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A REVIEW AND ASSESSMENT OF INSTITUTIONAL CAPACITY AND ROLE OF THE CENTRAL AGRICULTURAL RESEARCH INSTITUTE SUAKOKO, LIBERIA

A BACKGROUND REPORT
FOR RESEARCH AND EXTENSION PROJECT 669-0188
USAID MISSION TO LIBERIA
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EXECUTIVE SUMMARY

The Liberian economy will likely continue to face difficult economic circumstances for several years ahead. Real per capita GDP has declined roughly one fifth since 1980 and inflationary tendencies still prevail. The economy is highly dependent on foreign exchange earnings. The prospect for which is steady at best. Meanwhile, high population growth rates places pressure on the domestic resources base.

Domestic food output per capita continues to decline and food gap has widened resulting in increased dependence on imports.

For the immediate future, the highest national priority must be on increasing the production of the food production base which involves 170,000 smallholders who make up 70 percent of the work force.

Not until answers are found to enhancing the capability of land, through research, to find sustainable substitutes for shifting agriculture, prospects are dim for substantial improvement in per capita income in rural areas. If this is possible through adaptable technologies, then and only then, can the basis for a rising national GDP be established. Indeed, there are few other options.

Even though there continues to be interest in a high technology agriculture, based on external high foreign exchange using inputs, the answer to maintaining a sustainable productive soils base is critical for its success. Numerous attempts are relics of past failures.

Central to finding answers in dealing with resources constraints, is the role of the Central Agricultural Research Institute. Although CARI has a history of 30 years of erratic productivity, resulting from a number of internal and external forces, it is now in a position to tackle the fundamental constraints for increased agricultural output of the nation. Both the national government and donors alike failed to understand, until recently, the Institute's critical role in national economic development. As understanding and support of CARI's role is increased, then enhancement of agricultural output, increased employment opportunities, and reduction in rural-urban migration will be achieved. Indeed, there will be thus, increased income to pay for the roads, schools and medical needs of the population.

Continued understanding and support to CARI can yield high national returns. CARI has now arrived at the stage, given its new strategy, to begin achieving a much higher performance.

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A BACKGROUND REPORT FOR RESEARCH AND EXTENSION PROJECT 669-0188

I. BACKGROUND

A. General Agricultural Situation

The Government of Liberia (GOL) has enunciated general goals which emphasize food security, increased rural employment opportunities and improved rural per capita income. One of the principal factors supporting these goals is the rapidly growing dependence on rice imports, a major staple in the diet of Liberians. Since the rural population of Liberia represents 60 percent of population, these goals mandate a substantial increase in agricultural productivity from the smallholder sector.

The traditional subsistence sector represents roughly 170,000 farms predominantly in rice production and in shifting cultural systems based on a fragile natural resource and ecological base. Most of these farmers (114,000) are located in Bassa, Bong, Lofa and Nimba counties. Rice output is mainly for household consumption. The marketable surplus of rice is probably less than 20 percent. However, a substantial number of farmers produce in addition, vegetables and significant amounts of coffee, cocoa and sugarcane for the market (MOA, prod.).

There are approximately 9,000 Liberian owned commercial farms with most of them in rubber production and mainly associated with the large concessions. Other commercial farms include producers of oil palm, coffee, cocoa, rice, poultry, eggs and vegetables. Since the coup, many of the farms have been idled and have been adversely affected by world market prices and foreign exchange difficulties.

B. Constraints to Achieving Higher Agricultural Output

Overcoming the constraints for increased productivity requires interventions of external inputs into traditional food production systems, appropriately adapted for use on the fragile resource base of the nation. Often not understood is the fact that the Liberian resource base, as compared to other West African nations, is much more constraining and requires greater effort to sustain a food production base.

The major general constraints include the following:

1. the fragile nature and low productivity and high erodibility of the soils;

2. the scattered and relatively low spatial density of production units, weakly linked together in scattered villages and traditional market centers;

3. the cultural and language diversity; and

4. the long established economic and social system based on self-sufficiency, security and survival of the family, clan and tribe resulting in reluctance for change.

The above are the principal broad constraints and could be extended in more detail. All the constraints tend to interact with each other, and some are more intractable in obtaining increased food output then others.

C. Strategy Elements for Overcoming Key Constraints

Successful generalized strategies for overcoming development constraints have universal application to all societies. Strategies to increase agricultural output could include numerous specific activities. However, fundamentally they must together lead to building national capacity to support certain fundamental strategic elements. The principal strategy elements for increased agricultural productivity include the following:

1. enhancement of agricultural technology generation and diffusion, capable of producing a continual flow of adapted technologies for farmers;

2. improvement of the physical infrastructure, capable of efficient movement of inputs and outputs;

3. improvement in price/market systems that efficiently transmit supply and demand signals;

4. improved intermediary institutions for savings mobilization and credit delivery, especially for investment by farmers in new agricultural technology, but also for investment in rural industry and support institutions.

The above four strategy elements are central for agricultural productivity increases. Ideally, the national capacity to provide these interventions and to institutionalize their provision should move together and simultaneously because of their high interdependence. But this is rarely possible, particularly in earlier stages of development. The first strategy element must be in place prior to any significant effort on development in the following three.

The sequencing of initial efforts must begin with and emphasize building the national capacity for agricultural technology generation and diffusion. The extent of the development of the other strategy activities is dependent on the level of and sustainability of agricultural technology and diffusion capability. The initial packages of the agricultural technology must be carefully designed to take into account constraints imposed by deficiencies of the other three strategy elements.

The possibility of agricultural productivity increases is the prime mover in the economic growth model in earlier stages of development. Agricultural productivity increases historically have been the precursors in the economic

development of all societies. There are no shortcuts to this empirically established sequence in development. Development specialists now agree with the essential necessity of technology capacity building. Ruttan aptly captured the essence of this concept in the statement "the capacity to develop and to manage technology in a manner consistent with a nation's physical and cultural endowments is the single most important variable accounting for differences in agricultural productivity among nations" (emphasis mine) (Ruttan Chapter 2).

II. SKETCH OF EARLY EFFORTS IN BUILDING AGRICULTURAL TECHNOLOGY AND DIFFUSION CAPACITY IN LIBERIA

A. The Central Agricultural Experiment Station (CAES)

This unit was established formally in the Ministry of Agriculture in 1950 and represents the first organized effort in agricultural research. During the period 1953-1964 it was supported by a technical assistance team from the U.S. Department of Agriculture. Considerable research was undertaken and reported. The physical infrastructure was built at Suakoko and a network of five substations was established. Research was conducted and involved work in soil and crop science, farm management, agricultural engineering, animal science and others. The emphasis of research was on vegetables, tree crops (coffee, cocoa, palm oil, citrus), certain field crops, animal husbandry (cattle and swine).

Significant was the orientation of this effort. It apparently assumed that external technology and research methodology could be easily transferred from the outside. Most damaging to the viability of this research orientation was the lack of understanding of the Liberian resources constraints and socio-economic reality. Further, there was the implied intent to place much of the use of research findings in a large-unit commercial farming context. Indeed, speculation existed that large tracts or estates could be developed with much emphasis on the potential of export crops. Actually, only minor emphasis was placed on the traditional subsistence food crop farmers of the nation.

Research activity languished after 1964 after the expatriate technical team left. The physical infrastructure of the central station deteriorated. The MOA continued to direct, from Monrovia operations of the CAES, albeit at much lower levels of support. The nature of the administration and technical direction to CAES appeared to have been such that it did not permit building further a viable agricultural research capacity. The professional level of staff remaining was inadequate to the task of dealing with the agricultural research needs, addressing the fundamental constraints of increasing food output in Liberia.

B. Agricultural Extension

Agricultural Extension Service was formally adopted by the GOL in 1960 as an integral part of the MOA. Expatriate advisors from the U.S. were brought in to assist in this development and patterned the extension effort on the U.S. model. After several years the expatriate assistance ended and further development was left to the Liberians.

An effective extension function depends on the availability of a continual flow of adaptable technology suitable for use of both the traditional, as well as, the emerging commercial farmer in Liberia. There was "little to extend" relating to the food production constraints. Consequently, the extension service was, in fact, crippled from the beginning and little now remains in structural content and viability.

C. Period of Relapse in Capacity Building -- 1964 to Mid-1970s

1. General Nature of Agricultural Sector Support Activities

While definitive data and information are not available, it appears that in general, limited funding and support were characteristic of this period. The earlier limited efforts in both research and extension, in the context of national capacity building, were allowed to wither away. Donor support was essentially one of funding numerous small, often times unrelated projects, e.g., a multi-donor rice project, including the Gbedin rice sub-project supported by the Chinese mission; rinderpest in cattle; some commodity support, fertilizers, vehicles, and chemicals. Further, there was support for consulting and assistance for coordination within the MOA.

2. Experimental Farming Project, 1967-1970

The most significant effort of this period was this project originally suggested by executives of the Uni-Royal Corporation. They believed that commercial scale farm enterprises could be effectively developed and modern agricultural technology could be introduced easily in "underutilized areas" of the country. A wholly owned subsidiary, Liberian Agricultural Company (LAC), was established. USAID assisted in partial funding of the research effort. The intent was to develop technologies suitable for large scale rice and maize farming, cattle pasturing as well as swine and poultry operations. Much varietal testing of rice and maize was done. The major lesson learned was that commercial crop farming results have been well below "break-even" level, while cattle pasturing was reasonably successful. This effort, over a period of approximately six or more years resulted in development of a rice variety (LAC 23) now being introduced widely in traditional upland systems and a selection of a cattle that is tolerant to the tse-tse fly. Further, this effort indicated that domestic hog and poultry enterprises were feasible.

3. Significance of the Period of Relapse

Several useful research results were produced and have now become a part of the technological base at CARI. However, these results were intended for large scale commercial enterprises. They do form the basis for further adaptation and packaging for use by the smallholder with limited capacity for fitting them into his agronomic, economic and cultural setting.

The irony of the efforts of this period was that they were not targeted on local research and extension capacity development, nor focused on smallholders living on a fragile land resources base. The MOA

and donors apparently still believed that external technology transfer from the outside was relatively easy. USAID partially support LAC, an outside research entity, whose major purpose was to determine the feasibility of commercial large-scale application of technology to the "underutilized land resource" of Liberia. In a sense, this "undercut" the building of national indigenous capacity for research.

Strengthening the national research and extension capacity was essentially neglected except for the provision of some training. Little effort was expended on increasing the administrative, management and planning capability of the then fledgling institutions within research or extension. During this period research was really seen as an abstraction, by both the MOA and donors, something every nation should have! There was little understanding of the key role research and extension have in agricultural development.

Most important to the future of Liberian agriculture was the continued neglect of a national policy and research orientation on the needs of the 170,000 traditional farmers, who, through adaptable technologies, could have been mobilized to produce a larger share of national food needs and thus, by virtue of their numbers, contribute significantly to national output.

Commercial large estate farming approach, dependent on continuous cropping, cannot succeed unless technologies are developed to overcome the inherent low capacity of the soils and their protection from erosion and rapid deterioration. However, the idea of large commercial estate farming, dependent on large amounts of external financing and high levels of foreign exchange needs, lingers on despite numerous failures.

4. The Period of Integrated Rural Development Projects -- 1975 and Following

a. General Situation

The fact that per capita food output continued to decline and thus greater dependence on imported foodstuffs were seen by national leaders, donors and international organizations alike, as a signal of the impending serious food crisis in sub-Saharan Africa. Similarly, Liberia, given its high population growth rates, was experiencing declining domestic per capita food output and thus greater reliance on imported food. Complicating factors were declining foreign exchange availability, caused by a worldwide decline in prices of export commodities and the impact of the first wave of oil price shocks, beginning in the early 1970s.

The World Food Conference in Rome in 1974, under the auspices of the United Nations, highlighted the need for greatly accelerated efforts by donors and national leaders to counter the impact of these disquieting trends. Firmly established was that the focus of efforts should be on the small traditional farmers. It called for greatly increased contributions from the donor community. These concerns led to greatly expanded use of the integrated rural development approach by international donors in

much of Africa. This approach is better adapted to later stages of development, and its success often depends on large investments.

The fears were real, and available data suggested food crisis was indeed, in the offing. It was believed that by quickly mobilizing all the available technology with sufficient support of extension would reduce the impact of the pending crisis.

b. The Agricultural Development Projects in Liberia (ADPs)

A large effort in Agricultural Development Projects in Liberia was undertaken, covering substantial portions of three counties, Bong, Lofa and Nimba, and representing over 60 percent of rice growing farming of the nation. Planning and establishment of the ADPs recognized that availability of "on-shelf" technology was almost non-existent. Recognized also was that virtually no extension capability existed. The most important limiting factor, was that adaptable technology packaging capability was not present in the country, especially in the context of a focus on the constraints of smallholder traditional farmers. Infrastructural deficiencies usually affect the design of the packages that can be delivered. In the implementation of the ADPs this, too, was recognized, thus the provision of selected infrastructural components such as credit, storage and marketing. In short, research, technology, packaging, extension and infrastructure support were "wrapped up" within one effort to overcome quickly the national institutional deficiencies in support of the agricultural sector. The ADPs were, in effect, another research and extension entity within the country, weakly linked to the MOA but not fully integrated within the functional structure of the MOA.

The intent of the ADPs was to accelerate the process of introduction of adaptable technology to smallholder farmers. Some measure of success was achieved, but at costs much higher than can be sustained by the national government.

Another set of "costs" were those associated with staffing ADPs. In general, professional staff was drawn from the various agencies of the MOA and thus reduced functional capability of the Ministry. Especially serious was the drawdown of professional staff in research at CARI. During the period 1977-1981, 30 professionals left CARI, many to staff the ADPs. Considering that the average total professional staff complement at CARI ranged from 25 to 30 during the period, this loss seriously eroded away whatever professional capability CARI had attained. This large and rapid out-migration of talent reduced CARI to nearly "caretaker" status, the effects of which are clearly evident in the fact that constraints in achieving research capacity were exacerbated and continue to be felt to this day. CARI at this time, probably had the largest agricultural talent pool of the nation (Table 1).

TABLE 1 LOSS OF PROFESSIONAL STAFF BY 5-YEAR PERIODS BY DEGREE, CARI, 1977-1986

Period	Cert.	BS	MS	PhD	Total
A. Number of departures					
1977-1981	5	17	6	2	30[1]
1982-1986	2	5	2	-	9
					39

B. Number of departures by first employment, etc:

Ministry of Agriculture	12
Other Ministries	2
Agr. Development Organizations	9
Governmental Parastatals	6
Unknown	4
Outside of Country	2
Concessions/Private	4
Retired	1
Deceased	1
	39

[1]Note: Large losses occurred during 1977, 1978, 1979, i.e., 16 BS, 5 MS, 1 PhD.

Source: CARI records

A positive effect of the ADPs was that this effort highlighted the difficulties in fashioning and the delivery of technologies targeted on smallholders. This probably contributed to bringing a shift of focus within the GOL on smallholder constraints. They provided a valuable training experience for those nationals who were involved. A negative effect was that implementation of the ADPs contributed to the delay of the evolution of a national capacity in research and virtually eliminated extension as a national effort.

III. LAYING THE FOUNDATIONS FOR BUILDING CAPACITY, 1980 TO DATE

A. An Interpretive Review of the Preceding Three Decades

The 30 years of effort (1950-1980) by MOA and donors did not produce a viable national institutional capacity. Facilities and some infrastructure were built early on at CARI. Considerable training for nationals was provided, and expatriate teams supported the development of certain disciplines and departments deemed essential for quick adoption of western, mostly U.S., technology, then in practice in the U.S. The virgin, seemingly underutilized land and forest resource appeared to be ripe for full exploitation. Exotic breeding stock and seed were imported. The symbols of the approach for rapid commercial food production were the chain saw, the bulldozer, the mechanized equipment and the chemicals -- all heavily based on fossil fuel technology. This is a classic case of transplanting technology unproven in a local setting.

It was believed that, except for minor technology adaptations, research was deemed less important than the extension outreach function. The needed technology was presumed to require only little adaptation and that it was already available. The experience of this effort, not only in Liberia, but in developing countries everywhere, has virtually debunked the commercial industrial approach for increasing food output and increased rural per capita incomes. The focus was flawed.

There was little concern or recognition that the soils of Liberia have low exchange capacity; that the pH ranges from 2.5 to 5.0; that nitrogen, phosphorus and potash levels are extremely low. Unfortunately, compared to sister West African nations, Liberia has the highest proportion of deficient soils. The critically needed soil amendments (lime, chemical nitrogen, phosphorus and potash) are not available within Liberia. These soil amendments are critical to institute a commercial system of production, require heavy applications and therefore depend solely on foreign exchange availability.

It would be fruitless to fix blame. The host government, the donors and the expatriates readily embraced this approach as it was then the received doctrine and practice for agricultural development. Not until the mid-1970s did the growing empirically derived literature on agricultural development and the analysis of the role of agriculture in early stages in national economic development come together, into what is now a consensus both in doctrine and practice. Agreed now, is that to get "agriculture going", requires first a national capacity to develop agricultural technology suitable for the resources at hand, in accordance with culture and political framework of the nation. Further, this capacity must be indigenous as soon as is feasible.

B. A Review of the Roles of the ADPs

The ADPs, established in the late 1970s, were focused on the needs of the smallholder at his particular setting, and were virtually the only entities that dealt with assisting in organizing research, of which little was available locally, packaging it and extending it to users with a considerable infrastructure support. It is fortunate that the ADPs in the late 1970s brought, for the first time, a deliberate focus on the smallholder.

The ADPs were intended to hasten the process of technology adaptation and adoption. In a sense, they were designed to leap over all the institutional constraints with a hope that quick productivity increase could be achieved. The overriding concern appeared to be one of mobilizing resources (at a very high cost) to deal with the increasing and widening rice food gap. Very little lasting impact on farmer crop productivity was achieved in terms of sustainable yield increases. The time frame was too short. Probably the most important factor leading to increased total rice output in the nation was the impact of the GOL rice price policy (albeit with considerable problems in implementation) which provided price incentives to farmers to increase the acreage farmed which, in turn, resulted in larger marketable surpluses. Very little came from yield increases. Anticipated project targets were too optimistic for the short run.

C. The MOA Declarations of 1980 Provided Basis for Institutional Capacity Building

Success in the process of building institutional capacity in agricultural development requires at the outset an appropriate policy and organizational framework in the Government. Significant at the beginning of this decade were the policy shifts and implementation intent of the MOA (Blue Book). Several features of this statement bear directly on the necessary preconditions for building the agricultural technology generation and diffusion capacity of the nation. The more important initiatives outlined are the following:

1. Firmly established was the intent, for the first time, to focus on the needs of the smallholder farmer, predominantly on the fragile and poor soils of the nation.

2. The intent to establish a national Research and Extension institutional capacity. It established CARI as a semi-autonomous entity of the MOA and gave it government sanction. It was critical of the magnitude of ADP effort and especially the duplication of functions and resulting negative impact on the ability of the MOA to proceed to build indigenous local capacity.

3. Firmly expressed was the intent to support the building of an institutional capacity for data collection analysis and planning in order to provide the MOA with tools for management and policy formulation.

The full implementation of these thrusts remains as a continuing effort and is part of the "unfinished business". The MOA had neither the required professional talent base (much of it had been diverted to ADPs and the parastatals), nor the financial resources to follow through. The negative

impact of the worldwide economic recession on Liberia was overwhelming. Liberia's political instability intervened, resulting in reduced ability to proceed with a deliberate and committed effort. Several changes in the leadership of the MOA contributed to lapses in consistency of effort and in financing.

D. Lead Role of the USAID Research and Extension Project, 1980 To Date

1. Phase I, 1980-1985

This project was launched at a time of considerable political instability in the nation, which resulted in greatly reduced capability of the MOA and other ministries to provide full support of this effort. Project implementation was delayed for two years because of financial constraints, accompanying GOL reorganizations and staffing difficulties following the coup.

The purpose of the project was comprehensive and supported specifically developing "the capacity with CARI to conduct adaptive research...and to disseminate research results to the extension service". This focus on building "capacity at CARI" probably was the first explicit intent expressed in any prior donor project purpose. Prior efforts appeared to have been piecemeal and not explicitly to strengthen indigenous local <u>institutional</u> capacity.

The implementation of the project purpose from the outset was constrained not only by the difficulties alluded to above but also by the fact that the professional staff cadre was virtually depleted in the period 1977-1981, when 30 professionals had left CARI (Table 1 above). Facilities largely constructed in the 1950s and 1960s had deteriorated for lack of maintenance. Much equipment, because of poor maintenance, was inoperable.

Especially difficult was overcoming the administrative and leadership deficiencies at CARI. Considerable effort was expended on arriving at a consensus of the nature of the relationship of CARI to the MOA and vice versa. This latter issue had not been resolved at the end of Phase I.

Upgrading the level of training of the professional cadre was a very significant effort. Twenty staff members were added or trained at BS level or higher by the end of Phase I (Table 2). Nine staff members were in training as of June 30, 1985. The latter did not become available to the staff until well into Phase II of this project. Necessary as it was to upgrade the level of training of the staff, this large training effort reduced further the <u>number of staff in post</u> to conduct ongoing research. For example, in 1984, of the 36 nationals authorized in post, 14 were in training, leaving only 22 available for the operation of CARI. Six of 10 professionals in Crop Science were in training in 1984. The entire staff of two in inland fisheries were absent and in training (Table 3).

TABLE 2 SUMMARY OF STAFF DEVELOPMENT BY END OF PHASE I, JUNE 1985

Field	Planned	Actual[1]
Agr. Engineering	2	1
Agr. Economics	2	0
Agronomy	1	3
Animal Nutrition	1	0
Biochemistry	1	1
Extension	1	2
Fisheries	1	1
Rural sociology	2	0
Soils	1	1
Library Science	1	0
Entomology	0	1
Plant Pathology	0	1
	16	11

[1]In seven cases, participants did not complete their programs before end of Phase I and were switched to Phase II funding. The net return of staff to CARI was thus only four by the end of Phase I.

Source: USAID records

TABLE 3 COMPARISON OF THE NUMBER OF PROFESSIONALS, BS AND ABOVE, 1984 and 1987, CARI

	Total Nations[1]					
	In Posts					
	BS	MS	PhD	Total	In Training	Expatriates
Adm.						
1984	2	4	1	7	1	1
1987	3	1	3	7	-	3
An. Science						
1984	3	2	-	5	1	1[2]
1987	2	4	-	6	-	1[2]
Agr. Eng.						
1984	1	-	-	1	1	2
1987	1	-	-	1	-	-
Crop Science						
1984	7	2	1	10	6	3[2]
1987	5	9	1	15	2	2[2]
Inland Fisheries						
1984	1	1	0	2	2	-
1987	1	2	-	3	1	-
Land/Water						
1984	3	2	1	6	1	1
1987	5	3	1	9	1	1
Plant Prot.						
1984	3	1	0	4	2	
1987	3	2	-	5	3	
Socio-Econ						
1984	-	1	-	1	-	
1987	1	1	-	2	1	-
Totals						
1984	20	13	3	36	(14)	9
1987	21	22	5	48	(7)	8

Net Professionals Available and Active in Posts:
1984 36 - 14 = 22
1987 48 - 7 = 41

[1]Excludes Diploma and Certificate holders.

[2]One each of contracted expatriates in post.
Source: Professionals staff list, CARI, spring 1984 and 1987

On balance, despite considerable difficulties, a substantial training effort began to provide the beginnings of a talent base. Staff development "was actually" undertaken late in Phase I and continued into Phase II.

Understandably, research activity was adversely affected by the training effort as many staff members were in training. Facilities refurbishing has only begun. Nonetheless, despite these constraints, the effort in some research was maintained, albeit at very low levels of support. Obviously, planning and evaluation of research were not attended to since only a small cadre was available, which led to a research program heavily influenced by ad-hoc decisions and individual researcher interest and capability.

2. Other Donor Efforts

Substantial and continuing effort by the United Nations Development Program (UNDP) provided training and expatriate assistance in Plant Protection and Post-Harvest Technology, Vegetables and Tree Crops. During this period, the efforts in research in several of these areas were entirely manned by the UNDP team. The focus of these efforts was to strengthen staff capability of the particular research areas and thus was a positive contribution to building the talent base at CARI.

The effort supported by the International Development Research Center (IDRC) in Canada on cassava, similarly contributed to enhancing staff capability but also to bring to the attention of CARI the potential of the improved varieties of this crop to enlarge the food base of the country.

The efforts by both UNDP and IDRC contributed to strengthening the talent base and introduced improved research methodology at CARI, particularly in the areas they supported. However, they both had to work within the framework of the same constraints faced by the USAID effort outlined above, which affected adversely the intended project outputs.

3. Summary

The Phase I effort was essentially one of rebuilding the talent base of CARI, introducing acceptable research methodology for the various areas, and assistance in limited refurbishing of facilities and equipment. The efforts were positive. However, they fell short of projected outputs, leaving a residue of disappointment and frustration by all concerned professionals. Given the economic circumstances, too much was expected in a short time frame.

The lead role of USAID in <u>institutional capacity building</u> was maintained and continued to provide the framework for the developmental thrust. But this, too, fell short of the intended objective of achieving indigenous capacity, primarily because of circumstances. Fortunately, other donor inputs were generally supportive of the lead thrust.

IV. ASSESSMENT OF INSTITUTIONAL CAPACITY AT CARI -- MID-1987

A. GOL Ability for Follow Through

1. General

The intent of the MOA for follow through on the policy and organizational framework for supporting the development of the agricultural sector was sidetracked by events already alluded to above. However, the effort to rebuild the talent base, facilities, and the indigenous institutionalization of capacity at CARI proceeded, at times agonizingly slow. Lack of sufficient financial resources, irregular allotment of funds could be said to have been the greatest single set of impediments. However, a more important factor was the lack of understanding of the critical role of CARI in the development of the agriculture sector and its potential in enhancing over time, the output of this nation. There was little consensus on the status of CARI to the MOA, and to the extension functions. The ADP's activated in the late 1970s was a "crash program" to deal with the growing food gap. Although at that time it was seen as a most effective intervention, it diverted much attention and capability of the MOA to build the appropriate relationship of CARI to the MOA, and to establish a national extension service.

B. Relationship and Linkage of CARI to the MOA

One of the most difficult areas essential for a viable research entity was establishing a semi-autonomous status for CARI. The difficulty again was obtaining consensus on this need and retaining at the same time the authority and the guidance and support needs for the institution.

It may be useful to reiterate this need. It was found through experience that this status was an essential requirement for building local research capacity to deal with local problems. The experience in Europe, in North America, Japan and those of the Pacific rim nations attests to this requirement. A significant number of research institutions in the third world began with or achieved semi-autonomous status in their early stages of evolution, and have now become viable and effective contributors to their nations growth. As in Asia, several stations/institutes in Africa similarly have become reasonably effective once this status was attained.

Very simply stated, semi-autonomous status is chiefly concerned with establishing a work environment that allows creative thinking and independent effort, with little day-to-day interference of the typical bureaucratic system. However, this status imposes much greater responsibility for management, planning evaluations and for maintaining the process, especially in relation to its task of generating adaptable technologies.

At the present time, CARI has attained this status and must now proceed to establish the integrity of its performance and in this context build a technical base for the MOA as it continues its effort to build a viable agricultural sector.

C. Institutional/Leadership Capacity

Few would disagree that achievement of leadership capacity is one of the more difficult tasks in building institutional capacity, as well as one most critically needed.

Again, gaining this capacity at CARI was fraught with the deterrents faced by the entire economy referred to earlier. The constraints imposed by lack of a limited professional base, draw-down on staff by departures, by absences from posts for training, and varying levels of financial and weakened political support from the MOA delayed in establishing this capacity.

Not until recently was it possible to develop an administrative and functional framework for the institution that now appears workable and effective (Figure 1). Two of the three staff members involved in the program operations of the institute had returned from training during the last year. Further, a 1987 model Institute Research Strategy plan has now been adopted. Finally, after considerable work, an administrative personnel handbook will be available.

D. Professional Staff Capability

Simply stated, there were not enough "hands on deck" at CARI to obtain a consensus or feel a need until the key posts were filled. Only during the last two years this situation changed. The few senior staff members who had remained behind were fully engaged in keeping whatever research endeavor was possible going and in maintaining the facility.

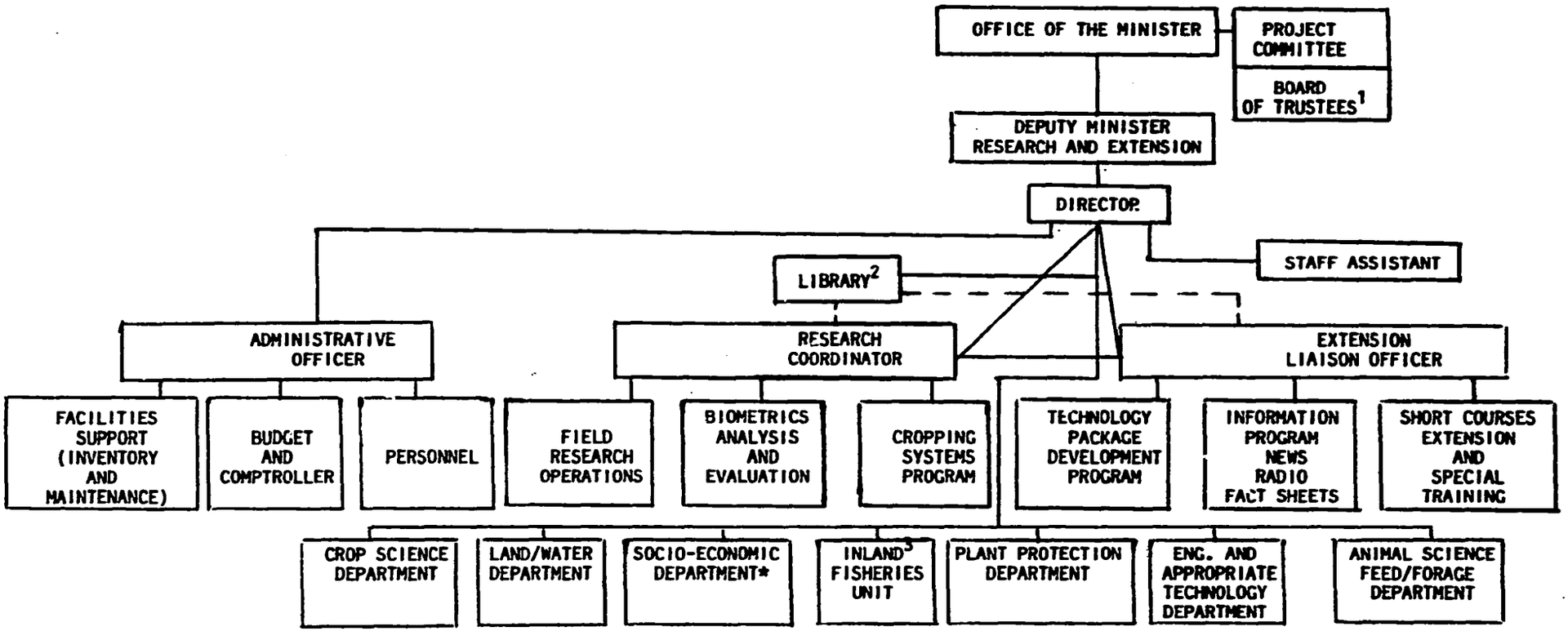
Comparison of the number of staff available for the work at the institute has changed dramatically over the last three years (Table 3). In 1984, the total staff complement, BS and above, was 36 and of this total 14 were absent from posts in training, leaving only 22 to man the institute.

By 1987, the total staff complement was 48 of which seven were in training, leaving a net of 41 professionals on board. Thus, in a 3-year period, the number of professionals active in posts had increased from 22 to 41 or an increase of 19. This increase of 86 percent in staff level within 3 years is remarkable given the economic circumstances and the continuing process of obtaining political consensus in the nation. Total gain in posts was 12, i.e., 48-36.

As important as the level of the available staff, is the quality or capability of the staff. One measure, but not the only one, is the level of professional degrees obtained by the staff. Another measure that is equally important is the level of experience. Data for 1987 indicate that the staff complement of 48 is comprised of 43 percent with Bachelor, 47 percent with Masters and 10 percent with PhD degrees (Table 4). This mix of talent by degrees would be considered approaching the ideal in earlier stages of institutional development.

At this stage of development of CARI, assessment of the experience factor in terms of the period of service beyond the date of the last degrees obtained, is revealing. While period of prior service must not be ignored, the experience beyond the last degrees indicates the nature and level of skills

FIGURE 1 ADMINISTRATIVE AND FUNCTIONAL FRAMEWORK, CARI



*Head serves on Project Review Committee.

[1]Possible future arrangements for policy direction.

[2]Library to be organized as two sections -- (a) Institutional records; (b) Research resources materials.

[3]Future status may be determined by studies and review of farmer acceptance/needs.

ADOPTED: _____
(DATE)

TABLE 4 NUMBER OF AND DATE OF HIGHEST DEGREE OBTAINED, PROFESSIONAL STAFF BY 5 YEAR PERIODS, CARI

	BS	MS	PhD	All Degrees
1986	0	5	2	
1985	2	4	0	
1984	2	2	0	
1983	3	2	1	
1982	1	0	0	
Total for 1982-86:	8	13	3	24
% of Total Staff:	38%	59%	60%	50%
1981	3	1	1	
1980	3	3	1	
1979	0	2	0	
1978	1	2	0	
1977	2	0	0	
Total for 1977-81:	9	8	2	19
% of Total Staff:	43%	36%	40%	40%
Prior to 1977:	3	2	0	5
% of Total Staff:	14%	15%	-	10%
Total Staff:	21	22	5	
Grand Total:				48
Percentage of Staff by Degrees:	43%	47%	10%	
Number and Percentage of Degrees Obtained 1980 and Subsequently:	14 67%	17 77%	5 100%	36 75%

Source: Professional Staff List, CARI, 1987

generally associated with and expected from staff with the BS, the MS and the PhD degree. A review of professional staff levels of highest degree attained indicates 67 percent of the BS, 77 percent of the MS and all the PhDs were obtained from 1980 onwards. Fifty percent of all higher degrees were obtained since 1981. Nine Masters of a total complement of 22 with Masters degrees and two of five PhDs were obtained during the last two years.

One can conclude that a substantial upgrading of staff capability has occurred from 1980 onwards. Furthermore, the staff is quite young and the period of substantial professional service since obtaining the last degree is relatively small and limited.

A preliminary gap analysis suggests that most of the added strength in numbers and level of training was in administration, Crop Science and the Land and Water Department. Except for these departments, critically needed increases in level of professional skills and disciplinary specialization continue to be high priority needs. Plant Protection, Socio-economic, Animal Science and Fisheries are literally at stand-still levels. Agricultural Engineering has extremely limited capability, with only one BS level professional aboard. All but one of the professionals in Plant Protection are on leave or in training.

Overall, a remarkable shift in strength and level of training has occurred, making it possible for the first time to have a professional basis on board to begin the serious continuing effort to build a high institutional capability. There is now the capacity to begin to adapt and use more aggressively, the research output of the International Agricultural Research Centers (IARCs) and especially the results from the West Africa Rice Development Association (WARDA) and the International Institute for Tropical Agriculture (IITA).

E. The Focus of the Institutional Research Strategy, CARI, 1987

1. Introduction

Not until a substantial professional base had been built at CARI was it possible to even consider a research strategy so essential for giving purpose and direction to the departments and staff. Not until this had been done, and become the Institute-wide guide for research activity, would it be possible to effectively harness the talent pool. Having in place a talent pool is only one of the preconditions for moving forward on the pathway of institutional development. Beginning in 1986, after a large influx of returning professionals from training, was it possible to initiate a process to develop an institutional research focus and strategy.

Fortunately, the CARI staff in this process was able to sort out the flaws and conflicts of the various developmental and ideological approaches as they addressed the needs for national agricultural development.

The adopted a focus on the needs of the smallholder farmer, rather than on continuing the conventional thrust of attention to the needs of commercial farming. More importantly, the intent is to deal

fundamentally with the constraints of the soils and ecological base; namely, to find alternatives to the natural slash-and-burn system. If managed fallow systems can be introduced economically to maintain and enhance productivity of soils, then and only then can a base for a productive agriculture be established in Liberia, whether for traditional or for emerging commercial farmers. In fact, once the soils constraints are overcome, with economically feasible approaches, the traditional farmers will become through time the small-scale commercial farmers and will thus produce more of the domestic food needs of the nation. Through time, given appropriate incentives, they will become the dominant mode of production in Liberia. Furthermore, this mode of production will likely be less destructive of the ecological base.

However, by tackling this constraint directly, CARI has taken on a formidable task, and few national experiment stations anywhere in the world, have faced such challenges. Whether this approach can succeed depends on the understanding and steady support from the highest levels of GOL and likewise from focused support by donors on the high priority of continuing to build the indigenous institutional capability. Failure in understanding and support will surely bring a relapse in capability which will require another half generation to rebuild.

2. The CARI Cropping Systems Approach

In coming to a cropping systems focus, the staff had to overcome and sort out the usefulness of the various interpretations of ideological, methodological elements embodied in "The Farming Systems" approach. This approach in its various interpretations has been instituted in many African nations, as an initial means to obtain a focus of current research effort in the countries where it has been adopted. Often, the unintended result of this effort has been to split emerging local institutions into two parts, i.e., a traditional research approach, and another part which emphasizes the study of the farmer in his setting.

The staff at CARI has chosen a cropping system mode to introduce a more integrative approach (Table 5). The approach focuses on the soil and resources base and attempts to harness the talent of the contributing disciplinary departments to find the technical interventions which farmers can use to overcome these constraints. The framework of study is one which for now embraces an analytical process of comparing the effectiveness and feasibility of substituting man-made managed fallow systems, i.e., perennial cropping and alley cropping, as substitutes for natural fallow.

As feasible interventions are packaged and introduced for use by farmers, another new set of constraints, as a result of the intervention and adoption, will arise and will have to be placed in a research mode. These new constraints to adoption of subsequent interventions could be, for example, changes in the sex distribution of labor, security of tenure factors, increase in diseases and pest populations, etc.

At least a minimum level of disciplinary talent is required to initiate this program focus. There is no question that the talent base will have to be enlarged, and through time, as new problems arise in the

TABLE 5 ILLUSTRATIVE FRAMEWORK FOR CROPPING SYSTEM FOCUS[1]

Overall Objective: To determine feasibility of "managed fallow" aimed at continuous cropping as substitutes for natural fallow (shifting cultivation), two-fallow regimes, perennial cropping and alley cropping.

Sub-Objectives/Study Elements[2]	Needed Discipline/ Departmental Inputs	Data/Measurement Requirements
I. To determine the possibility of maintaining natural productivity of the soil	Land and Water Crop Science	Monitor soil nutrients and organic matter
II. Determine need for soil amendments to maintain productivity	Land and Water Crop Science	Base line and continuing soil test data, long term with various soil amendments impact on crop yields
III. Determine effectiveness of alternate manipulation of legume/cover a. plow b. animal grazing c. minimum tillage	Crop Science Agricultural Engineering Animal Science Land and Water	Monitor the effects on crop yields and animal yields according to rotations and fallow regimes
IV. Determine cost/efficiencies of energy inputs a. human b. animal c. mechanical	Socio-Economic Animal Science Agricultural Engineering	Determine costs of inputs such as time/cost of animal/ machinery, labor used in the fallow regimes
V. Determine cost of various energy sources and inputs a. human labor, including shifts in sex distribution of labor b. animal c. machinery d. soil amendments e. pest control material f. weeding/harvesting	Animal Science Agricultural Engineering Land and Water Plant Protection Socio-Economic	Determine cost of labor, animals, machinery, tools, soil amendments, pest control materials, various rotations
VI. Determine outputs from various rotational schemes a. Food - rice, corn, cassava, vegetables, etc. b. Feed - corn, cassava, forage, browse c. Wood - fuel, construction material	Animal Science Crop Science Socio-Economic	Measure of yields and value of product according to regimes
VII. Determine the changes in populations of pest/diseases a. Weeds b. Insects c. Diseases d. Nematodes	Plant Protection Weed Scientist Entomologist Pathologist Nematologist	Monitor the incidence and changes in pest populations, diseases according to rotations and regimes
VIII. Determine cost effectiveness of pest control methods a. Biological b. Integrated control c. Insecticides d. Nematocides e. Weedacides f. Pathological agents	Plant Protection Weed Scientist Entomologist Pathologist Nematologist Socio-Economic	Make judgment decision on needed pest control methods based on severity of pest infestations

TABLE 5 ILLUSTRATIVE FRAMEWORK FOR CROPPING SYSTEM FOCUS[1] (continued)

Sub-Objectives/Study Elements[2]	Needed Discipline/ Departmental Inputs	Data/Measurement Requirements
IX. Determine degree of feed, food and fuel losses due to pests	Animal Science Plant Protection Socio-Economic Crop Science	Measure or estimate the effects of pests that interfere with reaching potential yields
X. Determine harvest and post-harvest costs a. Labor b. Animal c. Mechanical - harvesting equipment - storage d. Rodent control e. Insect control f. Processing	Socio-Economic Plant Protection Agricultural Engineering Animal Science	Measure or estimate cost factors to the various inputs according to fallow regimes and rotations
XI. Determine degree of infrastructure deficiencies impacting on evaluation of the system a. Market/Prices b. Storage c. Roads, etc.	Socio-Economic and others	Measure impact of deficiencies on cost of inputs, transport of outputs, etc.
XII. Determine security of tenure factors impacting on cropping system	Socio-Economic and others	Obtain baseline data and follow-on data
XIII. Determine yields and income per family/per capita over time	Socio-Economic and others	Obtain baseline data and follow-on data
XIV. Determine effects of system on quality of life, sex distribution of labor, and needed changes in extension delivery procedures	Socio-Economic and others	Obtain baseline data and follow-on data, by families, village community

[1]Various crop rotations (including tree crops) will be studied in two fallow regimes, i.e., perennial cropping and alley cropping of possible configurations.

[2]List of sub-objectives/elements is suggestive of variables to be observed.

pathways of discovery of solutions to them, additional disciplinary expertise will have to be added to the staff.

The cropping systems approach by CARI is fundamental to enlarging the food output capacity of the nation. Output results, however, from this effort will not appear in as great leaps in the output statistics of the nation. Dramatic change in national output cannot be expected in year one, five years or even in ten years. The results will only appear in small increments and may indeed not show increases at all, until the accumulative effects of hundreds of individual research results are integrated as packages used by farmers.

In accepting the correctness of the focus, it is likely that few in GOL or among the donor groups will realize fully, the impact of this approach. The use of and the testing of techniques, some of which are at the very heart of this approach, represent in a historical context all the elements of converting a low-capacity production system, now in substantial equilibrium, into one of higher productivity. The major elements one should note are rotations, soil amendments, legumes/grasses, i.e., artificial fallow, power requirements, i.e., hand, animal, mechanical, etc.

It may be useful to suggest that introducing them will not be easy. The western experience in the evolution and introduction of the major elements should be instructive. The following are examples:

a. Shorter rotational schemes required centuries to put in place. The three-field rotational system became an early mode.

b. Introduction of legumes in the three-field system required several centuries for widespread use.

c. The usefulness of lime to neutralize soil acidity required nearly a century to achieve wide usage.

d. Widespread use of fertilizer amendments to correct natural deficiencies in nutrients was also a long-time effort.

e. The shift from human to oxen, horses and mechanical power evolved over a long period of time.

3. Summary

In summary, the process of finding substitutes for natural fallow systems covers a long time frame. Now that a broad knowledge base is available, especially from the IARC's the process <u>in newly developing countries can be substantially shortened</u>. Too often, national governments and donors alike hope to compress the time frame required and in so doing <u>abort</u> the process by failing to build the indigenous capacity needed to <u>sustain</u> a persistent force for change in agricultural practice. In Liberia, it is critical that the <u>annual increase</u> in food output <u>exceed</u>

the annual population growth rate of three percent to accomplish a reversal of the declining per capita food output.

Well known is the Green Revolution in Asia, from a successful introduction of a package of technology, on irrigated systems, which had precise control of water. Quick adaption was assured from a farming population who had centuries of experience in managing irrigated agriculture. Unfortunately, there has been no, of what might be called a "green revolution" in rain fed areas of the world. For example, rapid increases in corn production in the U.S. is a product of 60 or more years of sustained incremental contributions from research. Nor has there been a Bean Revolution. Despite 50 years of efforts from various disciplines, yield increases of soybeans finally were obtained, but by small increments.

One of the most important questions now facing CARI; does it have the capacity to implement fully the "blueprint"; has the critical mass of talent and disciplinary mix been reached; and will it aggressively seek to capture and adapt the science based results of WARDA, IITA and other IARC's. Most important has the continuity of understanding and support been achieved, to take that first step of a long journey, as it seeks to challenge the constraints of the fragile Liberian resources on building a domestic food production capacity and in reversing the downtrend of per capita food output?

Finally, will the needed link from CARI research to potential users be forced? -- i.e., the extension services. The final test of the efficacy of the research and the packages of technology produced, even those of highest relevancy and potential, will be the extent to which they are adopted and used. This is the final test. The reality of CARI's effectiveness in its contributions lie in how well and how quickly the diffusion process can be institutionalized -- and integrated with the research process -- that is, an effective national extension service.

V. THE SIGNIFICANCE OF CARI IN THE NATIONAL ECONOMIC DEVELOPMENT OF LIBERIA

A. A Brief Sketch of the Setting

Liberia, in an economic development context, is faced with challenges. Few nations with a similar resources base and size of the economy have challenges as difficult and foreboding.

Much of the driving force in the economic history of Liberia over the past half century is associated with the development and exploitation of its primary resources from the investments of foreign-based firms in rubber, iron ore and timber concessions. In a more recent period, in an attempt to enlarge the foreign exchange earnings, was the development of a number of parastatals with the hope of being able to develop cash crop production for export.

Noteworthy is the fact that, in varying degrees, the commodities for export sales are subject to the vagaries of the swings in world prices of these commodities. These wide shifts in the world supply-and-demand conditions impact heavily on Liberia, resulting in either "boom times" or severe economic

recession in the economy. Because the monetized sector of the economy is relatively small, these swings impact most heavily on governmental revenues and the allied and supporting businesses in the major cities.

International coffee, cocoa, rubber, palm kernel and palm oil prices reached an unprecedented high level in the period of 1973-1975, resulting in a very favorable revenue situation for Liberia. Subsequently, a gradual downward trend occurred and by the late 1970s and early 1980s had reached disastrously low levels and adversely affected governmental revenues and the urban business community. Serious was the impact on the governmental investment in development efforts, which continues to impede development to this day.

Meanwhile, population growth rates began to accelerate. The growing urban population and the need for food (rice) was accommodated by rice imports which could be paid from export revenues. Virtually all domestic rice production was from traditional subsistence producers. Consequently, little marketable surplus was available in Monrovia (MOA, Stat). The level of imports of rice by the mid-1970s was four times that of 20 years earlier.

One of the major forces for economic change and adaptation is the population growth rate. The population of Liberia in 1980 at 1.8 million was double that of 1960. At present growth rates, among the highest in Africa, the population of Liberia will have reached 2.6 million within five years. The rural to urban migration already underway, likely will accelerate and could be a most difficult national problem. It will place extremely heavy pressure on finding employment opportunities for rural migrants and, consequently, overloads the urban social services infrastructure. Continued high unemployment rates can be expected in view of limited local value-added manufacturing and service industry. A continued reduction in employment opportunities in the capital intensive mineral industry is expected. Large estate capital intensive farming would further reduce employment opportunities.

B. Some Disquieting Trends

Although domestic rice production is expected to increase to 164,000 metric tons by 1992, consumption needs will increase to 305,000 metric tons, leaving a rice import gap of at least 140,000 metric tons. The foreign exchange impact of rising food imports is obviously significant. Recent trends in prices of major agricultural exports indicate a price recovery but total earnings in recent years from this source are no larger than in 1980. Prospects for mineral exports, even in the near term, are not bright, and the longer run prospects depend on whether projections of near-exhaustion of these resources are fulfilled (USAID Food Aid).

Liberia is essentially a "price taker" for its major agricultural exports. In terms of the proportions of the world trade in these commodities, it is a residual supplier. In rubber, the Asian producers dominate the market; in coffee, the South American producers are predominant; and in cocoa, some of Liberia's sister nations are larger producers. At any given level of world demand, obtaining a larger market share can only be achieved by virtue of having superior ecology and soils and lower productions costs (use of higher order of technology) than the major competitors. On both counts, Liberia is disadvantaged.

Logging operations, much by clear-cut methods, by concessionaries have recently increased and will likely continue to increase as demand for wood products will likely remain steady. Overexploitation of this limited renewable resource, can result in permanently changing the ecology of the forest, i.e., from the coniferous to the hardwoods and to the less desirable species in the successive regeneration processes. Meanwhile, the probability of larger soil erosion damage and reduction in fertility levels is high.

C. The Search for Options for Sustainable Use of Liberia's Resource Base

The viable options, at this stage of economic development, are few. Given the high population growth rates, the demand for food will escalate. Persons hoping to enter the job market, and especially rural migrants, will find little opportunity for work. The high proportion of the population 15 years and under, suggests the magnitude of this problem.

The problems or questions fundamentally are two:

1. Can domestic food output be increased to reduce drain on foreign exchange? Export earning prospects are that the foreign exchange earnings rate will be well below the growth rate of the demand for food -- much less so for satisfying the rising expectations for higher levels of living and especially for investments for economic growth.

2. Can productive employment be found for the ever enlarging proportion of the population entering the labor force?

A significant remaining untapped resource for Liberia is its population in the agricultural sector. This population represents 70 percent of the working population of the nation. However, the size of its contribution to the national economy is dependent on the amount this sector produces over its consumption needs. As output increases over consumption needs, it will be able to provide increasing amounts to the urban sector. The surplus it earns over consumption will become the basic source for investment, first in the technology to further increase its own productivity, but also for investment in national economic development. Traditionally and historically, this "rural surplus" is withdrawn by two means: an unfavorable rural-urban terms of trade or by heavy taxation. Fortunately for Liberia, at this stage neither of the above means to extract the rural surplus has occurred, primarily because much of the traditional sector has not become monetized. Indeed, the producer rice policy is favorable to producers. But intervening "non-price" factors up to now have not allowed full response for farmers to the favorable price incentives.

Among the more basic "non-price" impediments to price response is that, up to now, technical production packages have not been available, and whatever was available had not reached the farmer. The "rural surplus", in economic development terminology, just was not available for "extraction" for investment in national economic development purposes.

One must conclude that even small incremental increases over time in productivity of the 170,000 farmers can yield a "rural surplus" for increased employment, per capita income and for investment. Data now available suggest

that, depending on soil types and level of amendments, the value of the increased output from rice growing farms could be increased from $50 to $100 per farm in the near term for a total national aggregate value of $8.5 million to $17 million. Experimental results, with higher order amendments and especially in the cropping systems mode, could yield double or triple the increases over current average national levels of output per farm. If this could be accomplished, per capita income and employment will have increased and rural to urban migration rates reduced.

If it were possible to produce the nation's rice needs through capital-intensive large estates, the obvious first impact would be one of rendering much of the rural labor redundant, reduce incomes and stimulate rural to urban migration. Further, this possibility exists only if a man-made fallow system could be incorporated into commercial systems without destroying the soils base. The answer to this question for both traditional and commercial production depends on whether or not it is economically feasible. The answer to this question, whether "yes" or "no", depends on the cropping systems research efforts at CARI.

The choice of and sequencing of strategies for agricultural development, is inherently very difficult. This is because there is a need to consider a complex set of interacting economic and political variables. Among the more important considerations, are the interactions relating to per capita food output and income, employment generation possibilities, or rural-urban migration, tenure security issues and foreign exchange availability. In much of Tropical Africa, the need for introducing the capability of "science-based" technology, to overcome deficiencies of the resources base, is widely recognized. Increases in food output are needed to support a growing population and reduction in the drain on foreign exchange. Resolving constraints has often led to high level frustrations and impatience. It is highly tempting to initiate a "crash strategy" by concentrating resources, from both national and external sources, on atypically large capital intensive farm units, with their own special needs for infrastructure, and their own high claims on dwindling foreign exchange.

D. The Importance of Prioritizing and Sequencing Investment Interventions

Especially difficult are those choices of strategies that can support and activate the production possibilities of small farmers who are widely scattered in "the bush", weakly linked together in villages. The inherent low productivity of the soils focus the geographical dispersion of farm units in space -- 7 to 10 acres of natural fallow is required for each acre in food production.

For example, the need for level of and sequencing infrastructural support of small traditional farmers, depend on the answer as to whether or not and at what costs can a sustainable productivity base be established. Unless this is determined, investment in roads, storage and processing facilities can be mislocated, and with capacities far exceeding the ability of the land resources productivity base to support and pay for. It is true, rough estimates of potential productivity can lead to later positive return on investment, prior to needs, if the anticipations of productivity increases are actually fulfilled. A road or facilities constructed to serve a particular area without careful study

of the potential productivity of an area can, if potentials are not fulfilled, result in uneconomic use and failure to recoup investments made, whether from private or public, internal or external sources.

The legacy of little used or abandoned roads or facilities for lack of positive returns, estimated by either private or social returns, can be found in many economic development situations, whether in Europe, North America or in emerging developing nations. A natural productivity base must either exist or be established, by appropriate technological inputs to ensure that there is something to carry to and from an area served, at sufficient levels to recoup investments. It is possible that a portion of social returns can be derived from perceived political or military needs.

Not until it is established by research that soil amendments and "man-made" fallow can substitute for shifting agriculture will there be little volume of limestone and fertilizers or outputs to transport. In addition, the volume will depend on an acceptability by farmers of these interventions, the level of output increases obtained (to pay for them) and foreign exchange availability.

Finally, with respect to roads, consideration must be given to security of tenure issues which result from "site values" and thus encourages non-resident investments along the roads. Both equity and economic issues arise when the traditional farmer loses his rights to use land is forced to go further "in bush" or become an unemployed migrant to the cities (USAID, Cobb, et al).

Intervention priorities and sequencing issues are also involved in providing universal education, medical facilities, etc. These have high utility value and are highly prized consumption goods in all societies. The extent to which these can be provided depends basically on the productive capacity of the nation. As productive capacity increases, more can be afforded and provided. Accelerating, these highly desired objectives can be undertaken by national governments as a high national priority, as in Sri Lanka and Tanzania. Usually considerable external funding has been required to assist in introducing education and medical service in early stages of development.

E. Concluding Comment

The ability of a nation to make wise investments, to begin or to continue on the potential pathways of economic development depends on the nature of investments that are made. Crucially important, is that investments are made at particularly critical points on the pathway and that they are sequentially introduced to yield positive returns. National governments and donors alike can deflect, and delay attainment of potentials. In reality, there is neither a fully developed national agricultural data base, nor is there often sufficient knowledge and skills by governments and donors alike to know for certain that the correct investment interventions are made. Realistically, probably only after-the-fact analysis and hindsight, can indicate whether or not the development decisions made did yield results, even if quantifiable measures cannot be applied. Only recently has the empirical and historical framework, within which development takes place, been established.

A national data base requirements are high in order for governments to make wise developmental decisions, to monitor progress and to assess costs and benefits. Rarely are continuing data series available for management of development activities. Until this capability has been established, decision-making processes are hampered and often result in disappointments.

Observation and study suggest that if Liberia is to achieve rising national outputs and incomes, it must not overlook the constraints imposed by its resource base. The agricultural resource base is especially limiting now, and the question as to whether or not it can support a higher population with rising expectations remains to be answered. Research on this question is critical, and answers will likely not be forthcoming in the near term. Continuing and sustained investment in research and institutionalizing this process is the highest national priority. Again, it might be well to call to our attention the views of Ruttan, noted earlier: "the capacity to develop and to manage technology in a manner consistent with a nation's physical and cultural endowments is the single most important variable accounting for differences in agricultural productivity among nations".

The MOA has begun building a data base on some of the essential data needs for management of the development processes of the agricultural sector. Much greater capability is needed. There is a high risk of aborted efforts, and even failure, because of the lack of sufficient data. Strengthening this capacity must be among the high-priority tasks of the MOA. It has in its hands, the management of the agricultural development portfolio of the GOL.

Building the capacity for the generation and the management of technology in Liberia has begun. Enlarging these capabilities are among the first steps in strengthening the nations economy. The responsibility of achieving fully indigenous capabilities rests heavily on the Ministry of Agriculture and the Central Agricultural Research Institute.

VI. ADAPTATIONS BY CARI TO FACE THE CHALLENGE OF ITS STRATEGY

A. MOA/CARI Response to Conditions Precedent and Special Covenants, Phase II

During the first two years of the Phase II period, the conditions and covenants for implementation have been substantially fulfilled.

In the Project Data Sheet dated August 31, 1984, five "Conditions Precedents" and seven "Special Covenants" were set forth as conditional issues for final implementation of the project. Several political, social and economic events have occurred since the above date which have a direct bearing on the conditions/covenants. Examples of these events include the decline in national economic conditions and the consequent inability by MOA to fund CARI at originally agreed upon amounts; an election in October 1985 and the attempted coup or invasion on November 12, 1985; limited number of MIAC advisors (originally the contract called for six advisors but due to limits on funding only four MIAC members are in place). In spite of the above and other difficulties, the CARI/MIAC group has made significant progress in meeting the requirements of the original document.

1. Phase II Project Covenants and Conditions Precedent

A point by point discussion of each of the 13 conditions/covenants set forth on pages 1-3 (and repeated later) of the Project Data Sheet follows.

a. MOA shall...furnish evidence that CARI has created a Department of Socio-Economics...with a staff of at least three professionals.

Status: Department was established. Staff consists of three professionals. Another Agricultural Economist (MS) will be hired at the end of May, 1987. In addition to working with the other departments in consulting/ advisory role, the department is engaged in other economic studies.

b. Evidence that CARI has established standard procedures satisfactory to AID for the submission, review and approval of research proposals by CARI's staff.

Status: A formal peer review procedure has been established and a standard form for submitting proposals has been developed.

c. ...furnish AID in form and substance satisfactory to AID evidence that CARI has submitted an agricultural research strategy...

Status: A detailed strategic plan has been developed taking cognizance of all issues raised in this condition precedent. This document had the full input of all CARI and MIAC staff members. (Copy available.)

d. ...the Grantee shall...furnish to AID...evidence of the transfer of the Grantee's budget line item for operation thereof to CARI's budget.

Status: Budgets have been completed by departments, cropping system program, and administrative costs. Furthermore, budgets have been broken down according to fixed and variable inputs (example available).

e. (Agree) to furnish...evidence that a system of inventory control satisfactory to AID has been established for CARI's equipment and supplies and (b) a system of routine maintenance...has been established for all CARI's motor vehicles and machinery...

Status: An inventory control system is in place and routine maintenance is implemented. These functions are performed through the Administrator's office. However, under the new proposed administrative structure, the above items will still be under the Administrative Office but direct responsibility will be given to the Budget & Finance Comptroller.

f. (A long term) trainee (agrees in writing) to work for CARI two years for each year of training received.

Status: This is a CARI policy being strictly met. As a practical matter all trainees except one have returned to CARI after completing training under Phase I of the contract.

g. The Grantee agrees to create new staff positions as called for in Annex I...and to fill these with qualified personnel in a timely fashion.

Status: According to Annex I "Project Implementation Schedule" 17 new professional staff should be hired in the first five years of the contract August, 1984 to May, 1989 (N.B. the first members of the MIAC teams arrived September 1985). As of now (April 30, 1987), 12 new professional staff have been added to the CARI staff (see Table 3 above).

h. CARI agrees to provide housing, utilities, office space, secretarial support and vehicle maintenance facilities...for the ...technical assistance team.

Status: Although inhibited at times by external forces (L.E.C., telephone, etc.) and some delays CARI has fulfilled this special covenant to the best of its ability as constraints by local conditions still prevail.

i. CARI and MOA covenant to implement the following costs savings...:

a. Removal of the Marine Research Unit from the CARI budget, and

b. Reduction of personnel expenditures by removing unproductive workers from the...payroll and transferring pensioners from CARI.

Status:

a. The Marine Research Unit is being dissolved and some personnel will be reassigned to other duties while others will be declared redundant.

b. This "requirement" cannot be implemented by CARI. This is a National problem involving Civil Service regulations. The pension fund does not have a significant impact on the budget. The fund has dropped from $21,000 one year ago to $13,000 at present. It will phase itself out as pensioners pass on.

j. The Grantee agrees to assign annually ten MOA extension staff to CARI for not less than one year for training...

Status: CARI realizes the need for in-service and subject matter training and is committed to providing same. However, considering the cost of training and the demand on staff time, a limited number of specialized training programs will be conducted.

k. ...the MOA and CARI (agrees to establish, fund, and staff the Extension Liaison Unit).

Status: Extension Liaison is a function unit at CARI with ELO Dr. Othello Brandy and ELO advisor Dr. W.T. Wilkening in place. Furthermore, a research assistant has been hired and assigned to the Extension Liaison Unit.

l. CARI and MOA are to develop a national agricultural research strategy to be submitted to the Agricultural Research Council at the Technical Committee.

Status: The CARI staff has developed a national agricultural strategy and such document is ready to be submitted to MOA officials for their final comment and review.

m. CARI agrees to execute Memoranda of Understanding with Bong Co. ADP, Lofa Co. ADP and Nimba Co. RDP covering their respective roles in off station research and dissemination of improved varieties and technologies.

Status: A memorandum of agreement has been signed with BCADP and a letter of agreement has been discussed and agreed upon with NCRDP. This letter of agreement will be signed in the very near future.

In addition to agreements with BCADP and NCRDP, a memorandum of agreement has been signed and cooperation has begun with the University of Liberia, college of Agriculture and Forestry. Also working agreements have been established with Smallholder Rice Seed Project (SRSP) for cooperation in on-farm trials.

2. Summary

The above 13 conditions/covenants are, in the main, fulfilled or in the process of being fulfilled. Some have been overfulfilled, e.g., Special Covenant "g". A few others await complete consummation depending on completion of the amended document. Although CARI has been able to remove a limited number of workers from the payroll, the inability to remove other unproductive workers poses a serious constraint to the budget.

B. Adaptations in the Organizational Structure of CARI

The strategy adopted by CARI requires a realignment and strengthening of the role and functions of the Institute. This is now understood by the administration and the staff of the departments. Achieving understanding of the purposes of this realignment is central to the effectiveness of CARI in carrying out its adopted strategy.

The proposed reorganized structure of CARI is set forth in this section. The organizational chart is presented (Figure 1 above), and the departmental and administrative roles are discussed. Basically, the functional objective and responsibilities of each office are defined. Further, the major changes from the present structure are noted. For departments, some description is made of their collaborative responsibilities and contribution to the Cropping Systems Program.

Briefly, some major changes are:

1. A Socio-Economic Department has been established.

2. The field research operations are delegated to the Research Coordinator's office, while the Facilities Support (including building and grounds maintenance) remain with the Administrative Office.

3. Budget, finance and comptroller functions are delegated to a special section under the Administrative Office.

4. A Biometric Analysis and Evaluation Unit is to be added and will be responsible to the Office of the Research Coordinator.

5. The Coordinator of the Cropping Systems Program reports directly to the Office of the Research Coordinator.

6. The Extension Liaison Unit's role is more explicitly delineated to detail the three major roles to be performed.

7. The future functions of Fisheries are proposed to be absorbed within the Animal Science Department.

8. Methods of report preparation and departmental reviews and evaluation have been developed.

9. The library's status, function and future direction is considered and suggestions for its development indicated.

C. Adaptations in the Roles of the Office of Administration, the Office of Research Coordinator and the Extension Liaison Office

1. Administrative Office

a. Functional Objective

The Administrative Office exists to provide for the research institute orderly and efficient methods for managing the finances, personnel and facilities support section.

b. Functional Responsibilities

The Administrative Officer is directly responsible to the Director of CARI. Responsible to the Administrative Officer are (see organizational chart):

Facilities Support Group (Inventory & Maintenance)
Budget and Comptroller
Office of Personnel

The facilities support includes maintenance of the physical plant and grounds maintenance. It does not include field research operations. This is now a responsibility of the Research Coordinator. Inventory control is also included under this section. An advanced inventory system shall be instituted to augment the present system to facilitate accurate record keeping and to ensure that, at any point in time, the relevant staff know the availability of materials and equipment.

The budget and comptroller section manages all finances provided to CARI by GOL and other donor organizations. Budgets will be prepared for each ongoing research project or area to indicate funding requirements. This office shall ensure that departmental heads or team leaders keep within the range of budget expenditure for each project. Another duty of this section involves procurement. Personnel charged with procurement will be responsible for setting up a system which allows competitive bidding on local purchasing. Further, procurement personnel are responsible for seeing that items are delivered in a timely manner and in good condition. In order that all procured items be properly accounted for, this office must be closely coordinated with Inventory Control.

The third major section of the Administrative Office relates to Personnel Management. Personnel matters should be handled at all levels within the organizational structure, and information passed on to relevant persons. However, a professional and functional personnel division must provide services and advice to all department heads. Department heads must be given authority to approve such excuses as leave, clinical, etc., but must be guided by Civil Service Rules and bear full responsibility for work habits of their employees.

c. Changes in Structure

Most of the structure changes have been discussed above. The major change is that the Administrative Office will be able to delegate more of the day-to-day routine activities and devote more

of his time to management and organizational activities and less to the operations aspect.

2. Research Coordinator

a. Functional Objective

The Research Coordinator's primary objective is to oversee the research functions of the various departments.

b. Functional Responsibilities

The Research Coordinator reports directly to the Director and, as indicated earlier, all department heads are administratively responsible to the Research Coordinator. Besides the Coordinator's involvement with departments, he/she supervises the functions of:

1. Field Research Operations
2. Biometrics Analysis and Evaluation Laboratory
3. The Cropping Systems Program

In general, the Research Coordinator serves to expedite the research process at CARI by developing criteria and procedures for research implementation, publication and evaluation. Furthermore, this office should serve as a focal point for developing linkages among other research and extension agencies and donor groups.

c. Changes in Structure

The route of departmental reporting has changed. The newly added functions noted give a renewed emphasis to the importance to this office.

3. Extension Liaison Office (ELO)

a. Functional Objective

The basic objective of the ELO is to develop and deliver technical information packages and to provide linkages from CARI to the various extension groups.

b. Functional Responsibilities

The major responsibilities of the ELO can be summarized as:

1. Collaborate with departments in the design of adaptable technology packages for use by farmers.

2. Coordination of activities between CARI and the several extension agencies.

3. Transmission and dissemination of information to the several extension services and to other users of such information.

4. Determine methods most effective for reaching farmers.

To fulfill the above responsibilities several implementing activities are proposed including:

1. Communications methods: preparation and distribution of newsletters, guidesheets, special reports and radio programs.

2. Arrange for in-service training for Extension personnel.

3. Assist departments on demonstrations and on-farm trials.

4. State-of-the-art conferences.

5. Assist on Field Day arrangements.

c. Changes in Organization

All of the objectives and procedures indicated could be considered "net new". The "Blue Book" states, "A comprehensive and cohesive extension program does not exist" and "Relatively few farmers have been reached or affected by extension activities".

Not only are the programs "new" but the Extension Liaison Office personnel have arrived recently. Dr. W.T. Wilkening, ELO advisor, came to CARI in May 1986, and Dr. Othello Brandy, ELO, returned from graduate studies in February, 1987.

D. Realignment and Functions of the Departments of CARI

1. General Features of Realignment

a. Roles and Functions

The departments have been realigned in structure and responsibility to conform with the proposed priorities set forth. Emphases have been placed on integrated and coordinated research with tangible and obvious linkages to economic factors, commodity priorities, the Cropping System thrust and extension effort.

Six departments are proposed. At first blush, the departments appear little unchanged from present structure. However, major changes in function and responsibility have been proposed and will be adopted. These changes refer, in the main, to each department's role and subsequent refocus to support the Cropping Systems Priority.

As noted, a major emphasis in CARI's research strategy will be to investigate methods of replacing shifting cultivation with a more stable system as opposed to slash and burn in a shifting cultivation. The Cropping System effort involves a number of disciplines in all departments. Because of the cooperative nature in Cropping Systems, scientists' responsibilities will be altered. (See organizational chart, Figure 1). While a department head still has the opportunity to report in certain matters directly to the Director, in the main, the day to day liaison is from department to the Research Coordinator, and in appropriate cases the Extension Liaison Officer.

b. Methods of Report Preparation

This will be little changed except for using the new annual report forms. Strict adherence to objective fulfillment and procedure will be expected. For most departments, methods of reporting must include methods for widespread, popular dissemination -- field day activities, guide sheets, fact sheets, ratio, CARI NEWS, etc.

It must be recognized that reporting of research results differs by department primarily due to the nature of the research and the economic horizon involved. For example, some vegetable strains can be initially evaluated in 60 days or less while a breeding experiment with cattle may take several years before tangible research results are forthcoming.

c. Department Annual Review and Evaluation

The need for annual reviews is obvious. These reviews serve as benchmarks for the researcher, the administrative personnel, and the donor and funding groups. When made annually, an opportunity exists to make corrective changes in the project while still maintaining its initial focus and purpose. Those departments having major service responsibilities to other departments will be assessed on how well these services are performed as well as on their own independent research.

The process of evaluation implies a more in-depth review involving how well objectives and procedures have been followed and what tangible research results have been obtained or are forthcoming. By their very nature, evaluations imply (1) a time horizon, usually of several years, and (2) a team or committee effort charged with the evaluation. Both internal and external evaluations should be used, and in either case the team must be composed (dominated) by peers within the profession. Certainly, groups other than peers have an interest in the direction of the project and may have a major input in the evaluation process. But the major evaluation and suggestions for change in direction, efforts to expand, decrease or to terminate the project, etc., should come from recommendations of the peer group.

Evaluations should be especially cognizant to each department's role (and each research project's role) in the Cropping Systems Program. In addition those departments involved in priority commodities will be specifically examined regarding research on these commodities.

2. Role and Functions of Departments

A discussion of the roles of each of the departments, emphasizing objectives, functional responsibilities, collaboration, changes in structure, etc., follows.

a. Crop Science

This is the largest department in the Institute and will remain so in the proposed reorganization. Of equal importance is that four of the priority commodities -- rice, cassava, vegetables and tree crops -- are located in this single department. The department is one of the essential contributors in the cropping system strategy.

1. Functional Objective

The functional objective is to do applied research on crops with present and potential usefulness to Liberian small holders as they shift away from slash/burn systems to a more continuous cropping approach.

2. Functional Responsibilities

One responsibility will be to maintain variety testing of crops to ascertain and improve their adaptability (e.g., growth conditions, insect-disease infestations and resistance, etc.) to Liberian conditions. Other research is to be conducted on breeding new varieties, general agronomy and propagation of promising lines.

3. Changes in Departmental Structure

This department must work in close concert with support areas as land and water, agricultural mechanization and post harvest technology, socio-economics and plant protection. Institutional collaboration will be through joint experiments with University of Liberia College of Agriculture (ULCAF) and on farm testing with Smallholder Rice Seed Project (SRSP). Certainly donor agencies such as AAO, UNDP and IDRC will play important support roles. The department will maintain and possibly expand ties with international centers, e.g., ICRISAT, IITA, WARDA and CIMMYT.

4. Cropping Systems Priority

Support and intimate involvement in the cropping systems thrust is obvious and necessary. Certainly the recommendation of appropriate crops as well as techniques for continuous cropping must come largely from this department.

b. Land and Water Resources

1. Functional Objective

This department is involved with research on soil fertility, analysis of soil and plant tissue samples, soil survey work and compilation of needed meteorological information.

2. Functional Responsibilities

The department does research on soil fertility and its laboratory will perform soil and plant analysis for other departments. In the main, this department's major responsibility finally resides in its ability to make recommendations on soil management; fertilization, erosion, conservation correlation of soil test results with crop yields. Critical to the success of the cropping system thrust is an analysis of the soils of each plot area, on farm trial areas. Further, the department must observe erosion problems and indicate solutions as the system evolves.

3. Collaborative Responsibilities

Research and service are roles of this department. A senior scientist has leadership of the Cropping Systems program. The department's responsibility for collaborative research and service will increase when the soil laboratory becomes functions. The Cropping Systems approach demands a collaborative effort of which land and water development is a key and integral part. Relationships with other Liberian institutions (ULCAF, ADP's, SRSP, etc.) are expected to be strengthened and expanded. Cooperation with donor agencies is, in general, tied to an interdisciplinary effort at CARI although there may be a few exceptions.

c. Plant Protection

This department consists of the divisions of plant pathology and entomology. Much of the work is supported by a UNDP/FAO project. Three of the five staff members are away for graduate training sponsored by FAO.

1. Functional Objective

To work with other CARI departments, primarily Crop Science, to investigate and make recommendations regarding control of insects and diseases. This department does considerable nematode, insect and disease surveys and diagnostic work.

2. Functional Responsibilities

The department is available for research and service on the control of various pests affecting crops. Part of the work of this department is to assist in the development of insect, nematode and disease resistant crops. Pesticide recommendations are also a role of this department. There is no weed scientist at CARI, but a definite need exists. It has been suggested that a weed scientist be more appropriately assigned to the Crop Science Department; however, this is a moot point at this time. The relative issue is not where the scientist's "academic" home is but rather that such a skill is needed by the Institute.

3. Changes in Departmental Structure

The department is undergoing major changes. A new modern building will be finished in the near future and new equipment has been requested. Also, within one to two years a nemotologist, a plant pathologist and an enotmologist will return from graduate training (M.S. level) thus bolstering the professional thrust of this department. Furthermore, if a weed scientist is employed and assigned to the department, another area of research and service will be added.

4. Collaborative Responsibility

The Plant Protection Department, with the assistance of FAO advisors, is making surveys to determine the identity and extent of the pest problem. A secondary function is to provide advice to CARI staff and farmers on pest control. Also, the department assists crop scientists in the selection of pest tolerant and resistant varieties.

5. Cropping System Priority

As the cropping system changes dramatically from a shifting slash/burn type to alternate methods of cropping, the input of plant protection professionals will increase to monitor the changes in pest populations and devise control methods.

d. Animal Science

This major long standing department as an integral part of the institute is destined to play a vital albeit a bit different role than in the past.

1. Functional Objective

To reduce constraints on economical production of livestock in Liberia.

2. Functional Responsibilities

Currently the department is composed of three divisions: Animal Breeding & Production; Animal Health & Veterinary Science; Animal Nutrition. The present livestock research are beef cattle (D'Nama and their crosses), swine and small ruminants (sheep and goats). The basic thrust has been production and management, breeding, reproduction, identification and classification of livestock diseases and studies aimed at reducing animal feed costs through the use of indigenous feeds. Work in legumes as a field crop also takes place in this department. Veterinary services are very limited locally and CARI provides some of this service to local farmers. The project on work oxen has attracted much attention. As a means of reducing hand labor and contributing to the tillage input of the Cropping Systems program, the work oxen may prove to be a valuable avenue as Liberian agriculture goes from a subsistence type to an emerging semi-commercial structure.

3. Changes in Departmental Structure

This department is likely to undergo major changes in structure and focus. Two of the priority commodities -- poultry and swine -- specifically concern this department. Poultry research will be a "net new" endeavor and swine research will gain added emphasis with intent to enhance, if possible, the nutrient status of the nation. Furthermore, feed technology will be emphasized with the aim of expanding the use of indigenous feeds for livestock thus reducing dependence on imported feeds.

The Fisheries Department will be incorporated with the Animal Science Department. Personnel in fisheries are primarily biologists and can fill needed roles.

The beef cattle herd will be maintained at a constant level with little or no new inputs. The small ruminant project is due to be gradually phased out.

As pointed out above, the work oxen project will make a contribution to the Cropping System program and

possibly be refocused to include some demonstration teams in villages, and institutions (e.g., missions, etc.).

4. Collaborative Responsibility

Certainly the department must work closely with most of the other departments at CARI. For example, nutrition studies require direct input from socio-economics and crop science as well as others. The work oxen project needs close cooperation with agricultural mechanization and the land and water management personnel. Likewise, the department needs to be in professional contact with those international centers dealing with livestock, e.g., the International Livestock Center for Africa (ILCA).

5. Cropping Systems Priority

One of the major thrusts of the Cropping System program is movement toward continuous cropping (substituting legumes or grass for "bush"). With this new system the use of work oxen will be examined to determine the efficacy (deeper tillage to cover straw) as well as the efficiency (less man hours) to perform the operation. Further, an abundance of forage will be produced in the perennial cropping rotations, and only ruminant animals can make full use of forage and legumes.

e. Socio-Economics

This department, in an organizational sense, is the newest at CARI. From a functional sense, the department is not new. Since 1980, the Socio-Economic Officer, along with the Administrative Officer, the ELO, and the Research Coordinator, have functioned as advisors to the Director.

1. Functional Objective

To assess the economic impact of CARI research and to assist and advise other researchers on the economic viability of their projects. In addition, the department will conduct surveys of special interest to the Institute, e.g., swamp abandonment, fish pond feasibility, etc.

The socio-economic group is available for consultation on economic problems affecting crops and livestock. Benefit/cost analyses will be made concerning new projects and issues relating to macro economic and agricultural policy will be addressed. The department head will also serve on the Project Review Committee.

2. Changes in Departmental Structure

Since this is a new department, changes refer only to personnel. Three professional agricultural economists

and three para-professionals make up the department. One more agricultural economist (M.S.) will join the staff in late May, 1987. A sociologist may be added to the staff as funds permit.

3. Collaborative Responsibilities

Since the department operates as also a service organization, staff must not only be prepared to assist other scientists with economic problems but also to take leadership to ensure that all applied research is economically feasible.

4. Cropping System Priority

For the Cropping Systems program to succeed it must be economically sound. In other words, it must be profitable in relative and absolute sense to the farmer. This can be determined by budgets, cost analysis, linear programming and other economic techniques within the cropping systems framework. The socio-economic group can furnish this vital link disciplinary input in analysis.

f. Agricultural Mechanization and Post-Harvest Technology

1. Functional Objective

To provide the Institute with engineering advice and expertise on a variety of subjects: modification and adaptation of new tillage tools, soil and water management, small tools, engine repair and maintenance, etc.

2. Functional Responsibilities

Agricultural mechanization is a relatively new field at CARI. The acting head of this department returned to Liberia in 1984 and at present has no counterpart, no building and limited equipment. Agricultural mechanization (or engineering) is necessary in Liberia considering massive problems in swamp development, evolution from hand labor to animal traction, etc. At present, the engineer is expected to supervise land layout and maintenance of research equipment.

3. Changes in Departmental Structure

It is proposed that a MIAC advisor to the department be added soon. Further, the need for more professional and para-professional staff is apparent. The small Post-Harvest division should be moved out of the large Crop Science Department and be administratively responsible to the Agricultural Mechanization (engineering) Department.

4. Collaborative Responsibilities

As noted, this is primarily a service department and as such cooperates on a wide variety of projects for many departments. This should continue but as faculty members are added, the department may want to take on more individual research. Post-harvest technology personnel are already engaged in research involving prototypes and the rest of the department undoubtedly will be interested to do similar studies.

5. Cropping Systems Priority

A continuous cropping system calls for rigorous methods of conservation, soil erosion control, and field equipment modification, all requiring the talents of the Agricultural Mechanization group.

g. Fisheries

This department formerly was comprised of two division: Inland Fisheries and Marine Fisheries. As noted in CARI's response to the "Covenants", the Marine Fisheries unit is being dissolved. Whereas the department was established in 1980 to conduct adaptive research on fish culture, it, in fact, does not conduct research. Its function appears to be the production of fingerlings for distribution to farmers. Fisheries facilities are poor and the department has only two professional staff members. It has been suggested that this department be absorbed (merged) with Animal Science. Fish do represent a valuable source of animal protein in the Liberian diet but the cost/benefit ratio may be simply too high and farmer acceptance too low, to maintain a separate department.

E. The Library

1. Early Years

The library at CARI should serve as a reference source, as the Archives, and as a repository for administrative records and accounts of the Institute. The library, at the time of CARI's establishment (1980), was an uncoordinated jumble of a few non-indexed, outdated books, periodicals, reports, etc.

During Phase I of the project, much progress was made to make the library a viable entity at CARI. Several hundred volumes of reference books were received, and subscription was made to 25 professional journals. A part-time library consultant was hired to organize, catalog and shelve books and periodicals. In addition, the consultant had the responsibility of training the existing library staff.

2. Present Status

While much improved, the library remains inadequate in most respects. It is more of a reference/reading and conference room than a library. More space will soon be added to the area presently occupied. Space alone does not make a library, and in the budget there is an amount requested for remodeling the existing and added space.

The present adequacy of the Library can be improved by hiring a full-time librarian. This person should have a knowledge of and an appreciation for agriculture (not necessarily, however, a degree in agriculture). The major point is that the library be efficient, orderly and accessible. While it may be desirable to have a librarian with a degree, it may not be entirely necessary, at this point in time. The major requirements are good judgment, a sense of order and the ability to learn and adapt.

3. Recommendation

We strongly advise that a TDY librarian come to CARI for a period of time and advise on this important issue. The consultant's counsel is needed on library space, personnel, methods of filing, retrieval and storage. Of major interest would be the consultant's recommendation on the archival function and the library's relationship to the Administrative Office's records.

F. Institutional Relationship of CARI with Other Governmental Agencies

It is necessary for any governmental agency, regardless of its degree of autonomy, to be especially cognizant of its responsibility, interface and relationships with the other agencies. CARI is no exception.

1. General Setting

CARI, as presently organized, is headed by a Director who has line authority to the MOA Deputy Minister for Research and Extension. The Deputy Minister reports to the Minister who, in turn, is advised on CARI affairs by a Project Committee.

2. Proposed Relationship

The proposed advisory group for CARI is a Board of Trustees[1] headed by the Minister of Agriculture, and includes the Minister of Planning, the Ministry of Finance, the Director of CARI and representatives from the various donor agencies, e.g., USAID, UNDP, FAO, and perhaps other appropriate personnel and/or agencies.

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[1]Board of Trustees is only a suggested title. Board of Governors, Board of Regents, etc., would be a satisfactory appellation. The function rather than the name is important. In the interim the function may be referred to as the Project Committee.

3. Necessity for External Peer Review

CARI is disadvantaged as compared to experiment stations in the U.S. and other larger countries with respect to peer contact and consequent idea/information exchange. In the U.S. there are 50 state experiment stations from which an external peer review team can be drawn for unbiased and objective reviews. External reviews are done regularly by all 50 stations. CARI is the only such experiment station in the country and thus has no other source for outside professional agricultural scientists, for analytical and objective review of its program. The advantage of formal peer review is obvious, and such reviews constitute a source of continuing feedback for keeping projects relevant and institutions aware of their role as perceived by other interested and informed groups. It is recommended that CARI as an institution undergo a biannual external peer review and the findings of this review be made directly available to the CARI Director, the Deputy Minister for Research and Extension, the Minister of Agriculture, and the Board of Trustees.

Now, a major question arises: Who should serve on the External Peer Review Committee? After discussions with many informed people, it is suggested that the core of the Committee be made up of researchers at international research centers -- IITA, IRRI, CIMMYT, WARDA, and research personnel from ULCAF and from other African experiment stations. CARI and MOA would not play a role in this review other than facilitating and supporting the process.

G. Accomplishments and Potential Accomplishments of CARI Research

1. General Situation

For the first time in its history, CARI is in a favorable position to play a vital part in Liberia's economy for years to come. In terms of physical equipment and buildings, these are or will be operational in the very near future. Of more importance perhaps is the CARI staff. Many of CARI's most promising staff have completed advanced training and have returned and initiated or are initiating research projects.

For the first time in the history of CARI, a full-time Director heads the unit. Prior to July 1986, CARI's chief administrative officer was an Acting Director. Most damaging to developing leadership capacity was that the first CARI director was an expatriate. Subsequent to this period was the naming of two acting directors, and both were carried on the professional roster for at least three years. Obviously, this fact gave the wrong signals to the staff as to who is or will be in charge. Acting status for two incumbents reduced building leadership capacity at CARI and adversely affected the research output. An important review of the administrative structure has been made, and recommendations are in place to accommodate the responses of the researchers in a more efficient manner.

The Extension Liaison Unit is completely functional for the first time and is establishing linkages with other agencies associated with extension.

The CARI staff has completed a comprehensive research strategy which, along with reorganizing the administrative structure, puts research priorities on commodities within the cropping systems focus. Based on many factors, commodities were ranked according to their contribution or potential contribution to the Liberian economy. Central to the priorities is the Cropping Systems Program which has as its aim an eventual replacing of the prevailing method of shifting cultivation. This is a program, involving all departments, and it is the central focus of the research at CARI.

2. Accomplishments at CARI

Some important accomplishments of CARI with constraints that are limiting the impact of these accomplishments on Liberia's agriculture are shown as follows.

a. Rice

CARI has a breeding and variety selection program to find tolerance to iron toxicity that is common in swamps of West Africa. CARI found superior tolerance to iron toxicity in a variety they released to farmers under the designation of Suakoko 8. Later, they developed another variety tolerant to iron toxicity and name it Suakoko 10.

LAC 23 has been a high producing and popular variety in Liberia, but it has red kernels. Liberian people prefer white-kerneled rice. CARI staff found a few plants among LAC 23 with white kernels. These plants were selected and developed into a white-kerneled LAC 23.

1. Varieties

Numerous rice varieties undergoing testing produce higher yields than the standard upland variety LAC 23. These improved varieties reach their highest yield potential under high management. These high-yielding varieties are being tested under various Liberian climatic conditions as well as under farmer conditions before being released to farmers for planting. These need further evaluation for food quality and ease of preparation. Examples of some of the promising varieties and needs for further evaluation are listed in Table 6.

2. Fertilizer Response

Data from a number of experiments show that rice responds economically to inputs such as nitrogen and phosphorus under wide price ratios of rice to fertilizers.

Adaptation of fertilizer use has been inhibited by lack of knowledge regarding response, transportation and credit for purchasing fertilizers.

TABLE 6

Variety	Re. Yield*	Evaluation Needs for New Varieties
LB08-033-24-2	116	Further testing under farmer conditions
LAC 23	100	More quality and milling tests needed
IRAT-13	235	In multilocational trials and more on-farm trials needed
LAC 23	100	Quality and milling tests needed
IRAT-138	124	Same as above varieties
LAC 23	100	

*LAC 23 = 100

b. Cassava

Cassava varieties at CARI were selected for local climatic conditions from plants obtained from various locations in Liberia and from IITA.

Varieties selected at CARI have been named CARICASS I, II and III. Comparable yields are: 24.8, 34.2, 21.7 and 11.4 tons/ha for CARICASS I, II and III and the local varieties, respectively.

More research needs to be done on taste and other qualities that are desirable for human and animal consumption of cassava.

Research has shown that planting in mounds rather than on flat surfaces more than doubled the yield.

Economic increases from nitrogen and potassium fertilizers have been received. Responses vary depending on initial soil fertility levels.

c. Coffee

Experimental work in progress with shading and tree spacing indicates that reducing the amount of shade and spacing trees closer together, increased coffee yield by a factor of 2 to 1 on an acre basis. The indication is that with age, the proper spacing of trees will change. Long-term research is needed to determine proper spacing with age.

Research with coffee is labor-intensive, and economic evaluation of cost of new trees vs. cost of harvest from larger older pruned trees is needed relative to yield decline with age of trees.

d. Forage

Evaluation of numerous annual and perennial legumes has shown that several varieties grow well under Liberian conditions and have potential as cover crops in crop rotations to replace bush as an alternative to "shifting cultivation".

Data with work oxen show that the N'Dama oxen can be sustained on signal grass pastures that have been established for some time at CARI on land that would have -- under the "shifting cultivation" system -- gone back to bush. Further fertilizer experiments with signal grass indicate yield responses from nitrogen. The economics of fertilizing pasture need to be evaluated, especially with regard to beef production in Liberia.

e. Maize

Crossing of various lines is showing yield increases over the present corn being grown in Liberia. A significant reduction in plant height has been attained without reducing yield.

The need to investigate maize as a potential crop in rotations within the cropping system scheme is important.

A serious constraint for the corn-breeding program is a lack of fencing and/or other methods to prevent thievery of the crop prior to harvest.

f. Vegetables

Collecting and testing the various varieties of vegetables grown under differing Liberian conditions is in progress. The establishment of a germplasm bank will form the base for developing improved varieties for Liberian farmers.

3. Accomplishments in Animal Science

a. Animal Traction

After a work oxen demonstration at CARI last year, the Leprosarium at Ganta has purchased an ox team. Staff to handle the oxen were trained at CARI. Additional farmers have inquired about the purchase of oxen. Some farmers have oxen and want to receive training in handling the oxen as draft animals. ULCAF is receiving support on selecting and training oxen for draft purposes.

Experiments and plans involving animal traction and pasture establishment are underway for 1987. These will be established at select locations where the local farmers have expressed an interest. The experiments will serve to collect valuable data and as "show-and-tell" demonstrations for extending information to farmers on their own turf.

Constraints in use of animals include the following:

- cost of animals,
- lack of knowledge of large animal care by local farmers,
- lack of quality and adaptable animal traction equipment, i.e., plows with coulters to facilitate turning-under of residue, harrows to finish seed bed preparation,
- wagons or carts to be pulled by oxen to enhance transportation for local farmers,
- qualified people to modify and repair animal traction equipment, and
- insufficient qualified people to train farmers and extension personnel in the art of handling livestock.

b. Swine

Breeding stock has been purchased by numerous local swine producers from CARI stock. Nutrition studies using indigenous feed have been a major activity in the last two years.

c. Nutrition

Work with various local products that frequently go unused and in cases become problems in other crops indicates that feed rations for swine and poultry can be produced at lower costs than imported feeds. CARI has demonstrated that a storage period of six months is needed for rubber nuts to lose toxic properties. Rubber nuts, cassava and legumes are examples of products needing further economic evaluation from the standpoint of processing into feed as well as their value in the ration.

4. Accomplishments in Post-Harvest Technology

CARI has a number of devices that need to be introduced to farmers by extension staff. Sheet metal con-shaped rat guards placed on the supporting posts of rice kitchens prevent rats from climbing into the kitchens. The rice kitchen has a storage area for rice above a lower floor used for cooking.

Rodents and insects can be kept out of rice by stowing rice in large sheet metal bins with tight covers. The bins vary in size and can hold 500 or more pounds of rice.

The constraints to using rat guards and rice bins are the unavailability of sheet metal in rural areas and the know-how of making them. The extension staff can furnish the know-how, but the private sector needs to supply the metal and the craftsmen to make them.

5. Accomplishments in Plant Protection

CARI maintains the largest insect collection in Liberia. This collection is used for identification and training of personnel involved in crop protection.

Facilities for mounting and proper preservation of new insects for the collection are not available in Liberia. Therefore, the cost of having this done out-of-country is considerable.

Identification of insects and diseases through the various cropping areas of Liberia form the start of a data base necessary to develop the training programs and other information necessary to deal with these problems. Further comparing the known pest problems with known possible solutions will provide areas where Liberia's limited research resources can be utilized.

6. Accomplishments in Extension

CARI newsletters have been developed and are being printed and distributed on a quarterly schedule.

The establishment of the Rural Liberian Communications Network (LRCN) has provided CARI with another means for dissemination of practical information. The staff is preparing radio programs on numerous subjects on a scheduled basis.

Annual field days have been initiated. CARI staff participated in four in-service programs for County Extension agents in 1986. Continued support for this activity is planned.

A "State of the Arts" Conference on Rice was held. Others are planned.

VII. IMPLEMENTATION PLAN

A Overall Considerations

1. Relating to CARI

CARI has attained a level of professionals on its staff that bodes well for the near term. It now has a total of 48 nationals with professional degrees, BS and above. There were a total of 36 nationals on the staff in early 1984, or a gain of 12 professionals. The mix of professional degrees, 21 BS, 22 MS and 5 PhDs in terms of ratios is quite balanced for an institution at this stage of development. The administrative staff is now in place since two program leaders returned since July 1, 1986. The staff is young with limited experience. Fifty percent of the higher degrees were obtained since 1981. Nine Masters 22, and two of five PhDs were obtained in the last two years.

Beginning the fall of 1986, the staff undertook an effort to develop a strategy for the Institute. It has developed a focused strategy that, if carried out, is aligned with highest priority needs of agriculture, i.e., that of finding a sustainable substitute system for traditional shifting cultivation, which engages 70 percent of the national work force. Few stations anywhere, including the IARCs, have undertaken a task as challenging.

In order for CARI to move forward, build on its present base and gain a momentum, it requires a full understanding of the GOL and participating donors of the scope and nature of the challenge undertaken. The financial support, even though constrained at the moment, should be one of the higher priorities and, more importantly, should be made available in a timely fashion. The need for additional staff and training for existing staff is obviously related to the challenging task ahead. There are gaps in the disciplinary mix of the staff which must be filled in a timely fashion and scheduled so these disciplines are available as the research proceeds. Similarly, there are deficiencies in the level of skills of a number of key professionals in several disciplines that must be removed by additional training.

CARI is at a critical period in its history -- it can be maintained at standstill levels, resulting in acrimonious frustrations everywhere, or it can, with understanding of its critical role, move on to face the challenge it has undertaken.

2. Relating to the Data Base Needs

The MOA, having the principal portfolio relating to the further development of Liberia, must be in a position to have the capability to manage this portfolio. A data base should be established, including data series on a continuing basis as well as special studies impacting on the agricultural development process. In the developed countries, data series on the several agricultural parameters were available to researchers and policy makers well before the development of a modernized agriculture. Similarly, the several developing countries which have now moved forward in productivity have had a substantial data base on which to base development initiatives that were undertaken.

The MOA must have a sufficient data base so that choices among options for development can be made with considerable confidence and with minimum risk of failure.

B. General Responsibilities

1. GOL

(to be completed)

2. USAID

(to be completed)

3. Contractor

(to be completed)

C. Technical Assistance Plan

1. The Long-Term Technical Assistance, General Considerations

The overriding purpose of the core TA team will be to assist counterparts of the Liberian staff to accomplish the objectives of its Strategy Plan. All members of the TA team will have subject matter specialities. One will have administrative responsibilities with respect to on-site management and the support of the team and also serve as the responsible person to USAID/Liberia and to the Campus Coordinator of the project. If circumstances and needs require, one of the team members may serve in an advisory role at the office of the Research Coordinator.

The level of long-term technical assistance staff should be maintained at a level not exceeding five professionals. In view of the necessity to move forward on the Strategic Plan as expeditiously as is feasible, the advisory support will serve in these key roles. However, the intent of his support is to foster full Liberianization of the professional staff of CARI as rapidly as possible. Seen Annex I for description of scheduling of long-term and short-term Technical Assistance. (Annex I)

2. Technical Assistance: Short-Term Advisors

A number of short-term technical assistance advisors are needed over the 5 year time horizon. Listed below are the most obvious specialties, at this point in time. Undoubtedly, as time passes, not all of the TDYs listed will be required, while others not listed will be needed. In other words, flexibility must be maintained and TDYs brought to the project on an "as needed" basis. A bonus of TDYs is the sometimes serendipitous occurrence of having an executive visitor who is also a willing specialist in a particular field (e.g., Meador - Ag. Eng.; Kiehl and Ratchford - Ag. Econ. and Admin.; Nolan - Admin. and Sociology). Strong consideration should be given, early on, to bring a cropping systems advisor to assist in long-term design, perhaps from IITA.

The most mentioned (and hence probably needed) TDYs are:

- Cropping Systems Advisor
- Statistician, research design and analysis
- Agricultural Engineer
- Management (administrative)
- Librarian
- Weed Specialist
- Nematologist
- Agricultural Economist (marketing)
- Animal Nutritionist
- Cropping Systems Agronomist (alley and rotational cropping)
- Horticulturalist
- Data Base Advisor (MOA) -- to be provided on an intermittent and continuing basis, as needed

The above suggested TDYs are not necessarily listed in ordinal preference, nor is the length of stay specified. The details can be worked out with individual departments and units and with the TDY designate. TDYs, whenever possible, should be from MIAC institutions. Although the University of Missouri is the lead university in this contract, efforts should be made to include as many MIAC institutions in the TDY program as practical and possible.

To accommodate the needs of maintaining and strengthening the data base needs so essential for agricultural development, a TDY with short-term advisory responsibilities on an intermittent basis will be provided to the MOA, as requested. Details of the arrangement, selection of the professional who can serve effectively in this role remain for development. It would be expected that advisory assistance could be up to 90 days annually, with agreed-upon intermittent scheduling.

D. Training Plan

1. Participant Training

Participant Training will be a major input under the revision of Phase II. Much of the student training will continue as planned in Phase II but some modifications were made by a committee made up of CARI Senior

Staff and MIAC advisors. These modifications were made to reflect the changes in research focus and the perceived need for bolstering CARI's administration. FAO is supporting research in Plant Protection, Tree Crops, Post-Harvest Technology and Vegetable crops.

Participants who will be trained by FAO are also listed in Table 7, but are designated by an asterisk. Weed Science has been considered to be a part of Plant Protection, but the committee thought that it more appropriately should become a part of Crop Science. FAO has no plans to train a Weed Scientist so the person who will assume this position is slated for training.

Among the 28 students listed for advanced training, 18 are on the CARI staff (Table 8). Training will be needed for 10 new staff members to be hired to broaden the base of talent required to support the cropping systems focus. It would be expected that these new hires be on the staff for at least one year prior to their leaving for training (Table 9). The training positions were given priority ratings based on the training needs that will support CARI's revised research and administrative strategy. Some modifications in priorities may be made if it seems reasonable to accelerate or slow down training depending upon who has returned from training and who is critically needed to support the needs of ongoing programs. It is possible that some candidates for training may not meet the criteria for admission to graduate school and, therefore, some adjustments will need to be made.

Seven short-term training positions are listed, but the number of these will likely be increased as needs become apparent with anticipated progress of the cropping systems focus. It may be necessary to train additional people in operating and maintaining laboratory and other research equipment. It is critical that the utilization of the training opportunity be timely and sequenced in terms of needs. Some revisions in type of training needed should be expected. It is possible that some of this training can be obtained from Liberian institutions.

2. Short-Term Training

Short-term training is designed to provide intensive training of personnel in needed skills and update them in instrumentation, computer and management techniques to support scientists in the Cropping Systems. A person trained in computers will assist scientists in analyzing data, and assist the administration in record keeping. The person who will act as an Experiment Station Manager will be trained in the operation of land that is used for experiments. He will assign plot areas to scientists and keep a history of the treatments applied to blocks, and learn the general techniques of keeping research areas and research equipment ready for use by scientists.

The maintenance technician will be trained in maintenance of machinery and equipment for the Institute.

The administrative technician will be trained to handle record keeping and the general techniques in assisting in the administration of the Institute.

TABLE 7: DEGREE TRAINING OF CURRENT STAFF BY DEPARTMENT AND DISCIPLINE, BY FISCAL YEARS

Participant Training Department	Relative Priority to Cropping Systems	Training Priorities ** 1987/88	1988/89	1989/90	1990/91	Candidate Degree
CROP SCIENCE						
Seed Technologist	2	1*				BS
Legume/Pulse Spec.	2		2			MS
Prod. Agronomist	1			3		MS
Tree Crop Spec.		1				MS
ANIMAL SCIENCE						
Animal Nutrition	3	1				PhD
Animal Production	3	1				MS
LAND AND WATER						
Instrument Tech.	1		2			AA
Soil Fertility	2			3		PhD
Soil Survey	1				4	PhD
Soil Microbiology	2				4	MS
AG ENGINEERING						
Post-Harvest*	2	1				MS
Ag. Mechanization	1		2			MS
PLANT PROTECTION						
Entomologist	1		2			PhD
SOCIO-ECONOMICS						
Ag. Economist	1	1				MS
Ag. Economist	1		2			PhD
EXTENSION LIAISON						
Ag. Communications	2		2			MS
Extension Agron.	2		2			MS
ADMINISTRATION						
Management/Acct.		—	2	—	—	BS
TOTALS:		6	8	2	2	18

* May be supported by FAO
** Priority 1 = most urgent, 4 = least urgent

TABLE 8: DEGREE TRAINING OF STAFF TO BE HIRED BY DEPARTMENT AND DISCIPLINE, BY FISCAL YEARS

Participant Training Department	Relative Priority to Cropping Systems	Training Priorities 1987/88	1988/89	1989/90	1990/91	Candidate Degree
CROP SCIENCE						
Prod. Agronomist	1		2			MS
Weed Scientist	1		2			MS
Tree Crop Spec.					4	MS
LAND AND WATER						
Soil Management	1				4	MS
AG ENGINEERING						
Ag. Mechanization	1				4	BS/MS
PLANT PROTECTION						
Plant Pathologist	1			3		MS
Plant Pathologist	1				4	PhD
SOCIO-ECONOMICS						
Rural Sociologist	1				4	MS
ADMINISTRATION						
Librarian			2			MS
Statistician				3		MS
TOTALS:			3	2	5	10

TABLE 9: SHORT-TERM, NON-DEGREE TRAINING BY DEPARTMENT AND SPECIALTY, BY FISCAL YEARS

Participant Training Department	Relative Priority to Cropping Systems	Training Priorities 1987/88	1988/89	1989/90	1990/91	Specialty
LAND AND WATER						
Soil Survey	1	1				
Environ. Instr.	1	1				
ADMINISTRATION						
Maintenance Tech.	1	1				
Experiment Station Manager	1	1				
Computer Operator	1	1				

The soil survey technician will get short-term training in mapping and identification of soil types so that their suitability for various crops can be determined. Records need to be kept of rainfall, temperatures, humidity, intensity of sunshine, and evaporation.

The environmental instrumentation specialist will be sent for short-term training in instrumentation and maintaining these vital meteorological data.

E. Construction Plan

1. Housing

Additional staff housing is critically needed to reduce staff turn-over rates and as incentive to attract new staff for positions to be filled. Presently, many scientists are living off the compound at considerable personal and professional expense. A housing allowance averaging $150/month is allotted to each scientist living off the compound. Most suitable housing is located in Gbarnga, some 12 miles from CARI. Rent for such housing exceeds the allotment, not counting the utilities (which will be $100 to $150/month). Thus, the staff member may pay as much as $350/month and is reimbursed only $150/month for housing, which in most cases is inferior in quality to CARI housing. Additionally, the cost of the 25-mile round-trip is added expense. Intangible items include the loss of morale and esprit de corps, so necessary for an effective, efficient research unit.

2. Fence for Research Areas

Fencing needs for critical research areas were addressed in the original contract. The need for fencing of all research plots cannot be overemphasized. Every year, research plots suffer from theft which makes the collection of accurate research data impossible. Thus, no only is the scientist's time lost and all the expense of doing the research wasted, but, more critically, potential valid information necessary to help upgrade Liberia's agriculture production is delayed or lost. Presently, critical research plots at CARI are not located in a central location. Fencing small areas is more costly than one large area. However, fencing the bulk of the CARI compound is financially prohibitive.

In order to develop a workable solution to the important issue of security for critical research areas, the CARI fence committee has prioritized the research areas. Off-station work is planned for Kpatawee, where a larger block of land is available, and a cooperative site with ULCAF at Fendall is included. Alternative solutions to using the very expensive 8-foot security-type fence with an estimated cost of $10 per foot have been discussed.

One alternative is to use 4' high chain link fence with two barb wires coupled with warning signs, an educational program through the village chiefs and security personnel. The 4' fence would cost in the area of $4 per foot. A similar fence, using standard field woven wire

instead of chain link, could be constructed cheaper, but would provide no protection against large rodents, although this could be provided by a close-spaced cribbing wire.

A combination of the 4' fence around larger tracts, coupled with the more secure fence placed around the very highest priority areas, was also discussed as an alternative solution.

Continued effort will be made to utilize available fencing appropriations to adequately secure the largest possible research area.

3. Fertilizer and Chemical Storage Building

Fertilizer and chemicals needed for field research plots is expensive, and many of the chemicals must be properly handled because of possible health hazards and deterioration. Presently, warehouse space to store these materials is limited. Therefore, the need for a separate building to properly store and protect them from weather and theft is included in new construction.

4. Agriculture Support Unit

A major thrust of CARI's research effort for the next several years is to develop through the cropping systems approach alternatives to "shifting cultivation" (slash and burn), now in use. This effort will require improved equipment (hand, animal traction and mechanized) to develop efficient systems and to demonstrate these systems to Liberian farmers.

The equipment necessary to support the research program will be placed under the supervision of the Agricultural Engineering (Ag. Mechanization) department and controlled by the Research Coordinator. In general, separation of the equipment from that required for grounds maintenance is necessary to ensure that research equipment is not utilized for inappropriate operations.

Further, field plots research equipment is frequently specially designed for specific purposes, is expensive and has components that need to be protected from the weather. Thus, storage is important. Further, field plot equipment needs to be kept in good repair because field operations involving crop production research must be done in a narrow time frame or a costly experiment may be lost. The intended building will provide both the necessary storage and maintenance facilities needed.

5. Up-Grading the Electrical System

CARI's facilities are expanding. Thus, the power requirement for new buildings and equipment is expanding. The power requirement during normal operations frequently exceeds the output of the present generator. Buildings and equipment to be added in the next few years will require additional power. Up-grading the electrical system is mandatory if CARI is to conduct research work needed to improve Liberia's agricultural production.

A Liberian engineering firm is presently evaluating the power requirements for the next 5 to 10 years, in order to purchase the proper size generator as well as the proper transformers and other needed transmission equipment.

The present generator building is in need of repair and is not large enough to accommodate the new generator.

6. Library Expansion

CARI's present library space will be expanded into adjacent space that was vacated when the soil testing laboratory moved to its new location. Renovation will include access doors, improve/replace damaged wiring, lights, shelves for book storage and adding necessary furniture to expand the work areas for staff utilizing the library. Establishing a staff conference (meeting) room will be part of the expansion.

7. Equipment for Plant Protection Building

Funds to construct the Plant Protection facility were originally designated in the present USAID contract. The contractor building the Crop Science and the Soil Laboratory was on-site and thus could more economically construct the Plant Protection building. CARI is utilizing funds set aside to equip the building for construction; therefore, funds from USAID are being requested for equipment rather than construction.

Equipment for the laboratories will include storage cabinets, chemical-resistant laboratory benches, chemicals, etc. Staff members in pathology and nematology are in the United States working on advanced degrees, thus the spreading out of the equipment purchases.

TABLE 10 PLAN FOR USAID-FINANCED CONSTRUCTION INPUTS

Construction Total Cost (US$)	Year 1987/88	1988/89	1989/90	
Houses for National Staff	318,000	318,000		
Fence for Research Area	100,000	50,000	50,000	
Fertilizer and Chemical Storage Building	27,600		27,600	
Agriculture Support Unit Maintenance & Storage Bldg.	100,000	100,000		
Up-Grade Electrical System				
New Generator	200,000	200,000		
Generator Building	50,000	50,000		
Distribution System	150,000	150,000		
Library Expansion	25,900	25,900		
Plant Protection Building Protection and Freight	120,000	40,000	40,000	40,000
Total/Year		933,900	117,600	40,000

Total All Construction: $1,091,500

ANNEX I

COMPOSITION AND SCHEDULING OF TECHNICAL ASSISTANCE INPUTS

A. Long-Term Technical Assistance Team

The present TA team consists of the following advisors: a Chief of Party (with responsibilities in Agricultural Economics), a Research Coordinator, a Soil Fertility Specialist, and an Extension Liaison Officer. As the present long-term TA staff turns over, the disciplinary specialists provided will be indicated, as needs and timing should be dictated by the requirements of the strategic focus.

On the project administrative side, there will be a designated Chief of Party. A Research Coordinator may be designated, if deemed appropriate, but these persons need subject matter responsibilities occupying approximately 50 percent of their time. Depending on the needs of CARI and the availability of specialists (preferably within the MIAC schools), it appears that needed advisors in the next 3-5 years should include an agricultural engineer, livestock specialist, soil fertility specialist, agricultural economist, rural sociologist, extension specialist with a subject matter specialty. Probably not all of the above will be available as needed. The following list is not an all inclusive list, and considerable flexibility must be anticipated. However, the suggestions above represent current views of a reasonable "mix" of specialists that should be considered.

ANNEX TABLE 1 INDICATED TECHNICAL TEAM STAFFING, 1985-1990

Specialty	Fiscal Year 1985	1986	1987	1988	1989	1990	1991	1992
Agricultural Economist	1*	1*	1*	1	1	1	1	1
Research Coordinator	1	1						
Soil Fertility	1	1	1	1				
Agricultural Engineering			1	1	1	1		
Nutritionist					1	1		
Extension Liaison		1	1	1**	1**	1**	1**	1**
Rural Sociologist							1	1
To Be Determined							1	1

* Acts as Chief of Party. The Agricultural Economist through the years will not always be of the same specialty. For example, the first three years, the Agricultural Economist was basically in Farm Management/ Production Economics. In the future, agricultural economists specializing in policy, prices, marketing, etc., might assume the position, depending on the needs of CARI.

** Also has subject matter specialty

ANNEX II

COMPOSITION OF COMMODITIES AND EQUIPMENT

In requesting commodities for CARI from USAID, not all items are consumed in the production process in the same year (they are fixed items with a life exceeding more than one year) and are hence depreciable items. Machinery and some equipment dominate this category. Rarely are machinery and equipment used up in the cropping year, but rather its service (at varying rates, of course) extends over a series of years.

Commodities are items usually used up in a single cropping season or year. However, a few smaller items have life horizons extending past one year. Lime is an example of a commodity with a life of more than one year, while seed definitely has a time horizon of one year. Both are essential in the research process to determine their feasibility to induce yield responses.

Expendable supplies are definitely used up in the cropping year or the accounting year. There are grey areas in all the purchased areas concerning life span and degree of depreciability.

A. Depreciable Equipment

Noting in Annex Table 2, the Equipment items are all depreciable items and in most cases are needed for the next thrust in Cropping Systems. These items have a depreciation life of more than one year and supplement the core of machinery already existing at CARI. Considerable expense is incurred by the off-station plots required in this type of research. Further, the project calls for cooperative work with ULCAF, SRSP, NCADP, BCADP and perhaps other agencies. These organizations, in general, do not have research plot equipment.

The various experiment and demonstration plots require transporting equipment, supplies and personnel to more than one site at the same time. We are dealing with crops which must be planted at the same time. For example, rice variety plots will be planted at one location, while fertility trials at another and rotation studies may be at still another. In order to cooperate with the various agencies and to ensure that cognizance is made of some of the various ecological zones, mobility is a must. Also, given the equipment supply and repair situation in Liberia, limited duplication of machinery is a necessity as a back-up against break-downs during critical stages in research work. Field research is time-fragile -- this is, as opposed to laboratory research; failure in one period of the growing season means (or usually means) that the entire experiment is lost for that year, causing gaps in data and making results less reliable.

B. Commodities

As previously noted, these items are usually field equipment per se, although some depreciable items may be included. Best examples would include those variable costs of fertilizers, seed and plants, pesticides, certain operating expenditures -- gasoline, oil, small repairs -- publications, spare parts, etc. Budgets are usually stated in needs for one year, with an expanded

budget embracing the time horizon of the experiment(s). For example, the Crop Science Department may need about the same amount of seed and fertilizer each year, but the budget will vary from time to time due to the need for unexpected equipment, parts, etc., and the expansion or cutting back on some experiments.

Again, there are many overlaps in a commodities budget and perhaps, ideally, commodities should contain only non-depreciable items. But in the real world, these grey areas exist and will continue to persist. Expendable supplies would be a better title for commodities, and then in accounting and budgeting the fixed and variable items could be categorized and the costs derived therefrom be divided into fixed and variable. Once these costs are established, one can make ascertainments concerning the possible profitabilities of enterprises.

C. A Note on Data Processing Equipment

These commodities are discussed separately for several reasons: their use cuts across departmental and administrative lines; such equipment is new at CARI; the type as well as the brand is significant due to local servicing requirements.

D. Computer and Data Processing

"Stand alone" P.CV. computers are recommended. These computers can accomplish the research analysis, word processing and record storage needs at CARI.

The larger main frame computers are not recommended because of cost and the fact that they are impractical when spare parts and repair facilities are not available or, at best, long down-times occur frequently while waiting for parts.

Considering the needs of CARI as well as the staff, four computers and related software are requested. The computers initially would be assigned as follows:

- Administrative Office
- Research Coordinator
- Extension Liaison Office
- Socio-Economic Department

For a research facility with the size and complexity of CARI, it is almost inconceivable that the Institute does not have a <u>single</u> computer. Many of the staff have varying degrees of skill on computers. Computers would greatly improve the efficacy and efficiency of CARI's administration, library, secretarial pool and, of course, most importantly, research.

E. Fund for Cooperative Off-Station Trials

CARI conducts two kinds of off-station trials -- on-farm and multi-locational trials.

The primary purpose of on-farm research is to evaluate varieties and techniques under farm conditions. Multi-locational trials are used to evaluate the varieties and techniques under different ecological conditions. Both types of trials are vital steps in the process of releasing new materials (rice, maize, vegetables, etc.) from the Institute.

Due to the widespread spatial nature of these trials, it is difficult for CARI scientists alone to adequately conduct such a testing program. Consequently, discussions and/or memoranda of understanding have been negotiated with Nimba and Bong County Agricultural Development Projects (NCADP and BCADP), University of Liberia College of Agriculture and Forestry (ULCAF), and Smallholder Seed Rice Project (SRSP). Cooperating with staff from these organizations, the CARI staff is able to conduct the necessary trials, thereby shortening the release process for new lines (varieties).

Funding for off-station testing mainly provides for travel and subsistence, as well as limited materials. With USAID funding, this testing program can be ensured and will be greatly enhanced and expanded, thereby strengthening the collaborative effort.

F. Summary of Commodities and Equipment

Annex Table 2 contains a summary of suggested USAID financed equipment and commodities. The first section from "Vehicles to Plot Sprayer" consists of depreciable items. Also most of the equipment is fairly specialized and meant to supplement existing machinery for the cropping systems program. (The first two items, vehicles and motor bikes, are not necessarily specified for cropping systems, however.) The time of purchase is concentrated in the first two years -- although this probably could be modified by a distribution through time with little effect on the major thrust of the program in some cases.

The middle section refers primarily to computers and associated equipment. While it would be preferable to purchase everything the first year, this is negotiable. Purchases could be spread out over several years. Computers, copiers, etc., are, of course, fixed items subject to depreciation.

The last major section refers to commodities for various departments and these are, in general, non-depreciable items (even though some items which have a life exceeding one year or cropping season may be found in a few budgets -- shop equipment, protective clothing, etc.).

Finally, a fund for cooperative off-station research is presented.

Itemized details for each item in each budget request, whether equipment, commodities or the off-station, research funds, will be furnished by the CARI staff upon request.

ANNEX TABLE 2 SUMMARY OF USAID FINANCED EQUIPMENT AND COMMODITIES

Equipment	Amount	Year of Purchase 87/88	88/89	89/90	90/91	91/92
Five Replacement Vehicles	$70,000			$42,000	$28,000	
Five Motor Bikes	$10,000	$4,000	$2,000	$4,000		
Tilt Top Trailer (transport equip) (2)	$30,000	$15,000	$25,000			
1.5 Ton Truck (pull trailer) (2)	$41,000	$20,000	$21,000			
Head Row Planter (rice)	$6,000	$6,000				
Animal Traction Plot Equip.	$10,000	$6,000	$4,000			
Two Two-Wheel 10 to 12 hp Tillers	$15,000	$7,500	$7,500			
One 30-40 hp Plot Tractor	$14,000	$14,000				
No-Till (minimum till planter)	$10,000	$10,000				
Plot Planter with Fertilizer & Insecticide Att.	$10,000	$10,000				
Plot harvestor with Cath Attachment (2)	$3,000	$1,500	$1,500			
Portable Rice Plot Thresher	$8,000	$8,000				
Foot Power Rice Thresher	$3,000		$3,000			
Tillage Equipment for 30 hp Tractor Disk	$2,000	$2,000				
Chisel Plow	$2,000	$2,000				
Power Tiller Attachment	$3,00	$3,000				
Dry Fertilizer Application Equip.	$3,000	$3,000				
Repair Parts for Tillers and Equip.	$4,000	$1,000	$1,000	$2,000		
Back Pack Sprayers and Booms	$1,000		$1,000			
Plot Sprayer (mech. power) and Parts	$3,000	$3,000				
Sub-Total Equipment	$248,000					
Computers, Printers and Copiers						
Administration and Records Word Processing	$9,840	$9,840				
Research Coordinator data analysis and Word Processing	$9,380	$9,380				
ELO Office Word Processing Desktop Pub.	$9,000	$9,000				
Socio-Economic Data and Word Processing	$7,000	$7,000				
Copier	$7,000	$7,000				
Duplication and Stencil Equip.	$8,000	$8,000				
Ribbons, Paper, etc.	$4,000	$1,000	$1,000	$1,000	$1,000	
Sub-Total Computers, etc.	$54,220					
Commodities for Animal Science	$100,000	$30,000	$30,000	$20,000	$10,000	$10,000
Commodities for Ag Mechanization	$100,000	$30,000	$30,000	$20,000	$10,000	$10,000
Commodities for Crop Science	$50,000	$20,000	$10,000	$10,000	$5,000	$5,000
Commodities for Soil Fert.	$50,000	$20,000	$10,000	$10,000	$5,000	$5,000
Commodities for Plant Protection	$50,000	$5,000	$15,000	$15,000	$10,000	$5,000
Equipment and Supplies Analytical Lab	$70,000	$30,000	$20,000	$10,000	$5,000	$5,000
Commodities for Field Plot Work (Ag Support)	$70,000	$20,000	$20,000	$10,000	$10,000	$10,000
Library Fund	$35,000	$7,000	$7,000	$7,000	$7,000	$7,000
Supplies for Equipment Socio-Econ	$43,000	$13,000	$10,000	$10,000	$5,000	$5,000
Sub-Total Commodities	$618,000					
Fund for Cooperative Off-Station Research (5 years @ $12,000/year)	$60,000					
Grand Total	$980,220					

ANNEX III

A. PROJECT IMPLEMENTATION SCHEDULE

July 1, 1987 - June 30, 1992

DATE	ACTION	RESPONSIBILITY
July 87	Sign Contract Amendment	GOL; USAID
July 87	Solicit for TA person Ag. Mech.	Contractor; CARI
July 87	Prepare equipment order for first phase of fence construction	TA Contractor CARI
Aug. 87	Request for computer and support equipment purchase forwarded to MIAC/contractor	TA Contractor
Aug. 87	Issue RFPT	REDSO/RCD
Aug. 87	TA contractor submits annual workplan for USAID review (6 months)	Contractor
Aug. 87	CARI submits research strategy to board of trustees for approval	CARI; TA Contractor
Aug. 87	Send 2 or 3 participants to U.S. Animal Sci., Tree Crops, Maintenance	TA Contractor USAID
Sept. 87	TA and select CARI staff visit ICRISAT and appropriate research centers/stations select app. equipment	Contractor CARI
Sept. 87	Have CARI 85-86 annual research report published	CARI; Contractor
Sept. 87	Detailed plans and cost estimates developed for storage building and machine shed for Ag. support group	USAID (Engineer) TA Contractor
Sept. 87	Initiate plans for equipment Plant Protection Building	CARI; TA Contractor
Oct. 87	Prepare orders for farm equipment, commodities	TA Contractor
Oct. 87	Advertise for construction contract for houses, storage-machine shed and fertilizer and chemical storage and security fence construction	USAID; CARI TA

DATE	ACTION	RESPONSIBILITY
Nov. 87	Select contractor for construction of security fence First Phase	CARI; TA
Dec. 87	Contractor selected for construction machine shed and chemical/fertilizer storage shed, and staff houses	USAID; CARI
Dec. 87	Specifications for specific field equipment and supplies to be purchased sent to contractor	CARI; TA
Dec. 87	Agricultural Research Strategy adopted	CARI USAID Contractor
Dec. 87	TA Contractor submits annual report	TA Contractor
Jan. 88	Initiate construction staff houses, chemical/fertilizer storage and machine storage	Const. Contractor CARI; Contractor
Jan. 88	Seven long-term participants selected and applications sent to MIAC/Contractor	TA Team; CARI
Jan. 88	Agricultural Mechanization TA joins support team	Contractor; TA
Jan. 88	CARI hires three new professional staff	CARI
Jan. 88	TA Contractor and CARI submit to USAID workplan for calendar year	TA Contractor CARI
Jan. 88	Install computer equipment	CARI TA Contractor
Feb. 88	PIO/T issued for first external evaluation	USAID; Contractor
Feb. 88	TA Contractor submits workplan for 1988 to USAID	TA Contractor
Feb. 88	Farmers identified for on-site trials	CARI TA's
Mar. 88	Second request for purchase of equipment (field and scientific and supplies sent to MIAC/contractor	TA Contractor
Mar. 88	Fencing material arrives and fence constructed around first priority research areas	CARI TA Contractor
Mar. 88	Contract let for Library expansion	USAID CARI
Apr. 88	Order 88/89 equipment and supplies	TA CARI Contractor

DATE	ACTION	RESPONSIBILITY
June 88	CARI hires 3 technical staff	CARI
Aug. 88	First external evaluation held and report submitted	USAID Contractor
Oct. 88	Library expansion completed	Const. Contractor
Dec. 88	TA Contractor submits annual report	TA Contractor
Jan. 89	TA Contractor submits annual workplan to USAID	TA Contractor
Jan. 89	Ten long-term participants selected and applications sent to MIAC for placement	TA-Team; CARI Contractor USAID
Jan. 89	CARI hires 3 additional professional staff	CARI
Jan. 89	CARI staff houses completed	Const. Contractor
Jan. 89	88/89 equipment and supplies arrive	TA Contractor CARI
Mar. 89	CARI publishes 87-88 Annual Report	CARI TA-Team
May 89	89/90 equipment and supplies ordered	TA CARI Contractor
Aug. 89	Ten long-term participants depart for training	TA CARI Contractor
Oct. 89	89/90 equipment and supplies arrive	CARI TA Contractor
Dec. 89	TA Contractor submits annual report to USAID	TA Contractor
Jan. 90	TA Contractor submits annual workplan to USAID	TA Contractor
Jan. 90	CARI hires 3 professional research staff	CARI
Jan. 90	Ten long-term participants selected and applications sent to MIAC for submission to app. Univ.	TA-Team CARI Contractor USAID
Feb. 90	90/91 equipment and supplies ordered	TA Contractor
Mar. 90	CARI publishes 88-89 annual research report	CARI TA Contractor

DATE	ACTION	RESPONSIBILITY
Apr. 90	90/91 equipment and supplies ordered	TA Contractor
Aug. 90	Ten long-term participants depart for training	TA Contractor USAID
Dec. 90	TA Contractor submit annual reports to USAID	TA Contractor
Jan. 91	Four candidates selected for long-term training applications forwarded to MIAC for processing	TA-Team CARI Contractor USAID
Mar. 91	CARI publishes 89-90 annual research report	TA CARI Contractor
Apr. 91	91-92 equipment and supplies ordered	TA Contractor CARI

B. EVALUATION BENCHMARKS

TWO YEARS

Have 4 advisors on site

Finish construction of 5 CARI staff houses

Functional, adequate power and water facilities

Fencing of most critical research areas

Research Strategy developed and kept current

Interdepartmental research programs for cropping systems to replace shifting cultivation updated

Formal linkages established with ADP's (area development projects) with active cooperation visible

At least two cooperative research projects with University of Liberia

Off-station research sites selected and some adaptive testing initiated with Bong, Nimba and Grand Gedeh counties as well as SRSP (Smallholder Rice Seed Project)

A policy formulated for assembling and printing extension information specifically, fact sheets for individual crops developed by ELO (Extension Liaison Office)

Pilot on-farm trials initiated for testing technologies ready for adoption in Bong, Nimba and Grand Gedeh counties and for training extension field staff in conducting such trials

Research project peer review in place and working

CARI Station review initiated

Policy established for some degree of research funding flexibility at department level

Expand summer intern project with ULCAF and BWI students

Saye Dube Station operation with staff of three

Comprehensive plans for utilization of Saye Dube Station developed

Expand surveys relating to Cropping Systems

Have operational computers and word processors in place

Communication via radio with Nimba, Saye Dube and University of Liberia

Regular schedule of radio programs for extension in progress

Annual reports policy issued to include seminars scheduled for each researcher to present his/her work

Have library policy developed, especially procurement, abstraction journals, methods of obtaining gratis materials, and library management with expanded facilities completed

Phase out the propagation function (fruit trees - fish)

Adequate maintenance and repair facilities supporting research are operational

Proper supervision, layout and record keeping of research plot areas and research equipment in place

FOUR YEARS

Have 4 advisors on site

The Plant Protection building fully equipped and functional

Fencing of high-value research areas completed

Up to three cooperative research projects with University of Liberia in force

Printing and distribution of extension information from all departments is routine

Adaptive research conducted routinely at off-station research sites in Bong, Nimba and Grand Gedeh counties including Cropping Systems technology

Expand pilot on-farm trials and training of extension agents in priority counties

Preliminary technology packages developed for major food and tree crops in priority counties

Policy formulated for systematic training of extension workers

Well-established mechanism functioning to have full, interdisciplinary coordination in on-farm testing of developing technologies and systematic feed-back of producer problems to CARI

Have 6-8 Phase II long-term trainees back at CARI

Have a full-time statistician in place

Continue involvement of ULCAF and BWI students

Recommendations (based on research results) for cultural methods such as planting time, fertility, varieties and harvest procedures for major vegetables and root crops in print and being promoted

Production systems for swamp rice developed and promulgated to farmers

New staff scheduled for hiring on board

Preliminary recommendations and technology package out to select animal traction cooperators

Initiation of pilot farm testing of cropping system technology with animal and mechanical traction in priority counties

SIX YEARS

Production technology packages developed for all major food and tree crops for priority counties

Adaptive research conducted routinely at the second priority off-station research sites

Progressively advanced research being developed at CARI in all departments

Animal traction technology package available for distribution

Progressively advanced research being adapted at off-station research sites in priority counties

Close cooperation in force with University of Liberia

Extension information output becomes routine, and reaches all parts of the country

Systematic training of extension workers underway in Bong, Nimba and Grand Gedeh counties

On-farm testing of cropping system and other necessary research is expanded in the priority counties

Library becomes fully functional

Streamlined research support staff with well trained technicians, but with reduction in total numbers

Trained administrative support staff (accountants, etc.)

10-15 Phase II long-term trainees back at CARI

New varieties of major food crops being developed and seed supplies increased

Cropping Systems recommendations are expanded beyond the priority counties

ANNEX IV

SCOPES OF WORK FOR TECHNICAL ASSISTANCE TEAM

I. Agricultural Economist

A. Duration

Six years

B. Qualifications

A PhD in agricultural economics. Several advisors will occupy this position over the tenure of the project. Recommended specialities include farm management, marketing and policy. Prefer experience in cropping or farming systems research and/or work in third world countries with a multi-disciplinary team.

C. Duties

The position will involve working with a CARI counterpart in the following areas:

1. Participate with cropping systems team to determine the economic feasibility of various plans.

2. Cooperate in planning, supervision and implementation of research and on-farm trials and evaluation of improved technologies.

3. Assist the Extension Liaison Officer in organizing and implementing training courses for extension workers.

4. Conduct various surveys concerning Liberian agriculture, e.g., for marketing, fish pond evaluation, cost-of-production studies, etc.

5. Assist in training counterparts and other staff members on economic analysis through seminars, workshops, publications, etc.

II. Nutritionist (non-ruminant)

A. Duration

Two years

B. Qualifications

A PhD degree in animal nutrition emphasizing swine and/or poultry. Must have five years experience. Prefer experience in third world setting.

C. Duties

Work with CARI counterparts in developing research programs in poultry and/or swine nutrition. Specific responsibilities will be:

1. Studying effect of indigenous feeds on performance such as rate of gain and reproduction.

2. Study methods of integrating non ruminant livestock into the cropping systems approach.

3. Collaborate with extension liaison office in training extension workers, assisting with field days and implementing on-farm research and demonstrations of poultry and swine.

III. Soil Fertility/Chemistry Specialist

A. Duration

Two years

B. Qualifications

A PhD degree in Soil Fertility with a strong background in analytical chemistry and familiarity with soil testing procedures including the latest technology. Requires five years of research experience, and while knowledge of tropical soils is preferred, it is not essential.

C. Duties

To work with a PhD counterpart in soils in developing a long-range program of research in soil fertility for various eco-zones of Liberia and for a range of crop species. Additionally, to help organize a soil testing service to be offered at CARI for researchers, extension workers and farmers. Specific duties to include:

1. Assisting in the installation, operation and management of soil testing service.

2. Advising in the planning and implementation of soils research project, including prioritizing the research effort.

3. Advising, with the counterpart, on interdisciplinary research involving the Crop Science Department and the farming systems committee.

4. Assisting in soil surveys, both national and local.

5. Helping with farmers field days and with the installation of off-station demonstration plots.

IV. Agricultural Mechanization/Appropriate Technology

A. Duration

Four years

B. Qualifications

An MS or PhD degree in Agricultural Mechanization or Agricultural Engineering, a minimum of five years experience. Experience in third world countries preferred. More than one advisor may fill this post over the four year duration. Should possess skill with agricultural machinery, shop equipment, welding, sheet metal layout and fabrication, and shop management. Experience in land and water management helpful.

C. Duties

To plan, design and test technological innovation which are within the means of the small farmer, and to assist a counterpart and other CARI staff in shop management and equipment maintenance. Specific duties to include:

1. Assisting the various departments of CARI in identifying needs in the area of appropriate technology.

2. Design, construction and testing, in cooperation with a counterpart, of innovation useful to the small farmer, including post-harvest handling of commodities.

3. Assisting CARI staff in the proper operation of machinery and shop equipment and in their preventive maintenance and repair.

4. Help in the installation and management of machine shops and in acquisition of supplies and equipment.

5. Working with the Extension Liaison Officer at CARI Field Days and in on-farm demonstrations.

6. Provide input for the cropping systems interdisciplinary committee in matters relating to appropriate technology.

V. Rural Sociology

A. Duration

Two years

B. Qualifications

A PhD in Rural Sociology or Anthropology. Must have five years experience and prefer some third world experience. Must be willing to work into an interdisciplinary research extension setting.

C. Duties

1. Participate in the cropping systems team to help integrate research of various disciplines and test the system at the farm level with trials and surveys of improved technologies.

2. Assist the Extension Liaison Officer in organizing training courses for extension workers and developing recommendations for evaluating extension programs.

3. Conduct research in the acceptance of new technologies.

4. Assist in training counterparts and other staff in elements of sociological research through seminars, workshops, etc.

VI. Extension Liaison Officer

A. Duration

Six years

B. Qualifications

A PhD in an agricultural field with a minimum of five years experience. Experience in a third world setting preferred. Several advisors will occupy this position over the tenure of the project. Specialities recommended to be represented include Animal Science, Farm Management, Agronomy, Plant Protection, Horticulture or Agricultural Marketing. The advisor must have demonstrated capability in planning demonstration activities, applied research and training programs for farmers and extension workers. Working experience with researchers and field extension agents is required.

C. Duties

1. Participate in trials, tests and evaluation of technologies for smallholders.

2. Plan new methodology for training programs and assist with evaluation of extension training activities of the MOA and ADP's.

3. Continue and expand publication of CARI NEWS.

4. Expand mass media (radio) broadcasts featuring CARI research.

5. Help plan and implement the CARI Field Day and other demonstrations to show research achievements.

6. Participate with cropping system team in planning and implementing featured demonstrations.

7. Develop technology "packages" for use by extension workers.

LIST OF ACRONYMS

ADP	-	Agricultural Development Project
CAES	-	Central Agricultural Experiment Station
CARI	-	Central Agricultural Research Institute (Successor to the CAES)
FAO	-	Food and Agriculture Organization, United Nations
GOL	-	Government of Liberia
IARC	-	International Agricultural Research Centers
IITA	-	International Institute of Tropical Agriculture
ILCA	-	International Livestock Center for Africa
LRCN	-	Liberian Rural Communications Network
MOA	-	Ministry of Agriculture
SRSP	-	Smallholder Rice Seed Project
UNDP	-	United Nations Development Program
U.S.	-	United States
USAID	-	U.S. Agency for International Development Mission to Liberia
ULCAF	-	University of Liberia, College of Agriculture and Forestry
WARDA	-	West Africa Rice Development Association

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