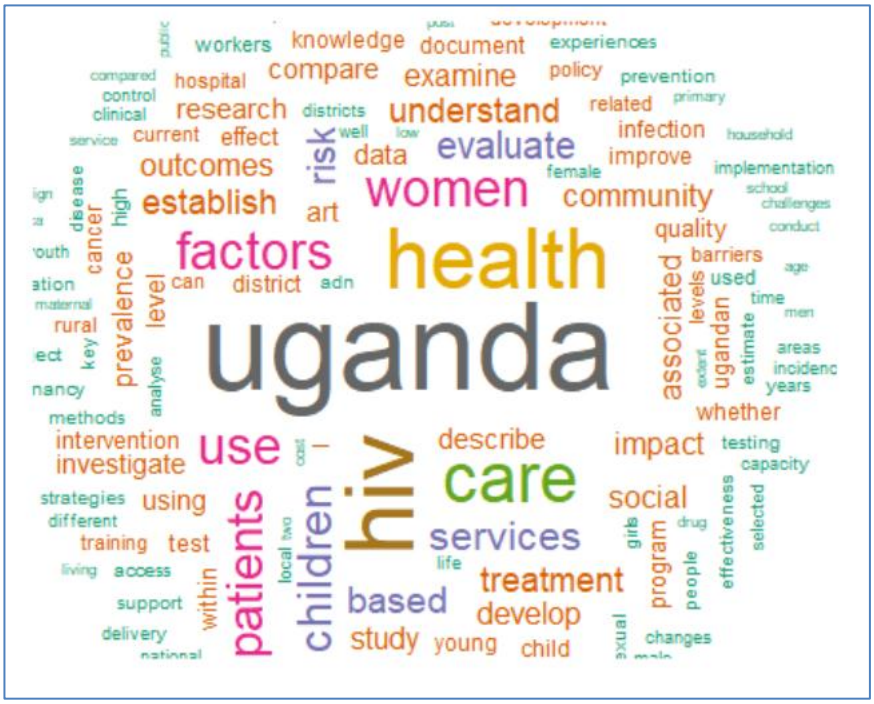
Figure 13: Word Count of Research Objectives



b. Top 150 words in research objectives

The image shows a word cloud where the size of each word corresponds to its frequency of appearance in the objectives. The more frequently a word appears in the objectives, the larger and more prominent it appears in the word cloud. This figure offers you a visual snapshot of the most frequently occurring words and concepts. It is evident that Uganda, HIV, factors, health etc. are one of the most salient aspects of the research objective.

Figure 14: Word cloud showing distribution of top 150 words in research objectives



c. Top 50 nodes/word association

This word association graph gives a visual representation that illustrates the connections between words

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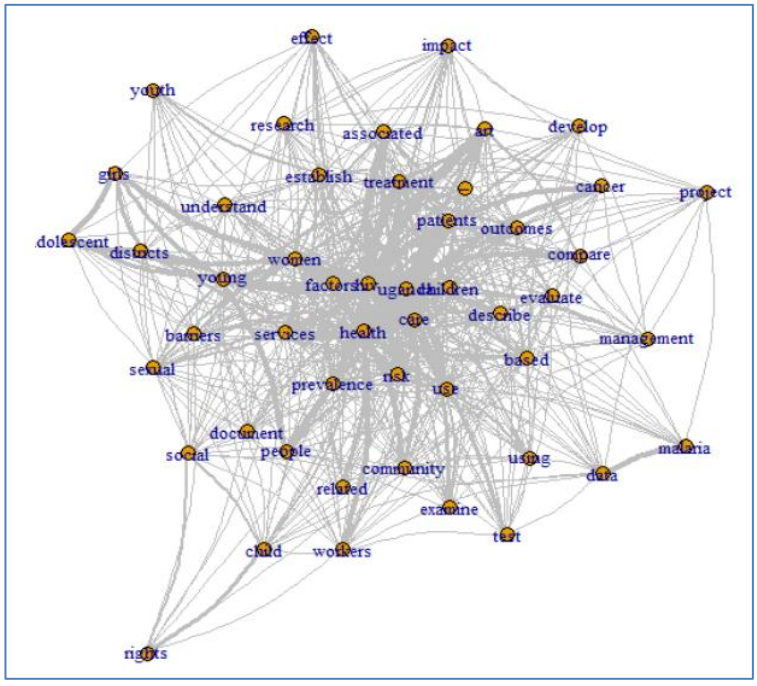
based on their co-occurrence and semantic associations within the research objectives. Nodes/words that are more closely connected and frequently co-occur together will be positioned closer to each other in the chart, while words with weaker associations will be farther apart. By examining a word network chart, you can gain insights into the co-occurring patterns of words and central concepts within the research objectives. The Chart show that the words of Uganda, care, health, services, risk, prevalence, children using etc. are central concepts in the research objectives

Figure 15a: Network Chart of the top 50 nodes/words associations



Research Objectives text Mining by Year of Registration

Fig 16a: Word Frequency of objectives for Research registered before 2019

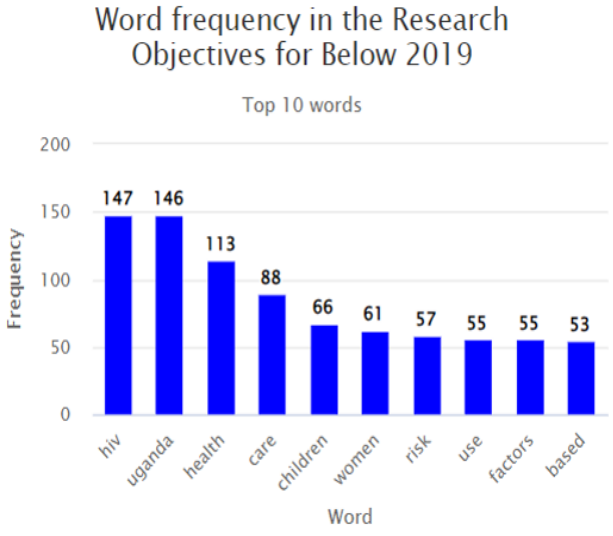
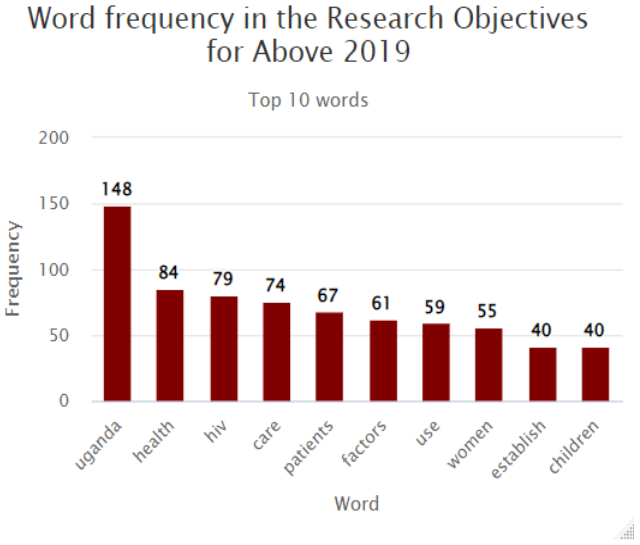


Fig 16b: Word Frequency of objectives for Research registered in 2019 onwards



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The Charts above show the top 10 most occurring words in the objectives as a comparison by years of registration before and in & after 2019, this reveals a shift in the key words and focus areas overtime. Before 2019, HIV is the most frequent (147 times) which shifted to the 3rd most used after 2019 showing a reduction in research focusing on HIV as time increased which may be caused to reduction in funding and interest in the focus area on HIV. Additionally, it can be observed that there was an increase (from 2nd to most used word) in research objectives with a geographical focus to Uganda during and after 2019.

Fig 17a: Word Cloud of objectives for Research registered before 2019

Fig 17b: Word Cloud of objectives for Research registered in 2019 onwards

From the images above, by inspection based on the rule that "the size of each word corresponds to its frequency of appearance and the more frequently a word appears in the objectives, the larger and more prominent it appears in the word cloud", It is evident that Uganda was evident in both periods, however HIV and health were more prominent in research registered before 2019 than those registered in the later years**.**

Fig.18a: Word co-occurrence Network of objectives for Research registered before 2019

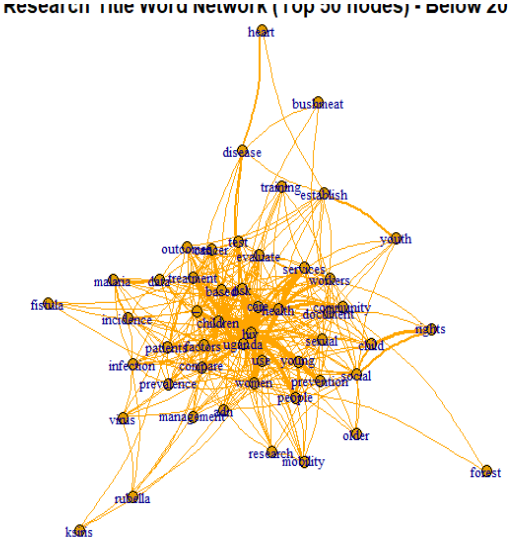
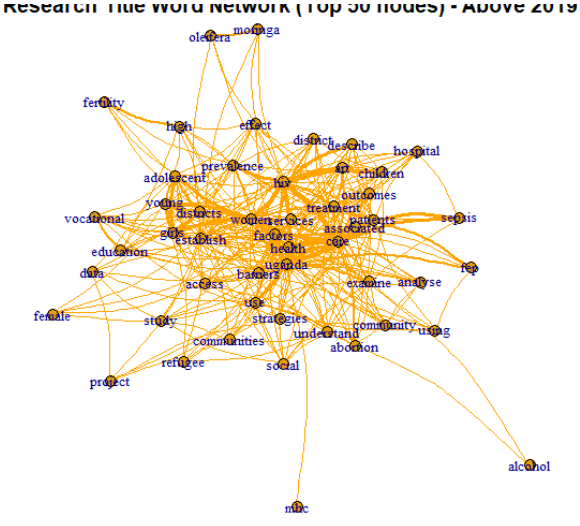


Fig 18b: Word co-occurrence network of objectives for Research registered in 2019 onwards



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This word association graph gives a visual representation that illustrates the connections between words based on their co-occurrence and associations within the research objectives. You can interpret the networks basing on the rule that "Nodes/words that are more closely connected and frequently co-occur together will be positioned closer to each other in the chart, while words with weaker associations will be farther apart. "Therefore, by inspection, and comparison between the research registered before 2019 and those in 2019 and onwards, there is a more co-occurring word pattern in wording of objectives for research projects registered in 2019 and above, this may imply that during the period research projects were focused on areas that are closely related as opposed to those registered before 2019 as they covered more diverse focus areas shown by the sparse population of nodes on then network chart

Text Mining Results for Research Title

Research Title Overall Text Mining

The top ten most frequent words reveal insights into the serious focus areas in the tittles. "Uganda" appears 425 times, highlighting the geographical context of the research. Following closely, "HIV" emerges at 128 times, "Health" appears 123 times, "Study" at 97 times. Additionally, Care (73), evaluation (69) and children (48) emphasizing the attention given to children specific considerations and evaluation elements. "Community" at 44, indicating a focus on the society.

Table 15: Word Results from Text Mining

Word	Frequency
Uganda	425
HIV	128
Health	123
Study	97
Care	73
evaluation	69
Children	48
Outcomes	47
Assessments	46
Community	44

Top 15 words in Research Titles

The imge shows a word cloud where the size of each word corresponds to its frequency of appearance in the titles. The more frequently a word appears in the titles, the larger and more prominent it appears in the word cloud. This figure offers you a visual snapshot of the most frequently occurring words and concepts. It is evident that Uganda, HIV, evaluation, study etc. are one of the most outstanding facets of the research titles.

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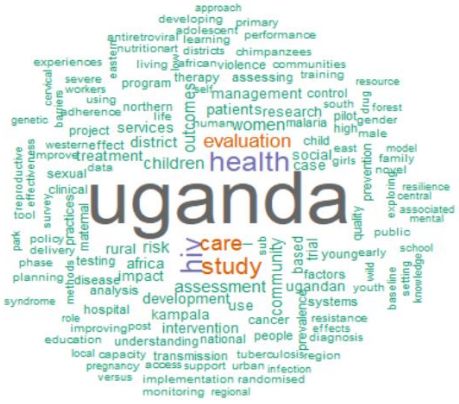
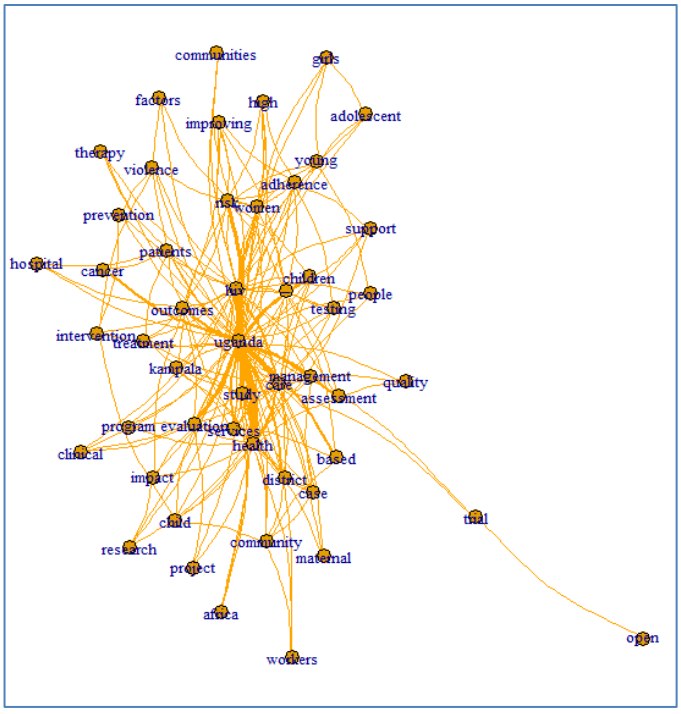
Figure 19: Word cloud showing spread of top 150 words in research titles



Top 50 nodes/word associations in research titles

This word association graph gives a visual representation that illustrates the connections between words based on their co-occurrence and semantic associations within the research objectives. Nodes/words that are more closely connected and frequently co-occur together will be positioned closer to each other in the chart, while words with weaker associations will be farther apart. By examining a word network chart, you can gain insights into the co-occurring patterns of words and key concepts within the research objectives. The Chart show that the words of Uganda, HIV, outcomes, study, Kampala, evaluation, children using etc. are key concepts in the research titles.

Figure 20: A word Network chart of the top 50 nodes/word associations in research titles



Research Title Text mining by Year of Registration

The Charts below show the top 10 most occurring words in the titles as a comparison by years of

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registration before and in & after 2019, this discloses more less no change in the key words and focus areas overtime. Before 2019 and after, Uganda, HIV, health is the most frequent showing a fairly consistence in the overall focus areas that were researched on. Additionally, it can be observed that the words of district and women were among the top 10 most frequent words for research projects registered in 2019 and onwards. This might imply a shift towards focus areas related to gender, and research projects focused on a smaller study area of districts besides those focusing on the whole country of Uganda.

Fig 21a: Word Frequency of titles for Research registered before 2019

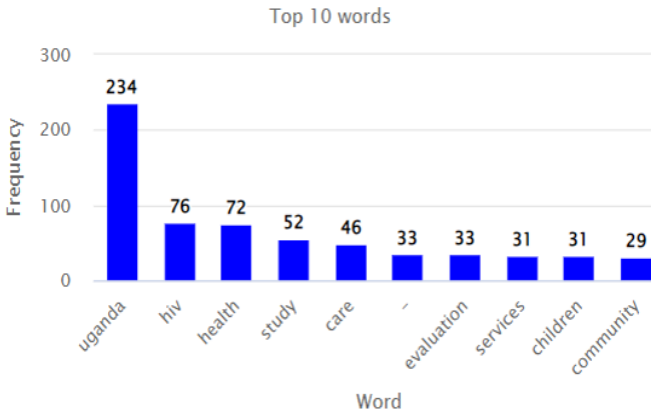
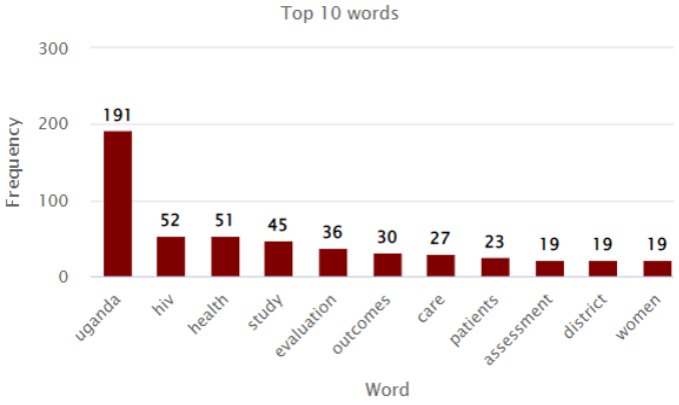


Fig 21b: Word Frequency of titles for Research registered in 2019 onwards



From the images below, by inspection based on the rule that "the size of each word corresponds to its frequency of appearance and the more frequently a word appears in the objectives, the larger and more prominent it appears in the word cloud", It is evident that Uganda, HIV, and health were prominent in research titles for projects registered in both periods. However, it can be seen in both periods that most words were less frequently used showing uniqueness of project titles.

Fig.22a: Word Cloud of titles for Research registered before 2019

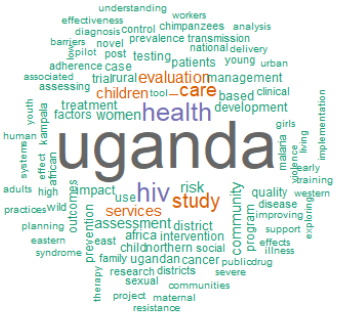
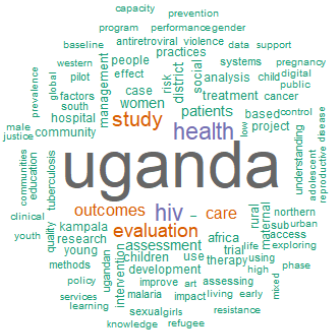


Fig 22b: Word Cloud of titles for Research registered in 2019 onwards



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Aligning international collaborative research to global and National objectives

Alignment of Registered Research and the Sustainable Development Goals (SDGs).

The analysis showed that the concentration of SDG research is mainly in the SDG 6 on Clean water and sanitation, SDG 3 On Good Health and Wellbeing and SDG 17 (Partnership for the Goals). On the other hand, the SDGs of Affordable and Clean Energy and Decent Work and Economic Growth had the lowest representation, both accounting for only 0.6% of the projects. These findings may imply that a significant portion of the research projects is directed intentionally or unintentionally towards addressing critical issues related to access to clean water, healthcare, and establishing partnerships, highlighting the recognition of their importance in sustainable development efforts. However, there seems to be a relatively smaller emphasis on other SDGs, such as affordable and clean energy and decent work and economic growth, suggesting potential areas for further research and targeted interventions.

Figure 22: Word Count and SDG Objective

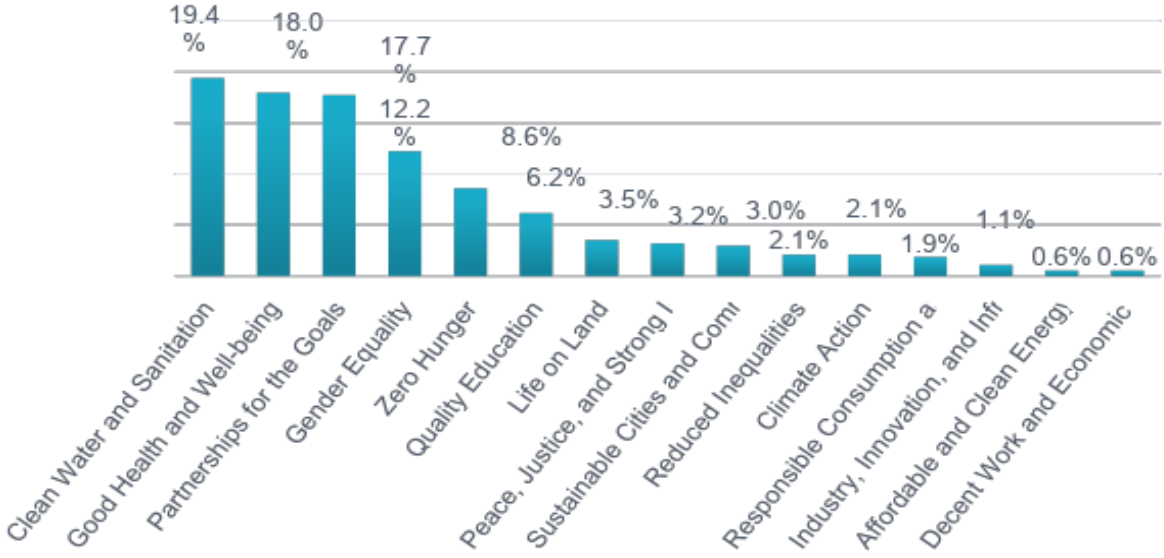

Table 16: Collaborative status by SDGs

Target SDG	Collaborative	Non-Collaborative	Total
Affordable and Clean Energy	0.6%	0.0%	0.6%
Clean Water and Sanitation	16.1%	3.3%	19.4%
Climate Action	1.5%	0.6%	2.1%
Decent Work and Economic Growth	0.4%	0.1%	0.6%
Gender Equality	9.0%	3.2%	12.2%
Good Health and Well-being	13.1%	4.8%	18.0%
Industry, Innovation, and Infrastructure	0.9%	0.2%	1.1%
Life on Land	2.5%	1.0%	3.5%
Partnerships for the Goals	14.1%	3.6%	17.7%
Peace, Justice, and Strong Institutions	2.0%	1.2%	3.2%
Quality Education	4.5%	1.7%	6.2%
Reduced Inequalities	1.5%	0.6%	2.1%

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Responsible Consumption and Production	1.2%	0.7%	1.9%
Sustainable Cities and Communities	2.2%	0.8%	3.0%
Zero Hunger	5.5%	3.1%	8.6%
Total	**75.2%**	**24.8%**	**100.0%**

Source: Primary Data

The table indicates the percentage distribution of collaborative and non-collaborative research projects across various SDGs. Collaborative research refers to research projects that involve researchers from multiple nationalities working together towards a common research undertaking. On the other hand, non-collaborative research projects involve researchers from a single nationality working independently. From the analysis, collaborative research projects displayed significant contributions across multiple SDGs. For instance, they made notable contributions to Clean Water and Sanitation (16.1%), Good Health and Well-being (13.1%) and Gender Equality (9.0%). Of note is that certain SDGs have a relatively lower contribution from both collaborative and non-collaborative research projects. Such goals include: Innovation, and Infrastructure, Decent Work and Economic Growth, and Reduced Inequalities had more modest contributions overall. This highlights the need for increased research focus and dedicated efforts in these areas to achieve meaningful progress. Collaborative research projects demonstrated notable contributions across multiple goals, emphasizing the value of collective efforts and partnerships. Simultaneously, non-collaborative projects showcased the significance of individual research endeavors. These findings underscore the importance of fostering collaborations, promoting knowledge-sharing, and encouraging interdisciplinary research to effectively address the complex challenges outlined in the SDGs.

From the results of the test (chi-squared = 18.852, p-value = 0.1707) show that there is insufficient evidence to reject the null hypothesis at the 0.05 significance level. This means that there is no significant statistical evidence to conclude that there is an influence of "Collaborative Status" to the "Target SDG". The implications of this finding indicate that the collaborative status does not appear to have a significant impact on the Sustainable Development Goals (SDGs) targeted by research.

NDP III

An Explanatory Analysis of the research objectives mapped onto the National Development Plan III objectives showed that the highest percentage of research was towards the Regional Development programme (27.6%). According to NDPIII, in order to address area-specific priorities and inequities in growth and household incomes, groups of local governments are supported to develop Regional Development Plans to address specific development programs that transcend district boundaries. Research objectives are therefore designed to provide evidence on region-specific issues.

Tourism Development emerged as another crucial objective to was mostly target by research projects, with a significant proportion of 25.6% implying that research has put emphasis on harnessing the potential of the tourism sector for economic growth and job creation.

Community Mobilization and Mindset accounted for 14.1%, reflecting the attention and contribution current research has given to community engagement and empowering individuals to actively participate in development initiatives. While Regional Development and Tourism Development were highly targeted by research projects, other crucial objectives such as Governance and Security (4.2%), Manufacturing (1.9%), and Sustainable Urbanization and Housing (1.8%) and others, were less targeted by research projects.

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Table 17a: National Development Plan Themes and Registered Research

NDP Program	Total public sector costing FY2020/21-2024/25	Percentage	Number of Research Project	Percentage
Regional Development	14,421	11%	251	27.6%
Tourism Development	3,043	2%	232	25.6%
Community Mobilization and Mindset	3,820	3%	128	14.1%
Human Capital Development	25,404	19%	81	8.9%
Innovation, Technology Development and Transfer	3,237	2%	53	5.8%
Natural Resources, Environment and Climate Change	7,415	6%	45	5.0%
Governance and Security	32,779	25%	38	4.2%
Manufacturing	3,203	2%	17	1.9%
Sustainable Urbanization and Housing	4,281	3%	16	1.8%
Agro industrialization	6,940	5%	10	1.1%
Digital Transformation	2,131	2%	9	1.0%
Mineral Development	3,164	2%	8	0.9%
Energy Development	5,789	4%	7	0.8%
Sustainable Development of Petroleum Resources	4,183	3%	7	0.8%
Public Sector Transformation	10,442	8%	5	0.6%
Private Sector Development	3,172	2%	1	0.1%
Grand Total			**908**	**100.0%**

Source: Primary Data

Table 17b: Collaborative status by NDP III Objectives

NDP III Program	Collaborative	Non-collaborative	Total
Agro industrialization	0.6%	0.6%	1.1%
Community Mobilization and Mindset	10.4%	3.7%	14.1%
Digital Transformation	0.6%	0.4%	1.0%
Energy Development	0.6%	0.2%	0.8%
Governance and Security	2.8%	1.4%	4.2%
Human Capital Development	7.5%	1.4%	8.9%
Innovation, Technology Development and Transfer	5.2%	0.7%	5.8%
Manufacturing	1.9%	0.0%	1.9%
Mineral Development	0.7%	0.2%	0.9%
Natural Resources, Environment and Climate Change	3.5%	1.4%	5.0%
Private Sector Development	0.1%	0.0%	0.1%

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Public Sector Transformation	0.6%	0.0%	0.6%
Regional Development	20.9%	6.7%	27.6%
Sustainable Development of Petroleum Resources	0.3%	0.4%	0.8%
Sustainable Urbanization and Housing	1.1%	0.7%	1.8%
Tourism Development	18.7%	6.8%	25.6%
Total	**75.2%**	**24.8%**	**100.0%**

Source: Primary Data

When examining the specific objectives of NDP III, it is evident that collaborative research has made substantial contributions across various domains. The objective of Regional Development stands out with the highest proportion of collaborative research projects, accounting for 20.9% of the total.

Tourism Development is another area where collaborative research has played a significant role, accounting for 18.7% of the total research projects. These findings underscore the value of international partnerships in addressing critical issues related to education, technological advancement, and environmental sustainability. On the other hand, non-collaborative research projects account for 24.8% of the total. While this represents a smaller share, it is crucial to acknowledge the contributions made by these projects as well. Although non-collaborative research may be more focused on specific national contexts, it still plays a role in advancing the objectives of NDP III. It is essential to recognize the role of non-collaborative research in addressing specific national contexts. The findings of this analysis can guide future research efforts, emphasizing the importance of collaboration to maximize the impact of research on national development goals.

Based on the results of the Pearson's chi-squared test, (test statistic = 29.636, p-value obtained is 0.0133). There is strong evidence to reject the null hypothesis. Therefore, can conclude that there is a statistically significant association between the collaborative status and the national target NDP objectives and programs. This implies that the collaborative status does have an influence on the national target NDP objectives and programs. It suggests that collaborative status may play a role in shaping or affecting the achievement of the target objectives and implementation of programs at the national level. This finding highlights the importance of considering the collaborative status when planning and implementing national targets, objectives, and programs.

NRM Manifesto

The highest percentage (54%) of research projects in the NRM Manifesto were under the objective of “Delivering education and health". This signifies a significant emphasis on prioritizing the provision of quality education and healthcare services by research. The "Achieving economic and political integration" objective attained the lowest percentage at 2.8%. These findings provide valuable insights for policymakers and stakeholders, emphasizing the need to allocate resources and efforts accordingly to address the identified government priorities effectively by leveraging research projects.

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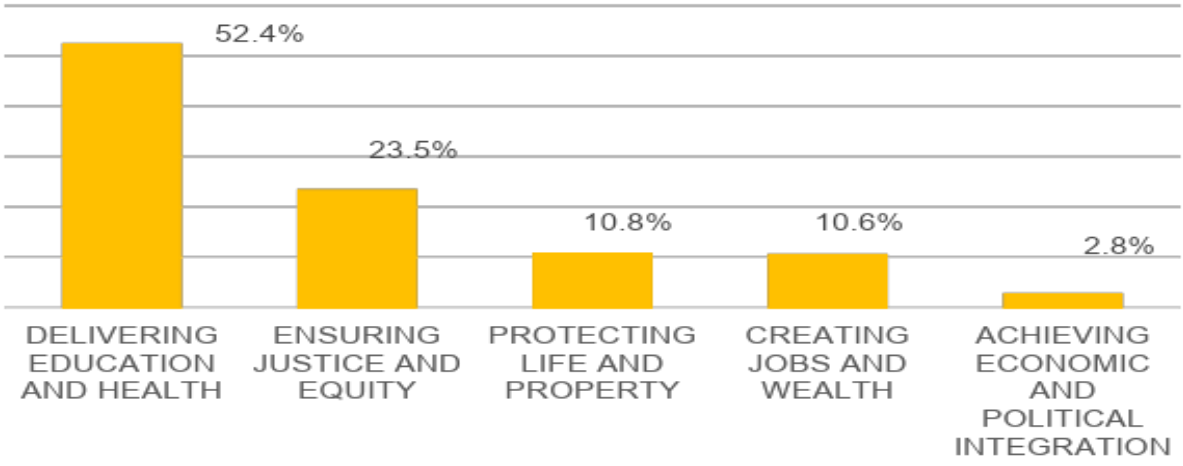
Figure 23: Collaboration Status by global and National objectives



Collaboration Status by global and National objectives

H0: Collaborative Status does not influence national targets objectives and programs

H1: Collaborative Status influences national targets objectives and programs

Table 18: Collaborative status by NRM Manifesto program

NRM manifesto program	Collaborative	Non-collaborative	Total
Achieving economic and political integration	2.3%	0.4%	2.8%
Creating jobs and wealth	7.9%	2.6%	10.6%
Delivering education and health	41.1%	11.3%	52.4%
Ensuring justice and equity	17.0%	6.5%	23.5%
Protecting life and property	6.9%	3.9%	10.8%
Total	**75.2%**	**24.8%**	**100.0%**

Source: Primary Data

The results have notable differences in the contributions of collaborative and non-collaborative projects towards the NRM Manifesto Programs. Collaborative projects exhibited higher levels of contribution in multiple program areas, including Achieving Economic and Political Integration (2.3% collaborative vs. 0.4% non-collaborative), Creating Jobs and Wealth (7.9% collaborative vs. 2.6% non-collaborative), Delivering Education and Health (41.1% collaborative vs. 11.3% non-collaborative), Ensuring Justice and Equity (17.0% collaborative vs. 6.5% non-collaborative), and Protecting Life and Property (6.9% collaborative vs. 3.9% non-collaborative). Overall, the findings highlight the significance of collaborative research projects in making substantial contributions towards the NRM Manifesto Programs. Collaborative efforts consistently demonstrated higher contributions across various program areas, underscoring the importance of cooperation and synergy in achieving the developmental goals outlined in the NRM Manifesto. Based on the results of the test (chi-squared value = 10.817, p-value = 0.0287), there is enough statistical evidence to reject the null hypothesis. Therefore, we conclude that there is a statistically significant influence of "Collaborative Status" of a research project towards the

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Target NRM Manifesto Programs. The observed association between these variables is unlikely to have occurred by chance alone. These findings have important implications for policymakers and stakeholders involved in the development and implementation of national targets and programs. Recognizing the impact of collaborative status on target can inform decision-making processes, resource allocation, and collaborative efforts among different stakeholders. It highlights the need to consider and promote collaborative approaches to effectively achieve the objectives outlined in the NRM manifesto program.

Discussion

Aligning national development objectives with research objectives is crucial for evidence-based policymaking and effective implementation of development plans. Specifically, national development objectives typically outline the key sectors and thematic areas that require attention and improvement. Research objectives should be aligned with these priority areas to generate evidence that directly informs policy decisions and interventions. By focusing research efforts on areas identified as national priorities, the findings and recommendations can have a more significant impact on development outcomes. As observed, that alignment is weak with regard to the national objectives reflected in the NDP III and the NRM Manifesto. This could be because the appetite for evidence for shaping policy in Uganda is limited, Engaging in dialogue and fostering partnerships between research institutions, government agencies, civil society organizations, and other stakeholders helps establish a shared understanding of development objectives and facilitates the integration of research findings into policy and practice. Jointly designing research projects and involving policymakers in the research process can enhance the uptake and utilization of research outcomes. By aligning national development objectives to research objectives, policymakers can leverage evidence and data-driven insights to design and implement more effective policies and programs. This alignment helps ensure that research efforts contribute directly to achieving development goals, improving the overall impact of national development plans.

Conclusion

Alignment of IRC objectives to national development objectives is a broad area, and there may not be specific references that cover the entire concept comprehensively. Currently, Uganda does not have a clear set of research objectives that outline the nationally strategic areas for research intervention. To address the poor alignment of research objectives to national development objectives, it is important to strengthen coordination mechanisms, enhance stakeholder engagement, and establish platforms for dialogue between research institutions and policymakers. This can help ensure that research priorities are informed by national development objectives and that research outputs are directly applicable to policy decisions and interventions. Additionally, increasing funding for research that aligns with national priorities and establishing mechanisms to monitor and evaluate the impact of research on development outcomes can help improve the alignment between research and national development objectives. This research applied text mining using keyword frequency analysis and research topic modelling to examine and map the association of research objectives to national development outcomes in three key documents. The results indicated research objectives of work undertaken and registered in Uganda is poorly aligned to the national development roadmap. The results from the text-mining demonstrate that better focusing of research is critical to ensure that ongoing research provides the necessary evidence base for policy. Moreover, the delineation of a nationally owned research agenda will sharpen the mapping between research objectives and the broader development outcomes reflected in the National development frames. Trend analysis can be performed to indirectly understand a

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country's R&D policy, as well as its rapidly changing science and technology sectors. This study may improve the strategic level of government R&D budget allocation and provide guidance for setting investment priorities, thus resulting in economic, social, and environmental sustainability. Further studies can be conducted on other data sets in major universities in Uganda to investigate the level of association between current research publications or patent activity on national development outcomes.

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