NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

REPORT ON A SURVEY OF SCIENTISTS, TECHNICIANS AND ARTISANS IN KENYA 1982
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FOREWORD

In an attempt to explore Kenya's scientific and technological manpower situation, the National Council for Science and Technology conducted a survey in 1975. The result of the survey was a publication entitled, "The 1975 Survey of Scientists and Technicians". The 1982 survey is much wider in scope than that of 1975.

The 1982 survey set out to fulfil various objectives. One prominent function was the focus on generating baseline data for the planning and execution of a scientific and technological potential (STP) in Kenya. This aim was achieved and an appropriate frame for the STP has been devised.

One notable finding from the 1982 survey is that, taken together, scientists, technicians and artisans formed about 1% of the total labour force (i.e., 85% of the population aged 18-59 years). Scientists and technicians alone constituted 0.5% of the labour force.

The report also discusses various issues and in particular the conceptual problems of the whole range of S & T manpower. It also touches on the critical area of utilization of these categories of manpower. A post-survey evaluation made it evident that a sectoral approach on the utilization of various groups of S & T manpower would shed more light on the crucial factors of supply and demand.

Finally, it is hoped that this report will generate interest and furnish manpower planners with some of the data needed in the national development efforts.

Dr F J Wang'ati
Secretary, National Council for Science and Technology
INTRODUCTION

The Kenya Science and Technology Act of 1977 specifies that the National Council for Science and Technology (NCST) should, among other things, consider and advise generally on all scientific activities including:

1. Scientific and technical manpower (actual and potential);
2. Science education, at both the advanced levels and at the lower levels in respect of general science education for the public; and

Apart from the need to fulfill the provisions of the Act, the NCST was eager to rapidly establish the "state of the art" in-so-far as the scientific and technical manpower stocks are concerned so as to act as a guide in the formulation of policies on manpower development strategies. In as far as statistics on scientists and technicians are concerned, only two surveys had previously been carried out in Kenya. The first, the Rapid Reconnaissance Survey was carried out in 1970. The second one by the National Council for Science and Technology was carried out in 1975 (NCST 1975). The current survey is, therefore, the third of its kind. This survey was aimed at the following three objectives:

1. Provide basic data for comprehensive and systematic planning and development of scientific and technical manpower;
2. Establish the growth rate in the scientific and technical manpower since 1975; and
3. Provide a basis for responding to requests for scientific and technological data on manpower.

Definition

The 1982 survey used the definitions recommended by UNESCO, although some modifications were made to suit the Kenyan situation. The following three main groups of skilled manpower were considered: scientists, technicians, and artisans.

Scientists

A scientist is defined as a person with technical training in industrial, medical, social, natural, agricultural and physical sciences and who has acquired the following:

1. a degree, and
2. training and professional experience which is nationally recognized as being equivalent to the formal education of a degree. For example, a director of an institution who has long experience in a specified area of science but has not got a degree.
Technician

A technician is defined as a person with a specialized vocational or technical training in any branch of technology as follows:

1. Training after form IV or VI level of education and graduation from polytechnics or institutes of technology in Kenya or elsewhere; and/or.
2. On-the-job training and supervisory experience of 10 years as an artisan.

Artisan

An artisan is defined as a person qualified in some skill as follows:

1. Has been certified to have passed the Kenya Government trade test I, II, III and/or the City and Guilds of London; or
2. Has acquired skills similar to those in (1) above during apprenticeship or in established firms or in the informal sector, and have practical experience of at least 10 years.

DATA COLLECTION AND ANALYSIS

A questionnaire was used to collect the data (Appendix 1). The questionnaire sought information on, among others, name, nationality, highest academic qualifications, area of specialization, designation, and experience in the job. The questionnaire content was deliberately brief but the data collected are basic and satisfy the current baseline needs of the National Council of Science and Technology (NCST).

After the listing of the firms and establishments to be surveyed the numerical strength of the enumeration manpower was determined as follows:

- Nairobi and Thika: 21
- Central Province: 6
- Coast Province: 7
- Rift Valley Province: 6
- Western Province: 2
- Nyanza Province: 3
- Eastern Province: 1

The enumerators who were of at least form four standard of education with a minimum of third division of the Kenya Certificate of Education (KCE) were trained before the survey began. The training involved an explanation of objectives of the survey, the enumerators' approach, the individual substantive items of the questionnaire and feedback system.
between the enumerators and the NCST. The training was followed by practical exercises and a debriefing session. A complete census of scientists, technicians and artisans in 340 firms and establishment throughout the country was conducted. The firms were under the following broad categories:

1. Kenya Government ministries and institutions;
2. Statutory boards;
3. Government corporations;
4. International scientific organizations; and
5. Private research institutions, manufacturing and industrial concerns.

The listing frame was obtained from the following sources:

1. Register of establishments compiled by the Central Bureau of Statistics (CBS);
2. Presidential circular of 1982;
3. The telephone directory; and
4. The statutory boards’ directory.

The establishments and firms surveyed are shown in appendix 2. The predominance of firms and establishments in Nairobi is a reflection of the effects of the industrial investments policy. And in terms of meeting the objectives of the survey, this uneven distribution of industrialization is innocuous.

Enumerators were allocated institutions to cover within one month. The method of allocation was designed in such a way that chances of double counting and omissions were minimized. Each enumerator was given an NCST identification letter, stating the purpose for which the enumerator had been deployed. Prior to the enumeration exercise, the Secretary of the NCST had written to each institution explaining the objectives of the survey, soliciting their cooperation, and guaranteeing the confidentiality of the information to be gathered. The enumerators were given the chance to explain further the objectives and usefulness of the survey. Furthermore, the enumerators made enquiries which produced answers that could not have materialized by correspondence.

**Problems Encountered**

Among the problems were the following: non-response, partial response, location of firms, manpower survey by the Central Bureau of Statistics at the same time and enumerator-related problems.

Incidence of non-response, although not serious, were mostly caused by firms forestalling interviews and writing to the NCST saying that they had no scientists, technicians and artisans in their establishments. Lack of speed in responding and failure to honour appointments were some of the problems encountered. Some firms simply refused to cooperate and insisted that the survey was not of a monetary value to them.
Partial responses although not a prominent feature, occurred either when part of the information could not be obtained because the firm was too large, or was as a result of laxity on the part of the respondent. Quite often no data would be made available even after a return visit to the firm. There were occurrences when some firms did not have clear addresses. A search for their locations inevitably increased the duration of the survey, but the increase was only slight. 

The CBS conducted a manpower survey at the same time that the NCST one was on-going and their sample selection included some of the firms that were to be covered by the NCST. These firms complained about the situation, which we hope will be avoided in future surveys.

Some enumerators failed to explain clearly what the survey was about and the expected use of the data to be collected. Some firms were suspicious about those enumerators who were improperly dressed and so were reluctant to extend their cooperation; Some in fact called the NCST to confirm the identities of those enumerators.

Data Returns and Processing

After the interviews each enumerator submitted the data to NCST for editing and endorsement. No payments were effected until completed work passed a quality test decided by NCST. Such quality test was mainly on consistency of the information. Where suspicion to quality of information arose, a counter-check with the institution was done. A record of enumerator production rates was maintained. Enumerators who performed above a certain average set by NCST were paid a bonus. At the end of the exercise all returns were received in Nairobi.

A manual analysis of the data was conducted. The data retrieval exercise was done on a sector by sector basis, and arranged as follows:

1. Data on scientists by nationality;
2. Data on scientists by their qualifications (i.e. B Sc/BA, MSc/MA, Ph D and above);
3. Data on scientists by field and by experience in years
4. Data on technicians by scientific field.

The results were tabulated within 30 days using a team of six clerks.

RESULTS

The inclusion of the social sciences is a result of the addition of the social sciences in the list of the scheduled sciences in the Science and Technology Act.

The number of social scientists is twice that of any single group of other scientists; this could be attributed to the colonial education system that emphasized the pursuit of
liberal arts for Africans. The high figure, therefore, demonstrates the effect of that education system.

In terms of coverage the survey frame for this study was much wider than those of 1970 and 1975; the social sciences were omitted in the 1970 and 1975 surveys. The inclusion of social scientists in this survey results in a significant percent increase in the number of scientists. Because of a lack of a common base between the three surveys, it was not possible to make a meaningful comparison of data. However, table 2 compares the number of scientists (excluding social scientists) and technicians obtained in the 1970, 1975 and that of the present survey (1982).

Table 1. Number of scientists, technicians and artisans by sector

<table>
<thead>
<tr>
<th>Sectoral Category</th>
<th>Scientists</th>
<th>Technicians</th>
<th>Artisans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>2,514</td>
<td>1,734</td>
<td>1,347</td>
</tr>
<tr>
<td>Industrial</td>
<td>2,347</td>
<td>7,161</td>
<td>16,921</td>
</tr>
<tr>
<td>Medical</td>
<td>2,662</td>
<td>5,987</td>
<td>9,768</td>
</tr>
<tr>
<td>Social</td>
<td>5,915</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Natural and physical</td>
<td>2,803</td>
<td>2,859</td>
<td>185</td>
</tr>
<tr>
<td>Total</td>
<td>16,241</td>
<td>20,408</td>
<td>28,706</td>
</tr>
<tr>
<td>Total (excluding social scientists)</td>
<td>10,326</td>
<td>741</td>
<td>28,221</td>
</tr>
</tbody>
</table>

Table 2. Comparison of 1970, 1975 and 1982 results (excluding social scientists)

<table>
<thead>
<tr>
<th>Year</th>
<th>Scientists (no)</th>
<th>Technicians (no)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scientists-Technicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>3,103</td>
<td>.</td>
<td>...</td>
</tr>
<tr>
<td>1975</td>
<td>6,207</td>
<td>7,412</td>
<td>100</td>
</tr>
<tr>
<td>1982</td>
<td>10,326</td>
<td>17,741</td>
<td>67</td>
</tr>
</tbody>
</table>

Table 2 shows a large increase (139%) in the size of technicians between 1975 and 1982. Although artisans were not enumerated during the 1970 and 1975 surveys, there is ample evidence that the size of artisans has grown considerably since 1970. This growth is a result of a direct effort by the government prompted by official recognition that implementation of development projects is frequently delayed and conducted with low technical standard because of a shortage of artisans and technicians. Hence the government focused on the expansion
of training capacities for both artisan and technician groups as highlighted in table 3.

Table 3. Institutions offering training facilities for technicians and artisans, showing their capacities

<table>
<thead>
<tr>
<th>Institution</th>
<th>Training capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya Polytechnic</td>
<td>4,500</td>
</tr>
<tr>
<td>Mombasa Polytechnic</td>
<td>3,200</td>
</tr>
<tr>
<td>Directorate of Industrial Training</td>
<td>4,100</td>
</tr>
<tr>
<td>Utalii College</td>
<td></td>
</tr>
<tr>
<td>Company Operated Centers</td>
<td>358</td>
</tr>
<tr>
<td>Others (including harambee institute of technology)</td>
<td>1,730</td>
</tr>
<tr>
<td></td>
<td>2,112</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16,000</strong></td>
</tr>
</tbody>
</table>


The demand for the middle and high level manpower during the 1979-1983 plan period was estimated at 16% per year. Owing to lack of historical data and non-existence of some of the institutions (such as harambee institutes of technology) it is not possible to demonstrate growth in training capacities. However, trainee vacancy capacity rates were estimated to be up by about 30% (Kenya Government 1979). The Kenya and Mombasa polytechnics taken together had an enrolment of 2527 in 1976. (CBS 1978).

The impact of government effort in effecting training facilities was therefore felt during the subsequent years. A special programme of youth development in the 1970s was the establishment and encouragement of village polytechnics. These polytechnics are a source of the artisan and technician levels of manpower. In 1981 there were 253 village polytechnics receiving government grants. This number rose to 286 in 1982 with an enrolment of 30,000 students. The 54% increase in the number of scientists between 1975 and 1982 was also expected. This rise was a result of declared government policies aimed at producing high-level professional manpower needed to achieve declared objectives. In an attempt to facilitate the realization of technological and scientific progress, science and technology-based disciplines received increased official support during the 1970s. Thus, the Kenyan student enrolment at the university level rose from 4520 in 1976/77 to 6492 in 1981/82, an overall increase of about 14.5% (CBS 1978, 1983).

Ratios of Scientists to Technicians to Artisans

It is often argued, ceteris paribus, that technical competence requires a certain combination of scientists, technicians and artisans. However, there are indications that technological innovations have made it difficult to uphold this argument in the developed economies.
The advent of frontier technologies is a manifestation of this situation. And it is now a reality that western industrial nations and Japan have taken to deployment of robotics.

Owing to Kenya's level of technological development there is a marked departure from the "inverted tumbler" combination of artisans, technicians and scientists earlier recommended by Council (i.e. 1:5:30). This position is shown in table 4.

Table 4. Ratios of scientists(S) to technicians(T) to artisans(A) (S:T:A) in various sectors

<table>
<thead>
<tr>
<th>Science Group</th>
<th>S : T : A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>1 : 0.7 : 0.5</td>
</tr>
<tr>
<td>Industrial</td>
<td>1 : 3 : 2</td>
</tr>
<tr>
<td>Medical</td>
<td>1 : 2 : 2</td>
</tr>
<tr>
<td>Social</td>
<td>1 : 2 : 6</td>
</tr>
<tr>
<td>Natural and physical</td>
<td>1 : 1 : 0.1</td>
</tr>
<tr>
<td>Total</td>
<td>1 : 1.2 : 1.4</td>
</tr>
<tr>
<td>Total (excluding social scientists)</td>
<td>1 : 1.7 : 1.5</td>
</tr>
</tbody>
</table>

It is conceivable that certain ratios of manpower are applicable in some sectoral operations depending on levels of technology in use.

Scientists by Qualification and Nationality by Sector

Apart from the higher education sector, there is indication of a pyramidal structure with a broad Bachelors' degree base narrowing to "bottle-neck" of Doctor of Philosophy category. This structural arrangement is depicted by sector in tables 5, 6, 7, 8 and 9.

Table 5. Number of scientists by highest qualification and nationality: Private sector

<table>
<thead>
<tr>
<th></th>
<th>Bachelors</th>
<th>Masters</th>
<th>Ph D and above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kenyan</td>
<td>Non-Kenyan</td>
<td>Kenyan</td>
</tr>
<tr>
<td>Agricultural</td>
<td>52</td>
<td>16 12</td>
<td>3</td>
</tr>
<tr>
<td>Industrial</td>
<td>320</td>
<td>44 37</td>
<td>4</td>
</tr>
<tr>
<td>Medical</td>
<td>169</td>
<td>46 1</td>
<td>1</td>
</tr>
<tr>
<td>Social</td>
<td>358</td>
<td>24 12</td>
<td>-</td>
</tr>
<tr>
<td>Natural and physical</td>
<td>166</td>
<td>28 7</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>1,065</td>
<td>312 87</td>
<td>58</td>
</tr>
</tbody>
</table>
Table 6. Number of scientists by highest qualification and nationality: Higher education sector

<table>
<thead>
<tr>
<th></th>
<th>Bachelors</th>
<th>Masters</th>
<th>Ph D and above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Kenyan</td>
<td>Kenyan</td>
<td>Non-Kenyan</td>
</tr>
<tr>
<td>Agricultural</td>
<td>74</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>Industrial</td>
<td>136</td>
<td>52</td>
<td>41</td>
</tr>
<tr>
<td>Medical</td>
<td>49</td>
<td>12</td>
<td>70</td>
</tr>
<tr>
<td>Social</td>
<td>2,265</td>
<td>478</td>
<td>253</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>1,061</td>
<td>559</td>
<td>87</td>
</tr>
<tr>
<td>Total</td>
<td>3,585</td>
<td>1,110</td>
<td>500</td>
</tr>
</tbody>
</table>

Table 7. Number of scientists by highest qualification and nationality: Government sector

<table>
<thead>
<tr>
<th></th>
<th>Bachelors</th>
<th>Masters</th>
<th>Ph D and above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Kenyan</td>
<td>Kenyan</td>
<td>Non-Kenyan</td>
</tr>
<tr>
<td>Agricultural</td>
<td>1,791</td>
<td>22</td>
<td>286</td>
</tr>
<tr>
<td>Medical</td>
<td>837</td>
<td>49</td>
<td>154</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>1,068</td>
<td>407</td>
<td>365</td>
</tr>
<tr>
<td>Social</td>
<td>1,401</td>
<td>7</td>
<td>146</td>
</tr>
<tr>
<td>Total</td>
<td>5,576</td>
<td>498</td>
<td>1,043</td>
</tr>
</tbody>
</table>

Table 8. Number of scientists by qualification and nationality: Parastatals

<table>
<thead>
<tr>
<th></th>
<th>Bachelors</th>
<th>Masters</th>
<th>Ph D and above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Kenyan</td>
<td>Kenyan</td>
<td>Non-Kenyan</td>
</tr>
<tr>
<td>Agricultural</td>
<td>51</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Medical</td>
<td>333</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>505</td>
<td>32</td>
<td>66</td>
</tr>
<tr>
<td>Social</td>
<td>3</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Total</td>
<td>932</td>
<td>83</td>
<td>123</td>
</tr>
</tbody>
</table>
Table 9. Number of scientists by highest qualification and nationality: National total

<table>
<thead>
<tr>
<th>Science Group</th>
<th>Bachelors</th>
<th>Masters</th>
<th>PhD and above</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Kenyan</td>
<td>Kenyan</td>
<td>Non-Kenyan</td>
</tr>
<tr>
<td>Agricultural</td>
<td>1,968</td>
<td>49</td>
<td>359</td>
</tr>
<tr>
<td>Industrial</td>
<td>1,626</td>
<td>316</td>
<td>270</td>
</tr>
<tr>
<td>Medical</td>
<td>1,289</td>
<td>465</td>
<td>446</td>
</tr>
<tr>
<td>Social</td>
<td>4,529</td>
<td>567</td>
<td>489</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>1,746</td>
<td>606</td>
<td>189</td>
</tr>
<tr>
<td>Total</td>
<td>11,158</td>
<td>2,003</td>
<td>1,753</td>
</tr>
</tbody>
</table>

Tables 5, 6, 7, 8 and 9 show a predominance of Kenya nationals in each science group. There is a noted clustering of Kenyans at Bachelors degree level in each science group. The bump phases out drastically at masters degree level where the number of Kenyans is almost twice that of non-Kenyans. Except for the social sciences the number of non-Kenyans holding PhD degrees is almost at par with that of Kenyans. Three conclusions would therefore seem to emerge from these data:

1. There is a drastic termination of education of Kenyans at first degree level;
2. Sufficient machinery and competitiveness in pursuit of higher degrees seem to be underdeveloped; and
3. The Kenyanization process is not complete in the field of science and technology.

Tables 10, 11, 12 and 13 show a predominance of Kenya nationals in all the scheduled science groups. In agricultural, industrial and social sciences the proportion of Kenyans exceeds 80%. The residual science groups have well over three-fifths Kenyans. The large numbers of Kenyans in various science groups and sectors is directly attributable to the government's commitment to the policy of Kenyanization.

Table 10. Per cent of scientists employed by government by nationality and science group

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>99</td>
<td>0.4</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>93</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>...</td>
<td>100</td>
</tr>
<tr>
<td>Medical</td>
<td>78</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Social</td>
<td>99</td>
<td>0.5</td>
<td>0.1</td>
<td>...</td>
<td>0.4</td>
<td>...</td>
<td>...</td>
<td>100</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>97.6</td>
<td>0.9</td>
<td>0.3</td>
<td>0.7</td>
<td>0.2</td>
<td>0.1</td>
<td>0.2</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 11. Per cent of scientists employed by parastatals by nationality and science group

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>97</td>
<td>2</td>
<td>0.5</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>100</td>
</tr>
<tr>
<td>Industrial</td>
<td>87</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Medical</td>
<td>86</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Social</td>
<td>96</td>
<td>3</td>
<td>0.5</td>
<td>...</td>
<td>0.3</td>
<td>...</td>
<td>0.2</td>
<td>100</td>
</tr>
<tr>
<td>Natural and</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>82</td>
<td>18</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 12. Per cent of scientists employed in the private sector by nationality and science group

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>Agricultural</td>
<td>50</td>
<td>14</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Industrial</td>
<td>63</td>
<td>12</td>
<td>5</td>
<td>14</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>100</td>
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<tr>
<td>Medical</td>
<td>31</td>
<td>25</td>
<td>5</td>
<td>26</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>100</td>
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<tr>
<td>Social</td>
<td>86</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>100</td>
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<tr>
<td>Natural and</td>
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<td></td>
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<td>0.8</td>
<td>1.2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
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</table>

Table 13. Per cent of scientists employed in higher education by nationality and science group

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Agricultural</td>
<td>80</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>Industrial</td>
<td>71</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Medical</td>
<td>76</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Social</td>
<td>91</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Natural and</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Physical</td>
<td>72</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>100</td>
</tr>
</tbody>
</table>

Brit. = British
Amer. = American
Can. = Canadian
Ind. = Indian
Aust. = Australian
Germ. = German

Tables 10, 11, 12 and 13 show that the medical, physical and natural sciences have a high proportion of non-Kenyans. In the private sector the proportion of Kenyans is less than that recorded for other nationals. In the higher education sector, there is a sizeable fraction of other nationals in the physical and natural sciences. The lower ratio of Kenyans in the medical sector could be attributable to the limited training capacities hitherto.
Scientific personnel in the physical and natural sciences have consistently drifted from teaching jobs to administrative (office) jobs as highlighted in proportions in the government, parastatals and the private sector.

Manpower Planning

Table 14 highlights scientific disciplines by sectors of performance. For policy-making purposes and more particularly for manpower planning (on the basis of projection and estimates) the statistics form the crucial point of departure. The better the statistics (reliability, detailed information, accuracy, comprehensiveness, etc.) the better are the possibilities to know about the demand and supply of manpower for the future. Manpower projections have to rely on a number of factors influencing the demand and supply of qualified personnel. It would certainly be too simple to project the development of the manpower potential on the basis of existing historical data based on this survey and on those of 1970 and 1975; Because the data obtained from these surveys are not compatible with each other. Furthermore, a trend extrapolation does not take into consideration factors on the supply and the demand side. Arising from this, the following methodological procedure for manpower planning is suggested:

Without taking a risk, the supply data can be calculated accurately on the basis of educational statistics (enrolment figures). Drop-out rates taking into consideration the output of the educational system can be calculated on the basis of input figures of the educational system. This exercise can be done for the various educational institutions including those offering higher degrees (masters, Ph D's) within the NCST scheduled sciences.

The demand side is more unpredictable than the supply side. A substantial number of influencing factors can affect the demand for qualified manpower. The best approach would be to enquire with the most important demanders for qualified

Table 14. Number of scientists by sector and discipline

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Private Education (higher)</th>
<th>Government Institutions</th>
<th>Para-statals</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>93</td>
<td>207</td>
<td>2,149</td>
<td>65</td>
</tr>
<tr>
<td>Industrial</td>
<td>582</td>
<td>282</td>
<td>1,060</td>
<td>423</td>
</tr>
<tr>
<td>Medical</td>
<td>226</td>
<td>202</td>
<td>2,216</td>
<td>16</td>
</tr>
<tr>
<td>Social</td>
<td>447</td>
<td>3,284</td>
<td>1,571</td>
<td>613</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>216</td>
<td>1,938</td>
<td>600</td>
<td>49</td>
</tr>
<tr>
<td>Total</td>
<td>1,564</td>
<td>5,913</td>
<td>7,598</td>
<td>1,166</td>
</tr>
</tbody>
</table>
personnel. According to the 1982 survey the most important demanders for persons holding formal degrees were the higher educational institutions and government establishments, followed by the private sector and the parastatals, in that order. With accurate maintenance of staff compliments, it will become increasingly easy to gauge manpower requirements in the central government. The private sector with less demand would, however, need a more in-depth enquiry because of their varying sizes and complexity.

DISCUSSIONS AND CONCLUSIONS

The data obtained provide an interesting picture of the situation as it existed in 1982. Taking into consideration the changing economic and technological circumstances, the task of projecting manpower in the scientific field is arduous. One would therefore need a close surveillance of the following inputs if one were to undertake the projection exercise:

1. Technological changes vis-a-vis factor combination in production;
2. Government policy in manpower utilization and employment in general;
3. Demand for labour on a sectoral level;
4. The likely economic situation for a decade or projection period; and
5. Education policy regarding capacities and capabilities of technical manpower.

Obviously these factors are interwoven and complex. It would, therefore, require a committed national effort to monitor and keep inventory of such factors.

The National Council for Science and Technology has already formulated policy guidelines covering all the scheduled sciences (NCST 1980). Various problem areas have been identified and action programmes proposed. To bolster this effort the following further actions are suggested for consideration and execution:

1. Analysis of the scientific and technical potential (STP) (manpower, material, technological know-how, scientific standards, research in progress, resources of science and technology information); research and experimental development, scientific and technological services and teaching and training.
2. Evaluation and appraisal of research projects (i.e., scientific utility, technological assessment);
3. Identification of short-comings within the scientific and technological policy guidelines;
4. Determination of new fields of research;
5. Dissemination of project planning and management techniques;
6. Organization of transfer of technology to the public sector.
Artisans

Of the three categories of manpower covered by the survey the artisan one was probably the most complex to handle. In many of the establishments surveyed, a very large number of people were considered "artisans" after being exposed to skills on the job. Many others called artisans by their employers may not be described as such by the Directorate of Industrial Training, or any other government organ in Kenya.

It has already been stated that those described as artisans in the present study are "holders of government trade tests and other recognized tests and persons who had attained expertise through apprenticeship in some technical field and had work experience of at least 10 years. Although this definition is practical, it did not indicate whether the apprenticeship was gained formally or informally.

On-the-job training can be considered as an informal apprenticeship. Many workers in Kenya have gained experience through very long spells of training on the job. They may not however be considered artisans if the jobs they have gained experience in are not sufficiently wide and rigorous to justify the term artisan.

The questionnaire was designed such that the data collected did not reveal the quality of the job and the nature of the task involved. And this can be regarded as the price of the simplicity of the questionnaire.

A further preliminary matter of definition related to one of the columns that enumerators had to fill in. In many forms, enumerators recorded the "highest academic qualifications". In some other cases, "professional qualification" was entered on the form. Although enumerators were told to emphasize "professional qualification" there was a preponderance of "academic qualification". Thus many forms contained information on CPE or EACE (KCE) but did not offer any insight on whether the worker had attempted or passed any trade tests or was a beneficiary of any inhouse training, or participated in the government's apprenticeship scheme. Other workers had that column filled with evidence of possessing a trade test, but that may not necessarily signify completion of a coherent training programme.

In summary therefore there are five elements that are important to the manpower surveys concerned with skilled labour:

1 Level of formal education;
2 Formal training and certification;
3 The employer's definition of the worker's occupational position;
4 Period of experience;
5 Judgement of the workers occupational category.

Categories of Artisans

1 The Artisan as Understood by the Government

The artisan as defined by the government is usually of the ordinary-level of education (Kenya Certificate of Education) from a technical secondary school and has had formal apprenticeship approved by the Directorate of Industrial Vocational Training Centre (DIVTC). Such an individual would then obtain a government trade test certificate. It would appear from the firms and establishments examined that not many artisans would qualify to be in this category. Indeed the questionnaire did not cater for formal apprentices. Trade tests are frequently mentioned, but of course these are sometimes taken without being part of government's formal apprenticeship scheme. It does not require mathematical or science-based knowledge. The formal artisan from the technical schools, and using the government facilities in the DIVTC is that of greatest interest to this survey. This is due to the fact that this category has implications for planning.

2 Job-trained Artisans

A job-trained artisan is much more difficult to define. Those with trade test certificates and many years of experience may and should be classified as artisans, even though some of the workers have primary level formal education only. When there was no evidence of formal training, the firm's judgement was sufficient.

3 Job-trained Artisan with Access to Establishment's own Training School

Job-trained artisans in many large corporations were considered as such, because it was assumed that such artisans must have had access to the firms training facilities. This was the case with the big parastatal concerns. It was not however easy to make a similar judgement about a person described as artisan and working in a small enterprise.

The Concept of Artisan and Its Application

The firms classification of area of specialization and job title were sufficient to identify an artisan. In making decisions about a worker's status the firms definition was
used, especially when there was no data on trade test or level of formal education.

Although the NCST decided on the status of an artisan on the basis of the firm's definition of the worker's position, a problem arose about the different job classification schemes being used in Kenya. Some examples to make this clear follow:

1. In a large processing firm there was a small number of maintenance mechanics, fitters, and other artisan trades in addition to a large group of "machine operators", almost all of whom had long experience in the firm. These machine operators were considered artisan for the reasons elucidated elsewhere in this report.

2. A certain processing firm had a job classification system that called people "artisans" with different classes. What was not clear is whether these groups constitute artisans as according to the duties assigned them.

3. In a certain pulp and paper firm there were about 50 different jobs actually performed by workers with primary and secondary school education. Several of these workers were obviously artisans (fitters, turners, electricians), but a very large number may appear not. For example, bleach and wash operator, fourth hand, switchboard attendant and evaporatory operator. All these 50 jobs were given "artisan" status as far as the company and the NCST were concerned.

4. A certain tube and tyre firm had a set of job titles that seemed to give the impression that an artisan rather than an operator job was being described. For example, the following job titles were used in association with the description "on-the-job trained": tyre-builders, tube-builders, pipe-fitter, machine operator, rubber mixing, component mixing, tyre repairing. The total of these on-the-job training jobs was over 150 while the artisan jobs was about 20.

Taking into consideration all the problems described above, it can be concluded that

1. there is a tendency by firms to overestimate the number of artisans;
2. the term artisan has a range of different meanings; and,
3. the major issue in the private sector is the extent to which people who are not formally trained, but are qualified in a broad sense as artisans are being termed artisans.
Direction of Technology as Depicted by Experience

Related to the question of artisans but not researchable from the data set is the link between the technology in use in the firms and the qualification of the labour force. Given that the Kenya Government training is predicated upon the importance and the need for long-term transferable skills, it is not clear that this is what private firms see as important. An estimate of artisans versus operatives in the larger industries would give some indication of changes in technology provided it is possible to get an accurate assessment of utilization of artisans.

One possible indication of the direction in which technology might be moving could be gained from an examination of the numbers of qualified artisans at different experience levels in a firm. A very large cluster of older artisans (15 to 30 years in the establishment) might suggest that new technology no longer made recruitment of such cadres mandatory. In the brewing industry, for example, artisans were spread across the experience range in the following proportions 50% (1-5 years); 24% (6-9 years); 26% (10+ years). That is, there were almost twice as many younger "artisans" as there were those with over 10 years service. In contrast, the proportions of a power supply firm were 25:11:120. This is to say that a much larger contingent of the skilled workers were experienced in the firm:

Training Needs

If it were possible to get an accurate picture of the direction in which skills were moving, then it would also be possible to gauge with reasonable accuracy, the kind of capacity required by the education and training system. At present there are levy-grant funds. The issue is whether certain sectors of industry are interested in utilizing these funds in formalising their training procedures and sending their workers through an approved scheme of training. Perhaps it could be useful to examine the pattern of labour use in particular industries in order to assess sector attitude to training. As it has been suggested above, this examination would not consist simply of asking how many artisans there are but a detailed analysis of the tasks of these artisans. One tendency in the private sector is to train workers on a very specialized range of tasks, and yet still categorise them as artisans. The opposite tendency seems to be operating in the public sector; a large number of workers are trained fully and formally at the artisan and higher levels than the work process can justify.

The Importance of Artisans in Major Public Bodies: The Parastatals

In the case of parastatals there is the problem of getting accurate numbers as is the case with other establishments.
Company-specific grades are used to describe work positions as artisan grade two, artisan, carriage and wagon maintenance. Only a close acquaintance with the organization can reveal whether there is much difference between artisan grade one and artisan grade three in another establishment, or amongst the very wide range of artisan titles.

The survey data suggest that the artisan grade is very important to the corporations; there were over 8,000 artisans in the parastatals. Whereas it would be possible from the survey data to examine the balance of experience amongst these workers (i.e., how many have been in the firm for 5, 10 or more than 10 years), it was not possible to establish whether the skill mix was the same among the younger and older workers. Also it was not easy to correlate the effect of amount of formal education possessed by younger workers and their practical utilization.

The Artisan in the Public Technical Ministries

It has been observed that there may well be a greater concentration of ideal type artisans in the government ministries than in the private sector. The government sector pays more attention to credentials for reasons related to remuneration and gradings. It is also true that the Directorate of Industrial Training is able to persuade ministries to attach importance to the training routines suggested. The results of this survey show that a large number of artisans were employed in the ministries of Water Development, Transport and Communications, Works and Housing, Office of the President, Livestock Development and Agriculture. These ministries employed more than 5,000 artisans; added to those employed by government corporations and parastatals made the aggregate number to be over 12,000. It is, therefore, clear that the government and its institutions are the major users of artisans in the country.

The following issues are therefore pertinent:

1. The relationship between the Directorate of Industrial Training system and the actual job description and performance of the artisans in the government and other sectors;
2. The extent to which government's efforts in training excessive numbers of artisans is effective and desirable as a policy to offset future staff turn-overs;
3. The standardization of artisan training; and,
4. The role artisans can play in the district focus for development planning.

Advancement to Higher Levels and Opportunities

The survey would certainly have been interested in knowing whether the manner and depth of artisan training provides the opportunity to develop into positions beyond the craft level.
For example, does the level of formal education provide the incentive to the artisan to ask at a certain stage to be exposed to technician level training. Or is it so specific that the Kenyan artisan will not be able easily to make the transition to different kinds of work? Furthermore, it may be argued that some corporations should be encouraged to train more than the number it requires, so that some of the workers may after several years leave their service to establish small enterprises of their own. It is evident that one of the functions of the public sector in particular is to train in the "ideal" manner more young people than can actually be retained. This role of training is not something that can be easily determined by looking at the low numbers of artisans in the labour force of different organizations.

Technicians

It has been noted that there were some conceptual difficulties in the definition of artisan manpower. The same is true of technicians. The 1975 NCST survey found that many firms used the term "technicians" to cover workers whose level of formal education ranged from post-primary level up to those with advanced level school certificate passes and even diploma qualifications. It is because of the comprehensive range of positions covered by this title that both the past and the present surveys have sought to apply relatively rigorous definitions of a technician.

The present study required that technicians be counted only if they were "holders of a diploma in any discipline or technology". The insistence upon a diploma underlines the fact that the technician is expected to be engaged in tasks that require significant component of primary science-based knowledge. It may be argued, as a corollary, that a highly experienced craftsman or artisan would not be able to operate at the technician level, because of lack of this level of formal education. Because of the insistence upon formal qualifications with technicians than with artisans, it is worthwhile to indicate the roles that technicians usually perform.

Role of Technicians

In construction, design and engineering activities, the technician has played an intermediate part between the designer, architect or engineer and the production of the building, the artefact or the item to be made. The technician has acted as draughtsman, as assistant to architect, surveyor and research scientist in whatever field. The technician is required to have sufficient scientific knowledge to carry out field tests, analyse products, check quantities, maintain accurate records of the processes under analysis. The problem however is that in a large number of fields and firms the capacity to do these tasks is usually preceded by a spell as
artisan or craftsman. This is not likely to be the case with pharmacists, or dental technicians and many related laboratory technician jobs. But in industry and to some extent in agriculture there is a scope for the more talented and enterprising workers moving from the production sector to the control of the quality of that product.

Ability in fault analysis on vehicles or on chemical products can be positively improved by having been exposed to the manufacture or repair of the item in question. Hence the difficulty in deciding what is the industrial equivalent of the laboratory technician in the medical or natural sciences. This has in a number of instances earned production supervisors and foremen the title of technician with or without attendance at any formal diploma course in the polytechnic or its equivalent. As with artisan definition, it would appear that the technician definition must to some extent take account of the task and technological level of the factory or process under review. Automation and frontier technologies have made inroads into the traditionally "difficult" areas of quality control in a chemical process and advanced instrumentation now does a great deal of the fault finding automatically. This happens more in the industrial and process sector than in the more labour-intensive service sector.

In many service sectors such as the provision of such services as water, telephones, education, health, and veterinary, the control of quality is less exercised upon materials than upon other workers. Hence a category very close to the technician is that of the inspector and supervisor. There is a whole array of such people employed in the service sector. In power supply firms, for example, there are jobs like turbine supervisor related to the machinery and installation inspector which in turn relates to the quality of work done by a particular team of artisans. The analogy in teaching would be the inspectorate at national, provincial and district levels who would be charged with maintaining the quality of ordinary classroom practice. Typically, these are selected directly from the ranks of successful "artisans" or school teachers, or primary school headmasters. At the national level, however, the inspector would be likely to have a degree and to be a specialist in a particular discipline. It is, therefore, possible that an "inspector" may range from degree level work down to primary school teaching certificate and years of experience. The same is true for many other service and supply occupations that there is a supervisory level checking the work of junior and larger numbers of both skilled and semi-skilled workers.

Areas for Further Examination

What probably would be useful is to look at particular sectors, for example, health, veterinary services, electricity supply, and examine the relationships between the lowest level of skilled worker, the supervisory, inspectorial cadres, and the
scientific and engineering cadres. The relationships and the ratios between these three categories probably differ rather markedly from sector to sector. However, a starting point for examining the role of the technician would be to clarify on a sectoral basis the typical tasks undertaken by the technician, and the extent to which these qualifications can be acquired through polytechnic diploma level training. In one major parastatal, for example, it was found that many of those classified as "artisans" were in such positions as inspectors, e.g., boiler inspector, mechanical handling inspector, and senior equipment inspector. The reason is not far to find. These positions are being held by people who appear only to have rather low levels of formal education, and very many years of experience. In the same parastatal there is a significant number of "design assistants", "draughtsmen", "assistant surveyors", "telecommunication assistants" who have important supervisory and quality control positions.

Sector-Specific Analysis

In policy terms an accurate sector-specific analysis of the use of technician level categories is, important, especially in view of the fact that new facilities are constantly being demanded at the polytechnics, and at the harambee institutes of technology. It would therefore be appropriate to give some account of the rate at which technicians are demanded by industry and government. Some indication of the direction in which demand is moving can be gauged by the numbers of technicians with different years of experience in the work force. At the sector level, it should be possible to know the rate at which technicians are being taken on in preference to other categories. This is likely to be much more obvious in the government corporations and public sector.

Industry preference would indicate where demand was most likely to come, and in turn the areas of polytechnic offerings needed for expansion. A difficult issue is the readiness of establishments to move away from hiring "barefoot technicians" - those who have grown gradually in the firm into technician level without going through any formal training. Again it would be to get some idea of the different sectoral response to this kind of "technician".

Scientists

The definition of scientists is much less complex than those of the other two categories. For the purpose of this study scientists were defined as those "persons with scientific or technological training who were engaged in professional work on scientific and technological activities, high level administrators and personnel who direct the execution of scientific and technological activities". Although the guideline stresses high level administrative tasks, it proved difficult to distinguish level of administrative
responsibility. The intention of the survey was to broaden the definition of scientists to include social science.

Experience of Scientists

There are a number of important implications that can be inferred from the data already gathered. One of the critical issues relates to the mix of experience in the cadres of scientists. The ratio of experienced to inexperienced scientists within a ministry is important in as far as practical activities are concerned. In several technical ministries, the ratio of young to old scientists was very much in favour of the young. This was partly because of the newness of some of the technical ministries, and partly because of expansion into new areas of work. The result is a severe imbalance between the experienced and inexperienced. The severity of the ratio implies that the apprenticeship of younger to older scientists is difficult to arrange. In one service ministry, there were about 340 scientists, mostly in the engineering, geology and hydrology fields. About 88% of these had served for less than 5 years, while 8% have more than 10 years of experience and 4% have between 6 and 10 years service. This leaves a very large number to learn their duties from each other rather than from established engineers in the service. It should be noted that a large number of the new scientists had between 1 and 3 years of experience.

Even in older ministries like Works, the proportions of young to old scientists were not dramatically different. Seventy one per cent (71%) of the scientists had less than 5 years of experience, 16% had 6 to 9 years, and 13% had more than 10 years experience respectively. It is unlikely that a workforce made up predominantly of newly qualified scientists would be efficient enough to produce work for the sub-professional grades as a workforce that has an even spread-out across the experience spectrum.

Foreign Professionals

Related to the question of learning from more experienced scientists is the issue of expatriate presence in technical ministries. This does not suggest that expatriates have the experience that is lacking amongst the younger African scientists, but in certain circumstances long serving expatriates could be of assistance along with the more experienced African colleagues in providing an "apprenticeship" in a particular profession.

It is in the national interest that a critical and accurate number of foreign advisors attached to all ministries is known, especially if some of these are carrying out key scientific and planning tasks. Estimating the number of high-level expatriate positions still to be Kenyanized would involve counting the establishment posts and all the advisory and project-related positions.
In addition to considering the ratio of new cadres of scientists to experienced scientists, and of Kenyan to expatriate, there is also the question of whether such large concentrations of younger officers in many of the ministries may lead to greater mobility than the cost of their training would merit. Again it is difficult by an examination of the data alone to obtain a clear and appropriate interpretation. It would also be relevant to know if the scientist cadres in the private sector is similarly skewed towards the young and inexperienced.

Formal Output Sources of Artisans, Technicians and Scientists

1 Artisans

The formation of skills leading to the artisan cadre of manpower in Kenya is characterised by a combination of formal training in established institutions and, especially for artisans in the industrial sector, informal on-the-job training. The heavy reliance on on-the-job training by the majority of employers in the industrial sector coupled with the resulting low demand for formal sponsorship of industrial artisan training makes it difficult to meaningfully define and compute the annual output for what is an extremely heterogeneous group of manpower.

Formal training for artisans in the agricultural sector is carried out at four government agricultural institutions namely, Animal Health and Industry Training Institute (AHITI), Bukura Institute of Agriculture, Embu Institute of Agriculture and Eldoret Agricultural Institute. The annual output of agricultural artisans from these institutions is about 400. Medical artisans get their formal training at 13 institutions attached to district or provincial hospitals in the country. In 1982, the total annual output of medical artisans from these institutions was 851. Some private hospitals also train medical artisans but their output has not been determined.

As stated earlier most of the industrial artisans are trained on-the-job and lack any formal certification for the skills they have acquired. It is therefore difficult to estimate number of persons who become artisans in this way. Formal industrial artisan training is done through established craft training centres (e.g., village polytechnics) and the passing of a government trade test administered by the Directorate of Industrial Training in the Ministry of Labour. In 1982 the total number of government trade test passes was about 1,000.

The natural and physical science sector artisans get their formal training at the Kenya and Mombasa polytechnics. In 1982 the output of artisans from the two institutions was about 350.
2 Technicians

There are 6 main institutions that train technicians in the country namely Kenya Polytechnic, Mombasa Polytechnic, Medical Training Centre, Egerton College, Kenya Science Teachers College and the Kenya Technical Teachers College. Other institutions are the Jomo Kenyatta College of Agriculture and Technology and the many harambee institutes of technology spread across the country. Table 15 shows the output of technicians in 1982 from the above named institutions broken down per science group.

Table 15. Output of technicians by 4 major science groups in 1982

<table>
<thead>
<tr>
<th>Science group</th>
<th>Output</th>
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</thead>
<tbody>
<tr>
<td>Medical</td>
<td>350</td>
</tr>
<tr>
<td>Industrial</td>
<td>376</td>
</tr>
<tr>
<td>Agricultural</td>
<td>458</td>
</tr>
<tr>
<td>Natural and Physical</td>
<td>319</td>
</tr>
<tr>
<td>Total</td>
<td>1,683</td>
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3 Scientists

The output of graduates from the University of Nairobi and Kenyatta University College was 2,178 in 1981. The number of foreign graduates or Kenyans who have since left the country permanently is not easy to determine. Nevertheless, it is expected that more than 90% of these graduates are employed in Kenya. Ascertaining the number of foreign-educated Kenyan graduates who come to Kenya annually is considerably more difficult. The Ministry of Education started to build up a comprehensive card index system for Kenyans studying overseas in 1965, but the very large number of students involved and the fact that the majority of them were privately sponsored and failed to register with the ministry as is formally required, makes the data collected unreliable. However, from the
information that exists it is estimated that the total number of Kenyan graduates from foreign institutions who secure jobs in Kenya is between 500 and 700 annually.

Two main issues are worthy of note in the foregoing presentations:

1. A sectoral analysis of utilization of scientific and technological cadres of manpower is necessary;
2. The extent of Kenyanization in scientific and technological fields needs to be examined more critically.

REFERENCES

APPENDIX I

NATIONAL SURVEY OF SCIENTIFIC AND TECHNOLOGICAL MANPOWER. 1982

<table>
<thead>
<tr>
<th>Name of persons engaged (Surname first)</th>
<th>Nationality of</th>
<th>Highest academic professional qualification</th>
<th>Area of specialization (e.g. survey or)</th>
<th>Designation</th>
<th>Experience (in complete years)</th>
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APPENDIX II
Establishments and Firms Covered

1. Ministry of Agriculture
2. Ministry of Basic Education
3. Office of the President
4. Ministry of Co-operative Development
5. Ministry of Regional Development, Science and Technology
6. Ministry of Labour
7. Ministry of Transport and Communication
8. Ministry of Lands, Settlement and Physical Planning
9. Ministry of Health
10. Ministry of Livestock Development
11. Ministry of Environment and Natural Resources
12. Ministry of Works and Housing
13. Ministry of Economic Planning and Development
14. Ministry of Culture and Social Services
15. Ministry of Foreign Affairs
16. Ministry of Commerce
17. Ministry of Finance
18. Ministry of Water Development
19. Ministry of Industry
20. Ministry of Tourism and Wildlife
21. Ministry of Information and Broadcasting
22. Ministry of Energy
23. Ministry of Local Government
24. Kenya Utalii College
25. Kimathi Institute of Technology
26. Western College of Arts and Applied Sciences
27. Kenyatta University College
28. University of Nairobi
29. Kenya Polytechnic
30. Mombasa Polytechnic
31. Teachers Service Commission
32. Kenya Science Teachers' College
33. Kiambu Institute of Science and Technology
34. Jomo Kenyatta College of Agriculture and Technology
35. East African Power and Lighting
36. East African Bag and Cordage
37. Kenya Meat Commission
38. Kenya Planters Cooperative Union
39. Kenya Marine and Fisheries Research Institute
40. Kenya Posts and Telecommunications Corporation
41. Kenya Industrial Estates Limited
42. Kenya Cooperative Creameries
43. Kenya Tea Development Authority
44. Kenya Cargo Handling Services
45. Kenya Railways Corporation
46. Kenya Airways
47. Kenya National Archives
48. Kenya Bureau of Standards
49. Kenya Breweries Limited
50. Kenya Commercial Bank
51. Cooperative Bank  
52. National Bank of Kenya  
53. Central Bank of Kenya  
54. The Standard Bank Limited  
55. Industrial Development Bank  
56. Cannon Assurance (K) Limited  
57. Pyrethrum Board of Kenya  
58. Uplands Bacon Factory  
59. Industrial and Commercial Development Corporation  
60. National Construction Corporation  
61. Brooke Bond (K) Limited  
62. Sony Sugar Factory  
63. Agriculture Development Corporation  
64. National Housing Corporation  
65. Development Finance Company of Kenya  
66. Potato Research Station  
67. Central Artificial Insemination  
68. Lake Basin Development Authority  
69. Tana and Athi Rivers Development Authority  
70. Kenya National Assurance  
71. Kenya Re-insurance Corporation  
72. Kenatco Limited  
73. Cotton Lint and Marketing Board  
74. Credit Finance Corporation  
75. Agricultural Finance Corporation  
76. Thika Cloth Mills Limited  
77. Pan African Paper Mills Limited  
78. Unga Limited  
79. Kartasi Industries Limited  
80. Plastic and Rubber Industry Limited  
81. Air Kenya Limited  
82. Kenya Consulting Engineers  
83. Industrial Workshop Limited  
84. Colgate Palmolive (E A) Limited  
85. Technical Engineering Limited  
86. Coca-Cola Company Limited  
87. Polycans Limited  
88. Amazon Motors Limited  
89. Caspair Maintenance Limited  
90. Caltex Oil Limited  
91. Timwood Products Limited  
92. Hall-Thermotank Equatorial Limited  
93. (EA) Match Co Limited  
94. The Booth Manufacturers Limited  
95. Allied Contractors Limited  
96. British Airways  
97. Westlands Motors Limited  
98. The African Highland Produce Co Limited  
99. Kenya Motor Corporation Limited  
100. Zakhem International Limited  
101. Gailey and Roberts Limited  
102. Bata Shoe Company Limited  
103. East African Spectre Limited
104. Aboos Engineering Limited
105. Scot Wilson Kirkpatrick and Partners Limited
106. Mac's Pharmaceuticals Limited
107. May and Baker Limited
108. Kiam Engineering Works Limited
109. Mumo Motors Garage Limited
110. Nicholas Laboratories Limited
111. Rasul's Garage Limited
112. Nightrose Cosmetics Limited
113. Mineral and Mining Cooperative Limited
114. Aberdare Timbers Limited
115. Specialized Engineering Limited
116. Ramji Haribhai Devani Limited
117. Elianto (K) Limited
118. Marshalls (EA) Limited
119. Tiger Shoe Co Limited
120. Berkeley-Steward Limited
121. Agip
122. Achelis Limited
123. Chameleon Limited
125. Mombasa Grain Milling Co Limited
126. Water Proffing Contractors Limited
127. Express (K) Limited
128. Interoffset Printing Limited
129. Production Mech Engineering Limited
130. J M Machine Tool Manufacturing Limited
131. Factual Films 1974 Limited
132. Cianda Industries Limited
133. Otis Elevator Limited
134. Vaker Building Contractors Limited
135. Spicers (EA) Limited
136. Corrugated Sheets Limited
137. Crescent Construction Limited
138. Kenya Orchards Limited
139. Hughes Limited
140. Bamburi Portland Cement Limited
141. Jogoo Industries Limited
142. East African Oil Refineries Limited
143. Central Pharmacy (K) Limited
144. Fortune Plast Limited
145. Mombasa Soap Oil Manufacturers Limited
146. The Blanket Industries Limited
147. Kerai Chemicals Limited
148. Diamond Perfumery Works Limited
149. Mombasa Soap Oil Limited
150. Simbarite Limited
151. Spessarite Limited
152. Computer Consultants Limited
153. Hatz and Bell Engine Limited
154. Kiwi Home Products Limited
155. Cadbury Schwepses Limited
156. African Synthetic Fibres Limited
157. Kakamega Food Industries Limited
158. Kisumuwalla Oil Industries Limited
159. Mitchel Cotts (K) Limited
160. Nation Newspapers
161. NU-Tread Tyres Limited
162. Hoechst Limited
163. Plessey Limited
164. Johnson Wax (E A) Limited
165. Nairobi Floor Mills Limited
166. Mabati Limited
167. J K Kiama Industries Limited
168. Kens Metal Limited
169. Silent Night (K) Limited
170. Kapa Oil Refineries Limited
171. Davinders Engineering Works Limited
172. Kenya United Steel Co Limited
173. Lyons Maid Limited
174. Orbit Chemicals Limited
175. Bi-Mach Engineers Limited
176. Kitale Printers (1975) Limited
177. KU G Timber Industries Limited
178. Karibu Timber Industries Limited
179. Milling Corporation Limited
180. Burns and Blane (K) Limited
181. Aan Industries Limited
182. Corporation Printers Limited
183. Kenya Rayon Mills Limited
184. Business Machine (K) Limited
185. Nakuru Oil Mills Limited
186. Premium Drums Limited
187. Crown Cork Limited
188. Coates Limited
189. Kenya Builders and Concrete Co Limited
190. Kamyu Industries Limited
191. Impala Glass Industries Limited
192. Nile Investments Limited
193. Kicomi Limited
194. Bayer (E A) Limited
195. Dawa Pharmaceuticals Limited
196. Mowlem Construction
197. Kenya Tanning Estracts Co Limited
198. Mecol Limited
199. Kenya Steel Fabricators Limited
200. Timsales Limited
201. K Kay Eng Works Limited
202. Kodak (K) Limited
203. Matter and Piatt (K) Limited
204. Sir Alexander Gibb and Partners Limited
205. Hussein Elect Engs Limited
206. Uchumi Super Market
207. Haco Industries Limited
208. Mobil Oil (K) Limited
209. Avery (K) Limited
210. Civil Engineering Services Limited
211. Ganijee Glass Mart
212. British Road Laboratory Limited
213. Arcadia Construction
214. Amalgamated Industries Limited
215. Agritoal Industries Limited
216. Auto Engineers Limited
217. Universal Garments Limited
218. Kenya General Industries Limited
219. Ezzivinl Products
220. Chana Engineering Works
221. Aisthope Timber Engineers Limited
222. Abbot Laboratories Limited
223. Marshall Fowler (Engineers) Limited
224. Meta Plastics Limited
225. Glaxo (E A) Limited
226. Kaluworks Limited
227. Twiga Paints Limited
228. Chloride Exide Limited
229. Central Automobile
230. Industrial Plant
231. Cussion and Company Limited
232. Capital Construction Limited
233. Ideal Casements
234. Chui Soap Factory
235. E N Jordan and Co (Builders) Limited
236. Bhupco Garment Factory Limited
237. ACMES Press
238. Interproducts Limited
239. Chandaria Industries
240. The Boots Company Limited
241. Wyco Paints Co Limited
242. Health and Beauty Product
243. Chesebrough Ponds (K) Limited
244. The Cosmi Crayon Co (EQ) Limited
245. Bruce Limited
246. East African Portland Cement
247. Bembi Motors Limited
248. Machenzie (K) Limited
249. Car and General Limited
250. Spinners and Spinner Limited
251. Kenya Canners Limited
252. Mater Miserericodial Hospital
253. Kenya Bus Services Limited
254. Didi Pharmaceuticals Limited
255. Finlay Industries Limited
256. Dominion Engineering Works Limited
257. Desert Locust Control Organisation
258. Dunlop (K) Limited
259. Firoze Construction Limited
260. Dalip Singh Electrical Engineering Limited
261. Daughty Limited
262. Kenya Engineering Works Limited
263. Shell BP (K) Limited
264. D T Dobie (K) Limited
265. Deweto (K) Limited
266. Emco Glassworks Limited
267. East African Fine Spinners Limited
268. David Motor Corporation Limited
269. Diplo Garments Limited
270. Acue Textiles Limited
271. The Standard Limited
272. East African Road Services Limited
274. Esso Standard (K) Limited
275. Coastal Printing Works Limited
276. Deepa Industries Limited
277. Aries Engineers Limited
278. Baby Soap Factory Limited
279. Sciex (E A) Limited
280. Allied Constructors Limited
281. Genitems Company Limited
282. Rivatex
283. Pac Laboratories Limited
284. Bhogals Garage Limited
285. Wellcome (K) Limited
286. Sterling Products Limited
287. Furniture International Limited
288. Vacu-Lug
289. Philips (K) Limited
290. Papeware Limited
291. Honty Hose Manufactures Limited
292. S Industris Refractories Limited
293. Habatula Brothers Limited
294. Sanyo Armco
295. Sumaria Industries Limited
296. Nairobi Laboratories Limited
297. Reckitt and Colman Limited
298. Pfizer Laboratories Limited
299. Sadolin Paints Limited
300. Research Bureau (E A) Limited
301. Kenya-Swiss Chemical Co Limited
302. Vic Products (E A) Limited*
303. Rigging Construction Limited
304. Rentokil Limited
305. Aeroelectronics
306. Ken-Wheat Industries Limited
307. Rai Plywood (K) Limited
308. Kenya Film Corporation Limited
309. Technical Engineering Services Limited
310. General Aluminium Fab Limited
311. East African Oxygen Limited
312. Kenya Taitex Mills Limited
313. Gilbey (E A) Limited
314. East African Foundry Works Limited
315. Afrique Chemicals Limited
316. CMC
317. Wigglesworth and Co (K) Limited
318. The Jubilee Insurance
319. City Printing Works Limited
320. ILRAD
321. Kenya Fishnet Industries Limited
322. Coast Chemical Industries Limited
323. International Computer (E A)
324. BAT (K) Limited
325. Berger Paints Limited
326. Sigma Engineering Works Limited
327. Geosurvey International
328. East African Cables Limited
329. Allied Plumber Limited
330. Associated Batteries Limited
331. Afropress Limited
332. H Young and Co (E A) Limited
333. Avon Rubber Co Limited
334. Aga Khan Hospital
335. Kenya Drilling Limited
336. Park Road Nursing Home
337. Consolata Hospital
338. Kenya Literature Bureau
339. Getrude's Garden Children's Hospital
340. Kenya Industrial Research and Development Institute