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# Assessment of research performance and scientific capabilities within the Kenyan science system.

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# Introduction

- Assessment of research performance of countries is on the increase globally, whether the analysis is at the level of institutions, research units, research programmes, departments, research groups or individual scientists (Reinhardt & Milzow, 2012).
- Research performance assessment performs various functions and serves the interests of a variety of stakeholders. The main purposes include:
  - To deliver on accountability demands – the public has the right to know what public research and innovation is being conducted and how public funds for S&T are expended;
  - To provide information for strategic planning and monitoring – to assess progress towards the achievement of national goals and priorities;
  - To benchmark the country's performance in strategic and priority areas;
  - To measure the scientific and social impact of the national system of innovation.

Ref: Rip, 2003

# Introduction

- Higher education systems and the public sector have undergone profound reforms, particularly in their "governance and management" structures. These reforms are linked to the rise of the "New public management (NPM)" paradigm (Meek & Davies, 2009:43; Pollit, 2007; Elzinga 2012).

- NPM is associated with several policy measures:
  1. Minimal influence by the state, while much of the governance roles are moved to the central university administration.
  2. Research-funding allocations are based on performance; thus, there is a shift from accounting for input resources to assessing outputs/outcomes.
  3. Need of accountability to convince the taxpayers that their monies are used effectively and efficiently, as well as, show that the set targets are met. Accountability is associated with increased use of "performativity metrics" coined by Elzinga as "accountingization" (Elzinga, 2010:307).

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# Research Aim & questions (1)

**Aim:**

- To analyze significant trends and patterns in the scientific performance of Kenyan research institutions.

**Main question:**

- What are the main trends in research performance for Kenya? How do these trends differ overtime? Why do they differ? What explains the growth rates of Kenyan science in the different periods?

**Research questions:**

1. What are the main trends of output between 1980 and 2015
    - What are the top research performing institutions for Kenya

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# Research questions (2)

2. What is the citation impact of Kenyan science between 2005-2015
   - Which are the highly cited fields in Kenya?
3. What are the research specialization areas for Kenya? Are the research specializations areas for Kenya in common with research priorities stipulated in the national S&T strategic plan of 2012? Is there a mismatch, why?
4. What is the nature and extent of funding of science in Kenya? How does funding provided impact on research productivity and collaboration?
   - Who are the main and top research funders in Kenya?
   - What are the main trends of [government] funding in Kenya?
5. What are the trends and patterns of research collaboration in Kenya? What are the collaboration profiles of specific fields and institutions in Kenya? How do these collaborations impact on research productivity and funding? Why?
6. What are the main (reported) factors that influence research performance of the Kenyan scientists; and the characteristics of the scientists who contribute to the Kenya's science base?

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# Data & methodology

- **A secondary analysis of data from a web-based survey** conducted for the Africa Young Scientist Project between May 2016 and February 2017.
- Self-administered, structured web-based questionnaire
  - Divided into 10 sections: Educational Background, Employment, Working Conditions, Research Output, Funding, Challenges, International Mobility, Collaboration, Mentoring, and Demographic Background
- The identification and contacting of individuals from the target population involved extracting corresponding authors' emails from the Web of Science and Scopus databases for each article published from 2005 to 2015 with an institutional address in Africa - (Kenya).
- The total number of corresponding authors' emails identified for Kenya was 5406. The valid emails identified were 3928. A total number of **345** individuals responded to the questionnaire.

**Bibliometric data:**

- Data from the Web of Science and Scopus databases (1980-2015 period)
- Emails of the authors with affiliations to Kenyan institutions

# Survey results

# General profile of the sample

- 29.2% are female scientists
- 42.7% are younger female scientists
- 64.8% are Kenyan nationals
- 90.5% of the Kenyan national work and reside in Kenya
- Natural sciences (26%) and health sciences (26%) dominate the sample
- 97.1% are PhD or masters holders
- 76.1 are PhD graduates
- 65.5% studied abroad
- 16% currently enrolled for postgraduate studies
- 51.8% are employed in higher/tertiary education
- 37% are researcher/scientist and 29% professors
- 72% are employed on permanent positions
- Females perform 51% of the house-work or care-work by themselves
- Most respondents had a higher average of children /dependents aged 19 or older.
- Average number of working hours per week is 37h
- 47% of time is spend on undergraduate and postgraduate teaching and research (36.6)
- 54.% studied/worked abroad in the past three years

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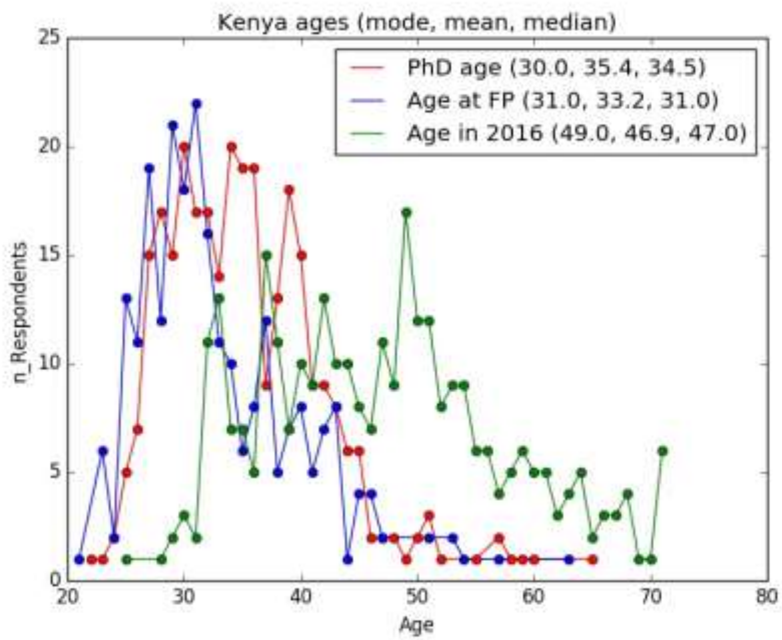
# Age and gender distribution




- Mean age at 2016 is 46.9 years
- Average age at first publication in a peer-reviewed article was 33.2 years
- Average age at PhD qualification is 35.4 years

- 51.1% with a PhD qualification were above 35 years

- The proportion of the female respondents (42.7%) was higher than the male respondents (26.50%) in the younger age category

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# Research output distribution

| | N | Mean |
|---|---|---|
| Articles | 313 | 21.78 |
| Books | 201 | 0.80 |
| Book chapters | 227 | 3.30 |
| Conference papers published in proceedings | 260 | 10.46 |
| Presentations at conferences | 286 | 16.29 |
| Policy documents | 236 | 6.97 |
| Popular articles | 236 | 6.30 |
| Patents applied or granted | 168 | 0.21 |
| Computer programmes | 147 | 1.90 |
| Research reports | 251 | 8.96 |

- Most respondents produced 1-3 articles and more than 11 articles
- A good proportion of respondents produced zero books
- About one in three of our respondents had 1-4 presentations at conferences

| Document type | Frequency | 0 | 1-3 | 4-6 | 7-9 | 9-11 | 11+ | n/a | Total |
|---|---|---|---|---|---|---|---|---|---|
| Articles published/accepted | N | 8 | 83 | 75 | 29 | 27 | 91 | 2 | 315 |
| | Valid % | 2.5 | 26.3 | 23.8 | 9.2 | 8.6 | 28.9 | 0.6 | 100 |
| Books | N | 134 | 54 | 9 | 1 | 2 | 1 | 27 | 228 |
| | Valid % | 58.8 | 23.7 | 3.9 | 0.4 | 0.9 | 0.4 | 11.8 | 100 |
| Book chapters | N | 82 | 110 | 24 | 4 | 2 | 5 | 13 | 240 |
| | Valid % | 34.2 | 45.8 | 10 | 1.7 | 0.8 | 2.1 | 5.4 | 100 |
| Conferences papers published in proceedings | N | 38 | 115 | 53 | 6 | 18 | 30 | 5 | 265 |
| | Valid % | 14.3 | 43.4 | 20 | 2.3 | 6.8 | 11.3 | 1.9 | 100 |
| Presentation at conferences | N | 11 | 93 | 88 | 14 | 23 | 57 | 4 | 290 |
| | Valid % | 3.8 | 32.1 | 30.3 | 4.8 | 7.9 | 19.7 | 1.4 | 100 |
| Written input to official documents | N | 68 | 107 | 36 | 1 | 11 | 13 | 10 | 246 |
| | Valid % | 27.6 | 43.5 | 14.6 | 0.4 | 4.5 | 5.3 | 4.1 | 100 |
| Article in popular journal | N | 77 | 99 | 30 | 3 | 13 | 14 | 7 | 243 |
| | Valid % | 31.7 | 40.7 | 12.3 | 1.2 | 5.3 | 5.8 | 2.9 | 100 |
| Patent applied/granted | N | 154 | 13 | 0 | 0 | 0 | 1 | 32 | 200 |
| | Valid % | 77 | 6.5 | 0 | 0 | 0 | 0.5 | 16 | 100 |
| Computer programming including co-writing | N | 123 | 13 | 7 | | 2 | 2 | 52 | 199 |
| | Valid % | 61.8 | 6.5 | 3.5 | 1 | 1 | 26.1 | 100 | |
| Other | N | 7 | 11 | 6 | 1 | 3 | 4 | 26 | 58 |
| | Valid % | 12.1 | 19 | 10.3 | 1.7 | 5.2 | 6.9 | 44.8 | 100 |

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# Profile of research production

**Research Output by age**

| Document type | Age category | | | | | | Mann-Whitney test comparisons p-values |
|---|---|---|---|---|---|---|---|
| | 40 or younger | | | 41 and older | | | |
| | Mean | Median | Standard Deviation | Mean | Median | Standard Deviation | |
| Articles | 18.76 | 5 | 34.114 | 35.93 | 9.50 | 44.70 | 0.0001* |
| Books | 0.1 | 0 | 0.31 | 0.61 | 0 | 1.57 | 0.03* |
| Book chapters | 0.59 | 0 | 1.119 | 3.75 | 1.00 | 15.527 | 0001* |
| Conference papers published in proceedings | 3.41 | 2 | 4.339 | 12.92 | 3.00 | 29.306 | ns |
| Presentations at conferences | 8.55 | 4.00 | 18.539 | 20.23 | 5.00 | 35.38 | ns |
| Policy documents | 1.17 | 0 | 2.122 | 10.68 | 2.00 | 27.826 | 0.0001** |
| Popular articles | 4.52 | 1.00 | 18.788 | 5.85 | 2.00 | 18.912 | ns |
| Patents applied or granted | 1.74 | 0 | 0.494 | 0.14 | 0.05 | 0.494 | ns |
| Computer programmes (incl co-written) | 0.24 | 0 | 0.830 | 0.37 | 0 | 1.159 | ns |
| Research reports | 5.86 | 2 | 18.78 | 6.95 | 3 | 18.720 | 0.007** |

- The older scientists are more prolific in production across all the document types when compared to the younger scientists
- No age differences in terms of the conferences papers published, presentations at conferences, popular articles, patents applied or granted and computer programmes
- Women publish their first article at a younger age
- Men are more prolific (with the exception of conference papers)

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The proportions of sources of funding

# Proportions of research funding

| National Sources | | | | International Sources | |
|---|---|---|---|---|---|
| | | Frequency | Valid Percent | Frequency | Valid percent |
| | 100 | 26 | 13.3 | 112 | 52.1% |
| | 60-90 | 26 | 13.3 | 45 | 20.9% |
| | 40-50 | 17 | 8.7 | 18 | 8.4% |
| | 10-30 | 46 | 23.6 | 25 | 11.6 |
| | 0 | 80 | 41.0 | 15 | 7.0 |
| | Total | 195 | 100.0 | 215 | 100.0% |
| Missing | System | 150 | | 130 | |
| Total | | 345 | | 345 | |

| Funding sources | Count | Frequency |
|---|---|---|
| Only international | 112 | 52.1% |
| More international than national | 45 | 20.9% |
| About the same | 18 | 8.4% |
| More national than international | 26 | 13.3% |
| Only national | 26 | 13.3% |

- Respondents in engineering and applied technology and natural sciences received fair proportions of national funding; while humanities, agricultural sciences and social sciences registered the highest means for receiving international funding.

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# Research funding profile

- Women raise more funds than their men peers. The gender differences are significant
- Younger females raise more funds than the younger males.
- No gender differences in terms of the international sources of funding
- No gender differences in raising of funding in the different scientific fields
- Higher proportions in the social sciences indicated did not receive any funding
- Older scientists raise more funds than their younger colleagues. Not significant.
- A good proportion of respondents with no funding spend at least 25% of their time on consultancy and service.
- For the respondents who spend at least 25% of time on research and post-graduate teaching, had funding.

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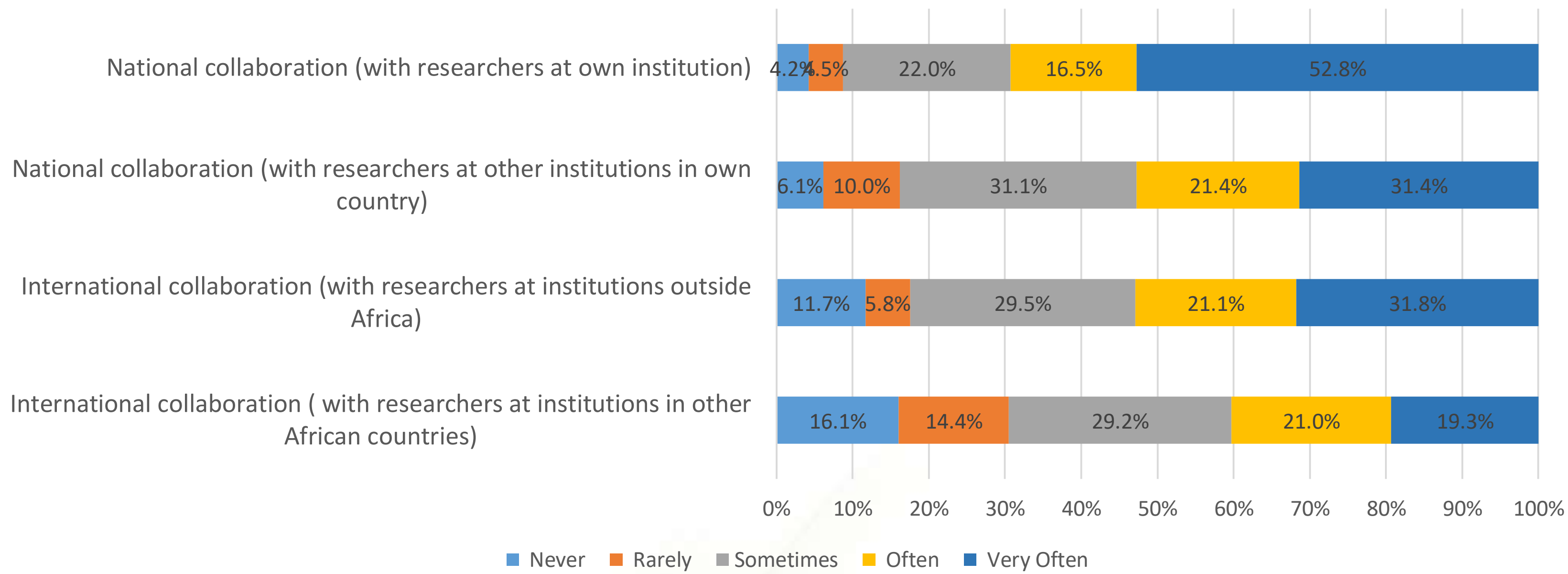
# Levels of research collaboration




- The majority of our sample (N=163, 52.8%) reported that they very often collaborate nationally with researchers at own institution. This is followed by international collaborations – outside Africa – (N=98, 31.8%) and national collaborations with researchers at other institutions in own country (N=97).

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# Profile of the collaborating researcher

- Female respondents are more likely to collaborate at the other levels of collaboration, except for international collaboration where they still have larger gaps compared to the males.
- Young respondents tend to collaborate more at the national level and the older scientists at the international level (outside Africa).
- Respondents in engineering and applied technology and agricultural sciences collaborate more at the national levels, while those in the health and natural sciences at the international level.
- Researchers and post-doctoral fellows exhibit more collaboration at the national level (own institutions) and internationally (outside Africa) and other African countries – postdocs.
- The more the respondents collaborate, the more funds they raise and the more the research output they produce.
- There is a link between collaboration abroad (outside Africa) and international mobility

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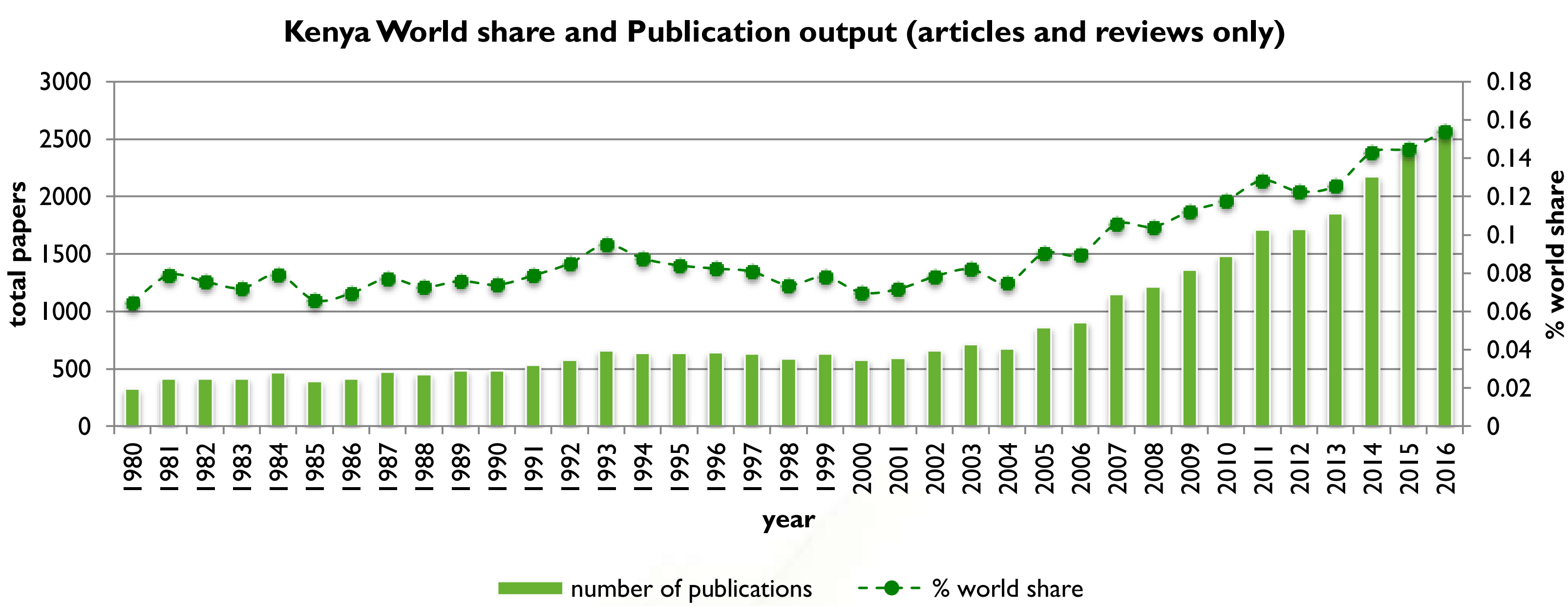
# Bibliometric results in general

# Trends in Research Output (Full papers) for Kenya: 1980 – 2016




- Kenya's annual output of scientific articles has been steadily increasing, particularly in the past decade: from 858 papers in 2005 to 2411 in 2015.
- This rate of increase surpassed the world's growth rates in the recent four years from the 2013 to 2016 period.

Source: Web of Science and Scopus Data (May 2018)

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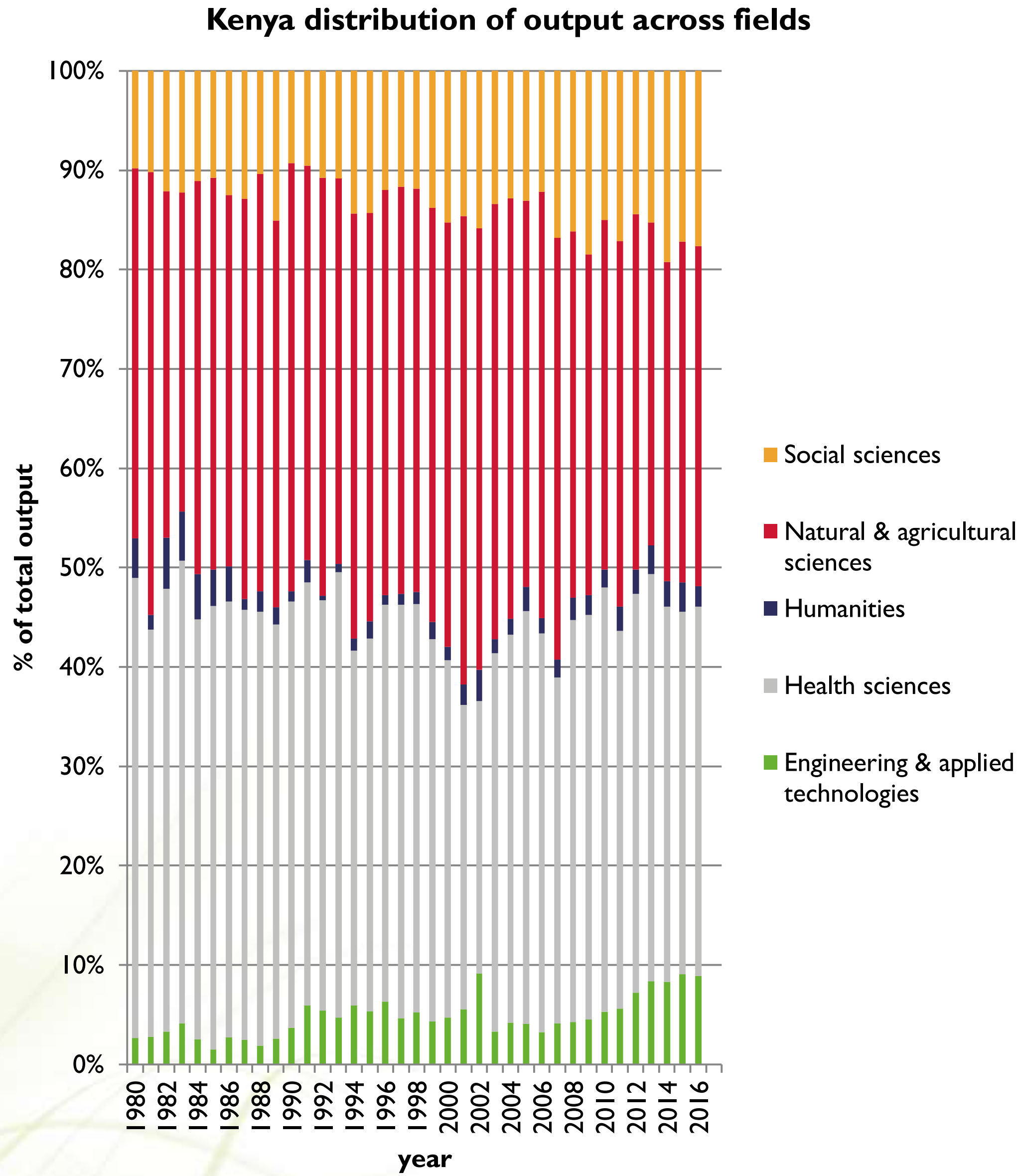
# Research Output (full papers) by field: 1980 - 2016

Fields which are large in volume and make significant contribution to world output, the following fields meet this criterion:

- **Level 1:** The health sciences and Natural and Agricultural sciences dominate production in Kenya followed by the social sciences.
- **Level 2:** Clinical and public health, Agricultural sciences, basic health science, Biological sciences.
- **Level 3:** public environment and occupational health, tropical medicine, infectious diseases, medicine general internal, immunology, parasitology, veterinary sciences, ecology & environmental sciences,




Source: Web of Science and Scopus Data (May 2018)

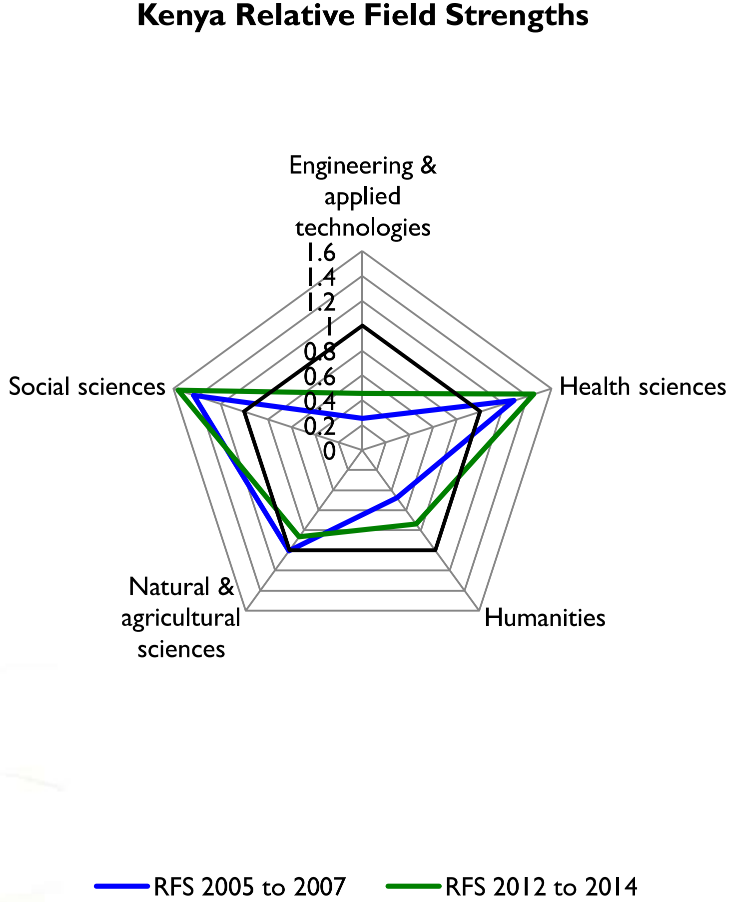
# Scientific output of the top research institutions: (2005 – 2007 and 2012 – 2014)

| **Kenya top performing research institutions** | | | | | |
|---|---|---|---|---|---|
| **2005 to 2007** | | | **2012 to 2014** | | |
| **Research Institution** | **nPubs** | **rank** | **Research Institution** | nPubs | rank |
| Kenya Medical Research Institute | 716 | 1 | Kenya Medical Research Institute | 1145 | 1 |
| University of Nairobi | 523 | 2 | University of Nairobi | 1142 | 2 |
| International Centre for Insect Physiology and Ecology | 220 | 3 | University of Oxford | 416 | 3 |
| Kenyatta University | 194 | 4 | University of London | 404 | 4 |
| University of Oxford | 192 | 5 | University of Washington, Seattle | 373 | 5 |
| Jomo Kenyatta University of Agriculture and Technology | 190 | 6 | Jomo Kenyatta University of Agriculture and Technology | 373 | 6 |
| International Livestock Research Institute | 170 | 7 | Moi University | 340 | 7 |
| Kenya Agricultural Research Institute | 152 | 8 | International Livestock Research Institute | 329 | 8 |
| Moi University | 152 | 9 | International Centre for Insect Physiology and Ecology | 291 | 9 |
| Centers for Disease Control and Prevention | 148 | 10 | Kenyatta University | 286 | 10 |
| University of London | 148 | 11 | Centers for Disease Control and Prevention | 271 | 11 |
| National Museums of Kenya | 144 | 12 | Ministry of Health | 263 | 12 |
| Egerton University | 115 | 13 | University of California System | 233 | 13 |
| Ministry of Health | 112 | 14 | World Agroforestry Centre | 214 | 14 |
| World Agroforestry Centre | 97 | 15 | University of Washington Seattle | 211 | 15 |
| Association pour la Promotion de l'Education et de la Formation à l'Etranger | 93 | 16 | National Museums of Kenya | 205 | 16 |
| University of California System | 75 | 17 | University of Washington | 197 | 17 |
| Maseno University | 75 | 18 | African Population and Health Research Center | 197 | 18 |
| University of Washington Seattle | 73 | 19 | Makerere University | 163 | 19 |
| University of Washington | 73 | 20 | Egerton University | 161 | 20 |

# Relative field strength – specialization

- Kenya's relative field strength (RFS) is in the health sciences and social sciences: the broad domains where the RFS index value is >1
- The natural & Agricultural sciences have weakened in the last five years.
- Kenya is weakest in the broad domain of Humanities
- In the broad field of **health sciences**: Kenya is relatively strong active in the clinical & public health and basic health sciences.
- Disaggregation by **Basic Health Sciences** shows: Kenya is active and strong in Infectious Diseases, Public, Environmental & Occupational Health, Tropical Medicine, Immunology & Virology
- Disaggregation of the **Social sciences** shows: Kenya is active and strong in the Environmental Sciences & Ecology.

Source: Web of Science and Scopus Data (May 2018)

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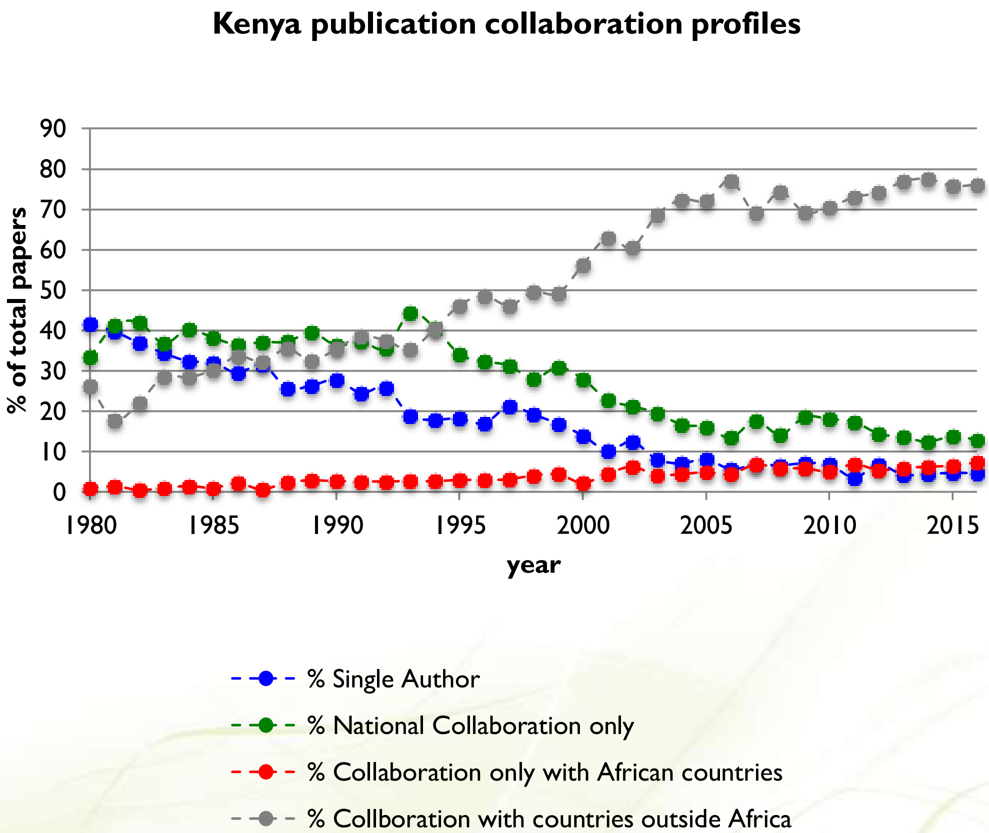
# Trends in collaboration patterns for Kenya: (1980 – 2015)




- Kenyan scientists increasingly collaborate with countries outside Africa (highest increase in the past 15 years)
- Collaboration only with other African countries is almost negligible
- There has been declines in national collaborations over the years
- A majority of the Kenya's papers fall into two groups: papers with authors from institutions in same country (National collaboration) comprising of **28**% of all papers and for papers where there is some collaboration with countries outside Africa (**54**% of the papers)
- In the past decade papers with some collaboration with countries outside Africa consists of **80**% on average.

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# Conclusion (1)

- A clear association between funding, research output and research collaboration
- Opportunities for research collaboration, training and research funding cited as main reasons for leaving country
- Funding (for research & equipment) is an issue for respondents: as a career challenge & mentoring received
- Scientists who are mobile internationally collaborate more, tend to be productive and receive more funding

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# Conclusion (2)

- Kenya's research output has steadily increased over the years, especially the in past decade
- The Health Sciences and Natural and Agricultural sciences dominate production in Kenya
- Kenya is strong and active in the health sciences and social sciences.
- Kenyan scientists collaborate more internationally with researchers outside Africa

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# To Do

- Analyze the survey-bibliometric linked data, to test:
  - The applicability of the Lotka's Law on Kenya's research output;
  - The hypothesis that age, gender & scientific field  is associated with research production, collaboration and funding.

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# Thank you

## Q&A