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Southern Sudan Agricultural and Environmental Sciences Higher Education Needs Assessment

Final Report

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Executive Summary

The nearly 50 year-long civil war in Sudan left the agricultural sector in the South in a state of collapse and higher education in agriculture and natural resource management virtually nonexistent. As a result of the war the University of Juba, the premier institution of higher education in the South, was withdrawn to Khartoum in 1989 and is now in the process of relocating back to Juba as a consequence of the Comprehensive Peace Agreement of 2005. First and second year agricultural students in the College of Natural Resources and Environmental Studies are now being taught in Juba. Meanwhile, a new private university, the Catholic University of Sudan, is launching its agricultural program in Wau, accepting its first year students in September, 2009. The post-conflict challenges facing these two universities are unprecedented. Foremost among these challenges is the need to respond efficiently and effectively to the short and long-term food security needs of the region and the related immense human capacity development requirements of the region.

Increasing food production to achieve food security and even become one of the major food exporting regions of East Africa is achievable in the intermediate term given the available agricultural resource base, including abundant fertile soil and water resources. A 25% increase in food production, the amount that is estimated to be needed for food self-sufficiency, could be obtained within two to three years if a trained agricultural extension force (GOSS and NGO) was in place with adequate resources to engage with farmers. The largest obstacle to such an extension program is the lack of trained Southern Sudanese available for implementation. Southern Sudan universities and other tertiary agricultural training centers must supply this trained extension force and over the longer term, provide the applied research foundation critical for the development of a food export industry.

This report describes the "needs assessment for higher education in agriculture and natural resource management" undertaken with Southern Sudan and U.S. partners through an associate award from USAID-Khartoum under the leadership of the SANREM CRSP and Virginia Tech. Through a series of two workshops with local, regional and international participants and a "key informant" survey of stakeholders in three states, short and long-term higher education needs were assessed. Among the greatest needs identified were the following:

- Huge deficiency in numbers of current and projected university-trained agriculturalists
- Universally recognized urgent need for practical, field-based training for degree candidates at all levels
- Urgent need for shorter-term certificate and diploma programs
- Shorter-term development needs require many more bachelors degree graduates with broad-based, general agricultural training
- Facilities and faculty training needs are acute and general
- Higher education to increase regional food security is priority number one.

In response to these needs, this report outlines curricula changes and other recommendations judged to be required for an optimal response to the challenges of post-conflict Southern Sudan. Curricula changes are made based on the needs assessment and a cross-sectional analysis of the

core curricula nine other regional and international universities. Specific curricular adjustments and recommendations for both the Catholic University of Sudan and the University of Juba are made subject to the assumption that required resources will become available.

All recommendations and curricula modifications are subject to a continuing review by our Southern Sudan partners and other stakeholders and should be considered provisional. A complementary effort to this needs assessment is currently being undertaken as a result of an HED planning grant to Virginia Tech under the Africa – U.S. Partnership for Higher Education.

Principal recommendations include the following:

General recommendations:

1. Short-term agricultural tertiary education efforts should focus on the training of agricultural generalists who could function as extensionists to assist smallholders and medium sized farmers and herders to improve their productivity and general food security in the region. Southern Sudan universities should take the lead in implementing these tertiary education programs.

Catholic University of the Sudan recommendations

1. The propedeutic (introductory) year represents an innovative response to student needs, especially since CUofS wishes to cater to students most disadvantaged in their previous education by the war. Nevertheless, the lack of practical agricultural training during this year is an important missed opportunity. Significant numbers of students will likely not be able to continue into the second year and beyond for various reasons. If targeted and significant practical agriculture experiences could be offered during this year and a credential (certificate) issued in recognition thereof, such students would be better qualified and empowered to enter into the labor force and provide valuable skills sets to the agricultural sector. Relevant training field-based modules could be adopted from the Crop Training Center in Yei and other regional training centers.
2. The proposed agricultural field experiences need to be fully integrated into the curriculum and credit awarded for work.
3. The third year of the curriculum contains the majority of the biophysical agricultural coursework. Inclusion of additional biophysical agricultural coursework in the second, fourth, and fifth years would provide continuity and should be considered.
4. If the program is to achieve its goal “To equip students with the skills needs to improve agricultural productivity and the development of rural communities”, additional coursework in agricultural production, forestry, a basic course in fisheries, and environmental sciences and ecology should be considered. However, addition of such coursework would require deletion of other courses during the fourth and fifth year programs.
5. Even as currently structured, the effective launch and full implementation of the CUofS curriculum will require very significant investments in physical infrastructure and collaborative partnerships with internal and external institutions of higher education. Implementation of the above recommendations would considerably amplify these needs.

University of Juba recommendations

1. Agricultural field experiences need to be fully integrated into the curriculum.
2. The virtual lack of social science throughout the curriculum must be addressed. Social analysis skills and knowledge of development theory in particular are relevant to post-conflict Southern Sudan.
3. Courses in agribusiness and marketing are necessary additions.
4. According to discussions with University of Juba, the first two years of study currently serves as a propedeutic or introductory years (as at CUofS) to help students overcome educational deficiencies due to disruption of secondary schools during the war. Many students (up to half) do not move on to the third year when university standards are much more rigorous. Alternative pathways/credentials should be considered for educationally disadvantaged students who cannot complete the B.S. program.
5. Early incorporation of credited practical field experience into the curriculum is highly desirable.
6. The above recommendations are made in full recognition of the necessity of careful sequencing of all changes over time. Current inadequate facilities and scarcity of trained personnel largely dictate such strategies as the long and shared core science curriculum. As in the case of the CUofS, effective launch and full implementation of the recommended curriculum changes will require very significant investments in physical infrastructure and collaborative partnerships with internal and external institutions of higher education. Full implementation of the above recommendations would considerably amplify these needs.
7. The University of Juba College of Natural Resources and Environmental Studies campus on the other side of the Nile should be rebuilt as soon as possible and be used to initiate short-term agricultural certificate and diploma programs, to provide quality facilities for the College of Natural Resources and Environmental Studies, and to incorporate practical field experiences into undergraduate B.S. agricultural degree programs.

Introduction

Goals and Objectives

The original goals of this study were to evaluate the tertiary education needs of the Southern Sudan in the areas of agricultural and natural resource management and to recommend how the proposed Catholic University of the Sudan's proposed Faculty of Agriculture and Environmental Sciences could respond to these needs. The scope of the project was expanded early on to also include recommendations for the University of Juba's College of Natural Resources and Environmental Studies.

The final project objectives were to:

1. Review agricultural and natural resource management challenges and opportunities in the southern Sudan.

   The product of this objective is a paper entitled "Role of Higher Education in Agriculture and Environmental Sciences in Post-Conflict Countries", which was presented in a previous quarterly progress report and is included in Appendix B.

2. Assess public and private sector agriculture and natural resource management human resource needs and potential employers in the Southern Sudan.

   The product of this objective is the “Assessment of agricultural and NRM human resource and educational needs”, which was presented in a previous quarterly progress report and is included in Appendix C.

3. Assess the knowledge and skills required for the identified agricultural and natural resource management human resource needs.

   The product of this objective is the “Assessment of agricultural and NRM human resource and educational needs”, which was presented in a previous quarterly progress report and is included in Appendix C.

4. Assess of the educational backgrounds of potential students for the identified human resource needs.

   The product of this objective is presented as the “Assessment of student preparation for tertiary education” chapter in this report.

5. Assess how well the Faculty of Agriculture and Environmental Sciences (CUofS) and the College of Natural Resources (University of Juba) agricultural science curricula were meeting the agricultural development needs and recommend curricula changes to address unmet needs.

   This objective is the main focus of this report and is presented in the "Curricula recommendations in agriculture and natural resources management for the Southern Sudan" chapter of this report.

Assessment of student preparation for tertiary education

The Catholic University of Sudan (CUofS) began its program in 2008 under the assumption that "many if not most of students in southern Sudan have had their earlier education interrupted or have studied in schools with limited resources in terms of qualified teachers, textbooks and educational supplies/materials[1]". Consequently, most were not adequately prepared to matriculate into their chosen faculty or department. Furthermore, since prospective CUofS students are not required to possess the Sudan School Certificate, which requires them to pass the standardized national higher education entrance exam, it would be expected that their pool of applicants would be less prepared than students applying through normal channels to public universities in Sudan. To address this situation, CUofS has instituted a "propaedeutic" or introductory year required for all incoming students. The curriculum for this year stresses secondary school disciplines and learning skills judged essential for adequate university preparation (e.g., how to study, logic, language and communication skills, general mathematics, use of computers, social analysis, etc.). Students must achieve an average grade point of 'C' or better before they are permitted to matriculate into a regular university course of study.
The assessment of student performance resulting from this strategy is only now beginning as the 'pioneer class' of CUofS is just beginning the first year of regular university studies. Fr. Michael Schultheis, Acting Vice Chancellor of CUofS, provided the following analysis.

> The profile for the first year ran the spectrum. Some were very able students with good backgrounds, including young men who had been in seminary formation and for different reasons decided not to continue their studies. Others had completed a year or two of philosophy, knew English well and were quick to respond to discussion questions and lead study groups. At the other end, we had students with very weak backgrounds and lacked the confidence to assert themselves, even to the point of working/studying diligently. Some of these came out of refugee school situations, but that seemed not to have been the determining factor, as some refugee schools were adequate. Within this group, a number of factors were operative – financial problems, local living conditions including diet, health factors and family issues. A third group of students included some who were talented/promising enough but had studied in Arabic language secondary schools (some probably didn't make the cut for the national Universities; others, their families preferred the environment of the CUofS). For this latter group, the first semester

[1] Documents Pertaining to The Catholic University of Sudan: Introduction and Planning Framework

was very difficult. But the promising students improved much the second semester as their capacity in the language improved.

In terms of continuity, some 45 showed during the first week of lectures last Sept/early October. Of these some dropped out in the first couple of weeks; some 35 wrote end of first semester exams; a few of them did not return for the second semester; 31 wrote end of second semester examinations. Of these two failed (one of them will repeat the first year) and we invited 29 to return to for the program in Economics & Business Administration. For some, the invitation is conditional on taking and passing resit examinations and/or paying their fees. I expect a few will not return; hopefully 25 of them will return and be able to manage the studies and the living situations during the coming three years. But it is not easy for many.

A more relevant assessment of educational backgrounds and deficiencies of potential students of agriculture in southern Sudan has been provided by the Prof. Aggrey Abate, Dean of the Faculty of Natural Resources and Environmental Studies (CNRES) at the University of Juba (UJ).

Entry to university is through the Sudan School Certificate or its equivalent. Universities are not involved in student preparation for university education. The medium of instruction, pre-university, is usually Arabic; in the UJ and, particularly, in the CNRES students are instructed mainly in English. This has often affected student comprehension of subjects taught and contributed to poor performance. There is also a drastic change in the way exams are set and marked once students get to UJ.

An examination of CNRES student performance in the last 3 years has revealed no particular pattern. In the 2005 intake, there were 350 students who finished the year with 10 coming from outside the country. The statistics showed that in the 2005 intake, 42.3% of the students passed, 20.9% were repeated while 36.8% were discontinued. In 2006, there were 349 students who finished the academic year with 16 having done their pre-university education abroad. Out of the 349, 65.6% passed, 13.5% were repeated while 20.9% were discontinued. The intake of 2007 had 171 students of whom 16 finished their pre-university education outside the Sudan. At the end of that academic year, 47.9% passed, 12.9% were repeated and 39.2% were discontinued. The 3 year averages are approximately as follows: 52% pass; 16% repeated and 32% discontinued. Poor performance has cut across all subjects but, over the years, the performances in Botany, Physics, Mathematics and English (not in order of intensity) have contributed more to the number of repeated and discontinued students[2].

Conclusion

Given the large percentage of repeats and discontinued students of CNRES *when resident in Khartoum*, it is reasonable to assume these numbers will only increase as UJ's move to Juba continues and more disadvantaged students from the south seek to gain entrance. Clearly, a propaedeutic year strategy is one that should be considered until such time as secondary education in southern Sudan has considerably improved. The case for such a strategy is made stronger given the results of the needs assessment survey undertaken as a part of the present project. We found general acknowledgement that practical knowledge and hands-on experience in agriculture, critical needs in post-conflict southern Sudan, are lacking among current university graduates and technicians. An intensive propaedeutic year strategy could address

[2] Personal communication.

many of the critical academic and skill deficiencies identified by UJ and CUofS and do so in an applied setting that also featured teaching practical agriculture knowledge and field skills. There are very successful models of higher education in agriculture that combine academic classes with extensive field work. The Pan American Agricultural School (el Zamorano) in Honduras is one such example. The residential, four-year curriculum structures learning around half-day classes in academic subjects and half-day work in the school's fields and agribusinesses. Discipline is strict and student learning outcomes are outstanding. Graduates are much sought after by the public and private sectors in Latin America and as well as U.S. university graduate schools. While a one-year propaedeutic strategy for southern Sudan would be much less ambitious than the Zamorano model, it is more practical and could build into a similar type of degree program sometime in the future. In the meantime, such a strategy could address academic learning and practical agricultural skill needs of both universities in the short-term. The most successful graduates would be adequately prepared for university studies and have the sound background in agriculture they currently lack. Less successful students may not qualify for university training but would possess a technical agriculture skill set (and a certificate credential) that is sorely needed for private sector development in southern Sudan. Such a program would require adequate facilities that could be constructed on either or both university lands or found and rehabilitated elsewhere (e.g., Nzara in Western Equatoria). In the short-term, appropriate arrangements with an agricultural training center such as the Crop Training Centre in Yei might be possible.

Curricula recommendations in agriculture and natural resources management for the Southern Sudan

The Bachelor of Science (B.S.) degree program recommendations were developed using information gleaned from the following sources:

- The "Role of Higher Education in Agriculture and Environmental Sciences in Post-Conflict Countries" research and synthesis paper
- The Assessment of agricultural and NRM human resource and educational needs
- A review of other agricultural and NRM B.S. degree programs in Africa and other developing countries.
- Discussions with representatives from the University of Juba; Upper Nile University; University of Bahr el-Ghazal; Catholic University of Sudan; Kenyatta University; Moi University; Virginia Tech; Washington State University; Cornell University, GOSS Ministry of Agriculture and Forestry; GOSS Ministry of Education, Science, and Technology; and various NGOs and donor organizations working in the Southern Sudan.

Results of the Review of Other Agricultural/NRM Degree Programs

The agricultural and NRM curricula of the following universities were reviewed to identify common course content for general agricultural B.S. degree programs.

- Panamerican School of Agriculture (Zamorano), Honduras
- University of Development Studies, Ghana
- Moi University, Kenya
- Haramaya University, Ethiopia

- Egerton University, Kenya
- Earth University, Costa Rica
- Catholic University of Sudan, Juba, Southern Sudan
- University of Juba, Southern Sudan (Khartoum, Sudan)
- Upper Nile University, Malakal, Southern Sudan (Khartoum, Sudan)
- Qatar University, Qatar
- Makerere University, Uganda

For the review, the agricultural/natural resource management curricula at each institution were analyzed and courses in different agricultural B.S. degree programs were classified into "generic" course designations/names according to course content. The generic course designations were then entered into a database to identify the most commonly occurring courses in agricultural B.S. degree programs. For universities with multiple B.S. agricultural degree programs, an analysis was first done to develop a representative general agricultural curriculum for that university. This involved identifying the core agricultural curricula and other courses that were present in the majority of the agricultural degree programs for that university. The representative general agricultural curricula were then compared across universities so that universities with multiple agricultural degree programs would not be given more weight in the analysis.

For example, the University of Development Studies in Ghana has agricultural B.S. degree programs in the following areas: Animal Science, Agricultural Mechanization and Irrigation, Renewable Natural Resources, Agronomy, Horticulture, and Agricultural Economics and Extension. The resulting derived representative general agricultural curriculum for the University of Development Studies is presented in Table 1. Only science and agricultural courses are included in the general agricultural curriculum analysis.

Table 1. University of Development Studies, Ghana Representative General Agricultural Curriculum

AGR 101 Intro to Agriculture	BTC Agricultural By-Products Utilization
AMI 101 Principles of Land Survey	FAG 120 Field Practical Training
AMI 102 Agricultural Meteorology	HRT 201 Introductory Genetics
BLY 113 Agricultural Botany	HRT 202 Principles of Horticulture
BLY 123 Agricultural Zoology	RNR 201 Intro to Forestry
CHI 121 Biochemistry	RNR 202 Intro to Grassland Husbandry
CHM 110 Chemistry I	RNR 203 Intro to Wildlife & Fisheries
CHM 120 Chemistry II	AEE 301 Farm Management & Accounting
FAG 120 Field Practical Training	AEE 302 Agricultural Extension Education
MAT 110 Math I	AEE 303 Intro Computing and Programming
MAT 121 Statistics	AEE 304 Intro to Agricultural Marketing
Math 129 Math II (Calculus)	AEE 305 Experimental Design & Analysis
PHY 110 Physics I	AEE 306 Intro to Farming Systems Design
PHY 120 Physics II	AGR 301 Principles of Plant Breeding
AEE 201 Introductory Agricultural Economics	AGR 302 Agricultural Entomology
AEE 202 Intro Agric Extension and Rural Sociology	AGR 303 Weed Science I
AGR 201 Intro to Plant Pathology	AGR 304 Plant Physiology
AGR 202 Intro to Soil Science	AMI 301 Agricultural Power Units
AGR 203 Basic Entomology	AMI 302 Intro to Irrigation
AGR 204 Arable Crops Production I	ANS 301 Poultry Production

AMI 201 Agricultural Machinery	ANS 302 Principles of Animal Breeding
ANS 201 Intro to Animal Science	ANS 303 Cattle, Sheep, and Goat Production
ANS 202 Anatomy & Physiology of Farm Animals	BTC 301 Mushroom and Snail Culture
ANS 203 Principles of Animal Nutrition	FAG 120 Field Practical Training
BTC 201 Apiculture	HRT 301 Plant Propagation
BTC 203 Biotechnology	FAG 120 Field Practical Training

In the cross-university synthesis analysis, the most commonly identified courses (courses occurring in over five or more of the eleven curricula considered) were identified. These courses and their frequency of occurrence are indicated in Table 2. It should be noted that the curricula are fairly strong in biophysical agronomy and science courses but there are far fewer social science courses and a noticeable lack of specific courses in agribusiness and development theory. Field experience components of various curricula are presented separately in Table 3.

Table 2. Common B.S. Agricultural Degree Curriculum

Course	Frequency of Occurrence
Soil Science I	100%
Statistics I	100%
Animal Science I	91%
Chemistry I	91%
Computer Science I	91%
Mathematics I	91%
Botany I	82%
Economics I	82%
Physics I	82%
Rural Sociology & Extension	73%
Biochemistry	64%
Crop Science I	64%
Ecology	64%
Mathematics II	64%
Zoology	55%
Chemistry II	55%
Genetics	55%
Plant Breeding	55%
Microbiology	45%
Biotechnology	45%
Entomology	45%
Environmental Science	45%
Farm Management	45%
Forestry	45%
Irrigation	45%
Marketing I	45%
Physics II	45%
Experimental Design & Analysis	36%
Geographical Information Systems	36%
Horticulture	36%

Field Experience: In addition to formal course content, programs were analyzed to assess the amount of practical field experience, field attachments, and field experiments included in each program. The results of this analysis are provided in the following table. As indicated, field experience credits range from zero credits at the CUofS to a high of 57 credits or 29% of the total course credits at Earth University. Earth University is also different in that it is a 4-year, year round program with three full semesters per year, so its program is academically equivalent to a 6-year B.S./M.S. program. While the amount of practical field experience varies widely across programs, it is clear that CUofS and the University of Juba are at the lower end of the practical field experience range.

Table 3. Field experience, field attachments, and field experiments in different programs

University	Field Experience (Field Experiments) Credits[1]					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Upper Nile University (5 yr)[2]	0	2	6	0 to 4	3	11 to 15
CUofS (5 yr)	0	0	0	0	0	0
Moi University, Kenya (4 yr)			4	4 to 8		8 to 12
University of Development Studies, Ghana (4 yr)	6	6	6	6		24
Haramaya University, Ethiopia (3 yr)		3	6			9
Egerton University, Kenya (4 yr)			4	4 to 6		8 to 10
Earth University[3], Costa Rica (4 yr)	12	15	24	6		57
University of Juba (5 yr)			0 to 4	2 to 7		2 to 11
Zamorano, Honduras (4 yr)	7[4]	7	7	7		28

[1] range for agricultural programs at a university
[2] number of years in B.S. program
[3] 12-month, 3 semester/yr program
[4] 20 hours practical experience per week

Catholic University of Sudan B.S. Program in Agricultural and Environmental Sciences

The proposed Catholic University of Sudan (CUofS) B.S. in Agricultural and Environmental Sciences is basically sound and comparable with other curricula analyzed. However, it could and should be modified to be more responsive to the short and intermediate agricultural development needs of the Southern Sudan. Modifications for consideration are included later in this section.

The CUofS's Faculty of Agricultural and Environmental Sciences program opened in Wau, Southern Sudan in September 2009 and admitted first year students (propedeutic year). The stated objectives of the program are:

- To provide students with an appreciation of rural communities and their relationship to the environment in meeting their basic needs and improving their livelihoods.
- To equip students with the skills needs to improve agricultural productivity and the development of rural communities.

In the first and second years of the five-year program, "students will be introduced to the main features of agriculture and the environment in the Sudan. This will include the following topics:

- Geography, natural resources including water, climate, geology, vegetation
- Agro-ecological zones and food productive systems in the Sudan
- Role of agriculture and the environment in the Sudan-society and economy
- The relationship of the Sudan to the Region and to the global economy (ecology, trade, historical features).

To promote a positive attitude for students towards studying Agricultural and Environmental Sciences, the program will utilize the following approaches: responsibility for tending crops and livestock and record keeping of university research farm operations and visits to commercial farms and farm enterprises. Students will share in any profits generated by the student farm activities. The number of hours that students will devote to university farm and other activities is not specified and since the university farm does not currently exist, it is unclear when these practical experience activities will be implemented.

The proposed curriculum for the first year is provided below. It is intended primarily to improve student study skills and overcome any student educational deficiencies.

Table 4. Propedeutic Year Programme. First Year Students

Discipline/Course	**1st Semester**	**2nd Semester**
CES 101 Study Skills	2 credits	
CES 102 Principles of Logic		2 credits
CES 103/104 Language/Communication Skills I & II	3 credits	3 credits
CES 105/106 Mathematics I & II	3 credits	3 credits
CES 107/108 Computer Studies I & II	3 credits	3 credits
CES 109 Social Analysis of the Sudan	3 credits	
CES 110 Social Ethics		3 credits
CES 111/112 Accounting I & II	2 credits	2 credits
AES 101 Intro. Agric. & Resource Use in Sudan	0 credits	0 credits
Total	16 credits	16 credits

Second Year Programme (From CUofS Introduction and Planning Framework, 2007)

"The second year courses will provide students with a foundation in the biological and physical sciences that in turn will become the basis for understanding the complex interrelations between agriculture and the environment. Because these courses are taught from the agricultural and environmental point of interest, the second semester course in each discipline is named agricultural chemistry, biology, and physics. Because of this perspective, they would ideally be taught by an agronomist or a team of agricultural/environmental scientists.

Agricultural Field Work. An integral part of the second year program is to involve students in work on the University farm plots, observing conditions and undertaking basic quantitative measurements: soil and crop, insects and diseases, yields, etc. Students will be allocated a plot of land to farm, with guidance in the choice of crops and/or animals - the selection of seed, planting, cultivation, harvesting, general husbandry and record keeping. They will also be introduced to the state of the art management systems and monitoring the impact of alternate uses on environmental systems. One objective of this approach is to provide a timetable for

"practicals" in science subjects based on weather and growing conditions (e.g. soil sampling, observation of crop maturity, etc.).

To deepen their awareness and understanding of rural communities and land use systems, students will be encouraged to do fieldwork and undertake simple surveys with and among rural communities in their home areas or near the University campus."

Table 5. Second Year Courses

Discipline/Course	1st Semester	2nd Semester
AES 201 Introduction to Biology I (& Lab)	3 credits	
AES 202 Agricultural Biology II (& Lab)		3 credits
AES 203 Introduction to Chemistry I (& Lab)	3 credits	
AES 204 Agricultural Chemistry II (& Lab)		3 credits
AES 205 Introduction to Physics (& Lab)	3 credits	
AES 206 Agricultural Physics II (& Lab)		3 credits
AES 207/208 Economics I & II	3 credits	3 credits
Math 201 Calculus & Analytical Geometry	3 credits	
Math 202 Linear & Matrix Algebra		3 credits
SRS 201/202 Philosophy I & II	2 credits	2 credits
ARA 101/102 Arabic I & II	2 credits	2 credits
Total	19 credits	19 credits

Third Year Programme

The third year is designed to lead students to a deeper understanding of the environment and the basic factors affecting sustainable agricultural production and to integrate the knowledge and experience they have gained during the first two years. At the conclusion of this third year, students will have a critical/scientific understanding of the natural resources (soil/land, crops, animals, water) involved in agricultural activities and will have strengthened their capacity for independent study/learning.

Agricultural Field Work: Students continue to work on their farm plots, observing conditions and undertaking basic quantitative measurements: soil and crop, insects and diseases, yields, etc. They will also work on agricultural production and management problems, incorporating an economic analysis of the results of their farm plot activities.

Field Attachment: Between the third and fourth year, students will undertake special projects related to the environment or be attached to an agri-business enterprise, a rural bank or a rural development programme. At the end of this period, they will write a report on the attachment and their experiences.

Table 6. Third Year Programme

Discipline/Course	1st Semester	2nd Semester
AES 301 Rural Sociology	3 credits	
AES 302 Animal Science	3 credits	
AES 303/304 Soil Science I & II (& Lab)	3 credits	3 credits
AES 305 Crop Science I & II (& Lab) 3 credits	3 credits	
AES 307 Hydrology (& Lab)	3 credits	
AES 308 Water Management		3 credits
AES 309 Statistics and Probability	3 credits	
AES 3I0 Statistical Analysis in Agric and Economics		3 credits
SRS 2031204 Theology 1 & II	2 credits	2 credits
ARA 201/202 Written & Spoken Arabic III & IV	2 credits	2 credits
Total	19 credits	19 credits

Fourth Year Program

The students will deepen their understanding of the basic factors affecting agricultural production at the farm level and the relation of agriculture and the environment to the national and global economy. The objective of the fourth year is to deepen the students' scientific understanding of the natural resources (soil/land, crops/forest, animals, and water) involved in agricultural production activities, within the context of the national and global economy. Students may begin to specialize according to their aptitudes and interests, under the direction of their supervisors and the Dean of the Faculty. This may take the form of special seminars and field research or study projects, such as crop sciences, plant breeding, animal husbandry, agro-forestry and/or agri-business.

Field Project in Adult Education and Extension Economics: Between their fourth and final year, students will undertake guided research among fanners in neighboring communities, observing farming conditions and practices. The objective of this project is to deepen students understanding of the problems and conditions of rural communities and the agricultural production and to bring students to the integration of the subjects they are studying. Under the direction of a supervisor, they will also prepare and lead an adult education program in a rural community.

Table 7. Fourth Year Programme

Course	**1st Semester**	**2nd Semester**
AES 40 I Environmental and Resource Economics	3 credits	
AES 402 International Economics		3 credits
AES 403 Geography and Land Use	3 credits	
AES 404 Geographical Information Systems		3 credits
AES 405 Farm Management	3 credits	
AES 406 Business Law and Management		3 credits
AES 407 Accounting and Analysis	3 credits	
AES 408 Adult Education and Extension		3 credits
AES 409 Principles of Marketing	3 credits	
AES 410 Research Methods & Report Writing		3 credits
SRS 311/312 Catholic Social Thought I & II	2 credits	2 credits
Total	17 credits	17 credits

Fifth Year Programme

In this final year, students will integrate the studies of the previous four years and bring together the principal features of agriculture and environment that are the foundations of sustainable national development. Students are encouraged to undertake further and independent studies in areas of their particular interest with a scientific and/or public policy focus. These independent studies will culminate in the development of a research project and the preparation of a substantive written report or thesis of some 50 - 60 pages or more, under the direction of a supervisor. In this study, students are expected to integrate the scientific understanding of the environmental and agricultural issues involved in their analysis and policy recommendations.

Table 8. Fifth Year Programme

Course	1st Semester	2nd Semester
AES 501 Rural/Regional Development Policies in the Sudan	3 credits	
AES 502 Finances & the Rural Economy		3 credits
AES 503 Agri-business Opportunities in the Sudan	3 credits	
AES 504 Domestic, Regional & International Marketing		3 credits
AES 505 Project Planning & Management	3 credits	
AES 506 Directed Study/Special Seminar		3 credits
AES 507/508 Senior Research Project & Thesis I & II	4 credits	4 credits
SRS 407 Interfaith Encounter & Religious Dialogue	3 credits	
SRS 408 Globalization & Catholic Social Thought		3 credits
Total	16 credits	16 credits

CUofS Program Observations and Recommendations

Observations:

1. In Table 9, the five-year CUofS B.S. Agricultural and Environmental Sciences curriculum is compared with the derived common B.S. Agricultural degree curriculum depicted in Table 2. As indicated, the CUofS curriculum is very similar, but lacks courses such as biochemistry, ecology, genetics, and plant breeding that are present in most curricula.

2. The first two years provide CUofS agricultural and environmental sciences students with a strong science background but little exposure to practical/applied agriculture other than the proposed work on the university research farm and the three courses in agricultural biology, chemistry, and physics, which presumably would include many agricultural and environmental science examples.
3. The third year of the proposed curriculum has a strong agricultural focus with the majority of the agricultural coursework occurring during this year. There is little to no biophysical agricultural coursework during the fourth and fifth years.
4. The proposed CUofS has a strong narrative description of its proposed hands-on practical field experience but it is unusual compared to other programs with field experience components because no academic credit is given for the field experiences and course loads are not reduced during semesters with heavy field experience requirements.
5. Priority educational needs for the Southern Sudan identified through the agricultural needs assessment that do not appear to be covered in detail in the CUofS curriculum include:

   Crop production, harvesting, storage, and processing needs (AES 305/306 Crop Science I & II):
   - Determination of optimum planting time considering local climate, weather, and crops.
   - Determination of land suitability for different crops.
   - Knowledge of land preparation techniques for particular crops.
   - Plowing with animals (oxen, donkeys and horses).
   - Planting and seed/tuber preparation including seed/tuber selection, spacing, depth of planting for various crops.
   - Weed management
   - Crop maintenance and management: integrated pest management, crop thinning
   - Crop harvesting and storage/preservation
   - Post harvest processing and production of value added products

   Forestry (AES 305/306 Crop Science I & II course description indicates that forestry is covered in these two courses also):
   - Managing seedlings, transplanting and caring for trees in homes and gardens.
   - Harvesting and processing of tree for lumber

   Livestock Management (AES 3002 Animal Science):
   - Animal health
   - Milk hygiene and processing
   - Pasture and range management

   Fisheries Management
   - Fisheries management (wild and aquaculture)
   - Fishing technology and practices
   - Fish preservation

Recommendations:

6. The propedeutic year represents an innovative response to student needs, especially since CUofS wishes to cater to students most disadvantaged in their previous education by the war. Nevertheless, the lack of practical agricultural training during this year is an important missed opportunity. Significant numbers of students will likely not be able to continue into the second year and beyond for various reasons. If targeted and significant practical agriculture experiences could be offered during this year and a credential (certificate) issued in recognition thereof, such students would be better qualified and empowered to enter into the labor force and provide valuable skills sets to the agricultural sector. The 'AES 101 Intro. Agric. & Resource Use in Sudan' course offers the possibility of including a significant field training component. Relevant training field-based modules could be adopted from the Crop Training Center in Yei and other regional training centers.
7. The proposed agricultural field experiences need to be fully integrated into the curriculum and credit awarded for work.
8. The third year of the curriculum contains the majority of the biophysical agricultural coursework. Inclusion of additional biophysical agricultural coursework in the second, fourth, and fifth years would provide continuity and should be considered.
9. If the program is to achieve its goal "To equip students with the skills needs to improve agricultural productivity and the development of rural communities", additional coursework in agricultural production, forestry, a basic course in fisheries, and environmental sciences and ecology should be considered. However, addition of such coursework would require deletion of other courses during the fourth and fifth year programs.
10. Even as currently structured, the effective launch and full implementation of the CUofS curriculum will require very significant investments in physical infrastructure and collaborative partnerships with internal and external institutions of higher education. Implementation of the above recommendations would considerably amplify these needs.

Table 9. Comparison of CUofS Agricultural and Environmental Sciences Curriculum with Common B.S. Agricultural Degree Curriculum

Course	Frequency of Occurrence in	CU of S Curriculum
Soil Science I	100%	Yes
Statistics I	100%	Yes
Animal Science I	91%	Yes
Chemistry I	91%	Yes
Computer Science I	91%	Yes
Mathematics I	91%	Yes
Botany I	82%	Yes
Economics I	82%	Yes
Physics I	82%	Yes
Rural Sociology & Extension	73%	Yes
Biochemistry	64%	
Crop Science I	64%	Yes
Ecology	64%	
Mathematics II	64%	Yes
Zoology	55%	Yes
Chemistry II	55%	Yes
Genetics	55%	
Plant Breeding	55%	
Microbiology	45%	
Biotechnology	45%	Yes
Entomology	45%	
Environmental Science	45%	
Farm Management	45%	Yes
Forestry	45%	
Irrigation	45%	
Marketing I	45%	Yes
Physics II	45%	Yes
Experimental Design & Analysis	36%	Yes
Geographical Information Systems	36%	Yes
Horticulture	36%	

University of Juba B.S. Program in Agricultural Sciences

The College of Natural Resources and Environmental Studies (CNRES) of the University of Juba was established in Juba in 1977. In 1989, the University of Juba was relocated to Khartoum. In 2008, the CNRES began the phased process of returning to Juba, initiating the first year CNRES program in Juba while simultaneously ending the first year program in Khartoum. Within the next four years, the CNRES program will close in Khartoum and all courses will be taught in Juba in English.

The goal of the CNRES, as stated in the university catalog, is to produce graduates with a broad-based multi-disciplinary education and training, making him or her capable of approaching

development and the management of natural resources in an integrated manner. The College offers a five-year program leading to a Bachelor of Science Degree (Honors) in Natural Resources with a selected specializations Agricultural Sciences, Animal Production, Environmental Studies, Fisheries, Forestry, Geology and Mining, and Wildlife. The first three semesters in the college (Tables 10 and 11) are currently common for all specializations and the college is in the process of expanding the common core curriculum further and adapting the entire college curriculum to more fully meet the agricultural and natural resource management development needs of the Southern Sudan. The CNRES curriculum for the B.S. in Agricultural Sciences is presented in Tables 10 to 14 as it is the generalized and most broad-based B.S. curriculum in the college. The B.S. degree program has numerous laboratories. However, laboratory facilities for CNRES courses do not currently exist and there are no functional university farms for practical field experience. The CNRES does have a separate campus complete with (severely war-damaged) classrooms, dormitory, laboratory and library facilities and land that could be developed in to a university research and demonstration farm. It is located approximately 15 km from the main campus on the opposite side of the Nile.

With the existing curriculum, the primary field experience for CNRES students occurs between the fourth and fifth years when the students participate in the NRG 423 Field Practical. During this four week period, students travel to private farms and observe a variety of agricultural activities. This is primarily an observation activity.

Table 10. First Year Curriculum (Department of Basic Sciences)

SEMESTER I		SEMESTER II	
Course	Credits[1]	Course	Credits
NRG 111 Botany I	2-3	NRG 121 Botany II Plant Anatomy	2-3
NRG 112 Zoology I	2-3	NRG 122 Zoology II	2-3
NRG 113 Physical Chemistry	1-3	NRG 125 Organic Chemistry	2-3
NRG 114 Inorganic Chemistry	2-3		
NRG 115 Physics I	3-3	NRG 123 Physics II	3-3
NRG 116 Mathematics I	2-3	NRG 124 Mathematics II	2-3
UJA 101 Arabic I	2-0	UJA 101 Arabic II	2-0
UJE 101 English I	2-0	UJE 101 English II	2-0
UJS 102 Sudan Foundation I	2-0	UJS 102 Sudan Foundation II	2-0

[1] First number indicates hour of lecture, second indicates hours of laboratory

Table 11. Second Year Curriculum (Departments of Basic Sciences and Agricultural Science)

SEMESTER I (Basic Science)	Credits	SEMESTER II (Agricultural Science)	Credits
NRG 211 Ecology	2-3	NAG 221 Principles of Plant Physiology	3-3
NRG 212 Microbiology	2-3	NAP 222 Principles of Animal Nutrition	3-3
NRG 213 Principles of Economics	2-3	NEN 224 Principles of Environ. Sciences	2-0
NRG 214 Principles of Entomology	2-3	NRG 222 Soil Science I: Fundamentals	2-3
NRG 215 Biochemistry I: Fundamentals	2-3	NRG 221 Biochemistry II: Metabolism & Biosynthesis	2-3
NRG 216 Genetics	2-0	NRG 223 Computer Science	1-3
NRG 217 Basic Statistics	3-0		
NRG 218 Introduction to Natural Resources	2-0		
UJA 201 Arabic I	2-0	UJA 202Arabic II	2-0
UJE 201 English I	2-0	UJE 202 English II	2-0

Table 12. Third Year Curriculum (Department of Agricultural Science)

SEMESTER 1	Credits	SEMESTER II	Credits
NAG 311 Crop Physiology	3-3	NAG 321 Crop Production I: Cereals	3-3
NAG 312 Soil Science II: Fertility	3-3	NAG 322 Horticulture II: Fruits	3-3
NAG 313 Principles of Plant pathology	2-3	NAG 323 Plant pathology:	3-3
NAG 314 Horticulture I: Introduction & Propagation	2-3	NAG 324 Forage crops Production	2-3
NAG 317 Principles of Crop Production	2-3	NAG 325 Mechanization I: Power Prime Movers and Intermediate Technology	2-3
NAP 311 Animal Husbandry	2-3	NEN 325 Introduction Remote Sensing	2-3
NEN 316 Applied Climatology	2-3		

Table 13. Fourth Year Curriculum (Department of Agricultural Science)

SEMESTER 1	Credits	SEMESTER II	Credits
NAG 411 Mechanization II. Implements	2-3	NAG 421 Irrigation	2-3
NAG 412 Agricultural Economics	2-3	NAG 422 Food Technology	2-3
NAG 413 Soil Science III: Conservation	3-3	NAG 423 Animal Production	2-3
NAG 414 Horticulture III: Principles & Physiology of Vegetable Crops	3-3	NAP 424 Farm Management	2-3
NAG 415 Crop Protection I Pests	2-3	NRG 421 Rural Extension	2-3
NAG 416 Crop Production: Oil Seed & Pulse Crops	3-3	NRG 422 Experimental Design & Methods	2-3
NRG 417 Sudanese Environmental Problem	2-3	NRG 423 Field Practical (4-weeks)	1-12

Table 14. Fifth Year Curriculum (Department of Agricultural Science)

SEMESTER I	Credits	SEMESTER II	Credits
NAG 511 Crop Protection II: Method of Pest Control & Integrated Management	2-3	NAG 521 Plant Breeding	3-0
NAG 512 Horticulture IV: Post Harvest Physiology	3-3	NRG 521 Environmental Resources; Policies and Laws	3-0
NAG 513 Crop production III: Fiber and Special Crops	3-3	NRG 522 Land Use Planning	2-3
NAG 514 Soil Science: Soil-Plant-Water Relationship	2-3	NRG 523 Research Project	3-9
NAG 515 Seminars	1-3		

University of Juba, B.S. in Agricultural Sciences Observations and Recommendations

Observations:

1. The University of Juba, although possessing a proud history of some 30 years, faces many problems due to the long civil war and the severe constraints confronting it as it reestablishes itself in the South. Its motto, "relevance and excellence", provides both the direction and destination as it seeks to respond to the collapsed agricultural sector and lack of trained agriculturalists in the region.
2. In Table 15, the five-year University of Juba B.S. Agricultural Sciences curriculum is compared with the derived common B.S. agricultural degree curriculum depicted in Table 2. As indicated, the University of Juba curriculum covers all but two courses in the model common agricultural curriculum: biotechnology and marketing. This indicates that the curriculum is very sound compared to other regional agricultural curricula.
3. The first three semesters of the CNRES curricula provide students with a strong science background and foundation for the rest of the curriculum.
4. The fourth to tenth semesters (years 2-5) of the curriculum have a strong biophysical agricultural focus with the agricultural coursework distributed throughout this period.
5. All of the science and agricultural courses have a laboratory component, which is typically three hours. Unfortunately, laboratory facilities to support these courses do not exist, with the exception of basic chemistry and physics laboratories.
6. The CNRES curricula is somewhat unusual compared to the other agricultural curricula reviewed in that it does not have a significant field experience component during which students personally prepare land and plant, manage, harvest, and process harvested crops. Although CNRES students appear to receive strong theoretical training in agricultural sciences that would prepare them to make substantial contributions to the development of the agricultural sector of Southern Sudan, the practical application of these skills is currently almost totally lacking.
7. The general CNRES curriculum offers extremely limited treatment of the social sciences, rural and agricultural development theory, and agribusiness.
8. Priority educational needs for the Southern Sudan identified through the agricultural needs assessment that do not appear to be covered in detail in the CUofS curriculum include:

Crop production, harvesting, storage, and processing needs (AES 305/306 Crop Science I & II):

- Determination of optimum planting time considering local climate, weather, and crops.
- Determination of land suitability for different crops.
- Knowledge of land preparation techniques for particular crops.
- Plowing with animals (oxen, donkeys and horses).
- Planting and seed/tuber preparation including seed/tuber selection, spacing, depth of planting for various crops.
- Weed management
- Crop maintenance and management: integrated pest management, crop thinning
- Crop harvesting and storage/preservation
- Post harvest processing and production of value added products

Forestry (AES 305/306 Crop Science I & II course description indicates that forestry is covered in these two courses also):

- Managing seedlings, transplanting and caring for trees in homes and gardens.
- Harvesting and processing of tree for lumber

Livestock Management (AES 3002 Animal Science):

- Animal health
- Milk hygiene and processing
- Pasture management

Fisheries Management

- Fisheries management (wild and aquaculture)
- Fishing technology and practices
- Fish preservation

<u>Recommendations:</u>

8. Agricultural field experiences need to be fully integrated into the curriculum.
9. The virtual lack of social science throughout the curriculum must be addressed. Social analysis skills and knowledge of development theory in particular are relevant to post-conflict Southern Sudan.
10. Courses in agribusiness and marketing are necessary additions.
11. According to discussions with University of Juba, the first two years of study currently serves as a propedeutic or introductory years (as at CUofS) to help students overcome educational deficiencies due to disruption of secondary schools during the war. Many students (up to half) do not move on to the third year when university standards are much more rigorous. Alternative pathways/credentials should be considered for educationally disadvantaged students who cannot complete the B.S. program. For example, certificates might be provided to students completing the first year and/or second years.
12. Early incorporation of credited practical field experience into the curriculum is highly desirable

13. The above recommendations are made in full recognition of the necessity of careful sequencing of all changes over time. Current inadequate facilities and scarcity of trained personnel largely dictate such strategies as the long and shared core science curriculum. As in the case of the CUofS, effective launch and full implementation of the recommended curriculum changes will require very significant investments in physical infrastructure and collaborative partnerships with internal and external institutions of higher education. Full implementation of the above recommendations would considerably amplify these needs.

Table 15. Comparison of University of Juba CNRES Agricultural Sciences Curriculum with Common B.S. Agricultural Degree Curriculum

Course	Frequency of Occurrence in other University Curricula	University of Juba
Soil Science I	100%	Yes
Statistics I	100%	Yes
Animal Science I	91%	Yes
Chemistry I	91%	Yes
Computer Science I	91%	Yes
Mathematics I	91%	Yes
Botany I	82%	Yes
Economics I	82%	Yes
Physics I	82%	Yes
Rural Sociology & Extension	73%	Yes
Biochemistry	64%	Yes
Crop Science I	64%	Yes
Ecology	64%	Yes
Mathematics II	64%	Yes
Zoology	55%	Yes
Chemistry II	55%	Yes
Genetics	55%	Yes
Plant Breeding	55%	Yes
Microbiology	45%	Yes
Biotechnology	45%	
Entomology	45%	Yes
Environmental Science	45%	Yes
Farm Management	45%	Yes
Forestry	45%	Yes
Irrigation	45%	Yes
Marketing I	45%	
Physics II	45%	Yes
Experimental Design & Analysis	36%	Yes
Geographical Information Systems	36%	Yes
Horticulture	36%	Yes

Shorter-Term Degree Program Recommendations

Highly applied agricultural and natural resource management certificate and associate (diploma) programs are needed to assist the people of the Southern Sudan in quickly restarting agriculture and other natural resource based industries. The University of Juba and CUofS "brands" on such programs would provide the necessary assurance of quality that graduates would need to find gainful employment in post-conflict Southern Sudan. In the short term, we recommend that efforts be focused on the training of agricultural generalists who could function as extensionists to assist smallholders and medium sized farmers and herders to improve their productivity and general food security in the region. They would also be highly sought after employees for the NGO and emerging private sector. The draft curriculum proposed below (Tables 16 and 17) is one possible vision to fulfill this need. Important considerations that must be addressed in finalizing the draft curriculum include:

1. The availability of resources (instructors and facilities) for implementation.
2. The first year curriculum will serve multiple purposes, including:
   a. Remedial work to prepare students with poor academic backgrounds for possible university level courses.
   b. Rigorous applied training and work experience to prepare the students to work in agriculture after completing the first year if they are not successful in the second year of the associate degree program. Students completing the first year program would receive a "Certificate in General Agriculture Production".
3. Students completing the 2nd year or diploma program could be provided a bridge to work toward a B.S. degree after two years of work in the public or private sector.

Table 16. Suggested first year curriculum for 2-year diploma degree.

Semester I		**Semester II**	
Course	**Credits**	**Course**	**Credits**
Mathematics I	2	Mathematics II	2
Botany	2	Zoology	2
Chemistry I	2	Chemistry II	2
English I	2	English II	2
Extension Methodology I		Extension Methodology II	
Work Experience Modules (3)	6	Work Experience Modules (3)	6
Other	2	Other	2
Total	18	Total	18

1st Year Work Experience for the Southern Sudan (Adapted from Earth University)

EXP 100 Work Experience

The first year Work Experience course consists of six modules, each lasting seven weeks. Each module requires approximately 12 hours of hands on work experience per week and the student receives 2 credit hours for each satisfactorily completed module. Students learn how to manage annual crops, perennials, trees, livestock, and small farm enterprises. Through oral and written reports on their work experiences, the students also develop oral and written communication skills.

The first year consists of six modules in rotation:

EXP 101 - Animal Production
EXP 102 – Crop Production
EXP 103 - Forestry Practices
EXP 104 - Sustainable Agricultural Practices
EXP 105 - Sustainable Agriculture – Integrated Organic Agriculture
EXP 106 - Horticultural Production

EXP 101 Animal Production Module

Topics covered include: animal breeding, health, feeding, watering, nutrition, housing, and management; pasture management; and use of animals for draught and plowing. Focus on common farm animals in the Southern Sudan: cattle, donkeys, poultry, ?

EXP 102 Crop Production Module

This module focuses on the correct use of tools and appropriate practices in farm work, such as: land clearing, preparation and maintenance of drainage systems, pruning, fertilizing, plant disease control, propagation of plants, and the planting and harvest of vegetables. The student also works in management of seedbeds and nurseries.

EXP 103 Forestry Production Module

Topics include: construction and maintenance of tree seedbeds and nurseries, collection and care of seeds, transplanting, care of seedlings and growing trees, tree climbing and techniques for estimating timber and other forest product yields.

EXP 104 Water Management Module

Focus is on water management practices for smallholder and intermediate sized farming operations using conventional as well as supplemental and deficit irrigation practices. Topics include: basic irrigation principles, irrigation techniques for dry season farming; supplemental and deficit irrigation techniques; methods for capturing and storing rainwater; pumping options; storage options; water source; etc.

EXP 105 Sustainable Smallholder Production Agriculture Module

Focus is on smallholder farming needs and production systems. Introduces concepts of sustainable and integrated farming. Topics include: agricultural production for both personal consumption and sale; crop production; harvest and storage; animal production and management; forest production and management; pest management; soil protection and management; seed selection; fertilization techniques; and product sales.

EXP 106 Horticultural Production Module

Focus is on production of horticultural species of economic interest in the Southern Sudan. Topics include: nutritional benefits of horticulture crops; seed nurseries; transplanting; pest management, fertilization; supplemental irrigation; harvest and post-harvest processing; and product marketing and sales.

Table 17. Suggested second year curriculum for 2-year diploma degree.

Semester I		**Semester II**	
Course	**Credits**	**Course**	**Credits**
Physics I	2	Agricultural Economics	2
Crop Science	2	Animal Science	2
Computer Science	2	Statistics II	
English III	2	English IV	2
Soil Science	2	Rural Sociology and Development	2
Work Experience Modules (2)	4	Work Experience Modules (2)	2
Statistics I	2	Applied Research Methodology	2
Total	18	Total	18

2st Year Work Experience for the Southern Sudan

EXP 200 Work Experience
The second year Work Experience program consists of 4 modules, each lasting seven to 14 weeks. Each module requires 6 to 12 hours of training and hands on work experience per week and the student receives 2 credit hours for each satisfactorily completed module. Through the modules, students acquire the skills require to manage small and intermediate sized farms and to teach others how to manage the same. Through oral and written reports on their work experiences, the students also develop oral and written communication skills.

The second year work experience modules include:

- EXP 201 - Post-Harvest Processing, Storage, and Value-Added Processing (12 hours/week, 7 weeks)
- EXP 202 - Off-farm Sales and Marketing (12 hours/week, 7 weeks)
- EXP 203 - Introduction to Agribusiness (6 hours/week, 14weeks)
- EXP 204 - Extension Practicum (6 hours/week, 14 weeks)

EXP 201 Post-Harvest Processing, Storage, and Value-Added Processing Module
This module focuses on technologies and practices to reduce crop losses and improve the quality of harvested products during harvest, processing prior to use/or storage, and during storage; quality control; seed storage; drying and other preservation techniques, etc.

EXP 202 Off-farm Sales and Marketing Module
Topics include: Identification of marketing opportunities; quality control and assurance; formation and operation of marketing cooperatives; ??????

EXP 203 Introduction to Agribusiness Module
Topics covered include: introduction to formation and management of an agribusiness; roll of the business in sustainable development; identification of market opportunities; business plan development; market analysis and feasibility study; and working as a team, the development of a business plan for a new agricultural enterprise.

EXP 204 Extension Practicum Module
Students working in teams and with a government or NGO professional extensionist identify an agricultural development problem (crop, animal, or forest) in a local agricultural community,

research the problem, identify possible solutions and then educate key stakeholders on how the problem might be solved.

Options after Graduation

Students satisfactorily completing the two-year diploma/associates degree program in agricultural and natural resource management would have two options upon graduation. Enter the workforce with the two-year diploma degree or start a Bachelor of Science degree (before or after real world work experience) in the College of Natural Resources and Environmental Science at the University of Juba, in the Faculty of Agricultural and Environmental Sciences at the Catholic University of Sudan, or other program. Students would enter as 2nd year students in these programs and would satisfy almost all of the first year B.S. curricula requirements either through formal course work or work experience as indicated in Table 18.

Table 18. Comparison of Proposed 2-Year Diploma Curriculum with curricula of University of Juba and Catholic University of Sudan

University of Juba (year)	Proposed Agriculture and Natural Resources Management Diploma (year)	Catholic University of Sudan (year)
Botany I (1)	Botany (1)	Biology I (1)
Zoology I (1)	Zoology (1)	
Physical Chemistry (1)	Chemistry II (1)	Ag Chemistry II (2)
Inorganic Chemistry (1)	Chemistry I (1)	Chemistry I (2)
Physics I (1)	Physics I (2)	Physics I (2)
Mathematics I	Mathematics I (1)	Mathematics I (1)
Arabic I (1)[1]		
English I (1)	English I (1)	Language/Communication I (1)
Sudan Foundation 1 (1)		
Botany II Plant Anatomy (1)		
Zoology II (1)	Animal Science (2)	Animal Science (3)
Physics II (1)		
Mathematics II (1)	Mathematics II (1)	Mathematics II (1)
Organic Chemistry (1)		
Arabic II (1)		
English II (1)	English II (1)	Language/Communication II (1)
Sudan Foundation II (1)		
Ecology (2)	Rural Sociology/Extension (2)	Rural Sociology (3)
Economics (2)	Agricultural Economics (2)	Economics I (2)
Statistics (2)	Statistics I (2)	Statistics & Probability (3)
English III (2)	English III (2)	
Soil Science I (2)	Soil Science (2)	Soil Science (3)
Computer Science (2)	Computer Science (2)	Computer Studies I (1)
English IV (2)	English IV	
	Crop Science (2)	Crop Science (3)
		Computer Studies II (1)
		Accounting I & II (1)
		Natural Resources of Sudan (1)
		Study Skills (1)
		Principles of Logic (1)
		Social Analysis of Sudan (1)

[1]**Unmatched 1st B.S. year courses bolded**

Summary and Conclusions

The challenges facing post-conflict Southern Sudan in general and the system of higher education in agriculture and natural resource management in particular, are daunting. The lack of facilities and resources; a large, matriculating youth population poorly prepared for a university education; the lack of a dynamic and growing private sector prepared to employ graduates; and, most of all, the absolute necessity of producing graduates at different levels who can re-start agriculture in the South and lead the region to a sustainable and food secure future are all major issues that must be addressed. This can be done but will require thinking 'outside the box'. The changes and additions to curricula recommended in this report are a major start in this direction. However, these changes will only start the process of higher education renewal and growth toward a food secure and peaceful future. Sustaining this long process will require not only strong and visionary leadership from Southern Sudanese educators, administrators, and other stakeholders, but also require enduring partnerships and the assistance of international universities and the donor community.

Appendices

Appendix A: Role of Higher Education in Agriculture and Environmental Sciences in Post-Conflict Countries

"One of the strongest factors conditioning post-conflict reconstruction and setting it apart is the pervasive sense of urgency. Yet peace building is a long-term activity" **(Buckland, 2004, p.85)**

I. Changing Priorities for Higher Education in Overall Development Strategy

Although there is general agreement that institutions of higher education are a necessity for all countries, the controversy regarding where the priority for these institutions falls among the multiple challenges facing developing countries has been ongoing for decades.

In Sub-Saharan Africa, institutions of higher education were clearly not a priority during the long colonial period. At the end of the 1960s there were only six universities in the entire region. Today, there are more than 300, a reflection of emerging national and international consensus that higher education plays a vital role in social and economic development. However, the extremely limited resources available to support quality higher education programs in most countries of the region have meant that students often get inferior educations. Curricula, teacher education, and facilities have all suffered as a result, a situation exacerbated even more by the huge growth in student numbers in many countries in recent years (Beverwijk, 2005).

National and international support for universities declined sharply in the 1980s in part due to the imposition of structural adjustment programs by the International Monetary Fund and World Bank. Indeed, the World Bank was the principal institution responsible for lowering the priority for higher education institutions in the developing world during this period. As the primary multi-lateral donor agency, the World Bank has enormous direct and indirect influence on the development agendas of individual countries as well as the international donor community. This World Bank policy towards higher education was largely influenced by early rate of return on investment studies indicating lower returns for higher education than for other investments. A 1986 study indicated returns to higher education in developing countries averaged 13% lower than returns to basic education (Center for Global Development, 2008). Another study in 2002 across 98 counties indicated that while primary education returns were around 19%, returns to higher education were less than 11% (World Bank, 2002). Additionally, the low and decreasing primary education enrollment rates in Africa - 81.7% in 1980, 75% in 2000 - meant that much ground needed to be made up (Center for Global Development, 2008). Implications for policy seemed straightforward. Limited resources were best used to promote widespread primary education to the detriment of investments in higher education. Higher education could best be found abroad or in internationally-supported training centers such as those of the Consultative Group for International Agricultural Research.

Despite this clear trend during the late 20th century, a consensus is now emerging that institutions of higher education must become a higher priority in the development strategies of developing

countries. Although no one disputes the highest priority for broad-based primary education, a more holistic view of the need to build a comprehensive education system, including higher education, is now the norm. This is partly due to the recognition that previous empirical studies are inaccurate. They do not capture all the benefits that accrue to society as a result of higher education. Such rate of return studies generally only measure easily quantifiable benefits (e.g., salary levels, taxes, etc.) resulting from higher education, not the broader social values such as increased entrepreneurial ability, enlightened leaders, and a more informed population with stronger democratic values and expanding choices (Center for Global Development, 2008; Global Joint Task Force, 2000). World Bank publications illustrate a somewhat schizophrenic, but definite movement over time toward this consensus. Although a 1994 report (World Bank) stressed that higher education should not have much of a priority in development strategies (in many countries), the executive summary of the same report states that higher education is of "paramount" importance. The Global Joint Task Force 2000 report stated that higher education "cannot guarantee rapid economic development – but sustained progress is impossible without it" (p. 19). A 2006 study found that due to the critical shortage of human capital in Africa, increasing the level of higher education by just one year would increase national income by 0.63% in one year and around 3% in five years (Bloom, et. al., 2006). Finally, by 2007 the World Bank acknowledged in a task force report that "a more knowledge-intensive approach to development is not an option for African countries, it is the only path" and that this requires a greater focus on tertiary education and on research" (Global Joint Task Force, 2000). The same report concluded that "without more and better higher education, developing countries will find it increasingly difficult to benefit from the global knowledgebase economy". Following this study, developing countries must:

- "provide increasing numbers of students, especially those from disadvantaged backgrounds, with specialized skills, because specialists are increasingly in demand in all sectors of the world economy;
- produce a body of students with a general education that encourages flexibility and innovation, thus allowing the continual renewal of economic and social structures relevant to a fast-changing world;
- teach students not just what is currently known, but also how to keep their knowledge up to date, so that they will be able to refresh their skills as the economic environment changes; and
- increase the amount and quality of in-country research, thus allowing the developing world to select, absorb, and create new knowledge more efficiently and rapidly than it currently does." (p10)

II. Priority of Higher Education in Post-Conflict Countries

While a consensus on the value and priority of support for institutions of higher education in developing countries has now emerged, the case for higher education in post-conflict countries is much more problematic. As a result of violent conflict, public and private economic, social, and institutional infrastructure is often in ruins and the stock of human capital has been seriously reduced due to death, emigration, internal displacement, and forgone opportunities for training and education. The challenges facing countries emerging from conflict are consequently much more daunting and foremost among these challenges is maintaining the peace.

Building peace on the ruins of conflict necessarily involves effectively addressing the causes of conflict in the first place. Such causes are unique for each conflict situation. A study by Collier et. al. in 2000 (Buckland, 2004) cites three main economic factors that contribute to conflict:

- low levels of per capita income
- low rates/stagnation in per capita income
- high dependence on primary commodity exports

The study indicates that when per capital income doubles, the possibility for conflict halves. Typically, violent conflict reduces GDP by around 15% and can affect agriculture much more (44.5% in Angola – (Zaur, 2006). Furthermore, if primary commodity (e.g., agricultural, oil exports) dependence is reduced to 10% of the economy, the possibility for conflict also reduces by 10%. This is in addition to the 'Dutch disease' problem due to heavy dependence on single commodity exports which may seriously complicate economic growth in the long term (Benjamin, et. al, 1989). A USAID discussion paper (2006) finds that 40% of post-conflict countries return to violence within a decade. The Zaur study finds that a country with a GDP of US $250 has a 15% likelihood of returning to war within five years. This likelihood decreases by half if GDP per capita reaches $600 and to 4% if it reaches $1250. Should economic growth **drop** by 5%, the likelihood of conflict the next year increases by 12%. Although other factors are clearly important in the unique case of post-conflict Southern Sudan, the highest priority for post-conflict countries in general must be stimulating economic growth if peace is to be maintained.

Reconstructing the education system in some form is the central peace strategy of post-conflict governments. There is universal recognition that re-establishing the education system is fundamental to the social and economic future of the country and signals among the population a much sought after feeling of a return to normalcy (Department for International Development, 2007). Although education, *per se*, does not cause or end wars, it may have contributed to the factors that underlie the conflict "but also has the potential to play a significant role both directly and indirectly in building peace, restoring countries to a positive development path and reversing the damage wrought by civil war. Early investment in education is thus an essential prerequisite for sustainable peace". (Buckland, 2006)

But where to begin? During conflict, primary education tends to stagnate but secondary, and especially tertiary education, tend to collapse rapidly. Post-conflict, primary education is more resilient due to strong local support and the more modest financial demands. However progress in re-establishing secondary and tertiary institutions is slow (Buckland, 2004; 2006). Donors have historically offered only minimal support to secondary and higher education due to their belief in the relative importance of primary education (Buckland, 2006). Their lack of enthusiasm for secondary and tertiary education may also be in part due to their preoccupation with Millennium Development Goals (see http://www.undp.org/mdg/basics.shtml), which target primary education but say nothing of secondary and tertiary education, and the fact that education at these higher levels is more expensive and subject to larger risks of wastage (Buckland, 2004).

The great danger for peace of not focusing on educating the youth who are of military age, tend to be involved in politics and often feel excluded in the post-conflict period, is that they may

too readily turn to crime or return to war. Consequently, there is a clear need to focus on **all** educational sectors and delivery modes or risk exacerbating conditions that return a country to conflict (Buckland, 2004; 2006). A system focus that includes Accelerated Learning programs (Department for International Development, 2007) for the "lost generation" that missed education opportunities as well as concerted efforts to rebuild secondary and tertiary programs of higher education must be initiated to offer a hope and a path for a better tomorrow to this vulnerable group (Mac-lkemenjima, 2008).

The demand for secondary and post-secondary-educated labor in post-conflict countries is subject to much controversy. In an economy largely destroyed by civil war, where will such people, particularly college-educated people, find appropriate jobs? Clearly the situation of every country is somewhat unique and subject to the near-term growth potential determined by the state of the destruction, existing skill levels of the populations, the natural resource endowment, support of the donor and NGO communities, and the policy environment provided by the government.

What we do know in general is that the demand for well-trained teachers at all levels, already in short supply in most developing countries, is universally high immediately post-conflict as large numbers of combatants and displaced persons return to tight labor markets looking for opportunities. Additionally, highly educated teachers are often among the first to flee conflict to opportunities abroad and are hesitant to return with their families until peace is restored and infrastructure, particularly adequate secondary and post-secondary education facilities, are in place to accommodate their children. Thus, an already short supply of teachers prior to conflict is exacerbated after conflict (Buckland 2004; International Institute for Education Planning, 2002; Center for the Study of African Economics, 2007).

Some highly skilled needs in post-conflict situations are temporary and will not be needed once normalcy returns. A "normal" society simply doesn't need skill sets appropriate for rapid change required in the immediate post-conflict years and the capacity building required for these skills takes too long. These skill sets are most appropriately provided by international non-governmental organizations and others specializing in post-conflict situations (e.g., resettlement needs, accelerated learning design, etc.) and imported from abroad. However, the immediate rebuilding of more general internal skill sets related to civil society is essential for long-term growth and peace. These skills cannot be supplied effectively to post-conflict society by "outsiders", even in the short-term (International Peace Academy, 2004).

In addition to the demand for teachers and general training for civil society skill sets, other additional considerations of the post-conflict economy must be taken into account in assessing the general demand for the college-educated. Although greater public sector leadership and management skills will be required, two additional general characteristics of post-conflict developing economies emerge as particularly important.

- There will be a continued dominance of jobs related to agriculture. Agriculture dominates pre-conflict economies and will continue to be the predominant employer and engine of growth for the foreseeable future. Consequently, appropriate skill sets to support agricultural development must be supported.

- Self-employment and unpaid family workers, largely rural and non-formal, will grow substantially in importance post-conflict. Advanced training in support of business and entrepreneurship relevant to the developing economy opportunities is therefore necessary. (The World Bank, 2003)

Given the globalizing economy and the high tech skills needed to integrate into and benefit from this economy, it is essential that training at most levels includes a strong science and technology foundation (Global Task Force, 2000), regardless of the current low level of technology in most post-conflict countries. There may be opportunities to leapfrog intermediate technologies in many cases and reap substantial productivity gains that benefit growth and development.

III. Priority of Agriculture and Environmental Sciences in Post-Conflict Developing Countries

Given the predominant size of the agricultural sector and importance of natural resources to sustainable growth and development, it has been clear to traditional development researchers for some decades that a high development priority for support to these sectors is essential (Johnson, et al, 1961). It is generally agreed that the so-called "urban bias" of development strategies of many developing countries during the last decades of the 20th century has contributed to stagnation and mass poverty (Lipton, 1977) and low agricultural productivity remains a significant barrier to growth and the development of other sectors of the economy (Gollin, et. al., 2000).

In post-conflict countries, agricultural growth and development may be even more important than in other developing countries. A 2007 study concludes that over 80% of incremental employment growth in the economy is due to agriculture and its economic multipliers. Agricultural multipliers drive rural non-farm employment which is central to peace and economic growth. The study also points out that agricultural growth services (including research and extension) are critical to the perception of good government by the rural community. (Economic Growth Office USAID, 2007)

Another analysis points to the extreme importance – indeed, "vital to reconstruction"- of the agricultural sector to food security and the need to invest in the sector to support post-conflict clean-up and agricultural development through public services, credit, and infrastructure. Such efforts are important for both the subsistence agricultural sector, which facilitates fast self-sufficiency and comprises by far the largest number of people, and commercial agriculture important for income and export growth. The analysis points to the importance of pro-active gender sensitivity in policies and programs put in place. This is especially important since as the result of conflict there is generally a large increase in female-headed households, most of which are agriculture-based. (Date-Bah, 2003)

Due to the links between the environment, and the productivity of agriculture and rural non-farm economic activities (e.g., game parks), a post-conflict country cannot afford to allow continuing environmental degradation, often a consequence of conflict, to continue. Clearly the sustainability of agriculture depends upon maintaining the productivity of soil and water resources. In addition, any authors have pointed out the relationship between environmental scarcity and conflict, particularly the scarcity of renewable natural resources (Zaur, 2006). Often

such scarcity is a major contributing factor to civil strife. However, there may be a positive side to post-conflict situations and conservation of the environment. For example, some see the post-conflict period as an extraordinary opportunity for promoting fundamental change since the slate is essentially wiped clean as a new country emerges from the conflict (Zahler, 2006).

IV. Post-Conflict Strategies for Higher Education in Agriculture and Environmental Sciences

Given the importance of economic growth to the maintenance of peace, the importance of agriculture and natural resources to economic growth and the welfare of the population, and the need to view the education sector as a holistic system that includes higher education, what can be said about priority directions for agriculture and environmental sciences in institutions of higher education in post-conflict countries? Unfortunately, the literature offers very little specific guidance to this important question. However, if a post-conflict situation potentially offers a 'clean slate', then a long-term, strategic approach may be found by examining different models and curricula within the context of the general, long-term role higher education is expected to play in the agricultural sector and the 'new', emerging country.

The classical view of the academe has changed beyond its teaching and research roots. A third mission, that of economic development, has become generally accepted as an additional responsibility of the university in our global 'knowledge-based' society. This 'new' model has been designated the 'entrepreneurial university' (Etzkowitz, et.al, 2000). This expanded vision for the university is well-known to U.S. land grant institutions and colleges of agriculture which trace their analogous tripartite mission of "teaching, research, and extension" back to 1862 (Science and Technology Policy Research, 2000). These three key pillars have come to be known as the 'agricultural knowledge system' or 'agricultural knowledge information system' (Michigan State University, 2001) and are considered essential for agricultural growth and development in all areas. Consequently, the issue becomes one of determining how an agricultural college or university can best catalyze and/or reinforce existing elements of this system in the difficult post-conflict environment. Since all resources are extremely limited, high-level coordination with overall government strategy is essential (Sommers, 2004). In the case of southern Sudan, the GOSS has prioritized agriculture as a main engine of economic growth and poverty reduction (Woodrow Wilson Center, 2004) and appears eager to provide this coordination. Other pre-conditions are also necessary, specifically, resources to support acquisition of basic infrastructure including land and a willingness to innovate and take risks while responding to existing labor market requirements.

The Zamorano Model. One such successful model of new college of agriculture development is the Pan-American Agricultural School, better known as 'El Zamorano'. Zamorano is located some 30 kilometers from Tegucigalpa, the capital of Honduras. It has been recognized as the best agricultural school in the region for many decades (Zamorano: Prestigio mundial, 2002). Today, among its 5,000 alumni found throughout the region are numerous past and present ministers of agriculture and other highly-placed public sector leaders, CEOs of successful large and small agribusinesses and agricultural enterprises, as well as extraordinarily large numbers of public and private sector researchers, extensionists, and NGO leaders. To be a 'Zamorano' today is to be a product of an entrepreneurial university that has acquired a prestigious education brand which

opens doors all over the world and is jealously guarded by all who have graduated from this rigorous 'learn by doing' program.

Zamorano began in 1943 as a private school funded initially by a significant grant from the United Fruit Company with a vision to impact not only Honduras but also the agricultural economies of the entire Latin American region. At that time, virtually all of Central America was in some stage of post-conflict development governed off and on by so-called 'caudillos' little interested in development and more interested in dealing with numerous hot spots flaring up from time to time. Higher education was generally accessible only to the rich elite and agricultural training schools were virtually unknown. Although the vast majority of the population was comprised of very poor and illiterate subsistence farmers, commercial tropical agriculture – particularly banana culture – was rapidly emerging and finding little local skilled labor needed to manage field production on the large and expanding plantations. Altruism was, perhaps, not the only reason for the United Fruit Company decision to provide early support to such a school.

The first director was a pragmatic visionary who saw an important niche and vigorously pursued local and regional governmental, donor, and private support to produce graduates who exemplified the motto *Labor Omnia Vincit* (work conquers all) (International Institute for Education Planning , 2004). He applied a strong disciplinary system to the three-year residential education curriculum composed of half-day modules of classroom learning and practical field experience, both supervised by the school's professors. There were initially only three departments: General Studies, Crop Science, and Animal Husbandry. It was always envisioned that partial support for the school would be provided by auto consumption of the food produced with the surplus sold through a school (and student) run store. Students accepted into the program came from a wide range of academic backgrounds (there were no fixed academic requirements - e.g., high school). The emphasis was on finding students who had a passion for learning about and 'doing' agriculture and then giving them the opportunity to learn and succeed (Malo, 1999). This acceptance policy remained in effect throughout the 40s and 50s. Graduates were expected to either return to the family farm or become extension agents (International Institute for Education Planning, 2004). Nevertheless, as the expertise of graduates became known, the commercial agriculture sector began to take more and more and by the 60s and 70s, graduates generally received multiple offers of employment. The best graduates were often employed as field instructors by Zamorano, itself, while others began going on to graduate schools in the US and elsewhere where Zamorano had carefully cultivated university partnerships. Often these graduate degree holders, always loyal 'Zamoranos', returned to the school to upgraded both teaching and the emerging research missions of the school.

The school has gone through a number of changes in its 65 year history. In one phase beginning in the 80s, the three-department structure and curriculum subdivided into a more traditional seven department structure including social sciences. An optional, then compulsory fourth year BS degree with a thesis requirement was added, followed by a masters degree option in conjunction with Purdue and Cornell universities. By combining research and engagement within the region, the thesis requirement has allowed the school to greatly increase the economic development component of its mission.

Today, to remain relevant to changing employer and societal needs, the academic program has returned to the school's more interdisciplinary roots and has four main departments: Agribusiness Management, Food Agro-Industry; Agriculture Science and Production; and Socioeconomic Development and Environment. (International Institute for Education Planning, 2004) Curricula for these departments can be found at: http://www.zamorano.edu/ingles/carreras_eng/carreras_eng.htm.

The campus is modern in every respect with distance learning facilities, multi-purpose classrooms, student dormitories, an extensive library collection, a health unit, visitor center, and extensive student athletic facilities. Learn-by-doing is still integral to the Zamorano education. Except for their final year when they're doing their thesis research (on or off campus), students continue their highly disciplined half-day rotation through the "University Enterprises" subdivision responsible for providing technical and business on-the-job training in relevant production, transformation and commercialization units. This subdivision is grouped into three areas, all run as real business units: agricultural production (horticulture, fruit culture, forestry, grains and seeds); livestock production (dairy cattle, beef cattle, swine, and agricultural irrigation and machinery); and processing plants (dairy, meat, animal feed and seed, horticulture, and wood processing). There is also a marketing and sales unit that involves student in direct sales to the public (the quality of Zamorano products is universally acclaimed). See: http://www.zamorano.edu/ingles/carreras_eng/cze.htm.

Despite this modern infrastructure and curriculum, strict discipline remains one of the most outstanding characteristics of this school. The 800 students are in class by 6:30 am and either work or attend class all day, five days per week during the 11-month trimester year (Cave, 2001). Study time beginning at 18:30 pm to 'lights out' at 21:30 is strictly enforced. Uniforms are required. Demerits for inappropriate behavior impose strict penalties and can lead to expulsion. On weekends, free time allows for various club activities, athletics and occasional excused travel home but teams of students are also required to 'police' and clean up the campus, even on Sundays.

Zamorano's road toward excellence has been long and has required significant adaptation to the changing needs in the higher education environment of its region. The model provides one of potentially many models which may help to sequence and catalyze the construction of the necessary 'agricultural information system' through leadership of agricultural and environmental sciences higher education programs in post-conflict counties. The Zamorano model began with a modest teaching component targeting the training of extension agents (economic development) through a broad interdisciplinary department structure. As the system matured and the teacher corps upgraded, a nascent, then vigorous research component developed within the modernized, but still broad departmental structure. This, in turn, spurred greater and more sophisticated economic development relevant to the changing agricultural and environmental conditions of the region.

V. Conclusions

Post-conflict regions such as southern Sudan will likely need to find their own unique model and path to building the agricultural information system it needs to promote social and economic

growth, development, and peace. Imported models, particularly in Africa, have a very high failure rate (Michigan State University, 2001). Careful coordination and sequencing of the three pillars in collaboration with willing partners inside and outside of the region will be necessary.

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Appendix B: Assessment of agricultural and NRM human resource and educational needs

Background Information

Sudan has a long and tragic history of civil conflict. The first civil war began immediately after independence and continued through to the Addis Ababa Agreement of 1972. In 1983, another civil conflict, which marked the formation of Sudan People's Liberation Movement/Army (SPLM/A), emerged. For the two decades that followed, the civil war was Africa's greatest human tragedy with an estimated 2 million civilian deaths and 4 million people internally or externally displaced.

With the signing of the Comprehensive Peace Agreement (CPA) in 2005 and subsequent establishment of the Government of Southern Sudan (GoSS) in Juba thereafter, the security situation improved. Approximately 50 percent of those internally displaced returned home.

As a result of this new development, GoSS, Non Governmental Organizations (NGOs), donor agencies, foreign governments and other international organizations have shifted their emphasis from the initial provision of humanitarian assistance to rehabilitation and development. The concern of the newly formed GoSS was that to address the root causes of the prolonged conflict and to prevent future conflict it requires expanding access to basic social services and overcoming the geographical inequalities.

In the Ministries of Agriculture and Forestry and Animal Resources and Fisheries, the main focus was placed on adoption of strategies to boost food production through accelerating delivery of inputs and provision of credit facilities to farmers. The ministries also emphasized a policy framework to increase extension services, market linkages and strengthen human capacity to ensure attainment of food self sufficiency by all households. The implementation was to take into consideration the six agro-ecological zones to ensure that natural resource base is used sustainably. The Ministries' visions echoed the attainment of food security as a measure of improved quality of life and economic prosperity. This was to be done by transforming agriculture from the traditional subsistence system to science based, market oriented, competitive and profitable agricultural system without compromising the sustainability of natural resources for the next generation.

Problem Statement

Sudan is the largest country in Africa and among the wealthiest in terms of natural resources; yet, in the Southern Sudan 80 percent of agricultural products are imported and the majority of the rural population depends on World Food Programme (WFP) and other humanitarian organizations for food and other nutritional needs. Anecdotal data attribute this to the civil war and the resulting loss of a generation or more of a skilled agricultural workforce, agricultural extension workers, and higher education in agriculture. The Catholic University of Sudan, the University of Juba, and other reestablished or newly established public and private universities are attempting to address the shortage of agriculture and natural resources management manpower through higher education programs in agriculture. In addition, foreign donors are sponsoring certificate programs in agriculture, forestry, fisheries, etc. to train ministry and NGO to work in these areas. As part of this project, we conducted a survey of agricultural and natural

resource management professionals in both the public and private sectors to identify their human resource needs.

Needs Assessment Survey

The survey was guided by the following research questions:

1. What levels of training and experience are needed by staff of the State Ministry of Agriculture and Forestry?
2. What are the perceptions of staff of the State Ministry of Agriculture and Forestry, about their training needs?
3. What do the staff at the state, county and Payam levels perceive to be the priority content areas for training and the innovative strategies that should be introduced in training programmes?
4. What are the priority areas in agriculture, forestry, animal resources and fisheries that require immediate attention for curriculum development and training at higher education in Sudan?
5. What skills are required for staff of the State Ministry of Agriculture and Forestry to discharge their roles effectively?
6. What key factors may promote or hinder the development of institutions of higher learning in agriculture in the Sudan?

RESEARCH DESIGN AND METHODOLOGY

Research Design

Survey design used a representative sample that eased data standardization and aggregation as well as the collection of quantitative data through questionnaires and structured interview guide. The study targeted the staff of the State Ministries of Agriculture and Forestry and Animal Resources and Fisheries. Stratified and simple random sampling was used to select respondents. Key respondents were state Director Generals and Directors of directorates and departments.

The sample included the following key respondents

DG Agriculture	Director of Extension	Director of Land Use
DG Forestry	Director of Horticulture	Monitoring and Evaluation
DG Animal Res. Fisheries	Director of Afforestation	Director of Animal Health
DG Planning & Statistics	Director of Extension & Training	Director of Fisheries
Food Security Officer FAO SCUK & OXFAM Juba South	Brach Manager and Board of Director Kenya Commercial Juba South	Hotel Manager Juba Gran Hotel, South Sudan Hotel and Hotel Intra Africa,

Data Collection Instrument

A structured interview guide was used to collect data.

Section 1 included general demographic information on the respondents. This included information such as gender, age, highest academic qualification, years of working experience and the current position.

Section 2 sought information about the number of qualified personnel available in the each department desegregated by gender and the years of working experience in their current positions.

Section 3 sought information on staff perceptions concerning their training needs, the priority content areas for training and the innovative strategies that should be introduced in training programmes.

Section 4 sought information about the priority areas in agriculture, forestry, animal resources and fisheries that require immediate attention for curriculum development and training at higher education and the knowledge, skills, attitudes and values that are necessary for staff at the state ministry levels to discharge their roles effectively.

Section 5 sought information on key factors in the country or the region that may promote or hinder the development of agricultural institutions of higher learning in the Sudan.

Description of Data Collection and Analysis Procedures
Data was collected by the principal researcher and four research assistants, two for each sampled state. The principal researcher identified and made appointments with the sampled respondents for interviews and assigned respondents to interview for each research assistant.

Data were coded and analyzed using of SPSS statistical software to generate frequencies and percentages and multi response analysis was performed to generate logical in-depth narratives from open ended items.

Human resource needs

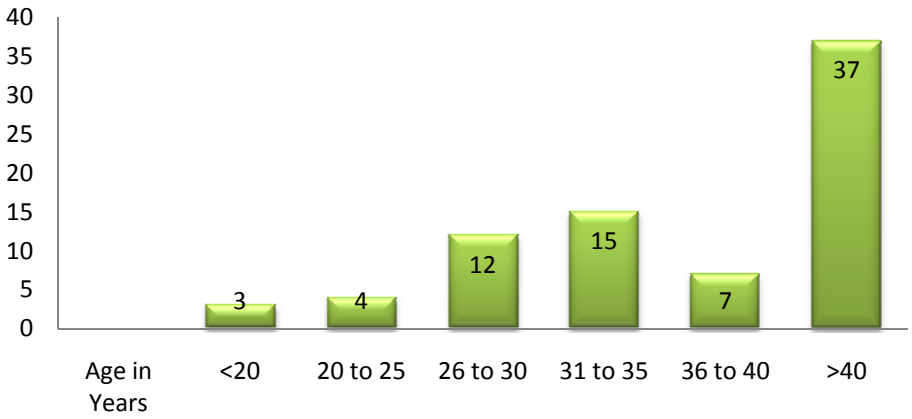
Background information of the respondents
Background information of the respondents displays data concerning the distribution of respondents by gender, age, highest academic qualification, years of working experience and the current designation.

Table 1. Distribution of respondents by gender

	Gender			
State	**Male**	**Female**	**Total**	
Central Equatoria	28	5	33	
Upper Nile	16	3	19	
Western Bahr El Ghazal	22	4	26	
Total	**66**	**12**	**78**	

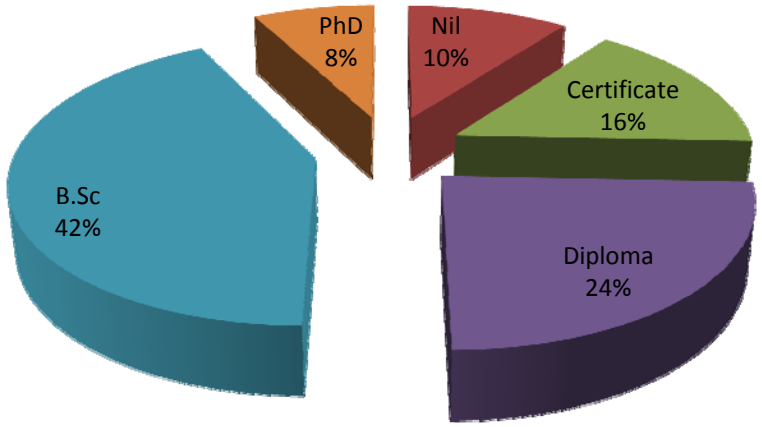
A total of 78 people participated in the study, 33 from Central Equatoria of which 6 were from the private sector and 5 were from the international NGOS, 19 from Upper Nile, and 26 from Bahr El Ghazal. The distribution by gender shows that majority 66 (84.6%) were male and 12 (15.4%) were female. The gender disparity was occasioned by the low number of women in public service in Southern Sudan. It is estimated that women form only 10% of the total classified government employees.

Fig 1. Distribution of respondents by age



The majority of respondents, 47.4% (37), were above 40 years followed by 15 (19.2%) who were 31-35. This data raise some concern about the human resource gap in agriculture since the majority of the age group are about to be reach the retirement age (60 years) stipulated in the civil service act.

Figure 2. Distribution of respondents by highest academic qualification



Out of the 78 people who participated in the study, 8% had a Ph.D., 42% had a B.Sc., 24% had a diploma, and 16% had certificates. A cross tabulation with work experience indicated that most respondents with a B.Sc. had less than three years work experience whereas those with long work experience had certificates and diploma.

Current and projected human resource needs

Information about the number and qualified personnel available in the each department desegregated by gender and years of work experience was provided by the head of the various departments. The information is as displayed in Table 2.

Table 2. Distribution of classified personnel by department and gender

Departments	Certificates		Diploma		B.Sc.		M.Sc.		PhD	
	M	F	M	F	M	F	M	F	M	F
Fisheries	37	10	9	5	16	4	0	0	0	0
Veterinary Science	18	3	2	0	10	3	0	0	1	0
Animal Production	17	4	6	0	17	4	1	0	1	0
Plant Production	18	5	2	1	3	4	0	0	2	0
Environmental and Tourism	15	4	2	0	2	1	0	0	0	0
Forestry	0	0	0	0	13	3	0	0	1	0
	105	26	21	6	61	19	1	0	5	0
Grand total	**131**		**27**		**80**		**1**		**4**	

Table 2 shows that majority of the current classified employees (131) had certificates followed by those with B.Sc., which according to the Directors are generally new graduates and newly hired, while those with longer work experience are diploma and certificate holders. The Directors also pointed out that the majority of the staff are "unclassified", many of whom were trained on job and hold senior positions but are not recognized by the civil service.

Table 3. Distribution of human resources needs by department

Department	Required Now	Required in 5 years	Required in 10 years
Fisheries	104	190	280
Veterinary Science	80	65	140
Animal production	76	108	320
Plant production	70	156	500
Environmental and Tourism	45	130	163
Forestry	462	743	1810
Total	837	1392	3213
Shortage compared to current staffing	71%	83%	92%

Table 3 shows that in all the departments there is a currently severe shortage (71%) of classified staff. This short fold was occasioned by lack of qualified personnel and inadequate government funding for the agricultural sector. Now with the State Ministry of Agriculture staff projection in the three States which stands at 1,392 and 3,213 for 5 years and 10 years, respectively, there is high need for training of people in the sector. In interviews with the Director Generals, some said the number of classified staff will be higher if the Government takes the decentralized approach to development seriously. This would require more classified staff at the Payam and Boma levels.

In private sector interviews, especially with the banking and hotel industries, managers mentioned the growing demand for skilled personnel with agricultural backgrounds. For example one of the Boards of Directors for KCB said:

…we are expanding our braches to most parts of Southern Sudan and in the near future we shall start providing soft loans to farmers…this will be preceded by training of farmers …this I believe could be done best if we have staff with agricultural backgrounds.

One hotel managers said:

Right now we depend on staff from outside the country for catering, cooking and general hotel management. We believe this work could be provided locally if there were people with skills in basic hotel management.

NGO respondents indicated a need for agricultural trainers at the village level. NGO food security and livelihood officers said:

…sometimes we had no option but to bring trainers all the way from East Africa…we advertise and re-advertise for a post but most often none of the Sudanese had the qualifications or skill in training of farmers…

Another food security and livelihood officer said:

It difficult to get people with the skills to train at lower level….the farmers need people who can train in the local language but the people whom we bring from East Africa do not know local languages hence making the training not really meaningful…I wish there were people who had skills and could communicate. Local language training would be easier and more beneficial to the farmers.

Perceptions of staff concerning their training needs

Table 4: Perception of staff concerning their training needs

State	Level of Training Needed					Total
	Very High		Medium		Low	
Central Equatoria	31	94%	2	6%	0	33
Upper Nile	10	53%	9	47%	0	19
Bahr el Ghazal	19	73%	7	27%	0	26
Total	**60**	77%	**18**	23%	**0**	**78**

The rating of the respondents shows clearly that there is very high demand for training even among the current staff. The data indicate that in Central Equatoria, nearly all the respondents (94%) indicated a very high need for additional training. Corresponding numbers Upper Nile and Bahr El Ghazal are 53% and 73%, respectively. The most interesting point to note is that no respondents reported a low need for additional training.

Educational needs

Skills required in the field of crop production

In an interview with the Director Generals/Directors of the State Ministry of Agriculture, managers of some private sector enterprises, and the food security and livelihood officers of the

NGOs, it is clear that skills required in crop production should aim to produce agricultural extension officers who are capable of training farmers in cereals productions especially (maize, sorghum and millet and wheat), tuber production (cassava, sweet potatoes and yams), vegetable production (okra, cabbages, pumpkins, soya beans, peas, ground nuts, sun flower) and fruit production (mango, oranges, bananas, pineapple, lemons, water melon, guavas).

When asked to mention specific skills required in crop production, the following were the most common responses:

- Determination of optimum planting time considering local climate, weather, and crops.
- Determination of land suitability for different crops.
- Knowledge of land preparation techniques for particular crops.
- Plowing with animals (oxen, donkeys and horses).
- Planting and seed/tuber preparation including seed/tuber selection, spacing, depth of planting for various crops.
- Weed management including weeding techniques and frequency for various crops.
- Crop maintenance and management: integrated pest management, pest and disease control, crop thinning, pesticide application rates and techniques.
- Crop harvesting and storage: determining when crops are ready for harvest, how to harvest various crops with minimal wastage, and drying and storing of crops.

When probed further about post-harvest skills, respondents gave the following responses:

- Production and preservation of juice and jam from pineapple, banana, water melon or mangos and paste production from ground nuts, simsim (sesame) and sunflower seeds.
- Production and preservation of paste from ground nuts, simsim (sesame) and sunflower seeds.
- Extraction of oil for cooking from sunflower, groundnuts and simsim.
- Baking bread.

Probed further reducing about crop losses and wastage, mostly the respondents from the private sectors and NGOs mentioned the followings:

- Methods for utilizing crop by-products for example composting of waste products or producing animal feed from local salt and sunflower cake.
- One person said crop wastage occurs during harvesting, transportation and storage and that farmers need skills and technology to reduce wastage.
- Two NGO food security officers indicated that food preservation skills are necessary to reduce wastage. Needed skills include sun drying, salting, heating or smoking.

<u>Skills required in forest production</u>

In an interview with the Directors of the Department of the State Ministry of Forestry concerns were raised that many people in the Southern Sudan have very limited skills and knowledge in the forest management. They pointed out the cases of indiscriminate cutting for trees in Western and Eastern Equatoria as an example of poor forest management, which may result in adverse climatic change.

When asked about the skills required to protect and use forests profitably, the majority of the Directors indicated the need for additional forest rangers. Priority skills needed for forest management included:

- Knowledge of the importance of forests and how they can be protected so that they can identify and explain to the people the factors that harm forests and the consequences of forest depletion.
- Managing seedlings, transplanting and caring for trees in homes and gardens.
- How to train the communities on how to harvest trees and produce timbers.

When asked if additional skills were required to enable communities to use timber profitably, carpentry was mentioned, especially making things such as chairs, stools, tables, beds, doors, and windows.

Skills required in animal resources and fisheries development

Issues raised during interviews with the Directors of the Departments of Animal Resources and Fisheries included the following: lack of Government investment in the sector, the pastoralist and nomadic way of life of those who own the animals, and the poor quality livestock. Needed skills/resources to improve animal resources and fisheries included:

- Community based animal health specialists to train local people on how to vaccinate or dip the animals to control diseases. One Director mentioned that Sudan is very big and there cannot be adequate government staff to treat the animals but if the local communities are trained and equipped with skills on how to manage animal diseases, then the quality of animal life will improve.
- Training of people on household milk hygiene and milk processing to make butter and cheese and improve the household diet.
- Pasture management: grazing management in most parts of Sudan is poor, people waste a lot of time moving from one place to another in search of water and pasture yet such time could be used for other valuable economic undertakings if the community were taught proper grazing systems

When probed further, Directors also noted the importance of production small animals including goats, sheep and poultry and recommended training of ministry staff in these areas to make livestock production more profitable and to improve meat production and nutrition.

Fisheries has not been a major economic activity and is primarily a part time activity for domestic demand along the Nile. However, Directors said training was needed in:

- Alternative fishing techniques (hooks, nets, etc.)
- Conservation to avoid over fishing
- Boat making
- Fish preservation (salting, smoking, drying, etc.)

Other skills to promote agricultural production in the Southern Sudan

- Beekeeping and honey production
- Office management
- Plant crafting

- Ox-ploughing
- Fish gear and boat building
- Animal diseases surveillance
- Artificial insemination
- Irrigation
- Tourism and hotel management
- Record keeping
- Marketing skills
- Basic computer skills (Word, Excel, Power Point and Access)
- Micro-finance management for rural agriculture
- Entrepreneurial agriculture focusing on home based food processing

Factors that may promote or hinder the development of agricultural institutions of higher learning in the Sudan

Factors identified by interviewees that may promote the development of agriculture and agricultural institutions of higher learning in the Sothern Sudan included:

- Land for agricultural development is available. Less than 1/3 of the land is inhabited and vast areas are fallow.
- Broad range of agroecological zones, which permits production of a broad range of crops, animals, and fish.
- High demand for trained agriculturists by both the public sector and donor/NGO communities. Likely to be high demand from private sector in the future.
- Land has high fertility, particularly after long fallow periods due to the civil war.
- Agriculture is traditionally the major livelihood with more than 90 percent of southern Sudanese are dependent on agriculture prior to the war.
- Good will.

Factors identified by interviewees that may hinder the development of agriculture/agricultural institutions of higher learning in the Southern Sudan included:

- Low standard of primary and secondary education
- Insecurity in some parts of the country
- Lack of proper land policies
- Poor road network
- Lack of training facilities
- Inadequate manpower
- Inadequate budget
- Overreliance on traditional agriculture
- Lack of agricultural inputs
- Competition from neighboring countries
- Insufficient research activities
- Ad hoc planning by the government
- Inadequate extension service providers
- Poor farmer recordkeeping

Conclusions

Based on the needs survey the following conclusions are made:

- There is serious human resource gap in agriculture especially in the public sector, which currently has 71 percent staffing shortage. This will increase as many staff in the Ministry of Agriculture and Forestry are nearing retirement.
- There is high demand for agriculture and forestry personnel with a projected shortfall of more than 3000 new staff over the next decade. This demand will be more than 50 percent higher if the government implements proposed programs at the Payam and Boma levels.
- There is wide gender staff disparity in agriculture and forestry, with women accounting for 2 percent of the total classified staff in the three states. In the Southern Sudan as a whole, women account for less than 10 percent of government employees.
- There is very high desire training among the classified staff of State Ministry of Agriculture as indicated by the respondents.
- There is need for diversification of agricultural skills according to agro-ecological zones.
- There is a need for short-term certificate and diploma levels agricultural and forestry training for people working in rural areas.
- Long-term B.Sc. training is also required.

Recommendations

Based on the conclusions the following recommendations are made:

- There is an urgent need for training skilled personnel in the field of agriculture especially at the certificate and diploma targeting those who can train the farmers directly.
- There is a need for gender friendly programmes to encourage women trainers in the field of agriculture since women form the larger workforce in rural agriculture.
- There is a need for flexible training programmes to accommodate those who are already in the job market. The programme should aim to train more the trainers of trainers who in turn can be employed by the NGO and the private sectors as resource persons at the village level.
- Agricultural training should be applied and practical since farmers may not have adequate education level and time to absorb theories.
- The goal of training programs should be to enhance the quality of rural life, improve food security and nutrition, and produce a surplus for sale.

Appendix C: Key Project Participants

Name	Affiliation	Position	E-Mail
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Appendix D: Needs Assessment Survey - Greater Bahr El Ghazal Region

Victor Loku, Deputy Vice Chancellor and Professor of Veterinary Science,
University of Bahr El Ghazal

DIRECTRATE OF AGRICULTURE/WBG/STATE.

POSITIONS	QUALIFICATION	VACANCIES	GRADE
Director General	BSc	1 vacant	2 (Acting)
Director of Agriculture	BSc	1 vacant	2 (Acting)
D/ Director of Agriculture	BSc	1 vacant	2 (Acting)
D/ Director of Agriculture	Diploma	1	4
D/ Director of Extension	BSc	1	4
D/ Director of Extension	Diploma	1	4E
D/ Director Plant Protec.	BSc	1	4
D/ Director Plant Protect.	Diploma	1	4
D/ Director Horticulture	BSc	1	4
D/ Director Horticulture	Diploma	2	5
D/ Director Nutrition	BSc	1	5
Inspector of Agriculture	Diploma	2	7
Inspector of Agriculture	Certificates	3	7 & 8
Inspector of Nutrition	Diploma	1	8
Inspector Nutrition	Certificate	1	8
Inspector/Mechanization	Diploma	1	7
Asst. Inspectors of Agric.	Certificate	4	10
Asst. Inspector/Extension	BSc	4	9
Asst. Inspector/Crop Prod.	BSc	3	9
Asst. Inspect/Plant Protection.		1 vacant	8
Asst. Inspect. Horticulture	Certificate	1	8
Asst Inspector of Nutrition	Diploma	1	9
Asst Inspector of Nutrition	Certificate	1	8
Asst. Inspector Soil Survey	BSc	1	9
Director Mechanization	BSc Agric Engine	1 vacant	4
A/Eng. Mechanization	BSc Agric Engine	2	9
Asst. Inspector Soil Survey	BSc	1	9
Director Mechanization	BSc Agric Engine	1	4
A/Eng. Mechanization	BSc Agric Engine	2	9
Extension overseers	Certificate	3	7, 8 & 10
Horticulture supervisor	Certificate	1	10
Horticulture overseer	Certificate	1	10
Nutrition supervisor	Certificate	1	14
Plant Protection overseer	Certificate	1	10

AGRICULTURAL RESEARCH CENTRE WAU

POSITIONS	QUALIFICATION	VACANCIES	GRADE
Inspectors of Land Survey	BSc Applied Sc.	1 Senior Surveyor	7
	BSc Applied Sc.	1 S/Inspector Land Survey	7
	BSc Applied Sc.	3 Inspect of Land Survey	8
A/Inspector of Land survey	BSc Agriculture	5 A/Inspect of Land Survey	9
	Certificate	5 Chainman	14
Soil chemist	BSc Agriculture	1	7
Laboratory attendance	Certificate	1	14

DIRECTRATE OF ANIMAL RESOURCES AND FISHERIES/WESTERN BAHR EL GHAZAL STATE.

POSITIONS	QUALIFICATION	VACANCIES	GRADE
Director General	BSc	1	2 (Acting)
Director Animal health	BSc	1	4 (Acting)
Director Animal Prod.	BSc	1	4 (Acting)
Director of Fisheries	Diploma	1	4
D/ Director Animal health	BSc	1	4
D/ Director of Animal Prod	Diploma	1	4
D/ Director Fisheries	Diploma	1	4 (Acting)
Livestock Officers	BSc	2	9
Vet. Officers/Clinic	BVSc	6	9
Vet. Officer S/House	BVSc	1	9
Fisheries officers	Diploma	2	5

UNIVERSITY OF BAHR EL GHAZAL ACADEMIC STAFF

POSITIONS	FIELD QUALIFICATION	CREDENTIALS	FIELD
Assoc. Professors	Nutrition	PhD	Agriculture
Assist. Professor	Molecular Genetics	PhD	Agriculture
Teaching Assist 22	Animal Production	BSc Agric.	Agriculture
Director	Agriculture	BSc Agric.	Investment Dept.
Anim. Science			
Professor	Pathology	PhD	Veterinary
Assoc. Prof. (2)	Molecular Parasitology	PhD	Veterinary
Assist. Professor	Animal Science	PhD	Veterinary
Assoc. Professor	Avian Pathology	PhD	Veterinary
Lectures (15)	Animal science	MSc	Veterinary
Teaching Assist. (22)	Animal science	BSc	Veterinary
Vet. technicians (12)	Laboratory	Diplomas	Veterinary

DIRECTRATE OF FORESTRY WESTERN BAHR EL GHAZAL STATE.

POSITIONS	QUALIFICATION	VACANCIES	GRADE
Director General	-	1 vacant	2
Director A forestation	-	1 vacant	3
Director Saw Mills	-	1 vacant	3
Director Mechanization	-	1 vacant	3
Director of Forests/Raga	-	1 vacant	4
D/ Director of Forests/Raga	Diploma/Agriculture	Filled	4
D/ Director of Forests/Wau	Diploma/Agriculture	Filled	5
D/Director Carpentry	Certificate/May V	Filled	4
D/Director A forestation	-	1 vacant	5
D/Director Saw Mills	-	1 vacant	5
D/Director Mechanization	Diploma/Agriculture	Filled	5
Forest Rangers	BSc Forestry.	4 Filled	9
Forest Rangers	BSc Forestry.	4 Filled	9
Forest Rangers	-	3 vacant	9
Assist Forest Rangers	BSc Forestry.	4 Filled	10
Forest overseer	-	Filled	10
A/H/Forest Guard	-	Filled	10
Conservation of Forests	-	2 vacant	6
Conservation of Forests	Certificates	3 Filled	7
Mill Manager	-	1 vacant	6
Asst. Mill Manager	-	1 vacant	6
Mill foreman	-	1 vacant	7
Mill overseer	Trained	3 Filled	10
Carpenter	-	Filled	5
Mechanics	Certificate	Filled	8
Asst. Mechanics	-	2 vacant	6 & 7
Saw doctor	-	1 vacant	6
Assist Saw doctors	Certificate	2 Filled	8
Carpenters	Certificate	Filled	5
Forest line keepers	8	vacant	10 & 12
Timber clerks	4	vacant	12

NGOs IN GREATER BAHR EL GHAZAL REGION.

POSITIONS	QUALIFICATION	ACTIVITIES.
FAO/WBG/ STATE		
Project Manager/Wau	BSc, MSc Agric Horticulture	FAO/SRCRP,TSU,CVAX
Project Officer/Wau	BSc, MSc. Agriculture	FAO/SRCRP,TSU,CVAX
Project Trainer	Diploma in Agriculture	Ox-Plough training
Fisheries Assistant officer	Diploma of Fisheries Science	Fisheries activities
FAO/Warrap State/Field staff		
Project Manager	BSc Agric, MSc Horticulture	Field staff
Project officer	Diploma Agric and Rural Dev	Field staff
UNDP/WBG STATE		
Project Manager	BSc. Agric., MSc. Food Science and Technology, Animal Husbandry and Livestock	Management. Economic Analysis.
UNICEF/WAU ZONAL OFFICE		
Field officers (3)	Medical officers	Public health, disasters and Environmental activities
Sanitation overseers (7)	Technicians	Wau and Awiel.
WORLD FOOD PROGRAM		
Senior Program Assistant	BSc, PG Diploma Agric.	
Senior VAM Assistant	BSc. Agric	Variability Asst Mapping
Field Monitor	BSc, MSc. Agric	Monitor
Field Monitor	BSc, MSc. Agric	Monitor
Field Monitor	BSc Agric.	Monitor
Field Monitor	Diploma Agric.	Monitor
Field Monitor	Diploma Agric	Land survey
IOM/WAU		
Field Officer	MSc. Agricultural	Livelihood specialist
OXFAM SPAIN (INTERMON)SCO		
Livelihood Manager	BSc. Agric	Livestock Specialist
Food Security Assistant	BSc. Agric	Raga
Food Security Ext. Workers	Certificates (6)	Field monitors
Water and Sanitation Assistants	Certificates (2)	Field work
Water and Sanitation Tech.	Local training (2) only	Field work
SRCS-Greater Bahr El Ghazal		
Branch Director/ Wau	BSc .Agriculture	
Public Health officer/ Wau	BSc Environmental Sci.	Public E. Health
Public Health Officer/ Lakes State	Certificate	Hygiene Promotion
Health and First Aider Warrap	Certificate	Hygiene Promotion

State		
Field Officer/NBG State-Aweil		Hygiene Promotion
WORLD CONCERN/WBG STATE		
Program Manager/Wau	BSc. Agric	Small scale farming for vegetables, Groundnuts paste Projects (micro-loans)
ACTED/WBG STATE		
Program Manager/Wau	BSc. Agric	Food Security
Assistant Program Manager/Wau	Diploma Agric.	Food monitor
Food monitor officer/Wau	Certificate	Food monitor
WILDLIFE AND CONSERVATION DEPT		
	No expert	Environmental skills
CATHOLIC CHURCH/WAU		
BUSSERE	Buildings of the seminary	Roads are passable/Wau
1.Schools 4.Printing Press	Near the river and water pumps	Namatina and Halima
2.Churches 5.Gardens	Gardens available to establish	Agric. Research Projects
3.Buildings 6.Vast area for activities	Livestock farms(Dairy & Poultry)	Demonstration/students
NAZARETH		
1. Church		
2. Accommodation	Staff and students	
3.Classes	All require maintenance	
4.Hall	Roofing of some buildings	
5. Garden	Enough area for activities	
AGRICULTURAL BANK /WAU		
Manager	BSc, MSc. Agric	Agricultural loans
Sub Manager	BSc. Agric.	Field Monitor

Data collection and reports of the Director Generals and Directors

Most of the Director Generals, Directors of the Directorates of the State Ministry of Agriculture, Animal Resources and Fisheries were able to come up with these report.

1. Most of the positions occupied by less academic qualifications only with long years of experience in their current positions.
2. There is no gender balance due to the fact that no graduates in the fields of Agriculture, forestry and fisheries departments.
3. There is a high general training need for staff currently in the various departments of Agriculture, Forestry, Animal resources and fisheries.
4. The drawn (proposed) curriculum for the Faculty of Agriculture and Environmental Sciences suited the priority areas in Agriculture, forestry and Animal resources that require immediate attention at training at Higher Education with the values that are useful for the staff of this Ministry.

5. There may be lack of Academic staff in the College of Agriculture and Environmental Science.
6. No planned research (Research Farms at Halima and Namatina) in the Research Centres in the State due to lack of facilities and trained personnel.
7. Most of the employees had certificates, diplomas and first degrees (BSc) in the Directorates of Agriculture, Forestry, Veterinary and Fisheries. In the Directorate of Veterinary, most veterinarians are new graduates.
8. Most of the Directors are acting with their low grades because the positions are not nominally filled.
9. There is total lack of funding for Agricultural sectors, Dairy and Poultry farms and Fisheries Industries in the state.
10. Though there is enough fertile land for agricultural activities, dairy production, poultry production, and fisheries activities yet there is no funding to these projects especially agricultural inputs, saw mills, trained forest rangers.
11. There is need for training in general.
12. There is need to train and promote rural people who have agricultural raw materials fisheries by products that can be utilized as fertilizers and animal feeds to earn them cash for their families who mostly defend on food aid.
13. There are Agricultural Research Farms at Halima and Namatina Wau and these may help in practical courses of the Faculty.
14. No constant monitoring by the Ministry of Agriculture and forestry and Ministry of Animal Resources and Fisheries (GOSS/Juba) to the state.