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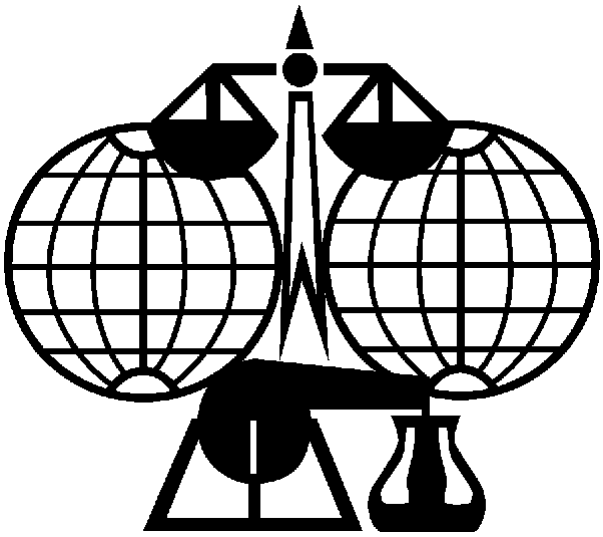

CHEMISTRY IN AFRICA'S LEAST DEVELOPED COUNTRIES AN OVERVIEW OF CAPACITY BUILDING AND RESEARCH SUPPORT

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1 BACKGROUND TO THIS OVERVIEW

The International Union of Pure and Applied Chemistry (IUPAC) has entered into an agreement with UNESCO to help develop and foster chemistry, with the emphasis on capacity building and research, within the world's Least Developed Countries (LDCs). During the initial period, it is planned to concentrate on the African region and to focus on development within a small number of LDCs with a demonstrated capacity to benefit from this initiative.

In dealing with facets of higher education, it should be acknowledged that the progress achieved in African education since the time of independence in the 1960s, has been truly remarkable. Quantitative expansion has been particularly impressive and, amongst other, African universities have registered notable progress to become legitimate institutions of higher learning. Despite these achievements and recognized pockets of progress in African universities, it is generally accepted that the universities of Africa are in crisis. [1)] This is briefly highlighted below.

IUPAC is conscious of moves to revitalize Universities in Africa and of the involvement of many foreign donor agencies active in Africa in the field of development-oriented research in the basic sciences (including chemistry). Furthermore, the need is frequently emphasized for improved co-ordination and concerted efforts amongst such agencies, *inter alia*, to increase co-operation amongst developing countries. [2,3)] This overview of current activities and initiatives in Africa was compiled to allow IUPAC/UNESCO to optimize its input, gain from the wealth of past experiences, and maximize co-operation.

2 INFORMATION GATHERING

On behalf of IUPAC approximately 40 government departments, donor and development agencies active in the field of tertiary education in Africa - with special reference to research and human resource development in chemistry - were approached through personalized letters for information (See Addendum A). Not all of them responded. Many indicated a broad involvement in the basic sciences, including chemistry.

Furthermore, a study of the extensive literature was undertaken and relevant statistical data on the sciences and chemistry in Africa collected. The overview was further enriched through extensive input by chemists from Africa.

3 AFRICA: THE UNIVERSITY ENVIRONMENT

Education in Africa, generally, and higher education, in particular, have been the subjects of extensive analysis and review. [1,4,5,6,7)] Science was singled out for detailed analysis.[8,9,10)] With regard to universities the period of the 1960s was described as one of euphoria, hope and romanticism. By the 1970s expectations were somewhat dampened, stung by the wave of military coups and the growing politicization of higher education. By the 1980s, disillusionment and decline were the norm. Overcrowding became an increasingly vexing problem and the quality of colleges and universities in most parts of Africa continued to fall, leading to a period of growing pessimism. [1)] However, the mid-1990s have seen new hope for successful change and transformation of higher education. There is growing belief in an African renaissance, further stimulated by improving economic prospects.

3.1. Revitalization of African Universities.

In a 1996 report to the President of the World Bank, the African Ministers of Finance listed the revitalization of African universities among the continent's critical developmental needs.[11] The World Bank leadership was requested to marshal donor community participation in a fully joint undertaking with African governments to address this and other regional shortcomings in institutional and human resource development.

As a response to the initiative of the African Ministers of Finance a First Draft (20 March 1997): "Revitalizing Universities in Africa. A Strategy and Guidelines for Action" was formulated. [11]

This First Draft stresses that the weight of available evidence indicates that the process of renewal within African universities can only begin when universities themselves seize the initiative - an initiative which should provide for a strategic planning process as an effective management tool. The strategic plan should emerge from wide internal consultation and consensus building and should address issues such as:

- expansion of access without further sacrifices to quality;
- the financing of higher education;
- the improvement of quality and relevance of university education;
- improved management of the resources of higher education;
- keeping pace with rapid global changes in scientific information and technology; and,
- the rekindling of university research activity.

Important is the recommendation that all funds contributed to a university by government and donor agencies be demonstrably linked to that university's stated mission and development goals.

This first draft was followed by a document produced by the World Bank and the Association of African Universities (AAU) in consultation with a wide range of other institutions devoted to higher education in Africa.[11] The document " represents a rather extraordinary degree of consensus among a range of representative from universities , associated organizations, governments, and donors on a topic on which there had previously been little agreement: how to revitalize universities in Africa". It provides guidelines on what universities, governments, donor agencies and The World Bank should do. In the case of the latter institution it is emphasized that it should make greater use of existing capacities within African universities and use USD 5-10 million per year of its estimated USD 50 million in annual project-related training expenditure to program training for strategic planning within African universities.

Any planned new initiative in chemistry should take cognizance of these and further developments.

3.2. Africa Education: Rising Enrollment and Stagnating Budgets

Africa currently has more than 3.224 million students enrolled for tertiary study. Of these 2.64 million are enrolled in only seven countries (Algeria, Egypt, Libya, Morocco, Nigeria, South Africa and Tunisia), each with more than 72 000 students. Hence, some 580 000 students are enrolled in the remaining Sub-Saharan countries, with 27 countries having less than 10 000 enrolled students! (See Table 1) [12]

The dramatic growth in demand for education, particularly tertiary education, and the stagnation of budgets in Sub-Saharan Africa, may be gleaned from Table 2. For Sub-Saharan Africa the education budget grew from USD 15.8 billion in 1980 to only USD 16.3 billion by 1994. However, the student index number for tertiary study rose from 100 (1980) to 339 (1994)! During the same period primary and secondary education enrollment grew respectively by 46% and 104%. [12)]

These developments severely impacted on universities in Africa.

Per student expenditures declined from USD 6300 in 1970 to an average of USD 1500 in 1988.[1)] Faculty and staff salaries fell significantly in the 1980s and 1990s with the consequence that large numbers of faculty members became part timers, affecting their performance in the classroom and relegating research to a peripheral activity of university staff. [13)] Improving the quality of education was hampered by a huge brain drain, the decline of institutions themselves, their libraries, laboratories, and working conditions. Frequently, lack of laboratory space, equipment and supplies, poorly qualified demonstrators and laboratory technicians, and lack of adequate supervision in consequence of the large size classes have adverse consequences for the students. [13)]

Despite the dramatic rise in enrolled student numbers, participation rates in higher education for the 20 - 24 age group (as used by UNESCO) remains very low for Sub-Saharan Africa and is predominantly arts based. The output of graduates in science (including chemistry) and technology is low (see Table 1). The pressure for access remains high! Certain countries appear to be on the verge of huge expansion of their universities. In Kenya, out of the 150 000 students, who recently sat for the Kenya Certificate of Secondary Education, only about 10 000 will be admitted at public universities,[14)] and is bound to remain a major political issue for years to come. It is not surprising that the institutional emphasis is on the all-important undergraduate training. Generally, there is no institutional drive for research.

3.3. Research in African Universities

Individual universities in Africa generally play a larger and more influential role in national development than do universities in other parts of the world. African universities frequently hold a near monopoly on the production of skilled managers and technical specialists for the public and private sectors, generation of new local knowledge through research, linkage of the country to the scientific world at large, and the inculcation of professional values. [11)]

In 1991, it was reported that the research output at African universities has declined drastically by 35% since the mid-1960s. During these decades, research money throughout the continent has been drying up largely because of chronic economic crises. What emerged was that much of African research became supported by foreign governments and philanthropic groups. [15)]

Through the much appreciated collaboration of Dr W. Val Metanomski, Chemical Abstracts Services, USA, an analysis was made of the abstracts in Chemical Abstracts "originating" from the countries in Africa for 1987 and 1996. The results are summarized in Table 1. [16)] The number of abstracts includes journal articles, conference papers, and technical reports.

However, a note of caution should be sounded: " Abstracts of papers by country" are based on the assumption that the address of the first author corresponds to the place of work. This is not always true. Be that as it may, this analysis presents the best available data and clearly underlines:

- the predominance in chemical research of the North African countries, South Africa and Nigeria;

- some 15 Sub-Saharan countries with sustained and strengthening chemical research contributions;
- the low or lacking research activity in chemistry in many Sub-Saharan countries.

In analyzing Africa's contribution to the world's chemistry literature, it should be noted that the world's journal articles, conference papers and technical reports, abstracted by Chemical Abstracts rose from 386 466 (1987) to 579 251 (1996) - an increase of 50%. Africa's contribution rose from 3917 (1987) to 5369 (1996) - an increase of 37%. Africa's contribution to the world's chemical literature is 0.93%.

Mrs. A. Pouris, Foundation for Research Development, Pretoria, also processed data from the Institute for Scientific Information, USA, for 1995. In addition, she also assessed the extent of international collaboration. The results are summarized in Table 3, which reflects wide intercontinental collaboration, but limited collaborative ventures between African countries.

Various chemists from Africa emphasized that chemical publication output of Africa is not fully represented in the existing abstracting databases. This is not necessarily due to lack of quality of the contributions, but to the selection of journals for abstraction. However, there is no international database that specializes in the output of scientific institutions in Africa. [17)]

3.4. Official Development Assistance in Africa: The Position of Chemistry

During the period 1986-1994, the total Official Development Assistance (ODA) by the OECD countries to developing countries remained in the range USD 54 - 61 billion per annum. The ODA provides for bilateral grants, bilateral loans, and contributions to multilateral institutions.[18)]

Of the USD 59.156 billion available in 1994 for ODA, the largest amount, USD 11.28 billion, went to Africa, with the major contributors France (27.7%), USA (16.1%), Germany (10.5%), and Japan (10.1%). [19)]

ODA and Official Aid constitute an essential source of funding in many Sub-Saharan countries, where 16 countries in 1994 received ODA and Official Aid varying between 20% and 103% of their respective Gross National Products. Others receive less. [20)] The proportion of ODA and Official Aid allotted to Higher Education is not known, but according to W. Saint, a 1992 survey of 17 countries from Latin America, Asia and Africa showed that 1%-2% of total aid was earmarked for Higher Education.[21)]

Japan is now the largest contributor to ODA with a contribution of USD 14.489 billion in 1995 of which USD 1.616 billion went to educational projects.[18)] In analyzing the type and number (in decreasing order) of projects supported in Africa by Japan, one notices a large number of grassroots projects followed by projects for increased food production, establishment of infrastructure (e.g. water availability, sewage systems, electricity, roads, ports, bridges), food aid, and less frequently a variety of further projects.[19)] During the past few years only two specific chemistry projects were supported, at the University of Cape Coast, Ghana (1996),[22)] and at the University of Zimbabwe, Zimbabwe (1993). [23)]

Recent years have seen the onset of "aid fatigue" in some industrialized nations, and some of these nations are even contemplating reducing their budgets. Contributing reasons for the threatened cuts are the strained finances of industrialized countries and the doubts about the effectiveness of their assistance, especially because African development has not been very successful. Donor countries use various agencies to address higher education projects. Due to their unique assistance philosophies and backgrounds, donor countries and international organizations each have their specialties in terms of regional expertise, aid, categories, and schemes. To become more effective, it is vital for donor

countries to co-ordinate with each other in their aid programmes.[19] The Association for the Development of African Education fulfils this requirement in part.

3.5. Donor Agencies and the African Research Effort

External resources are critically important to African educational development. In the early 1980s public international development assistance from OECD and OPEC sources, the Eastern Bloc countries, from private non-governmental organizations and non-concessional loans from the multilateral banks came to nearly USD 1.6 billion annually.[4] During 1981-83, higher education received 34 percent of direct education aid from external sources, but this declined towards the end of the decade. International development assistance will play a prominent role in efforts to stabilize and revitalize African universities. This is because severe financial constraints at the national level have, in many cases, reduced government funding for higher education to salary support and essential operating costs.[5] The African Ministers of Finance in their report to the World Bank proposed a cluster of interventions, *inter alia*, for increased World Bank and other donor investment support for institutions of higher learning and for the cultivation of regional centers of excellence.[11]

Regional or sub-regional cooperation may be pursued through several models. The "Centre of Excellence" model often requires heavy investment to acquire "state of the art" equipment and facilities and is usually donor driven. Although the host country often provides substantial support, contributions from other countries in the region are either marginal or totally absent.[7] The alternative model is the "Division of Labour" approach, which is advocated by CASTAFRICA II.[7,24] The main feature of this approach is the co-involvement of the participating institutions in the offering of the training program.

The first approach runs a major risk if donor interest wanes, whereas the second approach, if truly based on need, has a greater chance of sustainability even when donor interest declines.

Donor agencies have contributed in substantial ways to the growth and development of African universities over the past three decades. The support is recognized and appreciated by the institutions.

Relationships between Higher Education institutions and specific donor countries were established over extended periods. One of the truly successful outcomes, is the corps of African professionals trained in the best institutions the world has to offer; e.g. the Alexander von Humboldt Foundation provided the author with an address list of its 127 fellows from Africa![25] These trained professionals provide a sound and impressive basis on which to build. However, donor actions have also helped to exacerbate the current university crisis in Africa and this was critically reviewed by W. Saint,[5] who indicated that the composition of external support changed over the years. Donor projects focused increasingly on specific problems and became more results oriented. The following trends were observed:

- "A broad human resource development approach at country level.
- Long term program support rather than incremental project support.
- Building institutional self-reliance and sustainability.
- Strengthening local self-directing capacities.
- Improving appropriateness of projects and project-related training for the world of work.
- Promoting quality of education and training while trying to meeting expanding needs."

Indeed, African universities operate with core funds and additional grants. Many universities depend on external, usually foreign, support for their basic core functions e.g. the major universities in

Mozambique and Tanzania depend on foreign funds for more than 50% of their total expenditures, of which only a small part concerns research. Some universities depend entirely on foreign funding for the execution of research. As a whole, research aid for development represents approximately 5% of the overall development assistance.[26] A lack of balance between core resources and special projects stands out. The institutions are often weak and lack both the academic and administrative base required to make full use of external offers for support or cooperation. Criteria for accepting grants are not set, overheads are rarely charged. [27]

To depend on outside funding is debilitating. It is reasoned that development cannot be brought about from "outside", but must have roots "within" each country. Consequently, support from international agencies must be met by confirmed commitments from local academic and political leaders.[7] However, a frequent lack of strategic planning at institutional and governmental level frustrates longer term planning.

In the cases of weak institutions, assistance may be a necessary stage to reach a situation where they can engage in proper co-operation. [27] Donor support frequently assumes an institutional capacity within universities that is not always there. [5]

The most strategic need is to strengthen the institutional basis for research. This includes: [28]

- capacity for research administration;
- minimum of research facilities;
- capacity for maintenance of scientific equipment;
- libraries; and,
- qualified academic staff.

Without such a basis, research activities cannot be sustained beyond the lifetime of a project.

The second important part of the strategy is to establish university research, where scientific contacts and a critical group of colleagues are necessary to create a research environment. A quantum leap usually occurs when post graduate studies and research training is undertaken. African universities may identify strengths, invest in some selected areas, and co-operate on a regional level for research training. The notion of "regional centers of excellence" has been very popular among aid agencies. [27]

The significance accorded to human resource development saw the launch of a number of initiatives. International donor interest endeavored to improve their effectiveness through collaborative relationships and addressed the question on how to ensure that donor support is consistent with the universities' principal institutional objectives. [5]

In addition to the need for long-term financing, most donor agencies underline the need for joint interest, joint application, joint participation, publishing etc. [27]

Excellent overviews and analysis of existing research support programs were drafted by Manor and de Kadt (1990), [29] Gaillard and Thulstrup (1994) [30] and Gaillard (1995) [26]. According to the Ford Foundation, the Association for the Development of Education in Africa (ADEA) is compiling information on education grants from all member donors of ADEA to African countries since 1995. The information will be categorized by education sector. [31] Donors have an important role to play in the revitalization of African universities. That role should be based on dialogue, consensus, and partnership.

3.6. Information Technology and Libraries

The increasing cost of books and journals with decreasing government support reduced many libraries to "museum-like repositories of outdated books", which no longer receive journals regularly. Hence, most universities are no longer capable of supporting scholarly research and training. Moves are afoot to bridge this gap and if these moves could be complemented by efficient systems of document delivery, new opportunities will be opened up. Some of these initiatives are: [7)]

- The American Association of the Advancement of Science (AAAS), funded by the Carnegie Corporation of New York, the Ford Foundation and USAID, provides subscriptions and scholarly journals in 35 countries of Sub-Saharan Africa;
- Increasingly libraries are becoming involved in CD-ROM technology. The African Academy of Sciences, in association with AAAS, supplies bibliographic and full-text databases on compact disc to research libraries in 38 Sub-Saharan countries.

3.7. Networking

B. Abegaz, in his contribution on "Universities in Africa" (1994) [7)] reviews the challenge to African universities to optimize their interdependence and summarizes the networks in Africa established out of need on the basis of the "Bottom-up" principle. Particular attention is devoted to regional cooperation with a summary of centers, networks, and associations offering and promoting regional post-graduate teaching and research. The following are examples from the large number of bodies: [7)]

- African Network of Scientific and Technological Institutions (ANSTI);
- African Bio-sciences Network (ABN);
- Association of African Universities (AAU);
- Consortium of African Schools of Information Sciences (CASIS);
- Institute of Natural Resources in Africa (INRA);
- African Academy of Sciences (AAS);
- Pan-African Union of Science and Technology (PUST);
- Natural Products Research Network for Eastern and Central Africa (NAPRECA); etc.

By way of example some detail is provided on this last-mentioned multidisciplinary Network established in 1984. It mobilizes natural products scientists within Eastern and Central Africa to contribute to research and development of natural products from plants and other generic resources in the sub-region for socio-economic development. The non-political, non-governmental NAPRECA gets financial support from time to time, for implementing its programs. Membership fees are derived from member scientists, nine member countries, and donor organisations.[32)] NAPRECA's survival into the foreseeable future will largely depend on the continued strength and goodwill of its membership support.[28)]

3.8. Salaries and Subvention

Many staff members in African universities have performed under conditions never experienced by their colleagues in First World countries. [9)] They need to be provided with an enabling environment and incentives (e.g. income, working and learning environment, rewards for merit, matching grants from abroad, etc.). Generally, donors are sympathetic to some or other form of financial incentive. Problems

arise when the contracts ends and the subvention (incentive) cannot be sustained. This results in researchers losing interest and motivation. There is agreement that the incentive should be performance linked and that in promotion research achievement should carry greater weight. To highlight the extent of the problem the following could be quoted from the literature:

- In the late 1960's at a particular institution, senior staff earned the equivalent of USD 200 per month. By the late 1980s this was eroded for senior professors to USD 75 and to "make ends meet they have divided their time between the university and their informal paymasters: the pigs and the chickens they have to raise, the passengers in their taxis, and of course foreign consultation donors"; [33)]
- In the 1970s and 1980s, staff salaries were abysmally low with examples of salaries equivalent to USD 20 per month. The situation is still serious in many institutions, but some countries have more recently introduced improvements in university staff salaries; [9)]
- Within universities, consultations became the thing to do, which reduced the role of many academics into serving short range narrow objectives. To check the above deficiency, increasing numbers of institutions insist that their academic staff should combine both consultation jobs and independent research before they can hope to be promoted. [33)]

4 FOSTERING SCIENCE (INCLUDING CHEMISTRY) : DONOR ACTIVITY IN AFRICA

4.1. General

Evident from the previous paragraphs is that many donor agencies are operative in Africa in the field of human resource development and research in the pure and applied sciences (including Chemistry). Although unique requirements are built-in characteristics of the programs financed by the various donor organizations, many commonalties in the objectives exist between the programs. The objectives of the International Program in Chemical Science (IPICS), Uppsala University, Sweden were recently summarized as follows: [34)]

- to assist developing countries to strengthen their domestic research capacity;
- to give long-term project oriented support for developing active and sustainable research environments in selected countries in Africa by
  - exchange of scientists;
  - providing post-graduate education, *inter alia*, at doctoral or masters level with laboratory work sandwiched with sojourns at the host laboratories ("sandwich" courses);
  - funding purchases of equipment;
- to select research of strong relevance to the countries or regions concerned for long-term support;
- to carry out the work in close cooperation with one or more host laboratories and to invite scientists connected to the projects to come to host laboratories (for up to 10 months) to pursue research, to learn new methods, or perform measurements that cannot be done in the home country ("twinning", fostering of North/South collaboration);

- to sign agreements on cooperation for three to five year periods, which can be renewed if the project develops favorably and requires continued support (Individual support outside the framework of a project is not available);
- to foster the establishment of a regional exchange system, whereby members of research teams from recipient countries visit laboratories in neighboring countries where complementary research facilities and competence are available, thereby encouraging the establishment of active regional scientific networks (Fostering of South/South collaboration).

Much emphasis is placed on twinning arrangements, i. e. cooperation between institutions in developing countries and industrialized countries. Based on extensive experience a number of key recommendations for such co-operation were formulated: [28)]

a) each co-operating group should include a substantial number of researchers (the co-operation should be "institutionalized");

b) the partners should meet regularly to review ongoing work and plan future activities;

c) transparency in all budget matters should be ensured;

d) research papers should be written jointly e. g. names from both cooperating research groups should appear on the research publication;

e) project managers on both sides should be senior scientists in central positions in their respective institutions;

f) capacity building must include all aspects of the work to be done (e. g. in the case of a research project, not only the research itself, but also how to invest in, manage, and disseminate research);

g) no single capacity building project is able to secure development on its own, but must be carefully designed in co-ordination with other related activities in the country;

h) research training is an important part of capacity building towards sustainability. In order to increase the commitment, it should, whenever possible, be part of formal degree programs;

i) the remuneration of local staff involved must be sufficient to ensure a full time commitment;

j) efficient and fast communication channels must be available to secure efficient interaction between partners - especially fax and electronic mail facilities have been useful in many projects; and

k) project monitoring and evaluation are important, both as learning processes and as a way of providing incentives to project participants. Monitoring should concentrate on project outputs rather than on inputs.

An assessment of the twinning experiences suggests the conditions under which these arrangements are most effective: [5)]

- when they are part of a longer-term institutional development effort;
- when they are between similar faculties or departments;
- when they seek to upgrade existing programs rather than launch new ones;
- when both institutional associates have a capacity to manage the relationship effectively; and

- when such programs respond to local priorities and reflect balanced attention to the needs of each institutional partner.

To accommodate these conditions, a process was developed by the World Bank [5)] and has been tested in Africa since 1992. The process involves the following:

An African University Department:

- conducts its own needs assessment and identifies the types of inputs necessary to enhance its teaching and research activity;
- drafts the terms of reference for an institutional linkage program (twinning), with a short-list of potential linkage candidates and with criteria for selection;
- invites candidates from the short-list, once funding is assured to submit "bids" for collaborative programs (with indications on what it is prepared to contribute to the undertaking);
- makes its' choice and negotiate a time-bound agreement; and
- uses flexible funding for contact, travel, staff development fellowships, joint research, library acquisitions, equipment, communication, etc.

It should be pointed out that the World Bank makes loans (not development assistance or grants) available to its member governments in Africa, who in turn manage the various agreed projects. However, various African chemists stressed that although they were involved in the initial structuring and motivation for the loan applications to the World Bank, effective planning, and communication throughout the process was defective. The eventual structuring of the loans and the conditions pertaining to the loans (after input by World Bank advisors) frequently resulted in the planned projects not being implemented successfully. [35)]

It is important that new initiatives be preceded by intensive discussions about priorities by university leaders, invited professionals from the sub-region, policy makers and representatives from donor agencies. [7)] The greatest lesson to learn is the importance of allowing recipient countries themselves to formulate their critical needs and to provide catalytic support to meet these needs. [7)]

Some donors provide support for 1-3 years, but, generally, individual projects have an expected lifetime of 10-15 years. The philosophy is that the support is to be phased out as sustainability of the research capacity built up by the project is reached. One further issue requires attention.

Preliminary investigations, preceding the launch of a project, require funding. The Danish Agency, DANIDA, provides for this through so-called "Initiative Pool Grants". [28)]

Projects are reviewed every 3 years. Program performance indicators used include:

- progress in capacity building,
- research training carried out,
- output of research projects,
- dissemination of the research results,
- progress towards sustainability.

One of the most important criteria for success has proved to be the time and effort spent on project activities by well-qualified senior researchers. [28)]

4.2. Examples of Donor Involvement in Chemistry

As examples of donor agencies, two involved for decades and a newcomer to the scene, the following are highlighted.

4.2.1 International Programme in the Chemical Sciences (IPICS)

This is part of the International Science Programmes at Uppsala University, Sweden. [34)]

New projects are identified through direct contacts between the scientists concerned and IPICS and are selected after careful evaluation and planning. The initiative lies with scientists in developing countries in proposing research projects for cooperation.

Each project has an identified project leader who is responsible for the project, its management, and the contacts with IPICS.

IPICS supports five projects in Africa in the following fields:

- Biotechnology and Molecular Biology,
- Ecology and Environment,
- Food Science and Nutrition,
- Natural Resources.

In 1997, IPICS will be supporting different networks and one summer school in Africa. The networks are administered by scientists in the region concerned with financial support from IPICS. Each network has a board or committee for the management of the activities:

- African Laboratory for Natural Products (ALNAP) – Co-ordinator: Dr E. Dagne (Ethiopia);
- Cassava Safety Network – Co-ordinator: Dr Hans Rosling;
- The Network for Analytical and Bioassay Services in Africa (NABSA) – Co-ordinator: Prof. B. Abegaz (Botswana);
- Natural Products Research Network for Eastern and Central Africa (NAPRECA) - Executive Secretary: Prof. M. Nkunya (Tanzania);
- Southern African Regional Co-operation in Biochemistry, Molecular Biology, and Biotechnology (SARBIO) – Co-ordinator: Prof. J. Hasler (Zimbabwe).

The annual grants per project or network are in the range of USD 10 000 - 73 000 (Average: USD 34 000). The 1997 budget for Africa (45% of the total budget) amounts to SEK 3 173 000 (USD 400 000).

Worldwide there are 54 "sandwich" Ph. D. students and 23 "sandwich" M. Sc. students enrolled in projects supported by IPICS in 1997.

4.2.2 International Organization for the Chemical Science in Development (IOCD) [36)]

After a meeting at UNESCO in 1981, the IOCD was formed which aimed at helping to overcome the barriers to research in developing countries by:

- fostering collaboration between researchers in developing countries with internationally recognized investigators;
- creating opportunities for hands-on experience to chemists in developing countries.

The IOCD, *inter alia*

- created Working Groups on Fertility Regulation, Tropical Diseases, Plant Chemistry, and, with IUPAC, on Environmental Analytical Chemistry;
- provided research services to chemists in Africa through "Network for Analytical and Biological Services in Africa" (NABSA), (see 4.2.1);
- arranged workshops on techniques for bio-activity fractionation (Open only to African chemists);
- created a Biotic Exploration Fund to catalyze a major increase in bio-prospecting in developing countries, *inter alia*, to counter destruction of bio-diversity. The IOCD initiated the work of establishing this Fund in 1994 under a grant of USD 10 000 from the US National Academy of Sciences. IOCD hopes to attract sufficient funds (perhaps USD 2-3 million) to operate two or three pilot bio-prospecting projects in 1997-98.

IOCD funds its activities through grants from individual donors and agencies such as foundations, government organizations, and UN agencies.

4.2.3 Newcomer: Chemical Weapons Convention (CWC) [37)]

On 29 April 1997, the CWC entered into force, which meant not only the beginning of the elimination of chemical weapons, but also the launching of a series of programs to promote international cooperation within the field of chemistry. The programs are in particular geared towards chemists from developing countries. The programs include:

- support for participation in international conferences, seminars, symposia, etc;
- support for internships;
- support for arranging conferences on chemical topics of particular interest to developing countries;
- facilitation of bilateral cooperation, especially within the field of natural product chemistry;
- support for transfer of used, but still functional, laboratory equipment to laboratories in the developing world; and
- support for increasing the technical competence at laboratories involved in organic chemical analyses, which might be of use for the implementation of the CWC.

Many donor organizations indicated that they do not look at Chemistry specifically, whereas others have indicated that they support individuals rather than projects. A very general approach is the twinning of institutions between the donor country institutions and the institutions in developing countries receiving the financial support.

4.3. Donors: Extent of Financial Support

The extent of the financial involvement of various donor agencies can be gleaned from some selected examples:

- The Swedish International Program in the Chemical Sciences (IPICS) spends 45% of its funding *viz.* SEK 3.173 million (approximately USD 400 000) on programs in Africa. The annual grants per project or network are in the range of USD 10 000 - 73 000 for an average of USD 34 000. [34)]
- The Danish bilateral program for Enhancement of Research Capacity in Developing Countries (ENRECA) invested USD 7 million in 39 projects in 1995 (~USD 179 000 per Project); [38)]
- The German Gesellschaft für Technische Zusammenarbeit (GTZ) [39)] works with the Deutscher Akademischer Austauschdienst (DAAD), the Deutsche Forschungsgemeinschaft, and the Alexander von Humboldt Stiftung. Their guideline amounts for projects are as follows:
  - Standard Projects USD 21 800
  - Joint Applications USD 32 700
  - Small scale projects USD 2 700
  - Specialist literature USD 5 000

  DAAD operates on a budget of USD 179.2 million, [40)] while the Alexander von Humboldt Stiftung awarded DEM 73.781 million in the form of fellowships, equipment grants and bursaries. [41)]
- Grants by the International Foundation for Science (Sweden) are normally not more than USD 12 000 and renewable up to two times more. [42)]
- According to an IDRC estimate the total resources for development related research was USD 2 billion by the late 1980s. [26)]

World Bank projects (loans) in Africa expend roughly USD100 million annually on training, of which roughly half is for overseas training. According to estimates approximately 120 000 African students were studying abroad in 1990. To facilitate continued research for returning degree holders, some scholarships are supplemented with re-entry grants.[5)]

4.4. Detail to be Requested: Application for a Grant

This list was compiled from application forms outlining the detail required by some donor agencies to allow scrutiny of the applications by institutions in developing countries:

* Applicant's academic curriculum vitae:
- Family name
- Personal name
- Nationality Date of birth
- Name of head of institution
- Name and postal address of institution
- Name of immediate supervisor
- Name of department/research station
- Area code: Phone:

- Telex: Telefax:
- E-mail:
- Languages (Read; Comprehend; Speak; Write)
- Education
- Other postgraduate studies
- Present position [Starting date; Position; Permanent/temporary; Amount of time devoted to teaching(%), research(%), administration(%); Number of staff supervised by you: researchers, graduate students, technicians]
- Research areas
- Previous positions
- List of publications
- Research project title and short summary of the project
- Provide information about your experience on the subject of the proposed research and previous results achieved
- Provide information about related research in progress at your institution
- Background to the research proposal; objectives and expected outputs of the research proposal
- Research plan
- Relevant contacts already established by you (names, addresses and specialization)
- Additional contacts you wish to establish (names, addresses and specialization)

*Any other sources of funding to the institution for the proposed or related research (Name of funding organization; date of application or approval; amount)

* Budget
- Equipment (Specify and describe each item)
- Expendable supplies
- Literature
- Local travel
- Manpower requirements
- Other costs
- Expected duration of project

* Relevance of the project to the development needs of the country.

* Purpose for which the requested materials/equipment are to be used

*Peer appraisal of application

* Details of the materials/equipment requested, with costs, details on the housing thereof, maintenance and repair services available locally, connection facilities, monopoly, etc.

* Information on existing equipment

* Confirmation from the institution's principal/director of the feasibility of the planned project and the necessity for the purpose of the institutions teaching, research, or development program. Issues to be addressed are the correct setting up and commissioning of the equipment in suitable premises, the cost of expendable materials, necessary repair and maintenance costs, and customs duties and similar charges.

* Information on the number of staff who will benefit from the provision of the equipment and the description of the equipment's potential use for other purposes.

5 IUPAC (ICSU) ACTIVITIES IN AFRICA

Only two countries from Africa (Egypt and South Africa) adhere to IUPAC. However, IUPAC (and ICSU) are actively involved in many initiatives impacting on science, generally, and chemistry in particular, in Africa. Special attention should be drawn to the fruitful co-operation between UNESCO and IUPAC in those areas considered to be of high priority by UNESCO and which are reviewed in *Chemistry International*. [43)]

Attention is drawn to three new initiatives:

5.1. The Foundation for Research Development, Pretoria, South Africa

The newly established COSTED-IBN Regional Secretariat, hosted by the Foundation for Research Development, Pretoria, has been in operation since September 1995. The new initiatives by this Secretariat are:

- Capacity building in research in the basic and applied science education and training with the emphasis on the solution of problems encountered in the African continent;
- A concerted drive to encourage all countries of Southern and East Africa to join both ICSU and COSTED-IBN;
- Development of a framework for science and technology indicators for African countries. Such indicators have already been developed for Ghana and Uganda.

5.2. IUPAC-CTC/UNESCO/RADMASTE/CIFFERSE

In the past, Africa has received little attention from IUPAC's Committee on the Teaching of Chemistry (IUPAC-CTC). During 1997 a formal accord was established between the four organizations mentioned (RADMASTE - Centre for Research and Development in Maths, Science and Technology Education, University of the Witwatersrand, Johannesburg; CIFFERSE - Centre International Francophone pour la Formation de l'Education et de la Recherche en Sciences Expérimentales, Université de Montpellier, France). This accord provides for active cooperation in developing countries, particularly in Africa, in science education. An emphasis is given to the low-cost equipment for science education developed by RADMASTE.

A proposal has been submitted to ICSU for funding of the trial introduction of the microchemistry system developed by RADMASTE in one country from each of the five regions of Africa as defined by the OAU.

UNESCO/RADMASTE

Three projects are at various states of development. One project, already approved by UNESCO (Paris), provides for Prof. J. D. Bradley (Chairman: IUPAC-CTC; Director: RADMASTE Centre) to visit Kenya, Lesotho and Namibia later this year (1997) to introduce the microchemistry system developed by RADMASTE.

A second project is at the proposal stage. This project, developed by RADMASTE in cooperation with UNESCO (Pretoria), aims to introduce low-cost science equipment and provide teacher training and curriculum development in the sciences in a number of countries in the SADC region. Local distribution and manufacture are also provided for. It is hoped to initiate the project, at least in part, at the start of 1998.

A third project, also at the proposal stage, focuses on Rwanda. The proposal submitted to the Government of Rwanda, for funding by UNDP, provides for an intensive science education development program to begin at the start of 1998.

RADMASTE/Projet d'Harmonisation des Programmes de Sciences Physiques et de Technologie pour les Pays Francophones d'Afrique et de l'Ocean Indien.

A formal network for cooperation in physical sciences education has been established amongst the 18 Francophone countries of Africa and the Indian Ocean. At the second network seminar held in Dakar in April 1997, a formal resolution was taken to conduct trial implementation studies in a number of countries with the microchemistry system developed by RADMASTE. Some of these may be conducted in cooperation with CIFFERSE. These studies should be initiated later this year (1997), probably with the financial assistance of the French Ministry of Cooperation.

5.3. IUPAC - Macromolecular Division/UNESCO

UNESCO funding has been granted for the launch of a materials sciences project in Africa. Deeply involved in this initiative is Prof. R. D. Sanderson, Director of the Institute for Polymer Science, University of Stellenbosch, South Africa. UNESCO has selected the Institute for Polymer Science as a center for training in materials science.

6 THE AFRICAN VIRTUAL UNIVERSITY PILOT PHASE

This new pilot project by The World Bank could have a significant impact on future IUPAC/UNESCO initiatives. Activities being carried out under the pilot phase consist of delivery, by satellite – INTELSAT 803, of credit and non-credit instructional programs, from universities and educational institutions in developed countries through satellite receiver terminals to six English, six French, and three Portuguese speaking African countries. [44)]

Of particular significance is the development of a digital library program to make scientific information available to African students and faculties. Ongoing negotiations are underway with a number of content providers (Indexing and Abstracting Services and Full Text on-line) as well as library gateway providers. Once these negotiations have been successfully completed, it could pave the way for access to current scientific literature to African Universities.

Attention should also be drawn to the Francophone Virtual University, UREF, which seeks to utilize modern information technologies to serve the teaching, research, and information access needs of francophone Africa. A distance learning course for *inter alia* Chemistry will be introduced in 1998 on an experimental basis, with the view to set up a formal program of tertiary studies by the year 2000. [45)]

It would appear that Higher Education is experiencing a shift from teaching to learning, from contact to distance and open learning, and from books to electronic and virtual approaches, opening up possibilities for inter-institutional collaboration.

7 CONCLUDING REMARKS

In considering initiatives in Sub-Saharan Africa, there is a tendency to generalize, despite the great differences between countries and the institutions within those countries. With regard to research in chemistry, the performance of countries varies from practically non-existent, to institutions performing quite well with donor assistance. Research showed that those countries in need of aid, were the least

able to benefit from it. [26] Any strategy for the stimulation of human resource development and research in chemistry should cater for these diversities, which should preferably be addressed on a regional basis.

Due to the poor performance of the economies of many Sub-Saharan countries, the creation of job opportunities for the emerging trained individuals did not occur. Many Africans, trained in the best laboratories throughout the world, elected to pursue careers outside Africa (Brain Drain). [46] Nevertheless, Chemistry Departments in Africa have at their disposal a core of excellently trained chemists and leaders on which to build. Many academic staff members are demoralized due to the lack of housing, the scarcity and inconvenience of public transportation in the absence of private motoring, and low pay compared to cost of living. [47]

Addressing the human resource and research development issues of chemistry in isolation will improve the situation inefficiently, due to a large number of built-in interrelated uncertainties and deficiencies in the higher education system in many African countries. Concentrating on just chemistry already presents an international challenge of enormous magnitude, requiring a long-term commitment and a total investment that can only be met by a sustained international effort. The outcome of the project is largely dependent on political decisions by African governments on a continent of changing political fortunes and under-performing economies as well as on the universities to seize the initiative. It will be a challenge to be met by the universities - institutions under enormous pressure to meet access demands, requiring restoration of greater autonomy and greater financial security in order to strategically plan for and positively impact on the outcome of their countries' knowledge and technology driven future.

8 ACKNOWLEDGEMENT

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TABLE 1

Africa: Enrolled Students; Graduates in Natural Science and Research Output in Chemistry

COUNTRY	THIRD LEVEL STUDENTS (YEAR) 1)	GRADUATES IN NATURAL SCIENCE (YEAR) 2)	CA ABSTRACTS 1987 3)	CA ABSTRACTS 1996 3)	ISI CHEMISTRY ABSTRACTS 4)
NORTH AFRICA					
Algeria	303111 ('93)	1404 ('93)	56	165	45
Egypt	708417 ('91)	3852 ('93)	1753	2560	579
Libya	72899 ('92)	N.A	34	22	10
Morocco	250919 ('95)	6947 ('95)	48	246	125
Tunisia	102682 ('95)	958 ('95)	85	171	37
Western Sahara					
SUB-SAHARAN AFRICA					
Angola	6331* ('92)	38** ('92)	0	4	0
Benin	10986 ('94)	32 ('86)	1	11	0
Botswana	5062* ('95)	22 ('91)	4	8	3
Burkina Faso	8815 ('95)	402** ('92)	6	8	3
Burundi	4256 ('93)	132 ('92)	2	7	0
Cameroon	33177 ('91)	N.A	16	38	9
Central African Republic	3783* ('92)	N.A	1	1	0
Chad	2941* ('94)	69 ('93)	0	0	0
Comoros	229 ('93)	N.A	0	0	0
Congo	13806 ('93)	55 ('88)	4	4	1
Côte d'Ivoire	23642 ('87)	N.A	23	14	0
Djibouti	61 ('93)	N.A	0	1	0
Equatorial Guinea	578 ('91)	N.A	0	0	0
Eritrea	3137 ('95)	132 ('95)	0	0	0
Ethiopia	26218 ('92)	247 ('92)	10	42	15
Gabon	3000* ('92)	-	3	11	2
Gambia	1591 ('95)	N.A	0	7	0
Ghana	9609 ('91)	290 ('91)	13	30	8
Guinea	5366 ('91)	327** ('88)	2	1	0
Kenya	35421* ('91)	1099** ('91)	58	97	13
Lesotho	4001 ('94)	39 ('93)	1	1	1
Liberia	-	-	1	0	0
Madagascar	42681 ('93)	652 ('92)	5	12	0
Malawi	7308 ('93)	75 ('94)	2	1	0
Mali	6703 ('91)	N.A	1	4	0
Mauritania	8495 ('94)	15 ('94)	0	0	0
Mauritius	2161* ('94)	14 ('92)	0	0	0
Mozambique	5250 ('94)	25 ('94)	1	2	0
Namibia	11344 ('94)	9 ('91)	2	1	0
Niger	4513 ('92)	N.A	9	16	2
Nigeria	335824 ('90)	3311 ('90)	381	384	101
Rwanda	3389 ('90)	12 ('90)	3	1	0
Senegal	23001 ('93)	222 ('89)	22	33	9
Sierra Leone	4742 ('91)	N.A	5	12	0
Somalia	15672 ('87)	N.A	1	1	0
South Africa	869610 ('95)[5)]	2854 ('94)	1270	1359	250
Sudan	60134 ('90)	210** ('91)	42	9	7
Swaziland	4183 ('94)	57 ('95)	1	2	0
Tanzania	5254 ('90)	N.A	18	23	8
Togo	10994 ('95)	22 ('89)	1	4	0
Uganda	24122 ('94)	280 ('94)	4	3	0
Zaire	61422 ('89)	N.A	6	8	5
Zambia	15343 ('90)	62 ('89)	5	10	3
Zimbabwe	61553 ('92)	221 ('90)	17	35	9

AFRICA: ENROLLED STUDENTS; GRADUATES IN NATURAL SCIENCE AND RESEARCH OUTPUT IN CHEMISTRY

Information pertaining to Table 1

1) All institutions: universities and equivalent institutions; distance learning institutions, and other third level institutions.

* Refers to universities and equivalent institutions only.

Source: UNESCO Statistical Yearbook - 1996

2) Third level graduates in natural science (degree and postgraduate qualification). Natural Science includes Biological, Science, Chemistry, Geological Science, Physics, Astronomy, Meteorology, and Oceanography.

** Denotes qualifications including those not at degree level.

3) 'Abstracts of papers by country' are based on the assumption that the address of the first author corresponds to the place of work. This is not always true.

The numbers include journals articles, conference papers, and technical reports.

4) Abstracted from Institute for Scientific Information (USA) Database: SCI (Science Citation Index). Mrs. A. Pouris, Foundation for Research Development, Pretoria, is thanked for this analysis.

5) National Commission on Higher Education (1996). Figure includes 147 645 students trained at post-secondary level in private institutions.

TABLE 2

Africa: Public Expenditure on Education and Index Numbers for Enrolment by Level of Education

DESCRIPTION	**YEAR**			
	1980	**1985**	**1990**	**1994**
Public Expenditure on Education in Billions of USD				
World total	526,1	565,3	1014,8	1275,7
Africa	22,9	22,0	26,1	26,3
Sub-Saharan Africa	15,8	11,3	15,2	16,3
World Enrollment Index 1980 = 100				
1st Level *	100	104	110	117
2nd Level **	100	109	118	132
3rd Level ***	100	117	132	151
Sub-Saharan Enrollment Index 1980 = 100				
1st Level *	100	114	127	146
2nd Level **	100	138	165	204
3rd Level ***	100	161	246	339

*1st Level: Public and private primary schools

**2nd Level: High schools, middle schools, lyceums, gymnasiums, etc

***3rd Level: Universities, teacher training colleges, higher professional schools

SOURCE: UNESCO STATISTICAL YEARBOOK - 1996

TABLE 3
Collaboration of African Countries with Other Countries in the World: Joint Articles in Chemistry - 1995

Collaborative Country	AFRICAN COUNTRY																							TOTAL
	Egypt	South Africa	Morocco	NIgeria	Ethiopia	Algeria	Tunisia	Kenya	Libya	Zimbabwe	Senegal	Cameroon	Tanzania	Ghana	Sudan	Zaire	Zambia	Botswana	Burkina Faso	Gabon	Niger	Reunion	Congo	
Australia	1	4	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-	9
Austria	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Azerbaijan	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Belgium	3	1	3	-	-	-	1	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	12
Brazil	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Cameroon	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Canada	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Denmark	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Egypt	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
England	3	10	1	4	1	2	-	1	1	2	-	1	1	1	1	-	1	-	-	-	-	-	-	30
Ethiopia	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	2
Finland	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
France	4	1	82	2	-	25	10	1	-	-	4	2	-	-	-	-	-	-	2	-	2	2	1	138
Germany	20	4	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	27
Hong Kong	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Hungary	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Iran	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Ireland	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Israel	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Italy	2	3	1	1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	10
Jamaica	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Japan	8	-	2	1	1	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	14
Jordan	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Kuwait	9	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Libya	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Lithuania	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Malaysia	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Morocco	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Netherlands	-	1	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	4
Nigeria	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pakistan	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Papua New	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

TABLE 3
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Collaborative Country	AFRICAN COUNTRY																							TOTAL
	Egypt	South Africa	Morocco	NIgeria	Ethiopia	Algeria	Tunisia	Kenya	Libya	Zimbabwe	Senegal	Cameroon	Tanzania	Ghana	Sudan	Zaire	Zambia	Botswana	Burkina Faso	Gabon	Niger	Reunion	Congo	
Guinea																								
Peru	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Poland	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Portugal	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Qatar	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Russia	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Saudi Arabia	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
Scotland	-	1	-	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	5
South Africa	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Spain	2	1	5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	11
Sweden	2	-	1	-	1	-	-	-	-	3	-	1	-	-	-	-	-	1	-	-	-	-	-	9
Switzerland	2	4	1	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	10
Taiwan	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Tunisia	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Turkey	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
UAE	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
US	20	15	3	7	2	3	2	1	-	2	-	-	1	3	-	-	-	-	-	-	-	-	-	59
Wales	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Zimbabwe	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	130	57	105	38	6	35	15	6	3	10	8	5	4	6	3	3	1	2	3	3	2	2	1	448

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