Sida Evaluation 01/12

Sida's Support to the University of Asmara, Eritrea; College of Science and Faculty of Engineering

Eva Selin Lindgren

Department for Research Cooperation

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Table of Contents

Short summary of findings and recommendations

In this paragraph some overall findings and recommendations will be put forward. Motivations and other aspects/recommendations are discussed in the following paragraphs.

- The project on co-operation between the University of Asmara (UA) and the Swedish universities have so far fulfilled its objectives in an excellent way. This is true for the linkage with Uppsala University (UU), and there is definitely a great potential in the co-operation with The Royal Institute of Technology (KTH).
- The project on the whole has been very cost-effective, both as regards undergraduate education, staff development and support systems (library, infrastructure etc) at UA.
- The success of the project is due to many factors: The charismatic and dedicated leadership at the University of Asmara, the support of Swedish universities and of the Swedish research groups who have hosted the MSc and PhD students, the Asmara committee(s), and the work done by secondants as well as by MSc and PhD students.
- Since the building of a university is a long term commitment, and because the Sida/SAREC project in Asmara has been successful I recommend that the support should continue. In the future, however, there are major challenges in consolidating the College of Science and establishing new activities in the Engineering Faculty at the University of Asmara. I will address the most important of these challenges in this summary.

Recommendations for the future development of the College of Science and Faculty of Engineering:

- The College of Science should within one or two years have started MSc education in its most prominent areas/departments, with the perspective that courses intended for MSc also can function as PhD courses.
- The College of Science should also start planning for PhD education within prioritised areas in co-operation with UU and KTH. This activity can begin with developing curricula for Asmaran PhDs, and together with UU and KTH embark on a true "sandwich" training, in which the students spend successively more of their time in Eritrea. The aim should be to spend on the average half the time in Eritrea. The "sandwich" model has so far not been put into real practise at the University of Asmara, due to lack of infrastructure and trained staff in Eritrea. It is essential to note that implementation of a "sandwich" model would facilitate PhD studies for students with families, especially young women.
- In order to develop research which is fulfilling the criteria of quality, relevance and sustainability it is important that the research areas are well defined and have a sufficient number of staff involved, so that the research is not too vulnerable to the loss or absence of single persons. This can be achieved by forming research groups with competence in the intersection between a scientific or technical discipline and a prioritised theme.
- The establishment of research groups has several implications. Of high importance are 1) the choice of subjects and students for PhD education, 2) the form of co-operation with the

Swedish and other partners and 3) the "rewards" and stimulus given to the staff at UA. Thus I recommend the following:

- The specific *subject* of the PhD work within a prioritised area should be chosen in an agreement between all the parties involved: The student, UA and the Swedish counterpart (UU, KTH or both). In reality there is often a substantial overlap between research in science and engineering although they are organised in different faculties. In UA the staff at the College of Science and the Faculty of Engineering are used as a common resource. This is a good sign, and since some of the prioritised research areas will include basic science as well as technology it should be possible to recruit students from both institutions (Science *and* Engineering) to the same research theme.

- The PhD student should have a small group of supervisors around him/her (about three persons) to facilitate PhD work in both Sweden and Eritrea. The supervisors should come from Sweden as well as from Eritrea when competent researchers in UA are available. If the research area is directed towards an application two academics and one person from the field of application are recommended. Furthermore, it is important to realise that *the time period* between enrolment of a PhD student and his/her appearance in Sweden has sometimes in the past been far too short. The PhD student – as well as the research groups involved – need time to discuss the topic of research and to prepare for the stay in another country. The time aspect is also relevant for any guest researcher whether it concerns south-south or north-south co-operation. The time period between the choice of research topic and appointment of the student and the actual enrolment should be at least half a year.

- For a number of reasons (the work done in practise, the social situation, and the sustainability and endurance of a research partnership) it is recommended that the co-operation between UA and the Swedish partners should build on partnership between research groups, involved in the prioritised areas. Since research co-operation is a long term relationship it is important that senior scientists as well as PhD students from both countries are involved. This co-operation should allow secondment of staff from the Swedish research groups/departments, who can be involved in both undergraduate education *and* research, in time periods which are flexible and do not necessarily last a whole term. The model should also involve Swedish PhD students, who can work together with Eritrean PhDs in both countries. In a long-term perspective also other research groups from developing countries can be involved (the beginning of net-works in strategic areas).

- In view of the need to keep up and develop the competence of the academic staff in UA it is important that members of the staff are given half of their time for research and the other half for undergraduate education. It is also important that the staff in UA can spend time abroad as guest researchers, on sabbatical leave or as post docs, depending on their scientific status.

- The growth of the number of students and the implementation of new curricula in undergraduate education is very satisfactory. The purchase of new equipment has increased the access to more laboratory instruments on the part of the students and teachers. The ability to conduct experiments will have to be further developed in the future. There is, however, also a need to encourage critical thinking and problem-solving for students in the undergraduate courses. Thus I recommend more teaching experiments in which modern pedagogical findings are implemented. This is especially important in a country where the degree of literacy is low, but where the young generation may have acquired other knowledge from the older generations.

- The need for instrumentation to be used in the laboratories and in the field is urgent. UA has made a major effort to acquire new facilities for the laboratories, but if sandwich PhDs are to have a meaningful study period in UA, more and better instrumentation will be necessary. If the co-operation with Swedish research groups is of mutual interest, such instrumentation may at times be borrowed from the Swedish groups, who generally are better equipped. The "sharing" of instruments will be facilitated if Swedish and Eritrean PhDs are working together.
- Another important aspect of the infrastructure and long term sustainability of UA is the access to skilled manpower in the workshops and at the maintenance centre. UA has arranged that some of the key technicians have the possibility to go abroad for training. In this respect, however, much more needs to be done, and the present arrangement in which the Swedish counterparts assist in purchasing instruments and transfer knowledge of purchasing routines has been very valuable. The question of training of technicians/scientists and of maintenance and purchasing of scientific equipment will be addressed more extensively in another evaluation report (NUSESA).

Recommendations to the University of Asmara

The management and central administration of the University of Asmara has been of highest importance in the establishment and development of the College of Science and the Faculty of Engineering. The authority, dedication and integrity of the university leadership have been crucial for stimulating the rapid and noticeable progress that the institutions have achieved. However, in the perspective of global changes and the world-wide competition for "good brains", the management and administration are also subjected to challenges.

During the course of this evaluation I have found that most frustrations have been connected to lack of communication and information, and lack of efficiency in dealing with simple every day matters, for example changing bulbs in the class-rooms, acquisition of simple equipment and spare parts etc.

In paragraph 9 the issue is addressed of communication at the "right" level between the partners. If the "wrong" level is addressed there is an obvious risk of loss of information and/or time delay within the respective system. Thus, I think it would be wise for UA to make an information "chart" for its staff in UA, containing advice on whom to address in the first place in the Swedish organisations. Of equal importance is simple information specifying the mandate of the staff at the University of Asmara, so that it is quite clear who is responsible for effectuating small things that need to be done.

In summary I find that there are needs for developing the internal structure of UA on the following points:

- Delegation from the president to the deans (which apparently exists in practise but is not documented) and from the deans to the department heads should be documented in *written delegation orders*. This would fulfil at least two needs: 1) It would make the internal organisation *transparent* for the surroundings (for example donors, other organisations, people who seek assistance/help/advice from the university etc). 2) It draws up the limits for responsibilities and "power" for the people in charge. This in turn has a big effect on with which flexibility and smoothness the university works. It also has the advantage that the "right" persons in the organisations are credited for achievements (or blamed if things do not work out well). Such a delegation order needs not be very elaborate, but it is important that it is clear and draws up the "territorial boundaries" between the different actors.

- A matter of concern to the Swedish partners has been the delay in delivering material, reports, plans, information on PhD students and acceptance of secondants etc. This might have been due to the severe interruptions caused by the war in Eritrea. In view of the elaborate system for project management and the organisational leadership at UA these problems should, however, not happen in the future. I suggest, however, that the resources for administration are analysed and that administrative staff (department heads, accountant, auditor) at UA are given the opportunity to do study-visits to SAREC/Sida in order to increase their knowledge on the routines in Sweden.

- Encouragement and rewards are critical factors for stimulating teachers and researchers at the University to do their work as good and efficient as possible. The leadership at UA is aware of this and has discussed possibilities to increase the salaries of staff engaged in "entrepreneurial" activities initiated and run by the university. I suggest that this idea is put into practise and that a promotion scheme is worked out which is based on a combination of *scientific* merits (for example productivity and quality of publications, supervision of MSc and PhD students, project/program leadership, establishment/leadership of research group, development of PhD/MSc courses etc), *pedagogical* merits (for example high quality lectures, development of laboratory and field experiments, writing of textbooks and other teaching material etc) and *merits of relevance for society* (entrepreneurial activities within the university).

- Another matter of great concern is the possibility to establish democratic influence at UA of different parties within the organisation. It has not been possible for me to see through whether or not informal or formal democratic processes really are at work in the university. I am fully aware of the fact that "democracy" can mean different things in different cultures, and that the Swedish way of defining the concept is not the only one. However, with increasing mobility and contacts outside Eritrea, the academic staff and students will have opportunities to compare conditions in their own university with those of others. It is therefore important that the staff and students in the university have a real influence on the functioning of UA. One effect of democratisation, among others, is that the risk of brain-drain might decrease. The establishment of a student union has been a right step in this direction. In view of the great importance of educated and dedicated people in any successful organisation I recommend that UA develops a strategy for how the democratic influence of staff and students shall be ensured, and for how UA as a whole shall be attractive as a place of work for qualified Eritreans who are presently working in the country or abroad.

- The need for access to Internet for both staff and students is urgent. Since this need has been identified since long, and because the process is so slow, there is motivation for UA and SAREC/Sida to act jointly and ensure that Internet access is established as soon as possible at the university.

Recommendations to the Asmara committees

The co-operation with Sweden is governed by the Asmara committees at UU and KTH, which consist of highly qualified and motivated scientists. To the assistance of each committee is a qualified coordinator/secretary. I recommend that the Asmara committees take an active part in initiating and structuring research projects and PhD curricula within the prioritised research areas. At UU and KTH this kind of activity has already been initiated. In the implementation of research projects in UA, good use should be made of the experience and knowledge among the committee-members and the coordinators. Many of them have extensive experience in working internationally and not in the least in developing countries. They may therefore be instrumental in developing the partnership between

research groups in Eritrea and Sweden, and also extend their advice to south-south co-operation between Eritrea and other African countries.

I also recommend that the Asmara committees take responsibility for courses of general nature within the PhD education. Examples of such courses are 1) project management, 2) written and oral presentation of scientific/technical issues in English, and 3) basic economics and purchasing routines, 4) modern pedagogical training. Some courses of this kind are compulsory to all PhD students in some Swedish universities. Having a large group of PhD students – as has been the case in UU – it would not present surmountable difficulties to arrange such courses for the Eritrean MSc and PhD students.

Recommendations to SAREC/Sida

The urgency in getting access to the Internet for students and staff at all levels in the University of Asmara has already been mentioned. Since Sida/SAREC already has experts in this field, Sida/SAREC could be instrumental in speeding up the implementation of Internet in UA.

Another matter needs to be attended to by Sida/SAREC, and that is the budget, which usually is attached to the agreement between Sida/SAREC and the University of Asmara. One of my recommendations above is that the PhD education should occur on a true "sandwich-basis" with time periods spent in Eritrea and Sweden, and/or even some other country. The period in the different countries may vary from one PhD student to the other and is furthermore expected to vary over time for the whole group of PhD students. Therefore, it is recommended to include this perspective in the budget, at the same time allowing for as much flexibility as possible in the cost-estimations for the three parties (UA, UU and KTH).

Networks and centres of excellence to which research groups from many countries are invited are generally means of promoting co-operation between researchers in different countries. Sida/SAREC has applied these concepts in many cases of south-south co-operation. For UA south-south cooperation within MSc education has already started and is ongoing. I recommend that SAREC/Sida supports UA in establishing research co-operation within those areas of priority to the university, which also are subject of research in other African countries.

The imbalance in gender in the recruitment to undergraduate university education in science and engineering at the University of Asmara needs to be addressed. Thus in-depth information is needed about the social factors which prevent girls from engaging in these subjects. Sida may, however, already have this knowledge from similar situations in other developing countries. In paragraph 9 a pilot "scholarship project" at UA is discussed, which should be elaborated further in the context of information on social factors of relevance for undergraduate education of young women in Eritrea.

1 General objectives of the Sida/SAREC support to the University of Asmara

From an early stage in the development of the University of Asmara (UA) in Eritrea Sida/SAREC has supported co-operation between the College of Science in UA and Uppsala University (UU). Starting from a co-operation in the geoscience area (93/94) the project developed into a "linkage project", involving all basic scientific disciplines.

From the year 2000 Sida/SAREC is also involved in strengthening of the Faculty of Engineering at UA in collaboration with the Royal Institute of Technology (KTH) and Uppsala University. The levels of financial support are at 10 MSEK/year each for the College of Science and the Faculty of Engineering. In addition to Sida/SAREC also the Swedish universities contribute, by for example the work done by the Asmara committees and by the supervisors, as well as by offering facilities and resources to the students at their respective institutions.

The objectives of the Swedish support to the College of Science and the Faculty of Engineering are to

- strengthen the staff
- develop the research capability
- strengthen the teaching
- upgrade libraries and teaching facilities, including laboratories and workshop facilities
- establish new departments in fields of high relevance to the university.

The objectives are planned to be achieved by staff development, staff secondment, curriculum development, course development, development of good laboratory facilities, establishing of an Equipment Maintenance Centre, acquisition of textbooks and scientific journals etc, just to mention some of the most important activities.

2 Background information on the situation in Eritrea

Eritrea is located in the Horn of Africa and has a total area of 125.000 km^2 and a population of about 3.5 million inhabitants. The capital, Asmara, is located on a plateau, about 2.500 m above sea level. Asmara University is the only university in the country. After a long period of war for independence Eritrea is now engaged in the task of recovery and reconstruction. The Government has charted a plan of action that aims at transforming the economy into a modern one, characterized by self-sustaining growth.

Eritrea's macro-policy places special emphasis on the development of national scientific and technological capabilities through the strengthening and expansion of existing institutions, including the University of Asmara. The development of knowledge-intensive, export-oriented industries coupled with the promotion of up-to-date technology transfer are essential components of the national development policy. This will require selective expansion and strengthening of University-level science and engineering education and research.

Italian nuns founded the University of Asmara in 1958 as the Holy Family University Institute. In 1964 the name was changed to the University of Asmara, and English was established as the language of instruction together with Italian. The University came under Ethiopian control in 1977 with an increasing number of Ethiopian staff and students. In 1990, as the war of liberation intensified, the existing Asmara University was moved to Ethiopia, including staff, students and all movable properties. After the liberation in 1991, the University of Asmara was re-established as a centre of higher education in Eritrea.

At independence the University of Asmara lacked the basic laboratory facilities. The existing staff were also under-qualified. The University had five Colleges, namely, College of Science, College of Arts and Social Sciences, College of Agriculture and Aquatic Sciences, College of Business and Economics, and College of Education. Qualification of over 85% of its academic staff was at the level of BSc and MSc.

The most pressing need to be solved by the University was thus to improve the standards of the undergraduate education by initiating a Staff Development Program so as to upgrade the levels of its junior academic staff. In 1993 major restructuring was done, and the university adapted a linkage model, linking every College of the University to appropriate internal and external institutions in order to ensure relevance, quality, and sustainability of its programs.

Since 1991 the University has been able to consolidate existing Colleges and to create new ones, for example the Colleges of Health Sciences and Engineering, which were established in 1997. The institutional linkages in 1999/2000 are shown in Appendix 2. Since the present evaluation concerns the College of Science and the Faculty of Engineering the attention will be focused on these institutions in the next paragraphs.

3 The College of Science

3.1 Brief account of the first years

In the academic year 1992/93 when the University of Asmara started to function, the College of Science had only three departments, namely the departments of 1) Natural Science (mainly Biology and Chemistry), 2) Mathematics, and 3) Physics. It also had three other units, which were able to offer service courses to students belonging to other departments. The three units were: 1) Computer Science, 2) Earth Science, and 3) Statistics.

Table 1 Staff and student situation at the College of Science (1992–2000)

Academic year	Academic Staff on ground					Total number of students*	Staff: student ratio	Total number of graduates
	Eritrean			Expatriate	Total			
	BSc	MSc	PhD	PhD				
1992/93	6	25	5	1	37	912 (327)	1:25	35
1993/94	15	15	7	4	41	1076 (527)	1:26	7
1994/95	14	12	8	6	40	1272 (636)	1:32	33
1995/96	21	15	8	5	49	1085 (472)	1:22	130
1996/97	29	17	13	6	65	1300 (535)	1:20	146
1997/98	30	14	12	18	74	1275 (411)	1:17	132
1998/99	17	5	9	12	43	1375 (380)	1:32	109
1999/00	21	7	10	17	55	1398 (350)	1:25	96
2000/01	22	6	12	19	59	1458 (365)	1:25	-

* Figures shown are the sum of actual number of students belonging to the College (Figures in parentheses) and the full time equivalent of freshman, minor & service students.

In 1997 the Statistics unit was upgraded to a full-fledged Department of Statistics and Demography, and later it was transferred to the College of Arts and Social Sciences. In the academic year 1992/93, there was a total of only 6 PhD holders (one being expatriate staff) and 25 MSc holding staff in the whole of the College of Science (Table 1).

The staff was responsible for over 900 full-time students (staff: student ratio 1:25). The teaching facilities were either in a very poor condition (outdated and/or long used) or non-existent. In some departments there were no relevant laboratory facilities that could be used for demonstration, let alone for experimentation. Science education is best appreciated and understood when it is based on laboratory exercises/experiments. With the then existing very poor laboratory facilities, it was a big challenge for the College of Science to run its programs

3.2 Objectives of the College of Science – Strategic plan

The mission of the College of Science has been designed to conform to the official macro-policy of the nation. Therefore, the main objective of the College of Science has been tuned to produce the scientific

manpower for the country, and to address some of the problems of the country through research. Thus, the aims of the activities within the Sida/SAREC linkage project are the following:

1) Establishment of a full-fledged College of Science with undergraduate, graduate and post graduate programmes in the departments of Biology, Chemistry, Computer Science, Earth Sciences, Hydrology & Water Resources, Marine Sciences, Mathematics, and Physics.
2) Training men and women who can satisfy the manpower needs of Eritrea in all fields that require qualified scientific competence.
3) Building research capacity in the various disciplines in order to address the research needs of the country.
4) Training of Eritrean scientists and professionals to run the College.

In order to fulfil its objectives, the College of Science prepared a comprehensive 15-year strategic plan as quoted below from a paper by the Dean of Science.

Short-term plan (1995–2000)

In the short-term perspective, the College of Science was planned to be engaged in consolidating and strengthening the existing departments and upgrade its three units (Earth Sciences, Computer Science, and Statistics) into full-fledged departments. Furthermore, efforts were continuously made to enhance capacities in teaching and research through staff development and the strengthening of teaching and research infrastructures. The number of students increased during this period of time as shown in Table 1.

Medium term plan (2001–2005)

During this time period, the departments of Computer Science, Earth Science and Statistics will be strengthened. The Marine Sciences Department, currently in the College of Agriculture and Aquatic Sciences, is planned to be transferred to the College of Science. A Hydrology and Water Resources unit is envisaged to be established within the Earth Sciences Department (this will later be upgraded to a full fledged department). Some of the departments will be commencing to give programs leading to the MSc degree in their respective fields. By the end of this time research will have been strengthened at the departments.

Long term plan (2006–2010)

With the upgrading of the Hydrology and Water Resources unit into a department, the College of Science will have eight full fledged departments. Many of them will be offering programs leading to the MSc degree, and a few of them will start programs leading to the PhD degree. The teaching and research capacities of the departments will develop further and shall be in a position to respond to the needs of the country in human resources development, research and consultancy.

3.3 The Sida/SAREC linkage project

The Sida/SAREC linkage project has been an important precondition for realising the mission of the University of Asmara at the College of Science.

As mentioned earlier the mission has been achieved through staff secondment, staff development, strengthening teaching facilities, strengthening research facilities, and strengthening the library. The scope of each of these components is briefly described below.

3.3.1 Staff Secondment

Once implementation of phase 1 started, the College of Science had plans to send most of its junior staff to Sweden for higher education. Due to this, it was anticipated that an acute manpower shortage would arise in most departments. To cover this deficiency in teaching staff, the University of Asmara planned to suggest a form of co-operation in which up to three senior faculty members could be seconded from Uppsala University each year. Other major objectives that can be accomplished as a result of staff secondment include the strengthening of the linkage between the universities of Asmara and Uppsala, by for example giving advice to junior staff likely to go to Sweden, identifying research areas, and establishing joint research projects between the two universities. The duration of secondment was planned for at least one semester.

3.3.2 Staff Development

This component aims at developing the academic qualification and competence of members of the staff at UA. It has identified two elements: (1) Junior faculty members from the College shall continue their training in Swedish Universities for MSc and PhD degrees, and (2) Senior faculty members of the College will conduct research at Swedish universities for a period of up to 4 months.

3.3.3 Strengthening Teaching Facilities

The College of Science desires to strengthen its capacity in science teaching and research. This requires good laboratory facilities. This component of the co-operation is therefore expected to boost the capacity of the departments by enabling them to acquire the necessary laboratory and field instrumentation so that science teaching fully becomes laboratory based.

To enhance the effective use of laboratory equipment, the College of Science has established an Equipment Maintenance Centre, which needs to be strengthened to cope with the increasing demands as regards equipment for teaching as well as for research.

Modern textbooks for teachers and students are necessary for good university education. The acquisition of textbooks for the various courses given at the College is therefore another important area of activity in strengthening of teaching facilities.

3.3.4 Strengthening Research Facilities

In the future the bulk of scientific research activities in Eritrea will be carried out at the University of Asmara. Consequently, it is important that the College of Science strengthens the ability to conduct relevant research within UA, by establishing laboratories that are adequately equipped for the prioritised thematic research areas identified by the university.

3.3.5 Strengthening the Library

All activities of teaching and research require the services of a good library system. For this, the need to strengthen the University Library has been identified. From the point of view of the College of Science it is especially important to support the acquisition of good journals and books in science.

4 Achievements and activities of the College of Science

4.1 Activites at the University of Asmara

As a result of the Sida/SAREC assistance the following tasks have been accomplished at the University of Asmara.

1) As a direct result of the implementation of the Sida/SAREC support the University of Asmara has been in a position to expand and consolidate the undergraduate program. The four units that existed in 1991, namely, Biology, Chemistry, Earth Sciences and Computer Sciences, were upgraded into full-fledged departments. Moreover, the Statistics unit has been upgraded to department and has recently been transferred to the College of Arts and Social Sciences.

2) The College of Science recognises the importance of continuous development of the curricula for the undergraduate education. As a result of this the already existing curricula have been revised and new curricula have been developed to meet the demands of a modern university. Examples of curricula are shown in Appendix 13.

3) The services of the library for research and teaching have been improved through the training of two librarians and through the acquisition of:

   a) Bibliographic tools and reference materials;
   b) Library equipment such as photocopiers;
   c) Journal subscription for most disciplines addressed by the University;
   d) A limited number of text-books has been purchased to alleviate acute shortages. Except for the recently opened Department of Computer Science, currently most of the departments of the College provide one textbook for two students.

4) The Computer Unit has been strengthened through the acquisition of new computers, and associated accessories.

5) The laboratories of Biology, Chemistry, Earth Sciences and Physics have been strengthened through the acquisition of vital equipment and supplies (see Appendix 11). From the start of the 1997/98 academic year, three laboratories for the freshman program have been established. These laboratories have been equipped with appropriate facilities, ad this has removed the laboratory bottleneck of the College. As a result, the University has now approximately doubled the student intake in the freshman program.

6) A Geophysics research project has been launched and equipment has been received for monitoring seismic activity in the Eritrean environment with the view of assessing the hazards due to earthquakes. All collected seismic data are regularly published in a seismological bulletin.

7) Two vehicles have been bought to alleviate bottlenecks in logistic support for research.

4.2 Staff development.

Due to the fact that a large number of staff members demanded further academic education (MSc or PhD) a major part of the Sida/SAREC budget has been devoted to staff development in co-operation with Uppsala University.

Since the academic year 1992/93 the College of Science has sent 54 members of its staff to continue their higher studies abroad. Out of these 34 were sent to Sweden under the staff development program (see Figure 1 and Appendix 3), while others were allowed to pursue their higher studies with funds from other sources. These could be private scholarships (assistantships) offered by DAAD, State University of New York at Stonybrook, Fullbright, UNDP, Project of the Central Administration (University of Asmara), etc.

Out of those in Sweden, three staff members have so far successfully completed their PhDs and are already participating in activities of their respective departments. Moreover, three staff members form the Department of Computer Science, one from the Department of Biology and one from Chemistry have completed their MSc studies and are back at the University of Asmara (see Appendix 5). This is a positive indicator for the progress of the staff development program, and the College of Science expects more staff to be back in the coming few months. So far the staff development participants have published several quality research papers. A list of publications from the College of Science is given in Appendix 10.

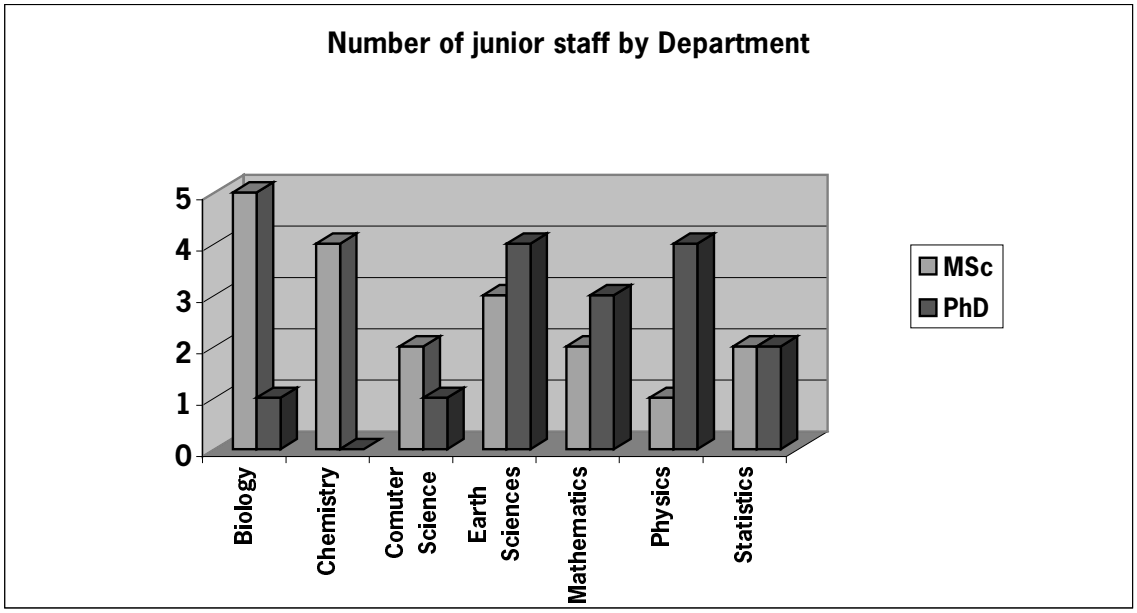


Figure 1. Junior staff (by Department) sent for MSc or PhD training in Swedish Universities (1994–2001)

A comparison of the staff on ground in the College in 1992/93 academic year with that of the recent years shows a significant increase by about 80% (Figure 2; Table 1). The staff-to-student ratio, however, remains nearly same, clearly attesting to the expansion of the College by the opening up of new departments. On the other hand, the number of highly qualified staff (PhD level) is expected to rise sharply in the years to come, when most of the staff on study leaves have completed their training. There are already positive trends in the number of PhD. holding Eritrean staff (Figure 2); the high number of the overall PhD. holders (Eritrean plus expatriates) is a reflection of the University's determination to improve the scientific quality of the staff at the University of Asmara.

It can also be noted here that one staff member in physics, who successfully completed his PhD, has opted to go for post doc research in Australia. Three other staff members have discontinued their studies (on their own initiatives) after following their studies for a period of 9 months to 1 year in Sweden and have moved on to other countries. On the basis of a recent agreement reached between

UA and South African Universities, all training of junior staff at the MSc level has been shifted to South African Universities.

The other component of the staff development program is the granting of research leave to senior faculty members of the College of Science. To date two faculty members made stays in Sweden in 1997, two in 1998, and one in 1999 (Table 2, Appendix 4).

Table 2. Number of senior staff who took part in the 3–4 months research leave in Swedish Universities/institutions (1997–1999)

Department	No. of participants
Biology	1
Chemistry	3
Computer Science	-
Earth Sciences	1
Mathematics	-
Physics	-
TOTAL	**5**

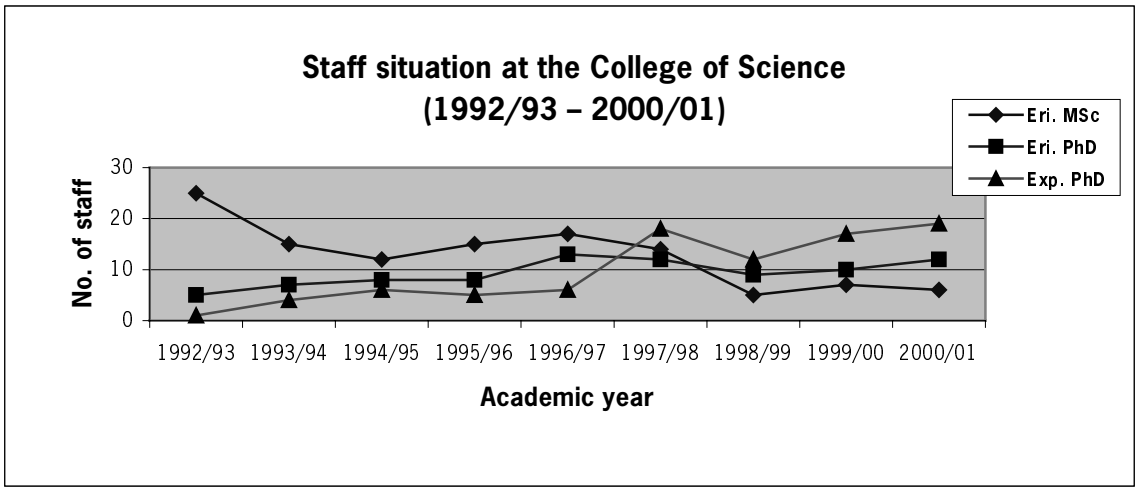


Figure 2. Staff situation at the College of Science (1992/93–2000/01)

4.3 Staff secondment

This component of the activity has been very useful and it is strongly felt from the Science College that it has a positive impact in the consolidation of the programs of the College. The only problem to be pointed out by the College is the difficulty encountered so far in getting regular staff secondants in Computer Science. The most probable explanation for this could be the availability of much more attractive jobs in this field elsewhere. Nevertheless, the following points are brought forward from the Science College to illustrate the positive impact of this component:

(i) The teaching activity of the College has been enhanced by the participation of secondants (Appendix 6). In addition to delivering high quality lectures, the secondants gave seminars and made wide ranging discussions on issues of teaching modalities that has created good grounds for positive improvements. Overall, the very aim of alleviating the acute manpower shortage in the College has been achieved. As shown in Table 3 there is a decline in the number of staff secondants after 1999/2000 (compare Appendix 6).

(ii) The linkages between the Universities of Uppsala and Asmara have been strengthened through the secondants. The positive experience of earlier secondants who are now back in Sweden has stimulated the interest of more faculty members from the University of Uppsala and other universities in Sweden to join the Staff Secondment Program. The Staff Development Program of the Project has also been the immediate beneficiary of this. The placement of senior faculty members from the University of Asmara in Swedish universities has been facilitated significantly by the secondants. The same goes for the placement of the junior faculty members.

(iii) Secondants have been active in advising junior faculty members who were preparing to go to Sweden for further training. In fact, a number of secondants continue to have contacts with the trainees in Sweden.

(iv) Secondants have actively participated in the curriculum reviews of the departments to which they are assigned. In this regard, they have played an important role in suggesting improvements in the curricula as well putting forward alternative ideas on various aspects of the courses.

(v) Other positive impacts of the staff secondment component are being expressed through the commitment and strong desire of the secondants to strengthen the research capacity of the department with which they were attached. An excellent example is the case of the Chemistry secondant who, after completing his stay at the Department of Chemistry for two semesters, not only donated a much wanted laboratory equipment (X-ray machine) but also once again came to the University to install the equipment and train staff on the operation of the equipment.

Table 3. Staff secondment from Sweden (1997/98 – 2000/01)

Department	1997/98	1998/99*	1999/2000	2000/01
Biology	-	1	2	1
Chemistry	-	1	2	-
Computer Science	-	-	1	-
Earth Science	1	1	1	1
Mathematics	1	1	-	-
Physics	1	-	1	-
TOTAL	**3**	**4**	**7**	**2**

* In 1998/1999, due to the Conflict between Eritrea and Ethiopia, one staff secondant each from Biology, Chemistry, and Earth Science were evacuated before finishing the semester

5 The Faculty of engineering

5.1 Background of the Faculty

The engineering program at the University of Asmara was launched in September 1995 under the College of Science, with three diploma programs in civil, electrical and mechanical engineering. In 1997 the engineering programs were given independent status under the Faculty of Engineering. From 1995 to 1998 the engineering programs were linked to the University of New South Wales (UNSW) in Australia, and from 2000 with KTH in Sweden. Tables 4 and 5 show the development of the enrolled undergraduate students, and the present status of the staff members in the different departments. The collaboration between UA and KTH is very young, and it is therefore too early to evaluate the effects of Sida/SAREC support. The necessity of a strong engineering faculty is, however, beyond all doubt. The Engineering Faculty in the university of Asmara is the only institute of higher technical education. It is already playing a leading role in training of engineers, although education up to MSc level has not yet been established. Degree programs in civil, electrical and mechanical engineering were introduced in the autumn of 1999.

5.2 Ongoing work and future plans.

The co-operation between UA and KTH is modelled after the linkage project between UU and the College of Science. The components of the co-operation are pretty much the same as those of the science co-operation – staff development, staff secondment, support services, curriculum review etc. The Faculty of Engineering has an ambitious staff development programme (see Appendix 7), and although the actual timing of staff development is sometimes not kept exactly according to plans, one gets the impression that the goals of the faculty will be achieved. For obvious reasons the Faculty of Engineering is expected to contribute to practical, hands-on solutions to the technical problems in society. Accordingly there are some specific elements in the plans that are not so pronounced at the College of Science, for example introduction of short training courses for engineers and technicians and for workers in industry.

There are also engagements in the Eritrean Standards Institution (corresponding to NIST in US) and in project management. The latter components have high priority in the ministries within the technical sectors (Public work, Energy and Mines, Transport and Communication, and Land, Water and Environment). During my visit to Asmara (May, 2001) I had the opportunity to see the ongoing activity in renewing laboratories for the three engineering departments, discuss curricula and education with the staff, and also interview some of the students at work in the electronics laboratory. The students are apparently aware of the demand of technical competence in society and are conducting project work of relevance for the surrounding society.

The engineering faculty has been very active in development of new curricula for the BSc degree in Civil Engineering, Electrical Engineering and Mechanical Engineering.

The first batch of BSc degree graduates will be out for work by the year 2001. Therefore, in the year 2002, the faculty plans to undertake sectorial assessment in order to obtain feedback from employees and graduates on the quality and relevance of the curriculum. Later on the Faculty will organize a local and an international workshop to discuss the results of the assessment that will serve to introduce necessary changes in the curricula.

In the near future two new departments are planned within the faculty, namely *Architecture and Urban Planning,* and *Chemical Engineering*, respectively. Drafts of curricula for these two departments are in preparation.

Table 4. Student enrolment in the engineering programs (1995/96 – 2000/01)

Academic year	Diploma enrolled	Total number of students	Graduated	Exam
1995/96	50	50		Diploma
1996/97	58	108		Diploma
1997/98	51	106	43	Diploma
1998/99	102	150	57	Diploma
1999/00	234	333	50	Diploma/ Degree
2000/01	155	488	81*	Degree
Remark			*To July-01	

Table 5. Staff situation in the Faculty of Engineering 2000/01)

Academic year	Civil Engineering	Electrical Engineering	Mechanical Engineering	Remark
Professor	2 (PhD)	2 (PhD)	1(PhD)	Expatriate
Asst. Prof.	-	1 (PhD)	-	Eritrean
Lecturer	1 (MSc)	2 (MSc)	2 (MSc)	Eritrean
Asst. lecturer	2 (MSc)	1 (MSc)	2 (MSc)	Eritrean
Grad. Asst.	2 (BSc)	1 (BSc)	-	Eritrean
Lab. Techn.	-	-	2 (Diploma)	Eritrean
Total	**7**	**7**	**7**	**21**

Discussions on research themes and priorities are ongoing at the Faculty of Engineering and also between the faculty and the Asmara committee at KTH. There has been a recent interesting input in the discussion by the Asmara committee (See the report from their visit Jan-Feb, 2001), and – as for the College of Science – it is obvious that the challenge for the faculty is to chose a few relevant themes, and focus interest and resources on these.

In summary, there is good hope that the progress of the Engineering Faculty will be as satisfying as that of the College of Science, but that it will be more directed to practical and immediate needs of the society.

6 Management and administration at the University of Asmara

Although the College of Science and – to a lesser extent – the Faculty of Engineering are in focus of this report a few comments on the administration and leadership of the university will be made.

The UA has for the last four years been organizing meetings in a *Project Coordinating Committee Forum* (PCC) where virtually all linkage partners and the respective country donor-agencies are represented. The PCC is a forum for reviewing the project activities and project expenditures of the previous academic year, and evaluating and approving the operational plan and accompanying budge of the next year. It is also an occasion for partners (both academic and donor agencies) to interact and harmonize approaches and methods of managing projects. This PCC process has assisted the UA to harmonize and reconcile the coordination, monitoring and evaluation of the many academic and non-academic linkage programs that have been implemented as part of the core capacity building endeavours. The PCC is organized and coordinated by the Office of Strategic Planning & International Projects Coordination.

The core institutional capacity building strategy for the UA builds on both academic and non-academic linkages with reputable higher education institutions abroad. To date it has no less than 16 universities in Australia, Europe and the US taking part in these linkage programs. Coordinating and monitoring the latter programs in a unified mode (grounded on the Management by Objective and Management Reporting System tools and culminating in the PPC) is the ultimate function of the Office of Strategic Planning & International Projects Coordination. The Office has a fulltime staff of four individuals and is headed by an experienced strategic planner.

The structure of the University of Asmara is similar to that of universities world-wide, with a hierarchy top-down (or vertical) from the university vice-chancellor (president) to deans of the different faculties and/or colleges and further on to department heads or heads of units. At present there does not seem to exist any established procedure for the staff at the university in selecting members of the university board. The present model seems to imply that the government selects the university vice-chancellor, and the university vice-chancellor appoints the deans. This model could present a difficulty, if the persons involved are not clear about their mandate and responsibilities. On the specific question concerning the degree of delegation from the vice-chancellor to the leaders at different levels, the information was given that the delegation from the vice-chancellor to the deans works in practice, although the order of delegation was not documented.

The Univesity of Asmara has adapted a management reporting system, "Management by Objective" in which the activities in the different colleges/faculties are registered as projects with a responsible leader (usually the dean), and divided into objectives with milestones, time-tables, participants, methodologies and comments/explanations. For each project and fiscal year an activity plan and planned budget are given, and at a later stage these are followed-up by activity and financial reports. From these sheets it should be fairly easy for an outsider to get an overview of the development of each college and/or faculty.

At the college/faculty and department levels the administration seems less developed, for example secondants from abroad are sometimes frustrated over the difficulties in purchasing simple maintenance equipment. The university leaders are, however, aware of these problems and are working towards greater efficiency in the daily management of departments. In this context the question also arises whether staff involved in accounting, purchasing and other administration has

training opportunities. I realise that such activities cost money, but the increased efficiency in dealing with different matters may well pay off in the long run. From the point of view of the Sida/SAREC administration it would be valuable if at least one or a few persons in the administrative staff (responsible for accounting and reporting) could spend some time in Sweden. There they could get first hand information on routines and expectations from the SAREC/Sida administration.

In colleges/faculties dedicated to education and research in science and engineering the existence of adequate technical infrastructure is a key issue. Thus it is of vital interest to have mechanical and electrical/electronic workshops, which can assist the teachers and scientists in purchasing and maintenance of specialised equipment. The leaders and staff at UA are highly aware of this. Accordingly a university workshop has been established, and some of the staff is sent for training abroad. However, the demands are at present much higher than the possibilities, and during my visit to UA there was some equipment in need of repair, which could not be attended to. Many difficulties also arise when the staff buy equipment and/or spare parts from companies in the west. There are often long time delays, and in some cases the ordered instruments are not working properly when they arrive in Asmara due to missing spare parts/details or lack of properly written manuals. – To get a properly functioning workshop would require a major effort from the university and a change of attitude from the part of the firms in the west. I therefore see this lack of support from western companies and the lack of dealers and business people dealing with equipment inside the country as real bottlenecks in increasing efficiency in research and education.

In the program for staff development in PhD training at UU I had expected to find some PhD courses which could support the academicians in their administrative and leadership roles when they return to Asmara. There did not seem to be any PhD courses of this character offered to the students, however. My recommendation to UA is to have an active attitude to the package of courses, which are part of the PhD curricula. I am sure that the Asmara committee at UU would have welcomed initiatives in this direction.

7 Evaluation of undergraduate education

From the tables quoted above (Table 1 and 4) it is evident that there is an increasing number of undergraduate students. About 90% of the students usually pass examination on specific courses. This must be regarded as satisfactory achievements from a quantitative point of view. – Efforts made to raise the quality of teaching, for example development of the library and the laboratories, MSc and PhD education of the staff, continuous development of curricula and the introduction of new educational programs are also very positive achievements.

Needless to say the undergraduate education is also very cost-effective, as measured by Swedish standards. To educate for one year (2000/2001) the approximately 1900 students taking part in the Science and Engineering programs (Tables 1 and 4) would give resources in the range of 75–95 MSEK in Sweden.

During the course of the evaluation I have had the opportunity to read a number of reports from secondants from 1997 to 2001, representing different programs in the College of Science. General observations/comments made by the secondants which have also been expressed in my discussions with the Asmara committees in Uppsala University and at KTH are:

- The most overriding problems are the lack of access to Internet, and also an inertia in the systems for e-mail, post, delivery of equipment etc. There also seems to be lack of infrastructure assistance for the teachers at the department level.
- The availability of textbooks has increased during later years, but there is still a certain shortage of good, modern textbooks. The present target is to have one book per two students at the end of the year. A long-term goal would be to have one book for each student.
- Although the access to laboratory equipment and equipment for making classroom experiments has improved during later years, there is a need for improvement.
- The students are very dedicated, hard-working and enthusiastic about their studies.
- The students are also highly dedicated to develop their country.
- The classes are large in the lectures, which decreases the chance to individualise the teaching.
- The students expect to be "bottle-fed" with facts and figures and have too little chance to exercise critical thinking.
- Most students are too concentrated on the results of the examinations, and (because of competition) they have too little motivation to help each other during the courses.
- The communication between the teachers is not ideal (probably due to too much work). For example, a reference file for each course should be useful (containing the latest course outline, laboratory manuals, handouts, lecture notes, exam questions, safety guidelines and comments on experiences and suggestions on improvements). The teachers should also be encouraged to increase the amount of team-work on a program, and thus take part of each others experiences.

The overall impression is that the secondants have done an excellent work, and that their observations also are of great value for Sida/SAREC, since they function as a kind of independent observers at the grass root level. Their reports and comments can thus actively stimulate an ongoing discussion within the university concerning the future development of UA. Their role, might however, in the future

become somewhat different, if they are part of a collaborating team in a research project. They can then do primary education as well as be advisory at MSc and PhD levels. Furthermore, I recommend that time periods for secondants are made more flexible dependent on their other duties in Sweden and internationally. If more flexibility is introduced – within a framework of planning made in good time – it should be possible to benefit from secondants also in respect to developing and giving courses at more advanced levels (for example MSc and PhD).

8 Evaluation of Research and PhD Education

8.1 Ambitions and goals in research at the University of Asmara.

The key concepts in developing the University of Asmara are *quality*, *relevance* and *sustainability*. These concepts apply to education, research and to the university administration and organisation as a whole. When assessing the research activities I will discuss these against the background of the three key concepts.

The *research areas* given priority by the University and College of Science are interdisciplinary and relevant for the country, namely:

- MEDICINAL PLANTS
- MATERIAL SCIENCE
- GEOPHYSICS

Since these three areas are broad the future task will be to focus on specific problems within these areas. There are, however, other highly relevant areas for Eritrea besides the ones mentioned, for example development of sustainable energy systems (including solar electricity and heating), management and development of water resources, marine sciences, transport and communications and food resources. These include R&D also at Engineering and other faculties.

To educate a scholar in interdisciplinary science is not easy, and there are rather few models for doing this. Asmara University has organised its departments within the Science College in basic sciences: Biology, Chemistry, Physics, Earth Sciences, Computer Science, Mathematics etc, in a fashion that is similar to that of most large western universities. With reference to appendices 3, 4 and 10 it is also seen that the identity of the scholars and their PhD thesis work refers to the traditional system.

The expected competence of a person working in an interdisciplinary area is that he/she should have at least double competence, namely to have one strong field of specialisation and also have a broad knowledge within the interdisciplinary or applied area in focus. In environmental sciences such persons are named "T-persons" as an illustration of both width *and* depth. The balance between these two demands is not always easy.

Changes in the society at large also act to strengthen the demands for education that combines specialisation with broader knowledge within the problem areas. Thus, today subjects like "complex systems", "systems analysis" etc are key concepts – and the reality behind is that humankind to some extent has left the "reductionist" philosophy and realised that the world at large consists of complex and interacting systems, be it ecosystems, transport- or communication systems or societies. In conclusion, I see a challenge for the academic leadership in the University of Asmara to address the complexity-problem in undergraduate as well as PhD education.

8.2 Staff development and PhD education.

As noted in the preceding paragraphs a major effort and a large proportion of the Sida/SAREC money have been directed towards developing the qualifications of the staff in close co-operation with UU and – recently – with KTH.

In order to be acquainted with and to assess the quality of the scientific work done by the staff in their PhD training in Uppsala University I have obtained four PhD theses, a few licentiate and MSc theses, and a number of published scientific papers for review. They have all been interesting to read, and I think that both the University of Asmara and Uppsala University deserve credit for supporting this research. A list of publications from 1992 to the present year is shown in Appendix 10. The number of publications each year (books, refereed papers etc) is shown in figure 3.

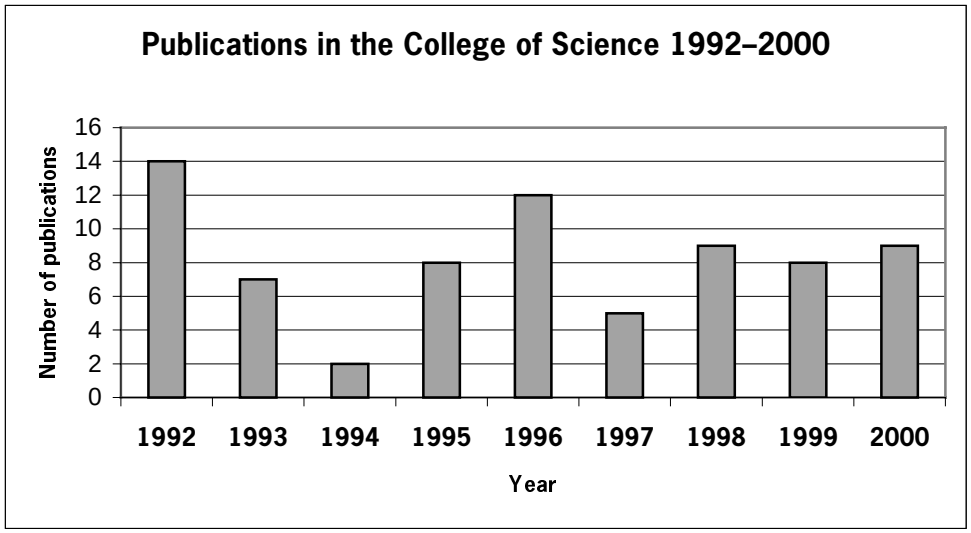


Figure 3. Productivity at the College of Science as measured in number of monographs, books and refereed scientific publications (See Appendix 10 for authors and titles).

I have also been supplied with "progress reports" concerning the PhD students in training (October 2000). The general impression is that the students have devoted much time to course work during the first year(s); and it is really difficult to see through the productivity concerning scientific papers in the first period of their stay in Sweden. On the other hand it is fairly normal – also for Swedish PhD students – that it takes some time to produce the first scientific publications, but when the dissertation comes closer in time the publication rate usually increases considerably. Thus one can foresee an increase in the productivity during the coming years.

As far as I can judge the PhD training of the Eritrean staff in Sweden is similar to that for the Swedish PhDs, with strong disciplinary specialisation. This is an advantage when the staff returns to the University of Asmara, provided that they will continue to do research in a rather narrow discipline and that they will teach courses within their speciality. On the other hand, the demands on the staff in Asmara will probably be different from those on staff in Sweden. The teaching situation is more difficult in Asmara, with relatively fewer university teachers, larger groups of students, less access to IT, library resources and instrumentation &equipment. Thus, the returning staff should be prepared to teach over a wider field than their research work covers, for example a specialist in one field of the basic disciplines is expected to be able to teach *all* courses in his/her discipline up to masters level. Within the framework of the prioritised areas the staff are also expected to be able to communicate and conduct joint research across present discipline boundaries. It is not evident from the lists of courses presented in the "progress reports" that any training in interdisciplinary work or in project management has been conducted. – The situation is somewhat different for the PhD students at KTH, since the engineering faculty usually is more interdisciplinary and deals with complex systems and structures (for example urban planning and construction, waste and waste-water treatment, electricity systems etc).

A problem related to the research within the traditional disciplines is the lack of "sandwich" PhDs in the present concept. It seems that – with a few exceptions – a small amount of the research work done by the staff has actually been performed in Eritrea. Thus, it is relevant to ask whether it will be possible for the staff returning to the University of Asmara to conduct research within their present areas of competence. – There may be many reasons why this poses difficulties, for example lack of instrumentation, infrastructure etc at UA, but it may also be the choice of specialisation and research problem which is difficult to realise with the facilities at hand in UA.

Thus it is relevant to ask about the procedure of recruiting PhDs to the different research fields. I have not got a clear picture of how the field of specialisation has been chosen and to what extent it meets the expectations of UA and is relevant for the prioritised areas mentioned above. In order to get a transparent system for how this can be done I suggest a procedure in which the choice of research problem for the individual researcher is made in a joint decision by the three parties 1) the PhD student, 2) representatives for UA and 3) UU or KTH, to ensure maximum support for the PhD student, and also to ensure that the three criteria of quality, relevance and sustainability are fulfilled. Furthermore, the choice of PhD student and the research task should be made at least half a year before coming to Sweden. The supervisors of the thesis work should as far as possible come from the host institution in Sweden as well as from UA. This will facilitate the "sandwiching" of the students, and also stimulate co-operation between relevant research groups in Asmara and Uppsala/Stockholm.

I have got the impression that during the past period the PhD students have been recruited into a suitable research group, and that it is not always so that a corresponding research activity exists or is planned in UA. The agreements between UA and UU respectively KTH have been made at the university level. Furthermore I get the impression that the PhDs are rather "lonely" within their specialisation when they return back to UA. Thus, there is a question concerning whether time has come to stimulate the co-operation between *research groups* consisting of experienced researchers and PhD students at the host institution in Sweden as well as in Asmara. Co-operation between research groups would facilitate the recruitment of secondants with the desired competence and also make post doc periods possible for all partners. It might also stimulate the Swedish PhD students to spend time in Eritrea working on joint problem areas with the Eritrean PhDs.

The formation of research groups in relevant areas in UA would increase the sustainability of UA and diminish the risk of losing key competence when losing one qualified person. Within a research group several scientists can substitute each other and have a vital forum for discussions. Needless to say, the existence of well-defined research groups would also influence the choice of PhD projects, and the research leaders would have to prioritise rather hard. In parallel with this, one can well expect that the teaching obligations at BSc levels should be wide and that the qualified persons can do excellent teaching jobs in more than a few areas.

My conclusions and recommendations regarding the staff development and PhD training within the co-operation are that:

- The quality of the PhD work is very satisfactory, and in view of the difficulties that meet the Eritrean staff in a foreign country, it must be stated that both the host institutions in Sweden and UA should have credit for this. Within the next few years also the productivity is expected to increase.
- There is a high degree of dedication and commitment from UA, UU and also KTH.
- The communication between UA and the Swedish partners has not worked in an optimal fashion.

- There are very few female PhD students from Eritrea, and it is in fact difficult to combine many years of studies in Sweden with keeping or building a young family in Eritrea.
- UA should begin to develop some courses within "strong" areas of research, which could function as masters *and* PhD courses. With the increases in qualified Eritrean staff that is expected within the next few years the College of Science has potential to give MSc in some of the more prominent scientific areas
- In the coming period some changes should be made concerning the support from the universities, for example supervisors for the PhD student should form a small group (about three persons) and should – as far as possible – contain experts from Sweden as well as from Eritrea.
- The time period between enrolment of a PhD student and his/her appearance in Sweden should be at least half a year.
- The subject of the PhD work should be chosen in agreement between the three parties: the student, UA and the Swedish counterpart (UU or KTH).
- The "sandwich" model should be put into practice; it is now possible in some fields and generally highly desirable that the PhD students conduct more of their research in UA. Implementation of a "sandwich" model would facilitate PhD studies for students with families, especially young women. From a 50-50 model in the beginning, the initiative and time spent in UA should gradually increase.
- The co-operation between UA and Swedish universities should involve partnership between research groups in both countries rather than individuals. Exchange of staff and students should increase. A prerequisite for this is, however, that stable and supercritical research groups are established at UA. How fast this can be achieved is dependent on many factors, of which the most essential is the support and encouragement of the staff at UA.
- The academic staff in UA should be given half of their time for research and the other half for undergraduate education. Implementation of this philosophy in practise would facilitate the establishment of research groups and motivate the staff in PhD education to return to Eritra after their PhD is completed.
- In order to strengthen the research at UA and keep up the scientific activity in UA it is important that the PhDs get post doc periods in other countries, and that senior staff can be on "sabbatical" leave for periods between a few months and half a year. These periods should also include research visits to co-operating groups/departments within the framework of south-south co-operation. This is especially important in many areas in science and technology, in which problems and solutions are of a "universal "character or – alternatively – a common problem to many developing countries (for example research on energy systems in hot climate, infrastructure/management of water resources in semi-arid areas etc).

9 Other aspects of the research co-operation brought up by different parties – sustainability in the future

I will now turn attention to some problems, which have been touched upon above, and which are common to undergraduate education and research activities. These are *communication, brain-drain, democratisation*, *gender balance* and *south-south co-operation*.

When interviewing involved parties in Sweden one of the most frustrating aspects of the co-operation with the University of Asmara is considered to be the difficulties in *communication*. There are complaints that the scientists in Asmara are difficult to reach and take a long to come into contact with. From the Asmara side the lack of access to *Internet* is a matter of great concern, and it is rather sad to read in the reports from secondants that this has been an important and recognised problem since more than five years. For undergraduate students as well as the staff the situation diminishes their ability to come in contact with modern literature and scientific papers. It is difficult for an outsider to judge whether the difficulty in coming in contact with the Asmara staff is due to an under-dimensioned e-mail system, lack of infrastructure or something else, but to get access to good communication in a technical sense is a matter of highest priority.

The other aspect of communication is the *human aspect*. Lack of communication between people can be attributed to differences in culture, in values or in means of expression – or it can just be due to misinterpretation and misunderstanding. It may also be that the difficulties to communicate in a technical sense may lead to frustrations that affect the human aspect of communication. Which-ever the factors behind the frustrations I think it is worth while to keep the communication problem in mind and from all sides make an effort to reach out and be very clear in statements and attitudes. It is also very important to communicate at the proper administrative level. There have been some confusion in the communications between UA and the Sida/SAREC staff. For example, it is important that the auditor/accountant in UA communicates with the corresponding person in SAREC, that the deans communicate with the SAREC research officer, the president with the administrative head in SAREC in policy matters and with the research officer in matters of scientific organisation and contents, etc. A similar reasoning can be applied to the lack of communication between the Eritrean students in Sweden and the staff at the University of Asmara. If a group of supervisors (main supervisor and assistant supervisors) are assigned to each PhD student, the communication between the staff in the supervisor group, and between these and the student should come automatically.

A problem that has affected the developing countries through decades is that of *brain-drain*. This problem is highly relevant in areas like science and technology due to the universal character of these fields of research and education. For Eritrea's part the risk of brain-drain has hitherto not been so great, mainly because of an unusually dedicated and motivated population. The University of Asmara has, however, adapted the concept of sustainability as a key issue. In the future, with increasing globalisation, information and mobility (especially in the young generation) the traditional values of Eritrea will probably not be strong enough to keep the best scholars and the most innovative brains within the country. Thus it seems that the University of Asmara should adapt a policy on how to take care of the large human capital that exists in the young generation of educated people and the staff at UA. Ways of doing this have been suggested in the previous paragraphs: To ensure that the PhDs returning from abroad feel that they are in demand, that they have working conditions, which allow sufficient time for their own research, that they are encouraged to take research periods abroad, forming strong research groups etc. Other means of ensuring that the staff and students are determined to work constructively for their country would be to establish a reward/promotion scheme, based on

qualities that are in demand in universities world-wide, for example scientific excellence and productivity, scientific leadership, interest in education and supervision, writing of text-books and instruction laboratory manuals etc.

Matters of equal concern are those of formal *delegation* of decisions, of forming *democratic* procedures for election of key positions in the administration, and of ensuring all staff (not only the academic) of enough possibilities to develop their own capacity in co-operation with their colleagues and in the interest of their country. I am fully aware that such processes and development will take time, but I think a democratic framework for the university is a key factor in forming a sustainable university.

The *gender aspect* is attracting a lot of attention in Sida. The interpretation of gender equality is, however, different in different countries, and there is no reason to discuss that further. From statistics from the University of Asmara it is, however, evident that there is a disproportion in the numbers of men and women in university education (See Figure 4 and 5 and Tables 6 and 7). The UA leadership has also expressed concern about this situation and have taken on some measures to stimulate more women to turn their interest to university education. I have already commented on the gender problem in connection with the staff development program. Sandwich PhD education – and research made in Eritrea – would make it easier for women to combine research and work with family obligations. But the disproportion between men and women are already in existence in the early years of university education. It is therefore not easy to change the situation.

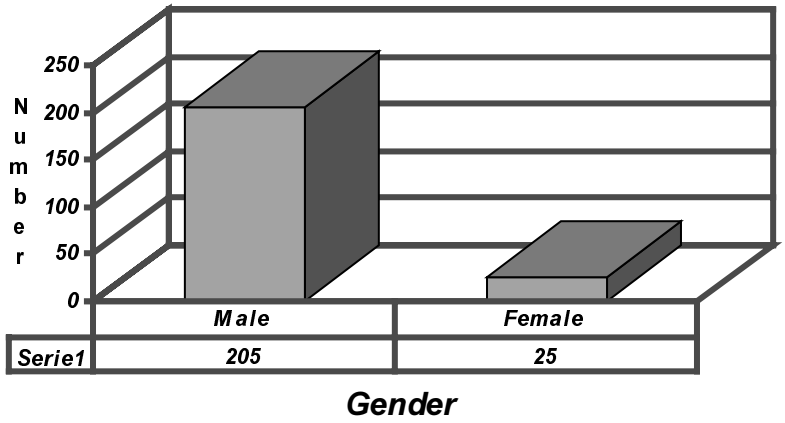


Figure 4. Gender proportions of the Academic Staff of the University of Asmara, 2000–01

Table 6. University of Asmara Faculty by Academic Rank: Academic Year 2000–01

Academic Rank	Faculty
Graduate Ast.	47
Ast. Lecturer	51
Lecturer	31
Ast. Prof.	58
Asoc. Prof.	18
Professor	25
	Total= 230

Together with UA, Sida/SAREC might consider a pilot scholarship program for young women entering the university. In such a program the young women could be:

1) encouraged to form a group supporting each other (Evidence from other countries show that if women are few and lonely they have a more difficult situation than if they have group support),

2) given special high-ranking mentors to discuss with during the university studies,

3) given housing facilities close to each other, maybe in the form of a special dormitory,

4) given some support money to substitute the "missing services" the young women are expected to give to their families, etc.

– There are many possibilities to develop a scholarship program for women, but I think that the underlying problems for the women should be analysed at depth before a pilot program starts.

Table 7 and figure 5 show the gender proportions for the non-academic staff at UA. It is not too different from the situation in Swedish universities, maybe somewhat more even in respect to the gender balance. Apparently the major imbalance is in the academic staff.

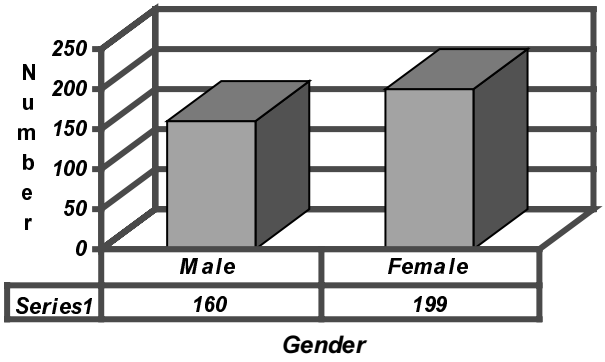


Figure 5. Gender balance in the non-academic staff at University of Asmara 1998–99.

Table 7. Non-academic staff at the University of Asmara by Gender

Year	Male	Female
91-92	122	183
92-93	130	196
93-94	111	192
94-95	107	184
95-96	82	77
96-97	79	80
97-98	156	198
98-99	160	199

An imbalance with respect to the gender situation among the academic staff will remain for a long time at the College of Science as seen in the gender ratio for the staff in PhD education in Sweden. Figure 6 shows the situation among the students in training in Uppsala. For the engineering faculty the imbalance is even more pronounced than in the

College of Science. Thus, in this faculty there are no females among the staff. In the Department of Mechanical Engineering all students are male, and in the Departments of Electrical and Civil Engineering the percentage of female students is 7 to 8% (See Appendix 8).

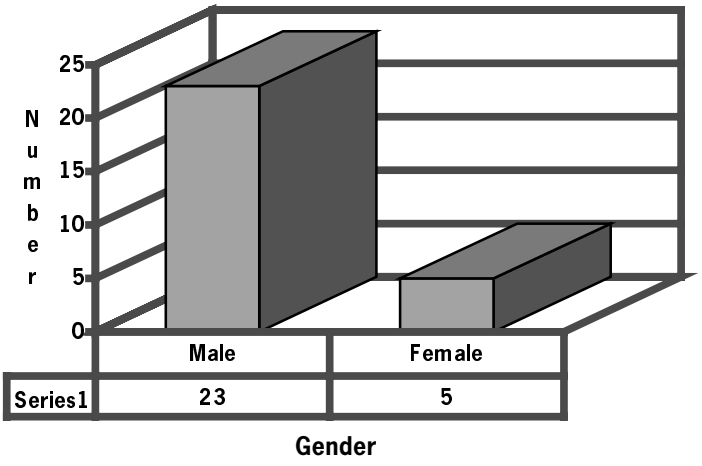


Figure 6. Gender proportions among the PhD students sent to Sweden to the Faculty of Science at Uppsala University

The fifth issue I want to address is that of *south-south co-operation*. Within Sida/SAREC this concept has gained strong support, and it is therefore interesting to see that the University of Asmara has made this concept concrete by sending students for training to other developing countries, for example South Africa, Zimbabwe, Botswana, Kenya and India. This has occurred within the framework of a large project "Eritrean Human Resources Development Project (EDRD)", supported by the World Bank. Many African countries are faced with the same – or very similar – problems and possibilities within science and technology. (Examples of those are development of sustainable electricity systems and water supplies, development of solar energy, sustainable use of mineral and biological resources etc). It would be of great value if the developing countries with similar challenges could share common experiences, exchange knowledge and competence, and also develop their own special fields of R&D within each country. South-south co-operation – also between research groups and departments – is in my view one of the key issues in the process of developing sustainable university structures in the African universities.

10 The co-operation between the University of Asmara, Uppsala University and the Royal Institute of Technology

10.1 The "shadow" faculties.

As mentioned before, there are co-operation agreements between the three universities and Sida. These agreements pinpoint the scope and objectives of the co-operation, and the undertakings by the different partners. There are also budgets attached to the agreements concerning how much money should be spend on different components in the co-operation. International Science Program (ISP) in Uppsala has been given the mandate to organise the exchange of staff and secondants on the part of Uppsala University. The model chosen for co-operation between Sida/SAREC and the University of Asmara is a "linkage model", which uses senior researchers in UU and KTH in science and engineering, respectively, as "shadow faculties". The "shadow faculties" in UU and KTH are organised in two Asmara committees with responsibilities for co-ordination and management of the Staff Development and Staff Secondment components for the two faculties, respectively. Each Asmara committee is headed by a chairman and has well-established and experienced researchers from different scientific/technical fields as committee members. An executive secretary (ES) for each committee is responsible for the administration and management of the Swedish part of the co-operation. In Asmara there is one Project Team – responsible for the management of the project – and one Internal Steering Committee composed of faculty members from the different departments, and representatives of local institutions. A sketch of the structure of the co-operation between the engineering Faculty of UA and KTH is shown in Appendix 9.

The Asmara Committees at UU and KTH are very valuable, because they represent quality, authority and experience within the subjects of interest, and are strong links to UU and KTH, respectively. It is important that the committee members have a high appreciation within the university systems, since this raises the status of the co-operation in the eyes of the other scientists. The executive secretary/co-ordinator gives service to each of the committees (writing the minutes for the meetings, and keeping the information on the staff development and staff secondment updated etc).

10.2 Cost-effectiveness.

The PhD education of the Asmaran students has been very cost-effective as compared to Swedish PhDs. According to the "breakdown of costs for jan–dec 2000" made by ISP, the cost for a scholarship PhD student for a whole year is usually in the range of 130.000–160.000 SEK, unless there are extra expenses for family or luggage. This sum includes scholarship, rent, travel, insurance and term fees, and a very modest bench fee for the research groups who have the daily responsibility for and contact with the students, and support them with equipment, room, laboratories etc. The cost of the Eritrean students is very modest in comparison with the actual cost for the Swedish PhD. In a Swedish report (SOU 2000:82) figures up to 800.000 SEK per year are mentioned for students in experimental research fields, and in an answer to this report Chalmers University of Technology appreciated the true costs for a PhD student to 750.000–900.000 SEK per year. These sums include costs for supervision of the student and equipment, office space etc. However, when making this comparison one should keep in mind that there are important differences between the scholarship holders from Eritrea and the doctoral students in Sweden. The Eritreans have a very modest scholarships (of the order of 6.000 SEK/month + rent for room) and the Swedish students are paid regular salaries,

(of the order of 15.000–20.000 SEK/month), which are subject of taxation. The Swedish PhDs are themselves responsible for their housing., whereas cost for rent is included in the figures for the Eritreans. – However, a major difference in the calculated costs of the Swedish PhDs and the Eritrean students lies in the estimated financial support given to the research departments in which the students actually work. Thus, the total bench fees to the research groups in UU for more than twenty students in the year 2000 was only 20% larger than the administrative costs for ISP (834 kSEK versus 701 kSEK). It is also worth noticing that the bench fees to the departments have remained the same (2.800 SEK/month for the lowest paid departments) for many years, while the administrative costs at ISP increased by 14% from 1999 to 2000. – My conclusion on this point is therefore, that the research departments are kept in a very tight position with no extra allowance for supervision or expenditures for the Eritrean students. There is a high cost for the ISP administration and management (corresponding to the total costs for about five Eritrean PhD students), and it is not obvious why the administration in Sweden is necessary at a semi-central level, or why the cost should be of the same magnitude as the bench fees for some twenty departments in daily contact with the students.

Estimates of the "true" costs for a Swedish PhD student at KTH are very similar to those quoted above, about 850.000 SEK per year (see also SOU 2000:82). These costs include salaries, supervision and guidance, PhD courses, and infrastructure (administration, rent for office and labs, telephone, access to instrumentation etc) at the university and department levels. A conclusion from KTH is that the engineering faculty supports the Eritrean students with about 200.000 SEK/y, and the research group/department gives a support of the same order of magnitude. Thus, a substantial financial support from the university is needed for the Eitrean PhDs. The costs can be borne if the student is involved in research activities that are also supported by other means (for example projects financed by research councils etc). If this is the case the student "pays back" with the work he/she devotes to the project. Both parties are then in a win-win situation, which will be the case if they share the same research interests. This situation is most easily achieved if there is a long-term co-operation at the department/research group level, which ensures that also other resources are allocated to the research areas in which the Eritrean students are involved.

10.3 Comments on the contents of the co-operation.

In the agreements between Sida/SAREC and the three universities (UA, UU and KTH), the word "co-operation" is often mentioned. The idea of this is that a "win-win" situation should develop. The benefit of the co-operation for UA is not difficult to see (staff secondment, staff development, development of teaching and research facilities etc). I have asked the Asmara committees about the benefits for the Swedish partners, and there were some statements on "insight, understanding of the situation in an African country, broadening of perspective" etc. Obviously, the respective university (UU and KTH) will also get recognition by Swedish authorities for the MSc and PhD examinations at their universities. – The Asmara committee at KTH, however, made a highly relevant remark concerning the challenging environment in Eritrea in many of the vital research areas, which are under discussion with the Engineering Faculty at UA (alternative energy, water resource management, wastewater treatment, rural electrification, hazardous pollutants, environmental chemical engineering, expansion of telecom services, sanitation etc). In these areas there is a potential for conducting co-operative research projects in Eritrea from which both parties will benefit. A similar observation can be made concerning the co-operation with UU; Eritrea has unique natural resources in the botanical, geological, oceanographic and marine areas, and many natural scientists in Uppsala feel the challenge to take part in collaborative research in projects related to these areas.

In the documents from the Asmara project there is little information on a possible linkage between the two cornerstones – staff development and staff secondment – which have been in focus at the University of Uppsala during the time of co-operation. I expected to find the names of the secondants in the list of publications from the Asmara University, but this seems to be the case only to a very limited extent. There is undoubtedly an added value, if for example the supervisors of the Asmaran PhD students can act as secondants in UA. Furthermore, the answer was negative or hesitant to my question, whether any Swedish PhD students had conducted field studies together with the Asmaran PhDs in Eritrea.

In my view many of the problems encountered in lack of communication, recruitment/acceptance of secondants, lack of linkage between the staff development and staff secondment could be overcome if research groups/departments in the two countries are involved in joint research projects. Such an approach would mean that the administrative burden at ISP could be decreased considerably, and that the project co-ordinator and the Asmara committees would be given the task to link the proper Swedish research groups to the corresponding research groups in UA. The research groups/departments in Sweden would have to pass on relevant documentation on budget and progress of the PhDs directly to the Asmara administration, but this information already exist at department levels in Swedish universities. The role of the Asmara committee and the project co-ordinator would be more active than today, in finding and "matching" the "right" research groups/departments. (To my understanding the Asmara committee at KTH are already thinking along these lines). A special challenge for the committee and co-ordinator would also arise if south-south co-operation between UA and research groups in some other African countries are linked into the research tasks.

– One can envisage a scenario for the future in which UA itself will do the necessary administration and bookkeeping of the programs in close contact with the co-operating research groups, and in which the Asmara committees and their co-ordinators can direct their efforts to development of research programs and educational programs, curricula and general PhD courses, and also act as "headhunters" and make contacts with relevant research environments in both north and south. The overriding question is which degree of "maturity" or preparedness to meet the demands on 1) scientific quality and productivity, 2) communication, 3) timing, 4) foresight and 5) response that exists at the University of Asmara. The final stage must be that UA itself is in full control over the resources given to support the two institutions (Science and Engineering). How soon this final stage can be reached is, however, dependent on many factors, of which some of the more relevant have been discussed in the preceding paragraphs. Already during the next three year period some new development can be recommended in the more prominent research areas, for which MSc and PhD education, true sandwich PhDs, establishment of group-group partnership etc should be put in place.

10.4 Comparison with other "forms" of co-operation

The "linkage model" in the College of Science has served as a model for the support of other institutions to the University of Asmara and is also a model for Sida/SARECs support to the Faculty of Engineering (See Appendix 2). There are many other forms of support for research, for example university support without linkages or "shadow faculties," support to specific programs, support to research centres, to networks etc. In my view, one of the most important aspects of support to education and research in developing countries is, is that it should *not be donor-driven*. There are many examples of projects or programs started/initiated by donors, to which the scientists in the developing countries adapt, even though the project/program may not be the optimal one and would not be carried out if they were completely free to chose. As far as I understand the intention from Sida/SAREC the co-operation projects with UA are intended to be Asmara-driven. The "shadow

faculties" are expected to give advice and support in matters where they have more experience, and are thus intended to be an asset for the developing country. This means in practice, that the "shadow faculty" will have a big influence on the education and research in the supported faculty as long as it gives good advice. From the perspective of the real donors – the taxpayers –, however, it is also important that the output of the invested money can be identified and that the money has been used in an efficient way.

In Sweden, the ethical values of the population also include some of the aspects mentioned above, namely democratisation, equality, gender balance, poverty alleviation (social and economic development), and sustainable society. – An alternative to the "linkage model", which is also applied by SAREC/Sida is that of university support (for example to the University of Dar Es Salaam), without "shadow faculties". In this model the university has a freedom to build up the capacity in the university according to a plan (and budget) which is discussed extensively with SAREC/Sida, and closely followed by Sida/SAREC staff during the fiscal years. From my perspective it is too early to tell which of these two models is best, but one might foresee a gradual development from a linkage model to a faculty support model without "shadow faculty", as the University of Asmara becomes more and more independent.

The advantage with the linkage model is that the "shadow" faculty" takes on a responsibility for the linked faculty which goes beyond what one normally expects. There is a commitment from UU and KTH; and there is someone to "lean against" if problems arise at UA. The drawback is that the model limits the number of available co-operation partners in Sweden and elsewhere to those selected by scientists/institutions in Uppsala and Stockholm. If south-south co-operation is included in the model, and if the Asmara Committees stimulate the co-operation between relevant research groups as discussed above, the limitations may not, however, be serious.

11 Impacts of the Sida/SAREC support

The impact of the Sida/SAREC support on the University of Asmara, and in particular on the College of Science is clearly seen in the tables and figures of the preceding paragraphs, and there is no need to repeat the achievements in undergraduate, MSc or PhD education here. Sida/SARECs assistance to the thematic project areas in science, namely Geophysics, Medicinal Plants, and Materials Science, has also contributed to the progress and in developing the research capacity by providing some of the necessary facilities. The quantitative results, as well as the development of new curricula, university library, laboratory facilities, staff and new departments speak for themselves. In a country like Eritrea, where much of the infrastructure in the country was ruined by war, and a large part of the population (approximately 80%) is illiterate, the impact is especially significant.

An impact from the "linkage project" in the Science College is the stimulus this model has had on the co-operations of other faculties and units in UA (See Appendix 2). The experiences from the Science College are taken care of and implemented in the new co-operation between the Engineering Faculty at UA and KTH.

The Eritrean government emphasizes two very urgent needs, the need for infrastructure and the need for qualified manpower. Both these needs are essential for the economic and social development of the country. In the previously mentioned "Eritrean Human Resources Development Project (EHRD CR 3003-ER) more than 1600 vacancies in need of educated staff at central ministries and the University of Asmara itself were identified. Among these is a substantial number of secondary school teachers, and the College of Science is responsible for the science components in the teachers training. The need for infrastructure includes many of the areas in focus within the Faculty of Engineering. This faculty, in turn is dependent on competence in the basic sciences in the College of Science.

There is a very close collaboration between the University of Asmara and the Eritrean ministries and their laboratories. Thus, for example, staff from the ministries take part in curriculum development and in other bodies governing internal matters in UA, and the dean in the Faculty of Engineering is active in the Board of Eritrean Standards Institution (ESI). ESI is responsible for evaluation of standards in for example Food and Agriculture, Electrical, Building and Civil Engineering, and for performing quality tests and issuing certificates. The undergraduate students do experimental work in the labs of the authorities, and undertake project work suggested by staff at the ministries, which in effect means that there is an impact of the Engineering education on society early in the education.

Another possible impact in the future will be that of contribution to the industrial development (textile industry, environmental technology, mining/mineral prospecting, IT industry etc). This is, however, more of a potential impact and has not been put into practise yet.

Acknowledgement

The author of this report is very grateful for the willingness to share experiences, ideas and material from the parties involved, namely SAREC/Sida, the University of Asmara and the Asmara committees at Uppsala University and KTH. (for contact persons during the evaluation, see Appendix 1)

Appendix 1

Contact persons during the evaluation

At the University of Asmara:
Dr. Wolde-Ab Yisak, President
Dr. Tewelde Zerom, Director of Strategic Planning & International Projects Coordination
Dr. Beraki Woldehaimanot, Acting Dean, College of Science
Dr. Mengisteab Manna, Dean, College of Engineering
Dr. Tesfamichael Haile, Chairman, Department of Chemistry
Dr. Ghidei Zedingel, Chairman, Department of Mathematics
Dr Woldai Ghebreab, Chairman, Department of Earth Sciences
Engineer Mussie Dawit, Chairman, Department of Computer Science
Ms. Yordanos Ghebreselassie, Department Head, Department of Computer Science
Mr. Biniam Ghebremichael, Lecturer, Department of Computer Science
Dr. Ghebrehiwet Medhanie, Chairman, Department of Biology
Dr. Chandu Venugopal, ChairmanDept. of Physics
Mr. Tewodros Tekeste, Chairman, Dept. of Civil Engineering
Mr. Mequanint Ablel, Chairman, Dept. of Electrical Engineering
Mr. Teclemariam G/Dngl, Chairman, Dept. of Mechanical Engineering
Mr. Assefaw Abraha, Chief Librarian
Ms. Lemlem Asfaha, Manager, Project Accounts
Ms. Ghenet Merhatsion, Internal Auditor

In Asmara official organisations outside the UA:
Minister Mr. Abraha Asfaha (Minister of public work)
Consulate of Sweden Lis Truelsen (Honorary Consul Sida Liaison)
Mr. Samuel Baire From Ministry of Energy and Mines

At KTH:
Members of Asmara committee:

Prof. Ingmar Grenthe
Ass prof. Bengt Finnström, Executive Secretary
Prof. Gunnar Jacks
Prof. Erik Granryd
Univ lecturer Olle Wahlberg
Univ lecturer Lennart Nilsson

Students:
Mr. Futsum Hailom – materials & manufacturing
Mr. Ghirma Siele – computer engineering

At Uppsala University:
Students:

Ermias Azeria – biology
Jemila Seid – statistics
Kidane Yemane – computer science
Lijam Zemichael – seismology
Kidane Asrat – mathematics
Samson Keleta – physics
Mehereteab Tseggai – physics

Supervisors/secondants:

Ass prof. Pia Thörngren, supervisor
Ass prof. Roland Tellgren, secondant and ass supervisor
Fil. lic. Kent Saxin Hammarström, secondant

Asmara committee:

Prof. Bengt Gutafsson
Prof. Christopher Talbot
Prof. Kersti Hermannsson
Ass prof. Mats Thulin
Ass prof. Staffan Wiktelius, Executive Secretary

At Sida/SAREC:
Dr. Per-Einar Tröften
Dr. Berit Olsson
Dr. Anita Sandström
Dr. Afzal Sher
Mr. Anders Trydell
Mrs Santa Nockrach

Persons whom I did not meet in person but with whom I had e-mail and telephone contact:
Prof. Sten Kaijser, Asmara committeee, Uppsala
Prof. Mohammed Hassan, TWAS, Trieste, Italy

Appendix 2

Status of Linkage Projects: Academic Years 1997–98 to 1999–00

Project	Linkage Institution(s)	Funding Agency/ Country	Status
Agriculture	Norway, Wageningen	NUFFIC/Netherlands NORAD/Norway	Project activities are on target save for delays in infrastructure project. Secondment not successful.
Arts & Social Sciences	University of North Carolina, Florida, UCLA	USAID/USA	Project activities are on target. New and revised linkage proposal discussed with partner.
Business & Economics	Cornell, Groningen, Tilburg	NUFFIC/Netherlands USAID/USA	Project activities are on target save for senior staff secondment. Some students absconded. Delay in implementing linkage with Cornell & W. Michigan.
Central Administration	Delft, Groningen	NUFFIC/Netherlands	Project activities on target. Software packages selected. Fiber-optic network to be up & running.
Education	Royal Danish U.E.	DANIDA/Denmark	At initial stage.
Engineering	New South Wales, Royal IT, Stockholm	AusAID/Australia SIDA/Sweden	One of the most successful of projects. Phased out due to lack of funding. New linkage with Royal IT.
Health Sciences	Bologna State University of New York Berkeley and Jokhns Hopkins	Ministry of Foreign Affairs/Italy USAID/USA	Project activities on target except for infrastructure delay. Linkage with Bologna in jeopardy and delays in consummating consortium agreements.
Law	University of North Carolina, UCLA, Trento	USAID/USA University of Trento	Project activities on target. Delay in implementing agreements.
Marine Biology And Fisheries	Groningen, Wageningen	NUFFIC/Netherlands	Project activities on target. Delays in construction. Research boat acquired. Second phase ready.
Science	Uppsala	SIDA/SAREC Sweden	Project activities on target. First phase reviewed, and second phase discussed—approved, adopted.

Appendix 3

College of Science

Staff Development participants (trainees)

Department	Name	Start date	Degree sought	Field of study
Biology	Maedot Waka	Sept. 1997	MSc	Invertebrate Zoology
	Simon Haile*	Jan. 1998	MSc	Vertebrate zoology
	Ermias Tesfamichael	Sept. 1997	MSc	Animal ecology
	Ghebrehiwet Medhanie	Sept. 1994	PhD	Systematic botany
	Kifle Ghebreab	Aug. 1999	MSc	Ecotoxicology
	Yonas Isaak	Aug. 2000	MSc	Zoology
Chemistry	Senait Ghirmay	Sept. 1997	MSc	Organic chemistry
	Paulos Eyob	Jan. 1998	MSc	Inorganic chemistry
	Giorgis Isaac	Sept. 1998	MSc	Analytical chemsitry
	Daniel Goitom	Aug. 2000	MSc	Instrumentation
Computer Science	Kidane Yemane	Sept. 1997	PhD	Software engineering
	Biniam Gebremichael	Sept. 1997	MSc	Computer science
	Yordanos Ghebreselassie	Jan. 1998	MSc	Computer graphics
Earth Science	Woldai Gebreab	Sept. 1994	PhD	Structural Geology
	Daniel Gebretatios*	Sept. 1994	PhD	Seismology
	Semere Solomon	Sept. 1997	PhD	Remote sensing
	Mekonnen Abraham	Sept. 1998	MSc	Economic geology
	Estifanos Haile	Aug. 2000	MSc	Hydrogeology
	Ibrahim Abubeker	Aug. 2000	MSc	Sedimentology
	Lijam Zemichael	Jan. 2001	PhD	Seismology

Mathematics	Abraham Zemui	Sept. 1997	PhD	Applied maths.
	Kidane Asrat	Jan. 1998	MSc	Discrete maths.
	Tsehaye Kahsu	Jan. 1998	PhD	Complex analysis
	Habtai Gebrewold*[1]	Sept. 1995	PhD	Algebra
	Senait Ghirmai B.	Aug. 1999	MSc	Topology
Physics	Frezghi Habte	Jan. 1995	PhD	Electronics
	Tuquabo Tesfamichael*	Jan. 1995	PhD	Renewable Energy
	Bereket Neway	Jan. 1998	PhD	Polymer physics
	Samson Keleta	Aug. 1999	MSc	Radiation Physics
	Mehreteab Tseggai	Aug. 2000	PhD	Materials Science
Statistics	Musie Sium*	Jan. 1998	MSc	Design exp.
	Jemilia Seid	Jan. 1998	MSc	Stat. comp.
	Habte Teweldeberhan	Sept. 1997	PhD	Biometrics
	Gebremariam Woldlemichel	Jan. 1995	PhD	Demography

* Absconded/left the program on their own initiatives

*[1] Broke off his training in Sweden on personal problems; now in a South African University

Appendix 4

Senior faculty in the College of Science who participated in the Staff Development program

	Name	Department	Period
1.	Dr Wezenet Tewodros	Biology	14/6/–11/9/97
2.	Dr Berhane Ghirmai	Chemistry	14/6/–11/9/97
3.	Dr Younis M.H. Younis	Chemistry	20/5/–29/8/97
4.	Dr Beraki Woldehaimanot	Earth Science	2/6/–24/9/97
5.	Dr Tesfamichael Haile	Chemistry	06/99–09/99

Appendix 5

Staff development participants who returned to the University of Asmara after completing their studies

Name	Date started	Date completed	Degree earned	Specialization
Ghebrehiwot Medhanie	1994	2000	PhD	Systematic botany
Gebremariam Woldlemichel	1995	2000	PhD	Demography
Woldai Ghebreab	1994	2000	PhD	Tectonics/Structural Geol.
Biniam Gebremichael	1997	1999	MSc	Computer science
Kidane Yemane	1997	1999	MSc	Software engineering
Ermias Tesfamichael	1997	2000	MSc	Animal ecology
Maedot Waka	1997	2000	MSc	Invertebrate Zoology
Senait Ghirmay	1997	2001	MSc	Organic chemistry
Yordanos Ghebreselassie	1998	2001	MSc	Computer graphics

Appendix 6

Staff Secondment: participants (1997/98 – 2000/01)

	Name	Discipline	Semester/Academic year
1	Dr Jan Landin	Biology/Entomology	II/1997/98
2	Dr Jan Lagerlof	Biology/Ecology	II*/1998/99; II/1999/2000
3	Dr Christer Wiklund	Biology	II/2000/01
4	Dr Solomon Tesfalidet	Chemistry/Analytical	II/1999/2000
5	Prof. Roland Tellgren	Chemistry/Inorganic	II/1997/98; II*/1998/99; I/1999/2000
6	Mr Hammarstrom, K.S.	Computer Science	II/1999/2000
7	Dr Risto Kumpulainen	Geology/Sedimentology	I/1997/98; I&II*/1998/99; I/2000/01
8	Dr Leif Abrahamsson	Mathematics	I&II/1997/98
9	Prof. Bengt Gustafson	Physics	I/1997/98
10	Dr Per Norblad	Physics	I/1999/2000

* Evacuated in February '99 due to the conflict between Eritrea & Ethiopia.

Appendix 7

Plans for Staff Development, Faculty of Engineering

Department	M.Sc.	Ph.D.
Civil Engineering	7	4
Electrical Engineering	6	4
Mechanical Engineering	5	5
Architecture & Urban planning	4	-
Chemical Engineering	4	1
Total	**26**	**14**

7.A Plans for Civil Engineering Department

Overview of time schedule

Specialization	Qualification	2000	2001	2002	2003	2004
Sanitary	Ph.D.					
Sanitary	M.Sc.					
Structures	Ph.D.					
Structures	M.Sc.					
Hydraulics	M.Sc.					
Geotechnics	Ph.D.					
Geotechnics	M.Sc.					
Water resources	Ph.D.					
Construction	M.Sc.					
Highway	M.Sc.					
Structures	M.Sc.					

Staff on training

No.	Name	Degree Sought	Expected year of completion	Specialization	Country of Study
1	Kibreab Afewerki	Ph.D.	2000-2003	Sanitary	Sweden (KTH) Funded by SAREC

Staff expected to leave in Aug. 2001 and accepted by the Universities

No.	Name	Degree Sought	Expected year of completion	Specialization	Country of Study
1	Aklilu Angesom	Ph.D.	2001-2004	Water resources	USA
2	Michael Andeberhan	Ph.D.	2001-2004	Geotechnics	Australia
3.	Teclay G/hewot	M.Sc	2001-2003	Structure	Sweden Funded by SAREC
4.	Samson Kifeleyessus	M.Sc.	2001-2003	Construction	Sweden (KTH) Funded by SAREC

Staff Recruitment and Secondment Plan

Specialization	Rank	2000	2001	2002	2003	2004
Sanitary	Professor					
Structures	Professor					
Hydraulics	Professor					
Geotechnics	Professor					
Water resources	Professor					
Highway						
Construction	Professor					
Civil Engineer	Grad. Assist.					

7.B Plans for Electrical Engineering

Overview of time schedule

Specialization	Qualification	2000	2001	2002	2003	2004
Communication & Signal Processing (P1)	Ph.D.					
Electronics & Computer Engineering (P2)	Ph.D.					
Communication & Signal Processing (P3)	Ph.D.					
Instrumentation Engineering (P4)	Ph.D.					
Power, Energy & Electrical Machines(M1)	M.Sc.					
Microwave communications (M2)	M.Sc.					
Instrumentation Engineering (M3)	M.Sc.					
Electronics & Computer Engineering (M4)	M.Sc.					
Communication & Signal Processing (M5)	M.Sc.					
Control Engineering (M6)	M.Sc.					

Staff on Training

No.	Name	Degree Sought	Expected year of completion	Specialization	Country of Study
1.	Dawit Seyoum	Ph.D.	2002	Power and Control Eng.	Australia
2.	Tadesse Ghirmai	Ph.D	2003	Communications & Signal Processing	USA
3.	Ghirma Siele	Ph.D	2004	Computer Engineering	Sweden SAREC

Staff expected to leave in Aug. 2001 and accepted by the Universities

No.	Name	Degree Sought	Expected year of completion	Specialization	Country of Study
1.	Mequanint Ablel	Ph.D.	2002-2005	Communication and signal processing	Sweden (KTH) Funded by SAREC
2.	Abrham Tareke	M.Sc.	2001-2003	Power Engineering	Sweden (KTH) Funded by SAREC

Staff Recruitment and Secondment Plan

Specialization	Rank	2000	2001	2002	2003	2004
Power Engineering	Assistant Prof.					
Microwave Communication	Assistant Prof.					
Control Engineering	Assistant Prof.					
Instrumentation Engineering	Assistant Prof.					
Electronics	Assistant Prof.					
Electrical Engineering (3)	Grad. Assistan.					
Electrical Engineering (2)	Grad. Assistan.					
Electrical Engineering (1)	Grad. Assistan.					

7.C Plans for Mechanical Engineering

Overview of time schedule

Specialization	Qualification	2000	2001	2002	2003	2004
Thermal Engineering	Ph.D.					
Manufacturing Engineering	M.Sc.					
Refrigeration & AC	Ph.D.					
Mechanical Design	M.Sc.					
Thermal Engineering	M.Sc.					
Thermal Engineering	Ph.D.					
Materials Engineering	M.Sc.					
Mechanical Design	M.Sc.					
Mechanical Design	Ph.D.					
Manufacturing Engineering	Ph.D.					
Staff Abroad (A)		2	5	7	7	4

Staff on Training

No	Name	Degree sought	Expected Year of Completion	Specialization	Country of Study
1	Daniel Tesfamariam	Ph.D.	2004	Manufacturing Engineering,	Sweden (KTH) SAREC
2	Futsum Hailom	M.Sc.	2002	Materials & Manufacturing	Sweden (KTH) SAREC

Staff expected to leave in Aug. 2001 and accepted by the Universities.

No.	Name	Degree Sought	Expected year of completion	Specialization	Country of Study
1.	Teclemariam G/Dngl	Ph.D.	2002-2005	Refrigeration & AC	Sweden (KTH) SAREC

Staff Recruitment and Secondment Plan

Specialization	Rank	2000	2001	2002	2003	2004
Materials Engineering	Associate Prof.					
Fluid Mechanics	Associate Prof					
Thermal Engineering	Associate Prof					
Applied Mechanics	Associate Prof					
Mechanical Engineering	Grad. Assistan.					
Mechanical Engineering	Grad. Assistan.					
Mechanical Engineering	Grad. Assistan.					
Secretary	Diploma					

7.D Plans for Chemical Engineering

Overview of time schedule

Specialization	Qualification	2000	2001	2002	2003	2004
Chemical Engineering	M.Sc.					
Chemical Engineering	Ph.D					
Chemical Engineering	M.Sc					
Chemical Engineering	M.Sc.					
Chemical Engineering	M.Sc.					

Staff Recruitment and Secondment Plan

Specialization	Rank	2000	2001	2002	2003	2004
Chemical Engineering	Associate Prof.					
Chemical Engineering	G. Assistants					
Chemical Engineering	G. Assistants					
Chemical Engineering	G. Assistants					
Chemical Engineering	G. Assistants					

7.E Plans for Architecture & Urban Planning

Overview of time schedule

Specialization	Rank	2000	2001	2002	2003	2004
Architecture or Town Planning	Professor					
Architecture and Town Planning	Professor					
Civil Engineer/Architect	Grad. Assist					

Staff expected to leave in Aug. 2001 and accepted by the Universities.

No.	Name	Degree Sought	Expected year of completion	Specialization	Country of Study
1.	Tesfaledet Michael	M. Arch	2001-2003	Urban design	Italy

Appendix 8

Student Enrolment and Sex Gender for Civil Engineering Department

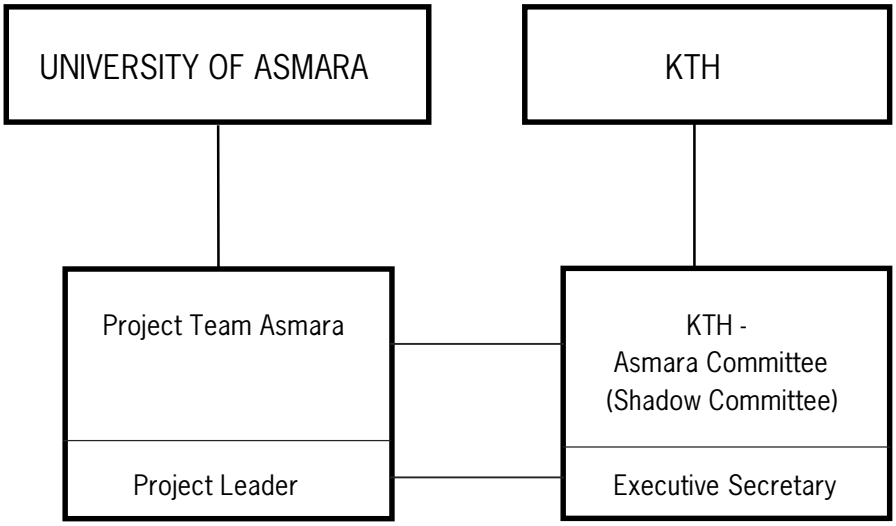
	Second Year		Third Year		Adv. Standing		Total		No of Grad.
Ac. Year	M	F	M	F	M	F	M	F	
1995/96	20	1	-		-		20	1	-
1996/97	22	2	20	1	-		42	3	
1997/98	22	1	22	2	-		44	3	21
1998/99	45	2	22	1	-		67	3	24
1999/00	51	5	43	2	42	3	136	10	

Student Enrolment and Sex Gender for Electrical Engineering Department

Ac.year	second year M	F	Third year M	F	Adv. Standing Fourth year M	F	Total	No. of graduates
1995/96	13	1	-	-	-	-	14	-
1996/97	18	-	12	1	-	-	31	-
1997/98	13	1	18	-	-	-	32	13
1998/99	31	5	13	-	-	-	49	18
1999/00	40	1	29	5	27	1	103	

Appendix 9

Sketch of the cooperation between UA and KTH



Appendix 10

Monographs, Books and Publications (on refereed International journals) by Eritrean Academic staff, College of Science [1992–2001]

Biology

Bremer, B., H. Eklund, **Medhanie**, G. S. Heidmarsson, N. Laurent, J. Maad, J. Niklasson, and A. Nordin, 1996. On the delimitation of *Matricaria* versus *Microcephala* (Astraceae:Anthemideae). Plant Syst. Evol., 200:263–271.

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Physics

Karmhag, R., **Tesfamicael**, T., E. Wackelgard, G.A. Niklasson and M. Nygren, 2000. Oxidation kinetics of Nickel particle. Comparison between free particles and particles in an oxide matrix. Solar Energy 68:329–333.

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Woldemichael, G., 1996. Demographic situation in Eritrea. Year book of Population Research in Finland 33.

Beraki Woldehaimanot (PhD)
Dean, College of Science

Asmara, June 25, 2001

Appendix 11

Acquired Teaching (Laboratory)/ Field Equipment

In this section, a list of the main items of laboratory equipment acquired by the departments of the College are given (Laboratory supplies and smaller items are not listed here).

1. Department of Biology

Laboratory equipment	Quantity
Freshman laboratory equipment	Complete Equipment for the lab
Microscopes (with accessories)	14
Entomology equipment	Complete set
Microcentrifuge (model 16km)	4
Soil PH and moisture tester	1
Soil salinity tester	1
Moisture and light meter	1
Micropipeetes (various volumes)	12
General purpose Refrigerator	2
Thermometer	4
Hand tool set	1
Overhead projector	1

2. Department of Chemistry

Laboratory equipment	Quantity
Freshman laboratory equipment (Two fume hoods, distiller, ice maker, oven, glassware)	Complete lab
FT-IR 410 (Jasco)	1
Flame Photometer - Gallenkamp	1
Polarograph (Radiometer POL 110-trace lab10)	1
Spectrophotometer (Spectronic Genesys 5)	1
GC-MS (Shimadzu QP5050A)	1
Double-beam Spectrophotometer (UV/VIS, CESIL 9500)	1
Bonb-Calorimeter (Gallenkamp)	1
Teaching Model HPLC	set
X-ray diffraction Camera - XDC-700	1
Furniture for analytical lab.	Complete set
Chemicals and glassware	set

3. Department of Computer Science

Laboratory equipment	Quantity
Server Pentium III	2
Workstation Pentium III & II	74
Network and communication devices	-
Software	-
Accessories (stabilizers, UPS, furniture etc.)	-

4. Department of Earth Sciences

Laboratory/field equipment	Quantity
Mirror Table Stereoscopes	17
Photomicrograph Camera	1
Lab demonstration aids: fossil specimen, thin sections, hardness pencils, crystal models, mineral specimen, fracture & fault model	Each 2 set
Field instruments/materials: GPS, Altimeters, hand lenses, streak plates, camping tents etc.	Sufficient for a group of 25 students
Seismographs	For three stations (Aba Selama, Ira, Massawa)
Lab furniture	Furniture for petrography and photogeology labs
Metal scaffolds for rocks and field equipment	6 units
Slide projector	2
Overhead projector	2
Dot matrix printer	1
Laser printer	1
Pentium II computers	2

5. Department of Mathematics

Laboratory equipment	Quantity
Pentium III Computers	6
Printers	3
Computer supplies	-
Lab furniture	Complete for a small lab

6. Department of Physics

Laboratory equipment	Quantity
Freshman laboratory equipment	Complete Equipment for the lab
X-ray spectrometer (KAT- 554-61)	1
MATEC Ultrasonic equipment (model 7700)	1
Light transmitter and receiver (model 47630)	1
Hall effect apparatus (model 58681-84)	1
Millikan oil drop apparatus	3
Electric calorimeter	3
UV digital wave sensor	1
Short, medium, and long wave sensors	3
Galvanometer OG-E66a	1
Electric oven for Frank hertz tube	3
Solar collector and solar cells	1, 10
Hand held lux meters and lux sensors	5,5
Pentium lll & ll computers (one with CD writer)	5
Laser jet printer	1

Appendix 12

Faculty of Engineering

Department of Electrical Engineering
Procurement of Elelectrical Lab Equipments and Softwares

NO	Type of Equipment and Description	Quantity			
				Est. Unit price	Est. Total price
1	**DC/AC Power Supply** Out put Voltage : -15V- 0V- 15V Out put Current : 0 - 5A Constant current/voltage operation Power requirements: 110/220VAC@ 50/60HZ 2A@ 250V fuse	2		$700	$1400
2	**Stabilized Power supply** Output Voltage 0-60V DC Output Current 0-3A DC Low Noise, High Stability Digital Voltage/current display	2		$1702	$3404
3	**Power supply:** Output voltage: 0 - 600V DC Output current: 0 - 1.5A Digital Current/ voltage display	1		$980	$980
4	**Multi-range analog multimeters:** Shock proof case 30V AC and DC V DC: 0 to 120mV,3, 30, 120, 300, 600, 1000 V AC: 0 to 3, 30, 120, 300, 600, 1000V A DC: 0 to 240µ, 60m, 300m, 1.2, 6 , 30A A AC: 0 to 60m, 300m, 1.2, 6, 30 Ohm RX1, RX10, RX100	5		$500	$2500
5	**Multi-range digital multimeter :** Auto power off Input warning beeper and 10Mohm impendance AC Voltage: 200mV – 750V DC Voltage: 200mV - 1000V Resistance: 200Ω - 20MΩ Frequency: 2KHz – 20MHz Capacitance: 20µf - 200µf	4		$99.95	$199.80

	Inductance: 20mH – 20H Continuity test and diode test, TTL and CMOS logic test Include test probes and 9V battery Include maintenance and operational manual				
6	Two-channel Oscilloscope: Vertical deflection: 5mV/DIV – 5V/DIV in 10 calibrated steps Bandwidth: 0 – 20MHZ Input impendence: 1MΩ Horizontal deflection: 2μs/div to 0.2s/div in 19 calibrated steps X-Y operation: sensitivity 5mV/DIV – 5V/DIV Max signal input voltage: 250V (DC and peak AC) Display mode: CH1, CH2 , Dual, ADD Triggering: trigger coupling, Ac/DC, HF, REJECT, TV trigger slope Z-axis input impendence: 5KΩ sensitivity about 3Vp-p Include maintenace and operational manual	4		$400	$1600
7	**Oscilloscop probe:** BNC male connector Hook and pointed probe Alligator clip ground wire Max: 600VDC Atten: X1, X10 BW: 3MHz, 40MHz Input impendance: 1MΩ,/180pf and 10MΩ/22pf	10		$18	$180
8	**Pomona Test Lead holders:** Max cable dia: 0.45 inch 11 inch length	10		$6.25	$62.5
9	**BNC Male Test Cable:** -Upper Connection: Two alligator clips red and black -Lower connection 23 inch RG/58U Cable with male BNC connector	20		$2.5	$50
10	**55 piece tech toolkit:** Include the following parts -3-pieces soldering aid kit -3 prong holder -7 way crimping tool -6 precision screw drivers -7 piece hex key wrench -30 watt soldering iron	1		$119.95	$119.95

	-adjustable wrench -anti-static strap -bent needle nose pliers -brush -carrying case has outer Velcro pockets to store paperwork, etc. -desoldering pump -diagonal cutting pliers -8inch lineman's pliers -screwdriver handle -6 piece mini-hammer set -5 piece of double edge blade				
11	**Alligator Clip Leads**	5		$2.75	$13.75
12	**Banana to Banana Test Leads**	2		$20.00	$40.00
13	**Storage Oscilloscope 100Mhz:** - has digital storage mode -Bandwidth: DC to 100MHz repetitive, 2 channel simultaneously DC to 29MHz single shot, each channels sampling at 100MS/s Non storage modes: BW: DC to 100MHZ, 1mV/div to 5V/div Time base: 2ns/div to 0.5V/div Sweep magnification X1, X5, X10, X50	1		$1500.00	$1500.00
14	**Decade resistance:** Large rotary switches Range 1Ω to 100MΩ in 8 decades, 0.1%	4		$300.00	$1200.00
15	**Decade capacitance:** Large rotary switches Range: 0.1nf - 1000microfarad in 8 decades, 1%	4		$300.00	$1200.00
16	**Decade inductance:** Large rotary switches Range: 0.1mH – 10H in 8 decades, 0.5%	4		$300.00	$1200.00
17	**Function Generator:** Frequency range: 0.02Hz – 2MHz Waveforms: Sine, triangle, square, ramp, TTL pulse, skewed sine Variable waveform/duty cycle symmetry Amplitude 20Vp-p (no load) , 10Vp-p (50Ω) Attenuator: -10, -20, -30db DC offset: -10V - 0 – 10V	3		$200.00	$600.00

	Linear sweep control from 1:1 to 100:1 Power requirements: 110V/220V, 50/60Hz, 20W				
18	**Op-amp** Dual 747	100		$0.22	$22.00
19	**OP-amp** Dual 741	50		$2.75	$137.5
20	**BJT Transistor** NPN, Vceo = 40V, 100@10mA, F_t = 300MHz, 2N3904	20		$0.09	$1.80
21	**BJT Transistor** PNP, Vceo = 40V, 100@10mA, F_t = 250MHz 2N3906	20		$0.09	$1.80
22	**BJT Transistor** NPN, Vceo = 40V, 100@150mA PN2222A	20		$0.16	$3.20
23	**BJT Transistor** PN2907A	20		$0.16	$3.20
24	**J-FET Transistor** J176	20		$0.35	$7.00
25	**J-FET Transistor** 2N7000	20		$0.29	$6.00
26	**J-FET Transistor** MPF102	20		$0.35	$7.00
27	**Transistor** NPN, Small signal RF/VHF/UHF transistors, Vceo 25V, 60@4 KSP10-FSC	20		$0.17	$3.40
28	**Transistor** NPN, Small signal HIGH VOLTAGE transistors, Vceo 300V, 40@10 KSP42-FSC	20		$0.23	$4.60
29	**Transistor** PNP, Small signal HIGH VOLTAGE transistors, Vceo -300V, 40@10 KSP92-FSC	20		$0.23	$4.60
30	**Darilington Power Transistor** NPN, Vceo = 100V , 1000@3A TIP102-SAM	20		$0.62	$12.40
31	**Darilington Power Transistor** PNP, Vceo = -100V , 1000@3A TIP107-SAM	20		$0.62	$12.40

32	**Transistor** PN5179	20		$0.55	$11.00
33	**AM Radio Trainer:** -Comparising 2 open-band units, a generator & receiver. Both units provision for implementing at least 8 common faults. Instruction manual containing at least 12 practical activities Provision for receiving normal broadcast signals.	1		$1250.00	$1250.00
34	**FM Radio trainer** a pair of open board units, one an FM stereo generator, the other an FM stereo receiver the receiver circuits operate over the range 80 – 110MHz, the generator provides a fixed output frequency of 100MHz with a 19KHz pilot tone Both units provide for implemtation of at least 12 common faults Provision to receive normal broadcast signals	1		$1250.00	$1250.00
35	**Antenna System Demonstrator:** Transmitter frequency 167.2MHz Power 0 – 5watts output Termination Approximately 50 ohm unbalanced Antenna size: 1150mm by 840mm Aluminium Constructed from 23 nickel-plated brass rods in various shapes 3 rods containing a lamp every 12cm, 1 flat sheet of aluminium containing a slot Voltage and current detector Display: Linear LED. Power supply: 5 volts from internal battery recharged from transmitter	1		$9,000.00	$9,000.00
36	**Telephony system Tutor:** Comparises Rapid Access Terminal (RAT) Telephone and interface board TDM/PCM board	1		$8,750.00	$8,750.00
37	**Transmission Line demonstrator:** power supply 200-250V 50/60Hz Display LED columns indicating positive and negative voltages at 13 positions Propagation time switch 0.25s, 0.5s,2s at zero attenuation representing line lengths L, 2L, 8L respectively. Transmission Line demonstrator using a simulated line to demonstrate visually at low frequencies the high frequency characteristics of a transmission line.	1		$4,205.00	$4,205.00

	Include manual of practical demonstrations and assignments covering all the important aspects of these characteristics Include maintenance and operation manual				
38	**Servo Trainer:** Analogue & Digital servo trainer with discovery software For open and closed loop speed and position control Inbuilt PC based information On board sine, square, and triangle waveform generator Linear motor drive, LCD speed and digital voltmeter, software for computer aided practical assignments	1		$5000.00	$5000.00
39	**Transducers Kit** employs at least 12 different kinds of transducers of wide variety includes instrumentation section At least 20 expriments A suitable poer supply is necessary Current less than 10ma, the 15V may be obtained from the sensor	1		$3500.00	$3500.00
40	**MATLAB Software:** MATLAB 6 with SIMLINK 4 Release 12 Professional version	1		$3000.00	$3000.00
41	**Communication Simulation Software: ACOLADE**	1		$2000.00	$2000.00
42	**Electronic Design and Analysis simulation software** -Pspice 9.2 professional version	1		$1000.00	$1000.00
43	**Electronic workbench:** Students version	1		$500.00	$500.00
44	**Power Systems simulation software:** POWER SYSTEM BLOCKSET	1		$2000.00	$2000.00
45					

Appendix 13

Extract from a 148 pages long document describing the education and curricula within the different departments of the College of Science curricula:

University of Asmara
College of science
Department of computer sciences

Revised (2) Curriculum for a Bachelor Degree in Computer Sciences
September 2000

1. BACKGROUND

As the Industrial Revolution that began in Europe more than 200 years ago reaches its conclusion, a new one is taking over: The communications and media revolution. It is to be noted that it began as recently as the 1970s and since then has succeeded in penetrating every aspect of our lives.

The different forms of mass communication characterize and influence our lives. We all recognize this fact with regard to radio, television or newspapers. However, in the last few years, what has characterized this revolution more than anything else has been the penetration of computers – large ones, small ones, portable ones – into every aspect of our lives; computers, banks, offices, supermarkets, in small stores, private homes and educational institutions.

Eritrea is facing the challenge of how to integrate modern technology along with basic industries, essential to its economic growth, in order to enable the country to be part of the larger world of communications.

Computerized information systems and computing technologies have attained a central status in all fields, to such an extent that certain fields are totally dependent upon computers in everyday functioning. The management of a modern state requires its leaders to develop and uphold national and dedicated information systems that will assist the government in making decisions concerning their strategic needs, that will supply effective tools for planning and control, and that will enable the various authorities to execute the governments policy on the operative levels, and give services to its citizens.

Effective management, and comprehensive integrative adoption of computerized information systems and computing technologies in the governmental and public sectors require a mechanism which will set up goals, plan, allocate resources, and establish standards and control.

In order to maintain these functions, it is necessary to create adequate administrative and organizational tools, while at the same time customizing the current computerized information systems to changing needs and technologies.

Such a process must take into consideration subjects like information requirements, problems of hardware and software, data communication, the development of a professional infrastructure, and the imparting of knowledge to both directors and staff.

In addition to these needs of the public sector, there is also the matter of the private sector. As witnessed by the proliferation of private computer companies in Asmara-schools, service bureaus, and retailers – the local demand for computer related business and services is great. With a sufficient number of trained professionals in the area, this segment of the market would have a good economic growth potential.

The development of a national software and computer network services industry especially Internet related services – in Eritrea also has great potential. In this area of business the paramount resource is highly trained and skilled people; as one of the greatest resources of Eritrea is the minds of its people, the possibility of becoming "the software capital of Africa" is quite promising. For this to become a reality though, a substantial population of highly trained and skilled people, and the facilities to train them, is needed, something that is largely missing now.

Finally, with a sufficient number of trained high-level professionals in the area, the country would become attractive to foreign computer related companies looking for a suitable location for African regional offices, headquarters, laboratories, or manufacturing plants, which in turn would boost the economic growth.

In conclusion we would like to mention that we had held a one-day workshop, where we have got interesting advices, or comments. Early introduction of the degree program was the general consensus of the participant.

2. JUSTIFICATION

The development of a country consists of development of its human resources, technology development and optimal utilization of its natural resources. This requires knowledge building and its effective utilization towards developing the new technologies and its implementation. Teaching and research are integral parts of establishing this knowledge base and are the prime duties of institutions of higher education. Primary and secondary schooling provide the basic background for higher education, whereas universities have to provide the latest education on par with international standards, and to produce graduates who have the ability to acquire and evaluate new methods and methodologies as they appear. In this country the University of Asmara has sole responsibility for providing this type of education.

In a university many subjects are taught. Some of these are necessary for mental development, some provide strong background for human resources and some are directly applicable to the productive units of the country. The subject of computer science falls into both the category of directly applicable, and that of providing a human resources background for the productive units.

As already mentioned in the background section, the need for qualified professionals in computer related areas is already large and seems to be constantly mounting. Additionally, as seen in other countries, computer related occupations are one of the good careers for many people with physical disablements, as a computer relatively easily can be adapted to compensate for many activity limitations and for limitations to access.

Currently this need in Eritrea is only met by private, vocational schools. While these can train the needed lower (user) layers within the area, and parts of the middle ones (technicians), there are two main problems with this situation:

- First of all, the cost of such training limits it to the affluent segments of the population.

- Secondly, a higher-level training is missing. This training is needed to critically evaluate, analyze, and deploy information technology, to identify, formulate, and solve new problems with the help of computer technology, to rapidly assimilate new technology and methodologies as they appear, and to make inventions in the field.

Further, if the work force at large is to become familiar with using computer tools, primary and secondary education teachers require training in the elements of computer usage and computer science. This in turn requires highly qualified academicians to train these teachers. Finally, computer science is more and more becoming an extremely important auxiliary subject for other academic disciplines, in the same way that mathematics has been for a long time. Currently, there is little support within the University of Asmara for this intramural function.

Computer science and computer technology change very rapidly, and require the ability to adapt quickly to the changing circumstances. To train human resources for effective use of the technology, according to the needs of the country, is as important as acquiring a new technology. It is against this background that the need to establish a curriculum in Computer Science has arisen. Introductory computer training is not new for the students of the University. Every student takes one or two courses in computer subjects, but this is not sufficient in the present scenario. A full-fledged degree programme in computer science is needed in view of the present and future needs of the country. Without such a programme, the country and its citizens will be limited in their ability to use this new technology, as the work force will at most be able to use whatever technology happens to be current when they are trained. With a degree in computer science, university graduates will be able to:

- Adapt to the rapidly changing circumstances in this area on their own, without need for costly re-training,
- Critically evaluate and implement various solutions based on information technology,
- Train the main part of the work force, whether in lower-level schools or in private establishments,
- Establish new businesses based on the new technology, and
- Contribute to the evolving technology, instead of being passive users of what has been developed elsewhere.

The establishment of a department of computer science will also be in the interest of the various other departments of the University, as it will open a new possible minor in many related areas (business administration, mathematics, psychology, and sociology, to mention a few possibilities).

3. OBJECTIVE

The proposed programme is for a bachelor degree (B. Sc.) in Computer Science, requiring four years of study at the University. The programme should produce graduates who understand the fundamental concepts of computer science and computer technology, and who have the skills and other mental tools required to acquire new technologies as they appear. In a field that changes as fast as information technology does, this is of paramount importance to avoid the need to retrain staff and managers frequently.

The purpose of the programme is to develop and maintain knowledge of and competence in computer science. The programme shall give its graduates the ability to adapt to the rapid changes in the industry, in terms of requirements for knowledge of specific technologies. The programme is intended to satisfy the need of competence in computer science in the industry and in public administration. A

graduate will be able to apply the methodologies and methods of computer science in his/her area, and will after a few years of work experience be able to independently use, evaluate, develop, and deploy new methods and methodologies, and to identify, formulate, and solve new problems.

The main objectives of the proposed department will be to educate and train students in this programme, and to offer certain forms of consultancy services to government agencies, schools, and university departments in evaluating and deploying information technology and in identifying, formulating and solving problems with the help of this technology.

The programme will consist of core courses (both within computer science and within other subjects, such as mathematics and electronics), and elective courses. In addition, the students will take the common, general, and English courses required of all students within the faculty. The elective courses will give the student the opportunity to specialize to some degree, according to their interests, and the core courses will provide a student with:

- A good understanding of the theoretical basis of computer science and its importance in software development,
- An understanding of the principles of computer systems and the applications that run on them,
- Good knowledge of mathematics, especially those areas of relevance to computer science,
- Good ability to identify, formulate, and solve problems with the help of computers and programs that are widely used in industry, engineering, and the sciences,
- Ability to solve problems with the help of computers by creating novel solutions, e.g. new programs,
- Ability to communicate effectively, both orally and in writing, with experts as well as with non-experts,
- A foundation in professional standards for the analysis, design, implementation, testing, and documentation needed in software development,
- Exposure to current and future technologies of networked computing,
- Experience of the group working needed for modern software development by means of group projects,
- Understanding of the use of computers as a part of larger systems, and the security and technical aspects of such uses,
- Knowledge of the interactions between humans and computers and of the effect of computerization on the work place and on society,
- The opportunity to develop practical skills needed for the latest applicable software by means of a senior project,
- A strong background for higher studies in computer science.

Initially, no minor will be available to those majoring in Computer Science due to the large number of courses required for a solid foundation in the field. This may change as the programme gets firmly established.

A minor in Computer Science will be available to other departments after consultation for each individual case.

4. JOB OPPORTUNITIES AND PROFESSIONAL PROFILE

The job opportunities for computer science graduates will be plentiful. As it is know, our country Eritrea lacks trained professionals in this area. Most of the government and private sectors have little or no personnel trained in information technology working for them. We are in a highly advanced technological era where the demand for these graduates will be very high, but few of the Ministries, government agencies and private companies have anyone to maintain or operate their network and communication centres, much less anyone to evaluate and deploy the various technologies. Most of them instead rely on the few computer centres in town. These centres themselves also have very few computer science graduates or computer engineers.

The current proposal is for a degree programme that will produce well-rounded professionals who are competent in their field. This degree shall give the student a various job opportunities in the following areas, among others:

- Information technology requirements analysis and evaluation
- Information technology implementation and deployment
- Computer operation and maintenance
- Network operation and maintenance
- Programming (in-house)
- Communication (e-mail, web technology, ...)
- Software development
- Automating offices and industries
- Establishing and maintaining databases (archives, statistical records, etc.)

We are of the firm opinion that the proposed programme will alleviate the current lack of expertise in this area in the country. All the ministries and authorities should have a resident expert in the computer related area. Most industries are currently using manual labour for their production. Computerisation of these industries would be possible with graduates from this programme. Most of the private companies need experts in this field, a need that the proposed programme could satisfy. With Internet now on its way we need more computer experts who can handle our day-to-day problems. For example, there will be many security and access issues involved in a networked environment.

5. RESOURCES

5.1 Staff on ground and on the pipeline or any other source

Current Staff	Degree	Specialization
Biniam Gebremichael	M.Sc.	Computer Science
Kidane Yemane	M.Sc.	Computer Science
Daniel Berhane	B.Sc.	Physics
Eyob Tsegay	B.Sc.	Mathematics
Eng. Mussie Dawit	M.Sc.	Electrical Engineer

Staff on the pipeline		
Mebrahtu Zemui	M.Sc.	Computer Science
Tedros Weldemichael	M.Sc.	Computer Science
Yordanos Gebresilasie	M.Sc.	Computer Science
Tamrat Woldu Tewoldeberhan	M.Sc.	Computer Science
Michael Hailom	M.Sc.	Computer Science
Yacob Yemane	Ph.D.	Computer Science

See also the attachment at the end of this document for the dates when staff members will leave or return.

5.2 Books and references

See Appendix A.

5.3 Offices and office facilities

Almost all departments of the various colleges of the University are now requiring their students to take at least one course of computers. In fact, all science students are required to take one or two courses. All computer courses have extensive laboratory session requirements. Because of this the Computer laboratory is now overloaded. To overcome this bottleneck, We recommend the following:

- Another large Computer Laboratory Room.
- Dividing the existing computer laboratory, creating an upstairs room for staff offices.

As far as the office facilities are concerned, the Computer Science department will need the following:

Laser printer

- Scanner
- CD-Writer
- External CD-ROM
- External Modem
- Photocopier
- File Cabinets (for documents, diskettes, and compact disks)

5.4 Administrative personnel

One secretary will be needed for the department.

5.5 Laboratories, Equipment, and other facilities

The Computer Science Department (CSD) will serve both computer science major students and students in other discipline. Computer science majors will take computer science courses, and their appropriate laboratory work, according to the curriculum of CSD. Students in other discipline will also continue to take courses in computer science or its application and the corresponding laboratory work.

5.5.1 Laboratory for the common courses

Though the set of computer common courses could grow from time to time according to the needs of the departments of the University of Asmara and the continuing upgrades of their curriculum, at this time there are two common courses given by the Computer Science Unit. These are Introduction to Computer Science (COMP 201) given to the Natural Science students, and Introduction to Computer Application (COMP103) given to Social Science students. Every semester up to 400 students register for these courses. Except for the first 2 weeks, the courses are given in the computer laboratory with one computer for two students. In a computer lab of 25 working computers, as it is now, 50 students are taught in one section, resulting up to 8 sections per semester.

The desired operating system for these common courses is windows 9x or above running Microsoft office 2000 and Moscow ML. Connecting the computers to a server and making a network is recommended to demonstrate the use of Internet and email to the students. It also facilitates package and file management within the laboratory. For such a laboratory to function properly and serve its students as desired, the following hardware and software resources are mandatory.

Hardware

1. 30 computers with network card (as a client)
2. One server capable of serving 30 clients and can run windows NT/2000
3. 32-plug switcher
4. 300 meters cat-5 network cables
5. 15000 Watts stabilizer

Software

1. Windows 2000 (a 30-terminal server)
2. Windows 2000 for clients
3. Microsoft Office 2000
4. ML compiler
5. Emacs for windows

5.5.2 Laboratory for the major courses

Most of the major courses consist of theoretical and practical parts. These practical parts include regular, scheduled lab hours and practice time, when students are free to continue unfinished assignments by them selves and to try their own programs.

This laboratory shall be separate from the common course lab, and run a different operating system and application programs; preferably Linux. Linux will provide us with much important and free software, which costs a substantial amount of money when implemented with Microsoft Windows. In addition, Linux has proven to be an excellent choice for educational institutions as it makes the underlying activities of the system and network easier to observe and manipulate.

The following hardware and software are required to set up a laboratory that serves the intended programme.

Hardware

1. A room or hall that can accommodate up to 25 computers
2. 25 computers including network card and Tbase10 cable for each of them
3. 25-pluggable switcher plus one Tbase100 cable
4. One server that is capable to serve 25 clients and can run Linux (RHL 7.0)
5. 15000 watt stabilizer
6. Electrical Lab (as specified as in the Electrical Eng. Dep't)
7. Up to 10 Intel 8086 family computers to run assembler and debugger
8. 2 TCP/IP compatible, heavy-duty laser printer
9. 1 whiteboard

Software

1. Red hat Linux 7.0 or grater
2. Assembler for Intel 8086
3. Library files for the courses:
   - 3.1. Operating system
   - 3.2. Compiler theory
   - 3.3. Computer Network
   - 3.4. Computer Graphics
4. Compilers and Interpreters for:
   - 4.1. Java
   - 4.2. Prolog
5. SOCK Proxy server
6. Concurrency workbench (CWB)
7. Real-time compiler (IAR)

6. CURRICULUM

6.1 Requirements for the major course code explanation

All computer courses are coded as COMP XYZ where:

- X represents the year the in which course is given.
- Y the middle number represents to which category the course belongs
- Z the last number represents which semester the course is offered.

The middle number in the Course code is grouped according to the their similarities and dependency.

- 0 - Software design
- 1 - System organization
- 2 - Programming methodology and analysis
- 3 - Computational complexity
- 4 - Network and security

- 5 - Database
- 6 - Logic design
- 7 - Graphics

LIST OF COMPULSORY COURSES IN MAJOR

Code No.	*Credits*	*Course Title*
COMP 201	3	Introduction to Computer Science
COMP 202	3	Methods of programming
COMP 2124	3	Computer Architecture
COMP 222	3	Algorithms and Data Structures I
COMP 311	4	Operating Systems
COMP 312	3	Compiler Design
COMP 322	4	Algorithms and Data Structures II
COMP 342	4	Data Communication and Networks
COMP 361	3	Logic Programming
COMP 401	3	Object-Oriented Programming
COMP 402	3	Software tools
COMP 412	3	Semantics and Principles of Programming Languages
COMP 421	4	Design and Analysis of Algorithms
COMP 451	3	Database Design
COMP 471	3	Human-Computer Interaction
COMP 492	4	Project work

Total 53

LIST OF MAJOR AND RELATED ELECTIVE COURSES

Three out of the following courses: 9-11 cr.

Code No.	*Course Title*	*Credits*
COMP 411	Real-Time Systems	4
COMP 422	Software Engineering	4
COMP 431	Programming Theory	3
COMP 432	Theory of Computations	3
COMP 441	Data Security	3
COMP 442	Communication Networks	3
COMP 462	Process Algebra	3
COMP 472	Computer Graphics	3
ELEN 302	Signals and Systems	3
ELEN 452	Microprocessors and Interfacing	3
ELEN 502	Signal Processing	3
MATH 302	Set Theory	3
MATH 312	Transformation Geometry	3
MATH 321	Modern Algebra	3
MATH 351	Linear Programming	3
MGMT 441	Management Information Systems	3

9–11 credits elective courses in B.Sc. degree.

LIST OF RELATED COURSES

Code No.	*Course Title*	*Credits*
MATH 221	Fundamental Concepts of Algebra	3
MATH 222	Introduction to Linear Algebra I	3
MATH 301	Mathematical Logic	3
MATH 341	Discrete Mathematics and Automata Theory	4
MATH 382	Introduction to Numerical Methods	3
MATH 391	Introduction to the theory of numbers	3
STAT 201	Statistical Methods I	4
ELEN 201	Fund. of Electrical Engineering I	3
ELEN 271	Electrical Engineering LAB I	1
ELEN 212	Electronics I	3
ELEN 312	Digital Logic Design	3
	Total	**30**

LIST OF COMMON SCIENCE COURSES

Code No.	*Course Title*	*Credits*
BIOL 100	Principles of Biology	4
CHEM 100	General Chemistry	4
MATH 101	Preliminary Mathematics	4
MATH 162	Introduction to Calculus	4
PHYS 100	Principles of Physics	4
	Total	**20**

COURSES IN GENERAL STUDIES

Code No.	*Course Title*	*Credits*
ECON 101[1]	Introduction to Economics	3
GEOG 101	Introduction to Geography of Eritrea	3
HIST 101	Introduction to History of Eritrea	3
PhED 101	Physical Education I	P/F
PhED 102	Physical Education II	P/F
	Total	**9**

COURSES IN ENGLISH

Code No.	*Course Title*	*Credits*
ENGL 101	Freshman English I	3
ENGL 102	Freshman English II	3
ENGL 201	Sophomore English I	3
ENGL 202	Sophomore English II	3
	Total	**12**

[1] Instead of ECON 101, students could take any one introductory course in either Philosophy, Logic, Ethics, Sociology, Anthropology, or Political science

6.2 Requirement for the minor

Initially, no minor will be offered to those who major in Computer Science.

7. BREAKDOWN OF COURSES BY YEAR AND SEMESTER

7.1 Computer Science major

YEAR I 1st Semester

Code No.	*Course Title*	*Credits*
CHEM 101	General Chemistry	4
ENGL 101	Freshman English I	3
GEOG 101	Intro. to Geography of Eritrea	3
MATH 101	Preliminary Mathematics	4
PHED 101	Physical Education I	P/F
PHYS 100	Principles of Physics	4
	Total	**18**

2nd semester

Code No.	*Course Title*	*Credits*
BIOL 100	Principles of Biology	4
ECON 101	Introduction to Economics	3
ENGL 102	Freshman English II	3
HIST 101	Intro. to History of Eritrea	3
MATH 162	Introduction to Calculus	4
PHED 102	Physical Education II	P/F
	Total	**17**

YEAR II 1st semester

Code No.	*Course Title*	*Credits*
COMP 201	Introduction to Computer Science	3
ELEN 201	Fund. of Electrical Engineering I	3
ELEN 271	Electrical Engineering lab I	1
ENGL 201	Sophomore English I	3
MATH 221	Fund. Concept of Algebra	3
STAT 201	Statistical Methods I	4
	Total	**17**

2nd semester

Code No	*Course Title*	*Credits*
COMP 202	Methods of Programming	3
COMP 212	Computer Architecture	4
COMP 222	Algorithms and Data Structures I	3
ELEN 212	Electronics I	3
ENGL 202	Sophomore English II	3
MATH 222	Introduction to Linear Algebra I	3
	Total	**19**

YEAR III 1st semester

Code No.	*Course Title*	*Credits*
COMP 311	Operating Systems	4
COMP 361	Logic Programming	3
MATH 301	Mathematical Logic	3
MATH 341	Discrete Mathematics and Automata Theory	4
MATH 391	Introduction to the Theory of Numbers	3
	Total	**17**

2nd semester

Code No.	*Course Title*	*Credits*
COMP 312	Compiler Design	3
COMP 322	Algorithms & Data Structures II	4
COMP 342	Data Communication and Networks	4
ELEN 312	Digital Logic Design	3
MATH 382	Introduction to Numerical Methods	3
	Total	**17**

YEAR IV 1st semester

Code No.	*Course Title*	*Credits*
COMP 401	Object-Oriented Programming	3
COMP 421	Design and Analysis of Algorithms	4
COMP 451	Database Design	3
COMP 471	Human-Computer Interaction	3
- xxx	Elective course	3–4
	Total	**16–17**

2nd semester

Code No.	*Course Title*	*Credits*
COMP 402	Software Tools	3
COMP 412	Semantics and Principles of programming languages	3
COMP 492	Project Work	4
- xxx	Elective course	3–4
- xxx	Elective course	3–4
	Total	**16–18**

SUMMARY

Field of study	*Credits*
Major courses	63–65
Common science courses	20
Related courses	30
English courses	12
General courses	9
Total	**135–137**

8. MINOR PROGRAM IN COMPUTER SCIENCE

Students, who want to minor in Computer Science, are required to take a minimum of 23 credit hours in Computer Science. The set of Computer courses for different departments will be as follows:

8.1 Mathematics major – computer science minor
Compulsory courses

Code No.	*Course Title*	*Credits*
COMP 201	Introduction to Computer Science	3
COMP 202	Methods of programming	3
COMP 212	Computer Architecture	4
COMP 222	Algorithms and Data Structures I	3
COMP 312	Compiler Design	3
COMP 361	Logic Programming	3
COMP 401	Object-Oriented Programming	3
COMP 402	Software tools	3
	Total	**25**

ELECTIVE COURSES

One out of the following courses: 3–4 cr.

Code No.	*Course Title*	*Credits*
COMP 422	Software Engineering	4
COMP 451	Database Design	3
COMP 471	Human-Computer Interaction	3
COMP 472	Computer Graphics	3

8.2 Physics major – computer science minor compulsory courses

Code No.	*Course Title*	*Credits*
COMP 201	Introduction to Computer Science	3
COMP 202	Methods of programming	3
COMP 212	Computer Architecture	4
COMP 222	Algorithms and Data Structures I	3
COMP 322	Algorithms and Data Structures II	4
COMP 361	Logic Programming	3
COMP 401	Object-Oriented Programming	3
	Total	**23**

8.3 statistics major – computer science minor compulsory courses

Code No.	*Course Title*	*Credits*
COMP 201	Introduction to Computer Science	3
COMP 202	Methods of programming	3
COMP 212	Computer Architecture	4
COMP 222	Algorithms and Data Structures I	3
COMP 312	Compiler Design	3

COMP 361	Logic Programming	3
COMP 401	Object-Oriented Programming	3
COMP 451	Database Design	3
	Total	**25**

9. COURSE DESCRIPTIONS….. etc (another 15 pages on course descriptions, here omitted)

Appendix 14

Terms of reference for an evaluation of Sida's support to the university of Asmara, Eritrea: College of Science and College of Engineering

1 GENERAL BACKGROUND

One of the fundamental tasks of Sida's Department for Research Cooperation, SAREC, is to provide assistance for strengthening of national research capacity. Sida recognises the national responsibility for development of higher education and research.

The Sida research co-operation aims to support the building up of sustainable conditions for research and research administration, involving research of high relevance for the development of the country in question. In this context Sida considers research universities and national research councils as key institutions.

The system of higher education and research vary from country to country. Sida's support for research development is therefore flexible and is tailored to match the local institutional conditions. For instance, support of national research councils may imply strengthening of planning functions and research administration. At universities it may imply staff development by training of lecturers and researchers to the level of PhD, contribution to faculty funds for research, equipment of laboratories and transferring of modern methodologies. The support may also imply the establishment of structures for evaluation of research and strengthening of financial administration systems. Improvement of library facilities also form part of the research support.

1.1 Evaluations of Sida support

In order to plan for and shape bilateral research co-operation as a strategic contribution, Sida needs access to relevant information on the impact of the support. In some cases, special evaluations are conducted, compiling available data into overviews and analysis.

The purpose of such evaluation is to provide an orientation about the results and the impact of the support and serve as a background for discussions on support to the universities and research councils.

1.2 Sida supported co-operation with Eritrea

Sida co-operation with Eritrea includes support for research cooperation with Asmara university. The support for the College of Science was initiated in 1992 and College of Engineering in 2000, and it is administered by Asmara university.

2 PURPOSE AND SCOPE OF THE EVALUATION

The purpose of the evaluation is to present:

(i) an assessment of the present situation at the College of Science and the College of Engineering;

(ii) an assessment of the "form" of cooperation, i.e., the faculty support, but also in relation to other "forms" of cooperation at Asmara university;

(iii) an overview and assessment of the results and impact of Sidas support to the College of Science and the College of Engineering;

(iv) recommendations for the cooperation with Asmara university.

The evaluation is expected to serve as background information for Sida in a dialogue concerning the possibility of future support for research co-operation with Eritrea.

The evaluation may also become useful for the Eritrean research community as a document for discussions concerning the future development of research, the research training, the research system/framework, and for fund raising (i.e., to motivate national and external funding for research).

The report should cover the following items:

2.1 Assessment of the present sitution

- Description of the academic level, capacity for research and research training at the College of Science and College of Engineering;
- List the current research capacity, research training and the larger ongoing research projects at the College of Science and College of Engineering;
- Brief description of the research management and administration at Asmara university and the administrative capacity.

2.2 Assessment of the "form" of cooperation

- Identify the key strenghts and weaknesses of the Asmara programme, i.e., faculty support to the College of Science and the College of Engineering;
- Compare this with other "forms" of cooperation at Asmara university, identify the pros and cons;
- Evaluate the impact of the coordinating function of ISP and if it is cost effective;
- Identify the "bottle necks" and weaknesse in the cooperation and present suggestions how they should be solved for making the support even more effective (e.g. communication and delegation).

2.3 Assessment of the results

- Present some major indicators for quantitative results for the past 10 years of Sida support: (a) annual number of PhDs/MScs and (b) annual number of international peer review publications (e.g. from Science Citation Index);
- Present some major indicators for qualitative results for the past 10 years of Sida support.

2.4 Assessment of the impact of Sida support

- For society. Describe the links to society (e.g. ministries).
- For the College of Science and College of Engineering.
- Other.

2.5 Recommendations for the future

- For the cooperation with Asmara university.
- For the College of Science and College of Engineering.
- Other.

The information and data presented in the report should also be presented as tables and figures, pedagogic "drawings", useful graphs and time series.

The selected person is free to add and comment upon issues of relevance to the evaluation apart from which has been described in the Terms of Reference.

3 METHODOLOGY AND TIME TABLE

The person selected for this task should be familiar with research, research training and have insight/understanding of research system.

In order to perform the study the person selected shall:

- Have access to e-mail, telephone, fax, and be able to travel.
- Visit Sida, Asmara university, Uppsala university and the Royal Institute of Technology (KTH) and interview relevant people for the evaluation and review key documents, appropriate publications, data and reports provided by them. The person selected shall also utilise other appropriate sources of data if necessary.
- Discuss the chosen set-up of the evaluation and expected content of the report with Sida, and later on discuss the draft report with Sida before presenting the final report.

A draft report of the evaluation is expected to be delivered to Sida for comments latest on *2001-07-30*. The final report is expected to be delivered to Sida latest on *2001-09-15*.

4 REPORTING

The review shall be written in English and should not exceed 50 pages, excluding annexes.

2 copies of the draft report shall be submitted to Sida no later than *2001-07-30*. Sida's comments on the draft report will lead to additional work for the evaluator. A final version in 5 copies and on a diskette shall be submitted to Sida no later than *2001-09-15*.

Subject to decision by Sida, the report can be published and distributed as a publication within the Sida Evaluations series. The evaluation shall be written in Word 97 for Windows (or in a compatible format) and should be presented in a way that enables publication without further editing.

ENCLOSURES

(1) Preliminary time schedule of the evaluation in relation to the preparations for the possible next agreement period for research cooperation with Eritrea.

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