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FIELD EVALUATION REVIEW

MLI/5/014
FIELD PERFORMANCE OF SELECTED MUTANTS OF SORGHUM AND RICE

EVALUATION SECTION
DEPARTMENT OF TECHNICAL CO-OPERATION

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ABSTRACT

The project MLI/5/014 was approved in 1995 as a model project and the current budget is $469,300 until 1997. Disbursements up to April 1996 amounted to $168,991. The project aims at supporting multi-location field trials to select high-yielding sorghum and African rice varieties and adding capability in tissue culture techniques for advanced mutation breeding, as well as in the use of nuclear techniques in soil studies.

The major conclusions of this evaluation are as follows:

- The performance trials on sorghum conducted in 1995 were carried out according to the project plan and following the recommended protocols. In spite of a relatively high dispersion of results, higher performance of two of the mutants was observed at two of the five trial stations (7% and 38% yield increases, respectively).

- The 1995 rice trial progress can be summarized as follows: (a) trials were performed at two out of three stations; (b) no harvest was obtained at one of them, owing to drought; and (c) the recommended protocol was not followed at the other station. As a result, the availability of seeds for 1996 was limited and a multiplication trial was set up in 1996 at Niano.

- Due to the delay in construction of the isotope laboratory building by the Institute of Rural Economy, analysis of samples taken during 1995 for N-15 soil fertility studies is currently being performed at the Agency's Seibersdorf laboratory. The prevailing absence of legislation on radiation protection poses some problems regarding the utilization of P-32, originally foreseen.

- The establishment of the tissue culture laboratory, linked to the technology transfer objective, raises concerns with regard to its cost-effectiveness and sustainability, as it may not be ready to serve the current breeding programmes of sorghum and rice under the project.

- In spite of the good quality of the training delivered, the establishment of an adequate team to ensure sustainable operation of the laboratory facilities under the project is a matter of concern.

- Competent management by the Project Co-ordinator of sorghum field trials has led to satisfactory results and subsequent programme adjustments. The national institutions involved in the project are therefore urged to give the national Project Co-ordinator similar powers for the African rice programme.

- The national institutions are also encouraged to include in their Agreement such provisions as will ensure meaningful and extensive utilization, within the breeding programmes of the Institute d'Economie Rural or in micropropagation of plants, of the laboratory facilities now available at the Institute Polytechnique Rural as a result of this project.

EXECUTIVE SUMMARY

Background

Agricultural research conducted in Mali by the Institute Polytechnique Rural (IPR) and the Institute d'Economie Rural (IER), for improvement of sorghum and African rice (Oryza glaberrima) with some Agency support, resulted in several advanced generations of sorghum and African rice with improved characteristics, including high yield. Project MLI/5/014 aims at further supporting both institutions to advance these promising results, particularly by supporting multi-location field trials to select high yielding plant varieties, and by adding capability in tissue culture techniques for advanced mutation breeding as well as in the use of nuclear techniques in soil studies.

The project was approved in 1995, as a model project and the current budget for the Agency's input amounts to $469,300 until 1997. The disbursements up to April 1996 amount to $168,991. The present mid-term evaluation aims at assessing the progress of the project towards its intended objectives and overall goal and the evaluation methodology applied was based on the Logical Framework Approach for project design.

Effectiveness -- Achievement of Objectives

In overall terms, effectiveness was rated as follows:

- The results of the 1995 sorghum breeding programme do not yet demonstrate the target performance of the mutants. However, the progress towards achieving this objective was of **"High Satisfaction"**.
- The 1995 rice selection trials have not provided meaningful results. The progress towards achieving this objective was of **"Low Satisfaction"**.

At the time of the evaluation, the status of project outputs may be summarized as follows:

(a) Sorghum Breeding Programme

The performance trials on sorghum for variety selection and soil fertility information, conducted in 1995, were carried out according to the project plan and following the recommended protocols. A relatively high dispersion of results can be pointed out. The higher performance of two of the mutants (MIK-SOR86-30-41 and MIK-SOR86-30-42) was shown at two of the five trial stations (7% and 38% yield increase, respectively).

Although the results of nitrogen uptake studies were not available at the time of the evaluation mission, several mutants (MIK-SOR86-25-20, MIK-SOR86-30-42 and MID-SOR88-10-01) have shown clear advantages with respect to the parent varieties, both in high and low fertilizer environments at one of the trial stations.

(b) African Rice Breeding Programme

In 1995, variety selection trials were performed on African rice (O. glaberrima) mutants irradiated in 1988, although not yet fully stabilized. 1995 rice trial progress can be summarized as follows: (i) trials were performed at two out of three stations; (ii) no harvest

was obtained at one of them, due to drought; and (iii) the recommended protocol was not followed at the other station. As a result, the availability of seeds for 1996 was limited and a multiplication trial was set up in 1996 at Niano.

Recommendation 1

Competent management by the Project Co-ordinator of sorghum field trials has led to satisfactory results and subsequent programme adjustments. The national institutions involved in the project are therefore urged to give the national Project Co-ordinator similar powers for the close follow-up of the African rice programme.

Efficiency -- Project Design and Management

In overall terms, efficiency was rated as follows:

- The design quality of the sorghum and rice breeding programmes was considered of **"High Satisfaction"**.
- Project Co-ordinator leadership and control over the execution of the whole programme was **"Not Achieved"**.
- Reasonable cost-effectiveness of the equipment delivered needs to be further substantiated by feasible agronomic research programmes: **"Low Satisfaction"**.
- In spite of some shortcomings related to lack of documented expert advice, Agency inputs were globally of **"Acceptable Satisfaction"**.

This assessment is further analysed in the following paragraphs.

(a) Isotope Laboratory

In spite of the delay in construction of the isotope laboratory building, analysis of samples taken during 1995 for N-15 soil fertility studies is currently being performed at the Agency's Seibersdorf laboratory. The prevailing absence of legislation on radiation protection poses some problems regarding the utilization of P-32.

(b) Tissue Culture Laboratory

The tissue culture laboratory equipment was provided by the Agency and the necessary laboratory space was made available by the counterpart. However, some modifications of the laboratory facilities are still pending as the design concept needs clarification. Some concerns are expressed with regard to the cost-effectiveness and sustainability of the tissue culture laboratory, as it may not be ready to serve the current breeding programmes of sorghum and rice under the project

(c) Trained Staff

The agronomic team had completed training on the application of N-15 labelled fertilizer, which was successfully utilized in 1995 soil fertility trials. Training to support the IER isotope laboratory team is still to come. Health problems caused an early termination of one fellowship on tissue culture. The difficulties encountered by the counterpart in identifying qualified candidates to receive replacement training raise concerns about how to maintain sustainable operation of the laboratory.

(d) Project Management

A Project Management Committee, in which the Agency and all the organizations involved are represented, provides the top level of project management. An overall Project Co-ordinator was also appointed. However, the authority and role of the Project Co-ordinator has been questioned by one counterpart, as well as the arrangements to obtain and distribute operational funds provided by the Agency.

Recommendation 2

The national institutions are encouraged to include in their Agreement such provisions as will ensure cost-effective and sustainable utilization, within IER breeding programmes or in micropropagation of plants, of the laboratory facilities now available at IPR as a result of this project.

Progress Towards Intended Impact

In overall terms, the progress towards the intended goal was rated as follows:

- Sorghum seed extension targets were largely achieved (20 kits in 1995): "**High Satisfaction**".
- Rice seed extension targets were not achieved. However this might be corrected in 1996 trials: "**Low Satisfaction**".

Assessment of Continued Relevance

- Relevance of sorghum and African rice mutants is of: "**High Satisfaction**".
- Adequacy to local conditions of N-15 isotopic analysis technique: "**Acceptable Satisfaction**".
- Adequacy to local conditions of P-32 isotopic analysis technique: "**Low Satisfaction**".

Risks and Opportunities on Impact, Relevance and Sustainability

	Opportunities	Risks
Impact	• Important role of project counterpart institutions in the Mali's agronomic research; • Involvement and participation of Extension Services and farmers - users of project's agronomic outputs;	• If target extension goals are not achieved within the project time span, the lack of other sources of project funding poses a risk to sustainable extension of African rice after termination of Agency funding;
Relevance	• The likelihood of sustainable utilization of isotope laboratory facilities and tissue culture laboratory would increase if the Agency advises the counterpart institutions on their economic and relevant utilization on other national/donor funded projects;	• P-32 technology poses a concern with regard to its adequacy vis-à-vis the lack of radiation protection regulations and infrastructure;
Sustainability	• Agronomic research programmes on sorghum and rice are on-going within IER and IPR, involving essentially the project team; • ICRISAT involvement is an asset for the sustainability of the sorghum breeding programme and extension of results;	• Since resources for consumables, maintenance, spares, retraining and upgrading come mostly from project-specific funding, sustainable utilization of laboratory facilities is at risk; • The sustainability of the tissue culture laboratory is at risk if cost-effective utilization on relevant and feasible programmes is not further substantiated.

1. INTRODUCTION

1.1. PROJECT BACKGROUND

Agricultural production is the mainstay of the Malian economy, absorbing approximately 70% of the national labour force and contributing slightly less than half of the GDP. Mali is an arid country, located in sub-Saharan Africa, with only 4% of the total surface area being devoted to rain-fed crops. Mali imports on an average $90 million worth of cereals per year which accounts for 6.5% of the GDP. Food production has increased at a slower rate than the population over the past 20 years.

In 1993, the agricultural production of the major crops consisted of 691,000 tonnes of millet, 694,387 tonnes of sorghum, 274,753 tonnes of maize, 388,483 tonnes of rice and 21,945 tonnes of fonio. During that year, 940,000 ha of land were cultivated with sorghum with an average productivity of 0.74 t/ha (maximum 0.8 t/ha) and 160,000 ha were cultivated with rice. The average yield for rice was 2.43 t/ha (maximum yield was 3 t/ha in irrigated zones and 1.5 t/ha elsewhere). The production of Asian rice type, mastering water supply, accounts for 70% of the total national production, and is concentrated in the Office du Niger area, based in Segou, in only 50,000 ha. African rice, O. glaberrima type, is cultivated elsewhere, mostly without mastering water supply.

Both sorghum and African rice crops are dependent on rain and suffer from stress conditions which occur from time to time during their growth period.

Mali's strategy in food and agriculture aims at achieving food self-sufficiency by stimulating the rural economy, increasing farmers' income and ensuring that the population has regular access to foodstuffs. The priority of the Fifth National Development Plan (1992-96) is to encourage farmers and agricultural co-operatives to use better performing crops that can ensure quick returns with short lead time.

During the period 1985-1988, the Agency assisted two institutions in Mali, the Institute Polytechnique Rural (IPR) and the Institute d'Economie Rural (IER), in their efforts to improve sorghum and both African rice (Oryza glaberrima) and Asian rice varieties, under a joint FAO/IAEA CRP funded by Italy on "Improvement of basic food crops in Africa through plant breeding, including the use of induced mutations", as well as under other technical assistance projects.

The mutant lines of sorghum that have been produced appear to have several desirable characteristics, such as early maturing, higher yield, drought resistance, non-lodging sensitivities, shorter than the parents and with a higher nutritive value.

The African rice mutants present white kernels, higher yield, are early maturing (two weeks to one month) and adapt themselves to culture without mastering water supply. These mutants were irradiated in 1988 and 1993 and are not yet stabilized. However, the genetic variability which has been created through this programme does not appear to be larger than the already existing variability.

Three of the varieties of Asian variety rice mutants most widely cultivated by the Office du Niger were irradiated in 1985. Among the resulting varieties, one was early maturing with reduced height. The mutants are stable but their extension was not

undertaken due the difficulties in their adaptation to the culture practices of the Office du Niger.

1.2. REASONS FOR THE EVALUATION

The project MLI/5/014 was approved in 1994 as a model project. In 1995 performance indicators were agreed upon between the Agency and the project counterparts. These included the target yields of the sorghum and rice varieties (a measurement of the effectiveness of the project's outputs to meeting the project's objectives), as well as the milestones for the extension of the best performing mutant varieties (expected impact).

In response to the request expressed by the Board of Governors to conduct evaluations of model projects, the Department of Technical Co-operation set up a mid-term evaluation of the project MLI/5/014, to assess project efficiency, effectiveness, relevance and sustainability, as well as the progress achieved towards the intended impact. The Terms of Reference of the evaluation, included in Annex A1, provide additional details on the evaluation concerns.

1.3. HOW THE EVALUATION WAS CONDUCTED

The integrated evaluation framework prepared earlier in the year was customized in order to address the specific concerns of this exercise. The details of the assessment and rating system are discussed in Chapter 2.

A review of the project since its approval in 1995 was performed at the Agency's Headquarters in April 1996, on the basis of the project documentation available in the files in the Africa Section, TCPM, and in the Joint FAO/IAEA Division. Interviews were held with the Agency staff involved in the project. The data reviewed included financial data, such as budgets and disbursements. Information relating to project design and implementation was also analysed.

From 5 to 9 May 1996, a mission was fielded to the project sites, conducted by:

- Mr. Didier Picard, Scientific Director, CIRAD (Centre de coopération internationale en recherche agronomique pour le développement), France.
- Ms. Silvia Alamo, Head, Evaluation Section, Department of Technical Co-operation, IAEA.

1.4. STRUCTURE OF THE REPORT

The evaluation report is divided into four main chapters. Chapter 2 includes a description of the evaluation methodology and Chapter 3 presents the evaluation results. There are three annexes to this report. The terms of reference of the evaluation are found in Annex A1; Annex A2 provides the project concept and implementation; and the field mission agenda is included in Annex A3.

2. EVALUATION METHODOLOGY

2.1. AREAS OF ASSESSMENT

The evaluation framework applied in this exercise is based on the Logical Framework Approach (LFA)[1] for project design. The general definitions adopted and the relationships between the evaluation concerns and the elements of project design are represented in Figure 2.1.

Figure 2.1 – Evaluation Concerns

PROJECT DESIGN ELEMENTS	EFFICIENCY	EFFECTIVE-NESS	IMPACT	RELE-VANCE	SUSTAINA-BILITY
OVERALL GOAL			The positive and negative changes produced, directly or indirectly, as the result of the project or programme	The degree to which the objectives of a project are, or remain, pertinent, significant and worthwhile, in relation to the identified priority or needs and concerns	The extent to which partner country institutions will continue to pursue the objectives and goals after external assistance is terminated
PROJECT OBJECTIVE		A measure of the extent to which a project or programme is successful in achieving its purpose			
OUTPUTS	A measure of "productivity" of the project process - how economically inputs are converted into outputs				
ACTIVITIES + INPUTS					

Efficiency is a measure of how economically inputs are converted into outputs. It is defined as the sum of the following factors: (a) *project design quality*, measured by the appropriateness and linkage of inputs and the activities that transform them into outputs; (b) *project implementation*, measured by adherence to schedule; timeliness and fitness-for-purpose of inputs, and budget utilization; and (c) *management performance*, measured by the ability to monitor progress and take corrective actions. Cost-effectiveness was assessed by comparing the approach adopted with other options.

[1]Adapted from "Evaluation, Based on the Project Cycle Management Method", March 1994, by K. Samset, Scanteam International, Oslo, Norway. Developed for Foundation for Advanced Studies on International Development, Japan.

Effectiveness is a measure of the extent to which the project objective has been achieved or is likely to be achieved, qualitatively and quantitatively, as per the performance indicators.

Impact is a judgment on the extent to which the project has contributed (positively or negatively) to the overall goal.

Relevance is a judgement on the extent to which the project addressed a national priority, adopting a commensurate design approach.

Sustainability is a measure of the extent to which the achievements of the project can be expected to last after the project is terminated. It is the ultimate test of success according to OECD.

2.2. EVALUATION PROCESS

The evaluation approach was as follows:

(a) The project was conceptualized as represented in Figure 2.2. The inputs from various sources and their links and relationships with the project activities, outputs and goals are discussed in Annex A2.
(b) Compliance with the pre-established performance indicators was analyzed at the level of inputs, activities, outputs, objective and goal (see Table 2.1).
(c) The evaluation questions associated to the key determining factors in each of the areas of assessment are summarized in Table 2.2, together with the methods utilized to address them and the estimated reliability of the information obtained.
(c) Based on the answers to the evaluation questions, the various issues were rated and the evaluation matrix in Chapter 3 was constructed.
(d) The evaluation findings and recommendations relate to the ratings assigned and aim at further enhancing the positive aspects, while reducing the risks.

2.3. RATING SYSTEM

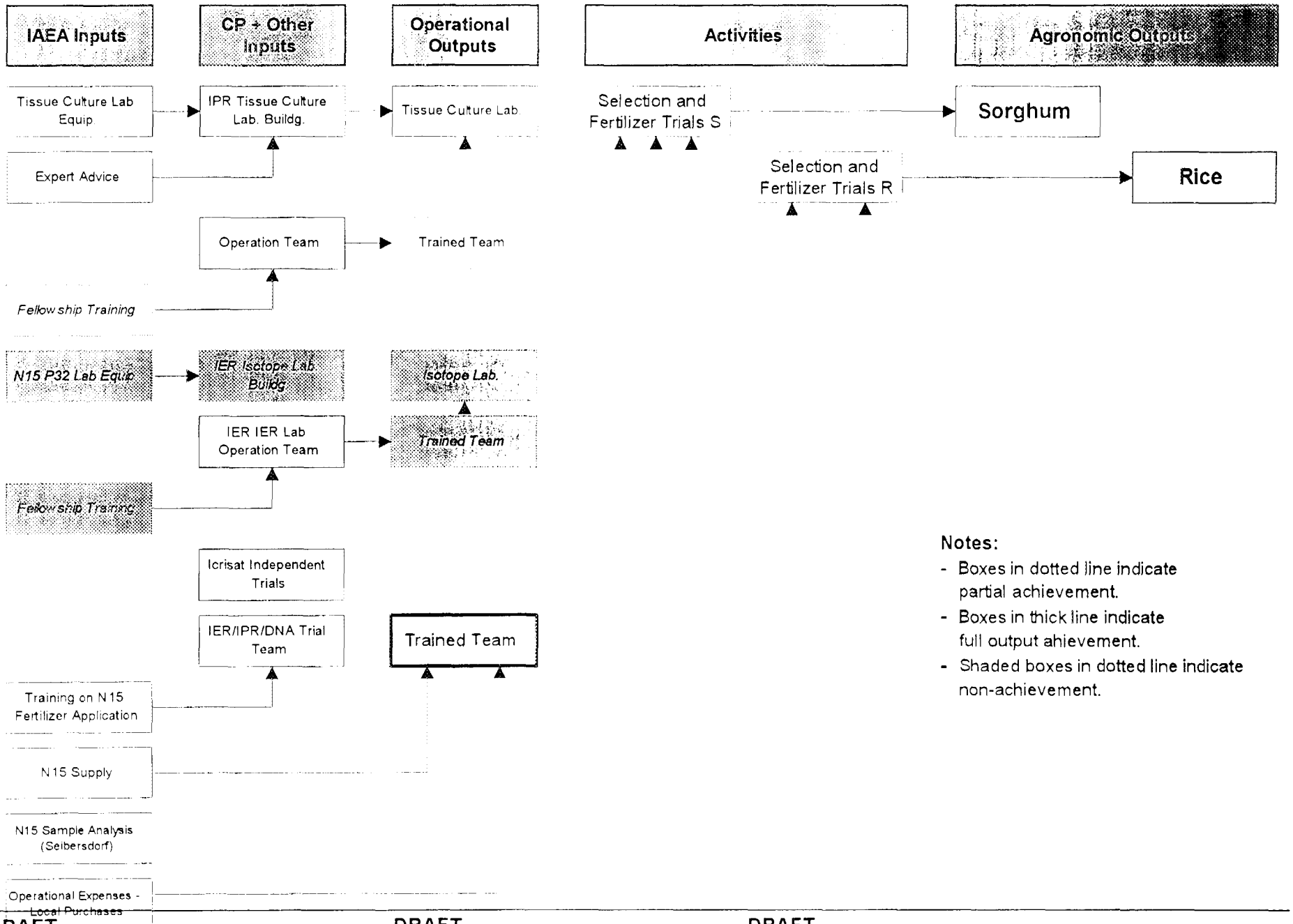
Judgement decisions were made against each evaluation question as to whether they were of High, Acceptable or Low Satisfaction or Not Achieved.

The indicators of efficiency were obtained in the following manner:

(a) The accomplishment of the key questions concerning efficiency identified in Table 2.2, i.e. quality of project design, performance and quality of Agency inputs, achievement of project schedule and budget implementation, are analyzed and rated in Section 3.
(b) Cost-effectiveness of the project is assessed by comparing costs to alternative project concepts or implementation approaches.

The assessment of effectiveness was measured versus the performance indicators adopted for the project, as per Table 2.1.

Figure 2.2 - MLI/5/014 Project Summary



Notes:

- Boxes in dotted line indicate partial achievement.
- Boxes in thick line indicate full output ahievement.
- Shaded boxes in dotted line indicate non-achievement.

Table 2.1 - Performance Indicators Matrix MLI/5/014

Project Documentation	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Development goal: To contribute to the development of sustainable sorghum and rice	Indicators of goal achievement: • Land coverage with improved varieties by 2000, as anticipated.	Project progress reports - trial and extension records	Acceptance by farmers and extension services.
Project purpose: Better awareness of best species by extension services and end-users	Indicators of achievement of purpose: • Seed extension (targets: 20 kits in 1995, 40 in 1996, 2000 in 1997).	Project progress reports - trial and extension records	Acceptance by farmers and extension services.
Outputs: Direct results of project activities: • **Agronomic: best perf. sorghum and rice varieties + Soil management information** • **N15 and P32 lab** • **Tissue culture lab** • **Trained staff**	Measures verifying achievement of major outputs: • Yield results of selection/agronomic trials (target 10-15% increase).	Project progress reports - trial and laboratory records	Performance of agronomic outputs as anticipated.
Activities: • R+S selection and agronomic trials • Seed distribution ***IAEA + CP Inputs:*** • Experts • Equipment + Bldgs. • Training	Milestones and targets (type, time, quantity, quality)	Project progress reports - trial and laboratory records	Inputs delivered as anticipated. Outputs produced as anticipated. Activities performed as anticipated. Radiation protection regulations enacted.

TABLE 2.2 - Evaluation Questions and Instruments

AREA OF ASSESSMENT	EVALUATION QUESTIONS	EVALUATION METHODS	RELIABILITY
Efficiency:			
* Project design	* Were Agency inputs adequately related to the counterpart activities and to the expected outputs?	* Desk review * Expert review	* Medium: data lacking * High * High * High
* Project implementation	* Were Agency inputs - training standards, expert & equipment - adequate in quantity and quality? * Were they adequately specified and delivered timely? * Did they correspond to specifications? * Status of work plan implementation	* Desk review * Field interviews with trained staff and expert review * Review of CP records	* High * Medium: few and in-consistent data * High * High * High
* Project management	* Is the CP organizational arrangement adequate for meeting the objectives? * Is the agency backstopping adequate for meet the objectives?	* Field interviews with CP * Expert review	
Effectiveness:			
Outputs meeting the objectives	* Status of agronomic outputs: CP Activities +schedule; trials conducted; results; baseline data; status of documentation of mutants yields	* Field interviews with CPs * Desk review of progress reports provided in the field	* High * High
Impact:			
Status of distribution of seed kits versus target Obstacles which might limit impact:	* Involvement of users - farmers and extension services * Probability of continuation of the research after ter-mination of funding - other sources of funding for this project	* Interviews with CPs and extension services * Interviews with CPs and extension	* High * Medium
Relevance			
	* Acceptance by end-users * * Relevance of N 15 and P 32 and tissue culture labs	* Interview with exten-sion services and farmers * Interview with CP and expert advice	* High * High
Sustainability			
	* Probability of use of lab facilities in other agronomic research activities * Role or position of CPs * Availability of budget for maintenance, re-training, spares	* Discussion of on-going research acti-vities with CP * Interviews with CPs * Visit to S/P/W lab	* High * High * High

3. EVALUATION RESULTS

3.1. OVERALL ASSESSMENT

The derived overall project performance, as compared to the indicators adopted for the project is summarized in Table 3.1.

Table 3.1. - Overall Project Performance

PROJECT DESIGN ELEMENTS	EFFICIENCY	EFFECTIVE-NESS	IMPACT	RELE-VANCE	SUSTAINA-BILITY
OVERALL GOAL			Sorghum seed extension targets (20 kits in 1995): **High Satisfaction.** 1995 rice seed extension targets: **Not achieved** Overall probability of achieving the anticipated impact: **Acceptable Satisfaction.**	Role of counter-parts in agronomic research: **High Satisfaction.**	**Risks on agronomic outputs**: If the targeted level of extension is not achieved within the project time span,
PROJECT OBJECTIVE		1995 sorghum results do not yet demonstrate the target performance of the mutants, however progress was of with: **High Satisfaction**. The 1995 progress towards achieving the objective for rice was of: **Low Satisfaction**.		Relevance of sorghum and African rice mutants: **High Satisfaction.**	**Low** probability of sustainable extension of sorghum and African rice after termination of Agency funding, due to:
OUTPUTS	**PROJECT DESIGN - High Satisfaction**: -Adequate concept for sorghum and rice breeding programmes. **COST-EFFECTIVENESS - Low Satisfaction**: -Reasonable cost-effectiveness of equipment input not yet ensured by a programme of utilization.			**Adequacy to local conditions** of isotopic analysis technique: N-15: **Acceptable Satisfaction.** P-32: **Low Satisfaction.**	**Authority line acceptance problems** among counterparts **and No other sources of funding** for this project.
ACTIVITIES + INPUTS	**AGENCY INPUTS - Acceptable Satisfaction**- However, -Shortage of staff to create critical in-vitro culture team at IPR. -Non-documented expert advice led to misunderstandings in building layout and delayed construction.				**Risks for sustainable utilization of laboratories**: limited local resources for consumables, maintenance, spares, retraining and upgrading.

3.2. ASSESSMENT OF EFFICIENCY

In overall terms, efficiency was rated as follows:

- The design quality of the sorghum and rice breeding programmes was considered of **"High Satisfaction"**.
- Project Co-ordinator leadership and control over the execution of the whole programme was **"Not Achieved"**.
- Reasonable cost-effectiveness of the equipment delivered needs to be further substantiated by feasible agronomic research programmes: **"Low Satisfaction"**.
- In spite of some shortcomings related to lack of documented expert advice, Agency inputs were globally of **"Acceptable Satisfaction"**.

The timeliness and fitness for purpose of Agency inputs and their relationships with project outputs, are analysed in the following paragraphs.

(a) Isotope Laboratory

Due to the delay in construction of the isotope laboratory building by the Institute of Rural Economy, the Agency could not deliver the laboratory equipment. However, analysis of samples taken during 1995 for N-15 soil fertility studies is currently being performed at the Agency's Seibersdorf laboratory. P-32 was not applied in fertilizer trials. In any case, the prevailing absence of legislation on radiation protection poses some problems regarding the utilization of P-32.

(b) Tissue Culture Laboratory

The tissue culture laboratory equipment was provided by the Agency and the necessary laboratory space was made available by the counterpart. Installation of equipment has, however, not proceeded as expected, and some modifications of the laboratory facilities are still pending as the design concept needs clarification. The establishment of the tissue culture laboratory, linked to the technology transfer objective, raises concerns with regard to cost-effectiveness and sustainability, as it may not be ready to serve the current breeding programmes of sorghum and rice under the project.

(c) Trained Staff

The agronomic team had completed training on the application of N-15 labelled fertilizer, which was successfully utilized in 1995 soil fertility trials. Training to support the IER isotope laboratory team is still to come. Training on biological nitrogen fixation (BNF) was conducted through a fellowship awarded to IPR, although BNF research has been phased out of the project. Only one of the two fellowships planned to support the IPR tissue culture laboratory research team will be completed successfully, since health problems caused an early termination of the other fellowship. Health problems caused an early termination of the other fellowship. The difficulties encountered by the counterpart in identifying qualified candidates to receive replacement training raise concerns about how to maintain sustainable operation of the laboratory.

(d) Project Management

A Project Management Committee, in which the Agency and all the organizations involved are represented, provides the top level of project management. An overall Project Co-ordinator was also appointed.

The authority and role of the Project Co-ordinator has been questioned by one counterpart, as well as the arrangements to obtain and distribute operational funds provided by the Agency.

The Agency's technical advice did not achieve an adequate level of integration among the various and interrelated technical aspects of the agronomic research activities. Multiple communications to counterparts and UNDP from different officers dealing with expert missions or placement of fellows led to some confusion.

Recommendations for Enhancing Efficiency

- The national institutions are encouraged to include in their Agreement such provisions as will ensure cost-effective and sustainable utilization, within IER breeding programmes or in micropropagation of plants, of the laboratory facilities now available at IPR as a result of this project.

- N-15 analyzer could easily be accommodated in the Sotuba Soil Laboratory, with minor modifications needed. Training in sample preparation and analysis could proceed independently. However, a cost-effectiveness analysis of isotope laboratory should be prepared by the counterpart, based on projected applications (potential samples per year) to other on-going research activities on soil fertility. The results of such prospective analysis should also integrate the dossier for requesting national funding that the IER has prepared.

- Handling and analysing P-32, as a radioactive isotope, needs training and precautions. The lack of radiation protection legislation and infrastructure poses a concern with respect to its safe and sustainable use. It is recommended that the Agency and the counterpart reconsider the convenience of utilizing this technique in the project.

3.3. ASSESSMENT OF EFFECTIVENESS

In overall terms, effectiveness was rated as follows:

- The results of the 1995 sorghum breeding programme do not yet demonstrate the target performance of the mutants. However, the progress towards achieving this objective was of **"High Satisfaction"**.
- The 1995 rice selection trials have not provided meaningful results. The progress towards achieving this objective was of **"Low Satisfaction"**.

The above ratings are based on the status of project outputs at the time of the evaluation, as analysed in the following paragraphs.

(a) Sorghum Breeding Programme

The performance trials on sorghum for variety selection and soil fertility information, conducted in 1995, were carried out according to the project plan and following the recommended protocols.

A relatively high dispersion of results can be pointed out. The higher performance of two of the mutants (MIK-SOR86-30-41 and MIK-SOR86-30-42) was shown at two of the five trial stations (7% and 38% yield increase, respectively). In view of these results the project

work plan for 1996 trials foresees the increase of trial sites to ten while reducing the number of varieties to be tested.

The results of nitrogen uptake studies were not available at the time of the evaluation mission. However, at one of the trial stations several mutants (MIK-SOR86-25-20, MIK-SOR86-30-42 and MID-SOR88-10-01) have shown clear advantages with respect to the parent varieties, both in high and low fertilizer environments. The 1996 trial protocol recommended by the Agency, however, (50m x 20m trial plot size) was not considered appropriate by the counterpart.

(b) African Rice Breeding Programme

In 1995, variety selection trials were performed on African rice (O. glaberrima) mutants irradiated in 1988, although not yet fully stabilized. Soil fertility trials were conducted on Asian rice type mutants irradiated in 1985. A dissociation between the mutants of both research programmes can be pointed out.

While African rice mutants appear of relevance to a vast zone in Mali, because of their white colour and good adaptation to culture without mastering water supply, the genetic variability which has been created through this programme does not appear to be larger than the already existing variability. Asian rice type mutants present low interest to their major user - the Office du Niger, producing 70% of the total production of Mali - due to their agronomic differences from the varieties currently being extended.

1995 rice trial progress can be summarized as follows: (i) trials were performed at two out of three stations; (ii) no harvest was obtained at one of them, due to drought; and (iii) the recommended protocol was not followed at the other station. As a result, the availability of seeds for 1996 was limited and a multiplication trial was set up in 1996 at Niano.

Recommendations for Enhancing Effectiveness

Competent management by the Project Co-ordinator of sorghum field trials has led to satisfactory results and subsequent programme adjustments. The national institutions involved in the project are therefore urged to give the national Project Co-ordinator similar powers for the close follow-up of the African rice programme. In particular, the following aspects need improvement:

- Follow-up of 1996 rice selection trials should be improved by the counterpart.
- The co-ordination between fertilizer and selection trials needs to be improved by the counterpart and further fostered by the Agency.

3.4. PROGRESS TOWARDS THE INTENDED IMPACT

In overall terms, the progress towards the intended goal was rated as follows:

- Sorghum seed extension targets were largely achieved (20 kits in 1995): "**High Satisfaction**".
- Rice seed extension targets were not achieved. However this might be corrected in 1996 trials: "**Low Satisfaction**".

3.5. ASSESSMENT OF CONTINUED RELEVANCE

In Mali, sorghum and African rice are priority crops in the National Agriculture Research Programme. The quality of the sorghum mutants achieved through the breeding programme conducted at the Rural Polytechnic Institute (IPR) was recognized by the Rural Economy Institute (IER) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the National Extension Services, and was encouraged by the project.

In overall terms, the continued relevance is rated as follows:

- Relevance of sorghum and African rice mutants is of: "**High Satisfaction**".
- Adequacy to local conditions of N-15 isotopic analysis technique: "**Acceptable Satisfaction**".
- Adequacy to local conditions of P-32 isotopic analysis technique: "**Low Satisfaction**".

3.6. RISKS AND OPPORTUNITIES ON IMPACT, RELEVANCE AND SUSTAINABILITY

Table 3.2 summarizes the factors that constitute valuable assets for the project, as well as those that pose risks to achieving its objectives. The recommendations made aim at enhancing the opportunities while reducing the risks.

Table 3.2. - Risks and Opportunities

	Opportunities	Risks
Impact	• Important role of project counterpart institutions in the Mali's agronomic research; • Involvement and participation of Extension Services and farmers - users of project's agronomic outputs;	• If target extension goals are not achieved within the project time span, the lack of other sources of project funding poses a risk to sustainable extension of African rice after termination of Agency funding;
Relevance	• The likelihood of sustainable utilization of isotope laboratory facilities and tissue culture laboratory would increase if the Agency advises the counterpart institutions on their economic and relevant utilization on other national/donor funded projects;	• P-32 technology poses a concern with regard to its adequacy vis-à-vis the lack of radiation protection regulations and infrastructure;
Sustainability	• Agronomic research programmes on sorghum and rice are on-going within IER and IPR, involving essentially the project team; • ICRISAT involvement is an asset for the sustainability of the sorghum breeding programme and extension of results;	• Since resources for consumables, maintenance, spares, retraining and upgrading come mostly from project-specific funding, sustainable utilization of laboratory facilities is at risk; • The sustainability of the tissue culture laboratory is at risk if cost-effective utilization on relevant and feasible programmes is not further substantiated.

ANNEX A1.

TERMS OF REFERENCE

PROJECT FIELD EVALUATION - MLI/5/014

"FIELD PERFORMANCE OF SELECTED MUTANTS OF SORGHUM AND RICE"

I. Background

From 1985-1988 the Agency assisted two institutions in Mali, the Institute Polytechnique rural (IPR) and the Institute d'Economie Rural (IER), for improvement of Sorghum and African rice (Oryza glaberrima) under a joint FAO/IAEA CPR funded by Italy on "Improvement of basic food crops in Africa through plant breeding, including the use of induced mutations".

Agency supported projects and subsequent national activities have resulted in several advanced generations of sorghum and African rice with improved characteristics including high yield.

Project MLI/5/014 aims at further supporting both institutions to advance these promising findings including the use of tissue culture techniques for advanced mutation breeding, and undertaking multi-location field trials to select high yielding plant varieties. Integrating these with the use of nuclear techniques in soil studies could lead to maximize the yields of these crops.

The project was approved in 1995, as a model project and the current budget for Agency's input amounts to $469,300 until 1997. The disbursements up to April 1996 amount to $168,991.

II. Scope and Objectives of this Special Review

In 1995 performance indicators were defined for this project, namely, the target characteristics of the sorghum and rice varieties (outputs) with regard to their yield (effectiveness) and the expected impact (rate of their extension to end-users). This evaluation is envisaged as a mid-term evaluation and the objective pursued is to assess:

- The role of the counterpart institutions in Mali's national agricultural programmes, as well as their links with other major national institutions involved in agricultural research and extension;
- The relevance of the project's outputs vs. its goals;
- The infrastructure available vs. actual project's requirements, i.e. the technical and organizational capability of the counterparts (manpower and qualification); the present status of facilities and equipment, sizing, maintenance programmes and budget, availability of spares, etc.;
- The adequacy and quality of the project design - activities and inputs - and their link with the project's outputs and objectives;
- The progress achieved towards the intended objectives;
- The project work plan implementation and budget utilization; other sources of project funding;
- The cost-effectiveness of the laboratory facilities delivered under this project in the framework of the use foreseen within the present project and in other present or future research activities;

- The adequacy of Agency's inputs - specification of requirements and performance of experts, equipment, subcontracts and training;

III. Evaluation Methodology and Procedures

The Integrated Evaluation Framework will be applied to this project as a case study. Project background material will be desk reviewed to assess efficiency related aspects. Effectiveness, impact, relevance and sustainability issues will be evaluated during a field mission.

A system to rate the project's efficiency, effectiveness and impact will be developed and tested in the context of this evaluation. The key aspects contributing to quality in each of the areas mentioned, together with associated standards, will be identified.

During the field mission counter part institutions and agricultural authorities will be visited and interviewed on the issues of concern of the evaluation.

IV. Evaluation time-table

Desk review of background material	26 April 1996
Field visit to Mali	6-10 May 1996
Draft report	24 June 1996
Final report completed	September 1996

V. Resources

The cost of the evaluation is charged to IAEA administrative funds.

ANNEX A2.

PROJECT PLANNING AND IMPLEMENTATION

PROJECT FIELD EVALUATION - MLI/5/014

"FIELD PERFORMANCE OF SELECTED MUTANTS OF SORGHUM AND RICE"

A2.1. PROJECT DATA

PROJECT NUMBER:	MLI/5/014
PROJECT TITLE:	FIELD PERFORMANCE OF SELECTED MUTANTS OF SORGHUM AND RICE
SECTORS:	5 B/5C - Soil Science, Irrigation and Plant Nutrition/ Plant Breeding and Genetics
PROJECT TIME-SPAN:	1995-1997
PROJECT BUDGET:	$469,300
STUDY PERIOD:	1995 - May 1996

A2.2. PROJECT COUNTERPARTS

The project's counterparts are:

Mr. A. Bretaudeau, Variety selection, Rural Polytechnic Institute (IPR) of Katibougou, Koulikoro
Mr. A. W. Toure, Soil fertility, Institute of Rural Economy (IER), Sotuba (Bamako)

A2.2.1. Institut Polytechnique Rural (IPR)

The IPR was founded in 1965, and is located in Katibougou, Koulikoro ca. 80 km from Bamako. IPR is an agronomy training institution, with 2300 students, including 252 female students and 70 students from neighbouring countries, and is attached to the Ministry of Education. Agronomy, forestry and animal breeding are the major training topics. The Institute also conducts research programmes on sorghum, biogas production, pharmacological plants, cultures in dry zones, BNF and poultry nutrition, among others.

A restructuring programme to respond to the present demands of the agronomic labour market is under way supported by UNESCO. In the near future the Institute will be attached to the Mali University. The IPR is also funded by UNESCO, for upgrading laboratory facilities, as well as from bilateral donors (The Netherlands). Twinning programmes with French, Russian and African universities also contribute to the availability of technical support.

The sorghum mutagenesis programme started in IPR in 1986, when several local varieties of guinea type sorghum were irradiated to obtain genetic variability and most of the material were in M4, whereas some of the lines are now in M8 generation.

The Agro-Physio Genetic laboratory at the IPR in Katibougou is the site for the tissue culture laboratory, funded by the IAEA in the framework of this project. IPR scientists and laboratory staff will operate the laboratory in the future and will receive ad-hoc training through this project, as well as on the use of N-15 and fertilizer.

A2.2.2. Institute D' Economie Rural (IER)

The IER is the major agronomic research institute in Mali. The Institute is based in Bamako and has established agronomic research programmes in various plants, such as sorghum, rice and cotton, among others. The IER is presently developing, with funding and support of the World Bank, a strategic national agronomic research plan.

Several regional research centres cover the various areas of the country, such as Mopti, Sikasso and Niano, which are involved in rice research programmes.

The regional research centre in Niano, located at the Office du Niger area, was visited by the evaluation team, as it is involved in the seed multiplication plots for O. glaberrima rice (African rice). The centre is involved in rice research programmes on Asian rice varieties relevant to the Office du Niger area. The present objective of the research activities is to improve the productivity with economical production techniques. Three research teams work on selection and agronomy, with a major focus on disease control.

Mutagenesis on rice was started in 1985 on three of the most widely used Asian rice varieties. Certain mutants presented interesting characteristics, such as reduced height and cycle, but they were not well adapted to extension due to their agronomic differences with the programme varieties at the Office du Niger.

At Mopti, ten varieties of O. glaberrima rice were irradiated in 1988 and in 1993, with the objective of improving colour and cycle. The selection of some of these varieties are the subject of this project. However, the genetic variability which has been created through this programme does not appear to be larger than the existing variability.

The Soil-Plant-Water laboratory of the IER, based in Sotuba, was visited by the evaluation team. This laboratory is the site foreseen for N-15 / N-15 isotope laboratory. The laboratory is well equipped (largely from bilaterally funded projects) for performing physical and chemical analysis of soil and plant samples, including sample preparation. It is capable of determining N, P, K, Fe, Mg, Mn and S in soil and plant samples, as well as organic material. The staff consists of two engineers, two senior technicians, four junior technicians and 2 labourers.

The laboratory serves the different research programmes and has analyzed between 6,000 and 12,000 samples per year in the last four years. The sources of operational and maintenance budget for the laboratory are mostly associated with funds from donor sponsored projects.

The IER participates in the TC project by providing the agronomic team in charge of fertilizer trials and the rice selection team.

A2.3. PROJECT CONCEPT AND PLANNING

Table 2.2 represents the project performance indicator matrix and includes a summary of inputs, activities, outputs, project objectives, overall goal, assumptions, indicators and means of verification. The project concept is represented in Figure 2.2 and illustrates the links between the various elements of the project design. Objectives, outputs, activities and inputs are discussed in the following paragraphs.

A2.3.1. PROJECT OBJECTIVES

Project MLI/5/014 aims at demonstrating the field performance of the economically valuable mutants of sorghum and African rice, developing new cropping patterns and management practices, and ensuring that enough seeds of the economically valuable mutants are made available to the farmers through the national extension services. The establishment of a tissue culture laboratory as well as an isotope soil laboratory, together with the training of the staff, is also foreseen.

The stated project objectives are:

- To contribute, using nuclear techniques, to the development of sustainable sorghum and African rice production through:

  ⇒ Induction and selection of improved mutants of local varieties of sorghum and African rice.

  ⇒ Field evaluation of the selected genotypes, their seed multiplication and release as new and improved varieties.

  ⇒ Development of a package of agronomic practices based on soil fertility and water management to realize the full potential of the released mutant varieties.

- To enhance the national capacity building in advanced mutation and plant breeding technologies and the capability of integrating nuclear techniques in agronomic research to support sustainable agricultural development.

A2.3.2. PROJECT OUTPUTS

The major anticipated outputs consist of: (a) agronomic outputs - selected best performing rice and sorghum varieties; (b) N-15/P-32 isotope laboratory and tissue culture laboratory; and (c) trained staff to operate the laboratories and to handle the isotopes applied in field trials. The following paragraphs discuss the role of the project's outputs and their link with the project objectives.

A2.3.2.1. AGRONOMIC OUTPUTS

The 1995 agronomic research programme on sorghum was planned on the mutant varieties and trial types identified in Table A2.1.

The 1995 agronomic research programme on rice was planned on the mutant varieties and trial types identified in Table A2.2. The variety selection trials are associated to African rice (O. glaberrima) mutants irradiated in 1988, whereas the fertilizer trials are associated to Asian rice mutants irradiated in 1985. The trials in farmers environment were associated to an extension project funded by the World Bank.

Table A2.1. - 1995 Sorghum Breeding And Fertilizing Programme

Mutant Type	Katibougou			Sotuba, Samanko (ICRISAT)	Longorola	Cinzana	Kolombada	Farmer environment (Tienfala)
	Breeding	Seed mult. + perf	Fertilizer	Breeding	Breeding	Breeding	Fertilizer	
MIK-SOR86-25-11			✓			✓	✓	
MIK-SOR86-25-13						✓		
MIK-SOR86-25-16	✓			✓	✓			
MIK-SOR86-25-20	✓		✓	✓			✓	
MIG-SOR86-30-03		✓	✓			✓	✓	
MIK-SOR86-30-41		✓			✓			
MIK-SOR86-30-42	✓		✓	✓			✓	
MID-SOR88-10-01	✓	✓	✓	✓			✓	
MID-SOR88-10-02	✓			✓		✓		
MIP-SOR90-30-23	✓	✓	✓	✓	✓		✓	✓
MIP-SOR90-30-54					✓			
Parent -CSM 388	✓	✓	✓	✓	✓		✓	✓
Control-IPS0001	✓		✓	✓	✓		✓	
Control-CSM 219						✓		
Control-CSM 228						✓		

Table A2.2. - 1995 Rice Breeding And Fertilizing Programme

Mutants	Mopti		Segou		Djalloube		Farmer Environt.	Fertilizer (Niono)
	Shallow	Medium	Shallow	Medium	Shallow	Medium		
SMG 88-8-1-1	✓	✓	✓	✓	✓	✓	✓	
SMG 88-8-1-3		✓		✓		✓	✓	
SMG 88-9								
SMG 88-13-1		✓		✓		✓	✓	
SMG 8815-2	✓		✓		✓		✓	
SMG 88-20-1								
SMG 88-20-2-1		✓		✓		✓		
Control 1	✓	✓	✓	✓	✓	✓		
Control 2	✓	✓	✓	✓	✓	✓		
Control 3								
1985 V1, V2, V3, V4								✓

A2.3.2.2. LABORATORY FACILITIES

A N-15 / P-32 Laboratory was foreseen to be established at the soil laboratory at Sotuba. This laboratory would enable the IER to analyze soil and plant samples associated with the fertilizer trials. At the time of the evaluation field mission, the IER envisaged the need of constructing a new isotope laboratory building and had requested national funding for construction. The Agency will provide the laboratory equipment. N-15 has already been delivered and used in fertilizer trials.

A tissue culture laboratory was planned to be set up at the IPR, Agro-Physio Genetic laboratory at Katibougou.

A2.3.2.3. TRAINED TEAM

Training to be provided by the Agency as input to the project was associated with the following issues:

- A general training course on the use of N-15 in soil-plant research programme was held. Twelve researchers on plant breeding and agronomy, including the Assistant Director of IPR, participated in the course.
- Application of N-15 fertilizer - was provided to IER technicians involved in fertilizer trials - through expert advice in a two week mission.
- Two fellowships on tissue culture laboratory techniques were awarded to IPR research staff. One of the fellowships terminated shortly after initiation, due to health problems of the fellow. The second one, presently under way, will be extended to nine months (from originally 3 months).
- One fellowship on N-15 and P-32 techniques in soil research and BNF was awarded to one IPR researcher and has already been completed. BNF trials have been phased out of the project.
- Fellowship training is still due in association with the isotope laboratory for IER laboratory staff - safe handling of P-32, soil and plant sample preparation and analysis.
- Two scientific visits have taken place. One IER rice researcher visited the Philippines and one IPR research staff visited France on tissue culture techniques.

A2.3.3. PROJECT ACTIVITIES AND WORK PLAN

The first phase of the project in 1995 was planned to concentrate on the implementation of field plot trials with selected mutants of sorghum and African rice at 4 to 6 locations. Training was planned to be provided to the counterparts in plant tissue culture techniques, in the use of isotopes in soil/plant studies and on N-15 and P-32 analysis. Laboratory facilities for N-15 and P-32 analysis were also planned to be established. The performance of the mutants of sorghum and African rice to the recommended fertilizer package were to be evaluated as a criterion for further selection. The seeds harvested from plot trials were to be analyzed and multiplied in sufficient quantity for multi-location field trials in 1996 and 1997.

The second phase planned for 1996 focuses on the validation of the results obtained during the first phase and on the assessment of nutrient (NPK) requirement for the production of selected mutants of sorghum and African rice. Nutrient requirement studies will also involve the assessment of the effectiveness of locally available natural phosphate rock as a source of phosphorus for the selected mutants. Associated studies on plant density, genotype interaction and nitrogen turnover in sustainable sorghum/African rice/legume cropping system was foreseen. The establishment of a basic facility for tissue culture was also planned.

The third phase in 1997 will be devoted to the preparation and distribution of protocols on recommended agronomic practices based on the results obtained from the studies on mutant performance and soil/plant/fertilizer relationship. Large scale seed multiplication and distribution of seed kits of the mutants of sorghum and African rice, selected during phase one and two, will be undertaken in collaboration with the Ministry of Agriculture and the National Extension Service. The project will ensure that enough seeds are released to farmers together with the related agronomic practices. National campaigns for dissemination of relevant information, using mass media will be carried out so as to reach farmers.

During 1995, on-farm trials of the selected mutants of sorghum and rice were to be performed. Twenty seed kits of 250g each were to be distributed to 20 farmers from a selected village, to plant along with their own local varieties and following routine culture practices. This scheme was planned to be repeated during 1996 with 40 farmers, and in 1997 with 2,000 farmers. This activity was planned to be undertaken with the involvement of the local extension services.

Monitoring of the project progress was assigned to the Project Management Committee. Annual progress reports were to be prepared by the project counterparts showing the degree of implementation, the achievement, the problems and actions needed for further progress.

The project agreement provides for the co-operation between the direct beneficiary institutes (IRP and IER) and the Ministry of Agriculture and extension services (DNVA), to ensure that sufficient seeds of those crops are multiplied and distributed to the farmers and that the agronomic procedures are widely disseminated through effective methods of communication.

A2.4. PROJECT IMPLEMENTATION

A2.4.1. Status of Agronomic Outputs

A2.4.1.1. Sorghum Selection Trials

The variety selection trials on sorghum conducted in 1995 were carried out according to the project plan and following the recommended protocols. Harvesting was completed, including the fertilizing trials.

A relatively high dispersion of results can be pointed out. The relatively higher performance of MIK-SOR86-30-41 and MIK-SOR86-30-42 was shown, although at some sites they were not superior to the control IPS0001 or to the parent variety.

Table A2.3. - 1995 Sorghum Selection Results

Site	Best perf. sorghum mutants	Characteristics - Results
Sotuba	MIK-SOR86-30-41 and MIK-SOR86-30-42	High productivity potential, comparable to parent.
	MID-SOR88-10-01 and MID-SOR88-10-02	Acceptable potential - Short cycle and culture advantages.
Samanko	MIK-SOR86-30-41 and MIK-SOR86-30-42	Higher productivity (37%) than parent.
	MID-SOR88-10-01 and MID-SOR88-10-02	Acceptable potential - Short cycle and culture advantages.
Cinzana	MIK-SOR86-25-13	Good behaviour but low number of panicles.
Katibougou	MIK-SOR86-30-41 and MIK-SOR86-30-42	Higher productivity (7%) potential than parent.
	MID-SOR88-10-01 and MID-SOR88-10-02	Acceptable potential - Short cycle and culture advantages.
Sikasso	---	Too high variation coefficients.

In view of these results the project work plan for 1996 trials foresees the increase of trial sites to ten while reducing the number of varieties to be tested.

Table A2.4. - 1996 Sorghum Selection Work Plan

Trial type	Sites	Mutants
Performance of selected mutants	Katibougou, Sotuba, Samanko, Bankoumana, Kolombada, Cinzana, Sougoula, Longorola, Farako, Sirakorola	MIK-SOR86-30-41 and MIK-SOR86-30-42 Controls: CSM388 and local variety
Performance for drought tolerance	Cinzana, Banamba, Bema	MIKSOR86-25-11 MIKSOR86-25-13, MIKSOR86-30-03 MIKSOR90-30-76
Selection trials	Katibougou, Sikasso	8 to 10 mutants (not yet determined) Controls: CSM388 and IPS0001
Plant density	To be determined	To be determined
Seed multiplication	Katibougou	MIKSOR86-30-41, MIKSOR86-30-42, MIPSOR90-30-23, MIKSOR86-25-13 Controls: CSM388 and IPS0001

The trial protocol recommended by the Agency (50m x 20m plot size) is not considered appropriate by the counterpart.

A2.4.1.2. Sorghum Fertilizer Trials

The results of plant nitrogen uptake were not available at the time of the evaluation mission. However, in Kolombada, several mutants (MIK-SOR86-25-20, MIK-SOR86-30-42 and MID-SOR88-10-01) have shown clear advantages with respect to the parent varieties, both in high or low fertilizer environments. Trials performed in Katibougou have only proved the superiority of SOR88-10-01.

The mutants and sites subject of the soil fertility and water management part of the 1996 work plan are summarized in Table A2.5. Two sites in the central part of the country, Sikasso and Cinzana and one site in the dry zone will be selected. The trial protocol recommended by the Agency (50m x 20m plot size) is not considered appropriate by the counterpart.

Table A2.5. - 1996 Sorghum Soil Fertility Work Plan

	MIKSOR-86-41, MIKSOR-86-42 Parent CSM-388,	MIGSOR-86-30-03, MIKSOR-86-25-13, Parent CSM-219 and CSM-388
Sikasso	✓	
Cinzana	✓	
Not identified	✓	
Not identified	✓	
Cinzana or Bema		✓

A2.4.1.3. Rice Selection Trials

Rice selection trials were performed in two of the three sites. The trials at Djaloube (FAO site) were not performed since FAO project was terminated. The trials at Mopti have not provided results due to drought. The trials at Segou did not follow the recommended protocol (bloc Fisher). As a result, the availability of seeds for 1996 was limited, and a seed multiplication trial was set up in 1996 at Niano, together with the fertilizer trials.

The 1996 work plan on rice will be based on five sites (Mopti, Segou, Niono, Gao and Timbuctou) and five mutants and Gorbal as control. Seed multiplication trials will be conducted at Mopti on five mutants and Gorbal as check, with 1/10 ha per variety.

A2.4.1.4. Rice Fertilizer Trials

Rice fertilizer trials have been performed on mutants of a different generation and variety than those subjected to variety selections. The delay in trial performance has affected the optimum development of the varieties.

The results, pending the information to be provided by the analyses on plant nitrogen absorption capacity, are shown in Table A2.6.

The work plan on agronomic evaluation of the rice mutants will be developed as soon of the results of 1995 analysis are available.

Table A2.6 - Results of 1995 Rice Fertilizer Trials

Variety	Site	Trial type	Results
V1 - BMC (bulk mutant, short size, cycle 165 days)	Kogoni, "moursi" soil type	Capacity of N absorption	- Heterogeneity in maturity - Low yield - High size - High sterility
V2 - BMTM (bulk mutant, medium size, cycle 160 days)	Kogoni, "moursi" soil type	Capacity of N absorption	- High sterility
V3 - BH2 (cycle 160 days)	Kogoni, "moursi" soil type	Capacity of N absorption	- High sterility
V4 - Gambiaka kokum (local variety, cycle 145 days)	Kogoni, "moursi" soil type	Capacity of N absorption	- Highest yield
IR 32307-107-3-2-2 (cycle 105 days)	Niono	Determination of optimal dose	- Fractions 3/8, 1/2 and 5/8 provided in 2 doses appear to lead to best yields

A2.4.2. Status of Operational Outputs

N-15 and P-32 laboratory

Due to the delay encountered in the construction of the isotope laboratory building, the analysis of the samples taken during 1995 for N-15 fertilizer trials is under way at the Agency's Seibersdorf laboratory.

P-32 was not applied to fertilizer trials. Although under development at present, the absence of legislation on radiation protection poses some problems regarding the utilization of radioactive isotopes.

Tissue culture laboratory

At the time of the evaluation field mission the laboratory equipment had already been provided by the Agency and the counterpart had made available the necessary laboratory space. As the concept of tissue culture laboratory is still under consideration, some as built modifications of the laboratory facilities appeared to be under consideration, including the reduction of the culture room space, the elimination of the window recently installed and the reconstruction of the previously existing wall which had been demolished following the advice provided. Installation of equipment was still due awaiting for Agency's expert assistance.

The availability of funds for future laboratory maintenance poses a concern. Minimum safety protection features to protect the investment should be installed.

The tissue culture laboratory under the project, linked to the technology transfer objective will not be ready to serve sorghum and reice breeding programmes until after the project formally ends.

Trained team

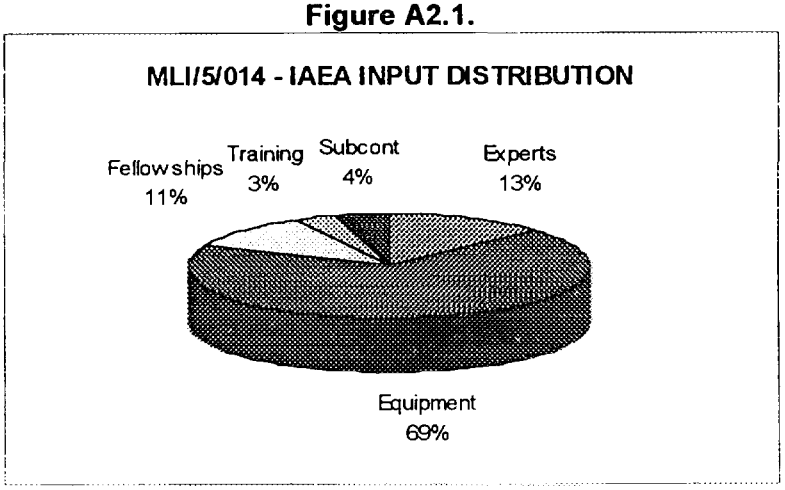
- The project agronomic team has completed training on application of N-15 fertilizer.
- The training to support the IPR tissue culture laboratory research team was planned to consist of two fellowships. However, health problems caused an early termination of one fellowship. The difficulties encountered by the counterpart in identifying qualified candidates to receive replacement training raise concerns about how to maintain sustainable operation of the laboratory.

- The training to support the IER N-15 / P-32 laboratory operation team is still due. It was planned to consist of one fellowship training on analytical techniques, to the technician in charge of the laboratory. One IPR researcher also received training through a fellowship on N-15 analytical techniques.
- Training on BNF was also conducted, through the fellowship awarded to IPR.

A2.4.3. IAEA AND COUNTERPARTS INPUTS

The IAEA input to the project amounts to $469,300, and is distributed among the project components as represented in Figure A2.1. The current budget for the period 1995-1996 amounts to $337,200 and is distributed, as well as the disbursements to date, according to a similar pattern.

Figure A2.1.



The following paragraphs describe in some detail the delivery of Agency's and counterparts inputs.

One IAEA/FAO National Training Course on the use of stable isotopes in soil fertility and plant nutrition studies was held from 17-28 April 1995.

The objective of the course was to train scientists in Mali on the use of project relevant nuclear techniques for research on soil fertility, nutrient turnover, and nutrient uptake by plants. Agency experts, Dr. F. Ganry of France and Mr. Sanginga of Nigeria lectured in the training course.

Twelve participants took part in the course as detailed in Table A2.7, from all the institutions participating in the project.

The interviews held by the evaluation team with participants show good appreciation of the training course, as having provided the necessary background information to a wide range of agronomy researcher with regard to the application of isotope techniques to agronomic research, beyond the project specific application.

Table A2.7. - Staff Participating in Training Course

Participant	Institution	Occupation
Wahab Toure, Abdoul	IER/Sotuba	Agronomist - In charge of project fertilizer trials
Bagayoko, Moussa	IER/SPW lab. - Sotuba	In charge of SPW laboratory
Famanta, Mahamadou	IPR	Assistant Director
Dembele, Sidiki Gabriel	IPR	Researcher - Agropedology/Soil
Diallo, Bocar A.	IPR	Left IPR
Guindo, Dore	IER/ Niono	Agronomist - Programme leader on irrigated rice
Odiaba, Samake	IER/Mopti	Agronomist - Rice programme
Diane Fane	IER/Sikasso	Rice selection programme
Bagayogo, Minomba	IER/ Sotuba	Agronomist -in Germany under a fellowship
Traore, Sadio	IER	Agronomist - Groundnuts
Doumbia, Mamadou	IER/ Sotuba	Agronomist- fertilizer trials
Guindo, Issaka	DNVA	Extension services

The status of fellowships and scientific visits, together with topics on which they were acting and the results achieved, is shown in Table A2.8. No fellowships have been awarded to date in connection with the operation of the isotope laboratory. The counterpart expressed its willingness to proceed with staff training, in spite of the delays encountered in the construction of the building.

Table A2.8. - Status of Fellowships and Scientific Visits

NAME/ INSTITUTION	HOST INSTITUTE	DATES	TRAINING SUBJECT	RESULTS
Dembele, Sidiki Gabriel IPR, Agro-Phisio Genetic lab.	Cirad (Montpellier, France)	95/10/01-95/12/31	N-15 / P-32 techniques in soil/plant nutrition - agronomic + analytical techniques - and BNF.	-Adequate training standards; -BNF activities have been removed from the project; -N-15 and P-32 analytical techniques in Mali at risk.
Cisse, Fousseyni IER	International Rice Research Institute (Manila, Philippines)	95/04/30-95/05/20	Scientific visit to become familiar with the host activities for rice improvement.	-Adequate training standards;
Bakari, Traore / IPR	University of Louvaine, Belgium	96/02-03	Tissue culture techniques to various cultures (not including sorghum or rice).	-The fellowship was terminated shortly after initiation due to health problems.
Adama, Berthe	University of Amiens, France	95/11-96-07	Tissue culture techniques to various cultures (not including sorghum or rice).	-On going, extended to 9 months (originally 6).
Bretaudeau, Al Housseini/ A. W. Toure	-FAO/IAEA Agricultural and Biotechnology Laboratory, Seibersdorf and Plant Breeding and Genetics Station, Vienna; -CIRAD, Montpellier-France.	96/04/01-04 96/04/29 - 05/3	-To report on project progress and results obtained. -To discuss with CIRAD various collaborative programmes, with particular attention to the lay-out of the laboratory and equipment for tissue culture techniques.	

The status and results of the expert missions related to this project to date is summarized in Table A2.9. An expert mission is shortly due for installing the tissue culture laboratory equipment.

Table A2.9. - Status of Expert Missions

NAME	DATES	DUTIES	RECOMMENDATIONS
Mr. Ahloowalia, Mr. Danso	1995-4-9 to 16	(i) Participate in first project co-ordination meeting; (ii) Definition of plan of field perf. trials	(i) Expert advice on the management of field trials needed: implemented by the Agency. (ii) Personnel training needed for plant breeding, fertilizer studies, use of emission spectrometer: implemented on plant breeding training. (iii) Resolve location of isotope lab at Sotuba: not yet implemented by CP.
Mr. Awonaike	1995-4-15 to 29	(i) Train on N-15 fertilizer and assay techniques and N fixation (ii)Train on isotopic techniques in soil fertility and plant nutrition.	(i) Mr. Bagayogo to submit fellowship application: training still pending. (ii)Certificates should be issued to TC participants.
Mr. Awonaike	1995-8-13 to 26	(i) Review work and set up N 15 fertilizer experiments, using N-15 labeled fertilizer. (ii)Train on application of N-15 and normal fertilizer and plot sizes to be treated.	(i) Mr. Toure should be awarded a fellowship: still pending. (ii)Agency should supply a shredder to aid harvesting of seeds: implemented by the Agency.
Mr. Ahloowalia	1995-10-2 to 10	(i)Review of sorghum and rice trials.	(i) Recommendations on sorghum and rice trial protocols: implemented on sorghum. (ii)Recommendations on tissue culture lab. space lay out: implemented.
Mr. Pamperl		(i) Tissue culture laboratory space arrangement.	(i) Recommendations on laboratory modifications: to be implemented.

A list of the equipment provided is included in Table A2.13. Figure A2.2 represents the various concepts which received support under this project, namely transportation, local purchases, and tissue culture laboratory equipment. No problems were encountered at reception of equipment supplies. Tissue culture laboratory equipment is awaiting for expert mission for installation and development of operations protocols.

A2.5. PROJECT BUDGET AND BUDGET UTILIZATION

The approved Agency support for the project was $ 447,900. The original and the current distribution of the budget allocations by year is given in tables A2.10 and A2.11 respectively.

Table A2.10. - Approved Budget

	Experts	Equipment ($)	Fellowships	Subcontracts ($)	Total ($)
1995	(M/D) 2/0 $22,800	110,000	(M/D) 6/0 $19,800	10,000	162,600
1996	(M/D) 2/0 $25,200	100,000	(M/D) 6/0 $18,000	10,000	153,200
1997	(M/D) 1/0 $13,200	90,000	(M/D) 6/0 $18,900	10,000	132,100
Total ($)	61,200	300,000	56,700	30,000	447,900

Table A2.11 - Current Budget

	Experts	Equipment ($)	Fellowships	Training ($)	Subcontracts ($)	Total ($)
1995	(M/D) 2/0 $22,800	130,700	$14,800	15,700		184,000
1996	(M/D) 2/0 $25,200	100,000	(M/D) 6/0 $18,000		10,000	153,200
1997	(M/D) 1/0 $13,200	90,000	(M/D) 6/0 $18,900		10,000	132,100
Total ($)	61,200	320,700	51,700	15,700	20,000	469,300

Due to the delay encountered by the IER in Sotuba, in conditioning the laboratory space for the isotope laboratory, the project budget implementation was achieved by forwarding the disbursements on tissue culture laboratory equipment foreseen for 1996. The disbursements and unliquidated obligations, as in June 1996 are included in Table A2.12.

Table A2.12. - Disbursements and Unliquidated Obligations by June 1996

	Experts	Equipment ($)	Fellowships ($)	Training ($)	Subcontracts ($)	Total ($)
1995	(M/D) 1/22 $23,063	102,579	11,679	12,542		149,865
1996	(M/D) 0/23 $8,771	51,138	3,589			23,084
Total ($)	31,834	153,717	15,269	12,542		223,364

A2.6. PROJECT MANAGEMENT

A2.6.1. NATIONAL PROJECT ORGANIZATION SCHEME

The organizational arrangements adopted were agreed upon by the two partnering institutions within the ad-hoc project contractual agreement. The designated project co-ordinator is Mr. Bretaudeau, from IPR.

A project Committee, where all the organizations involved are represented, including the Agency, provides the maximum level of project authority.

The organization arrangements presented in Figure A2.3 have been objected by one of the project counterparts. His major objections were the following:

- The responsibilities and functions of the Project Co-ordinator are not explicit as to the nature and scope.
- The institution involved should receive in advance the funds for local expenditures and running costs. The project administrative arrangements, specially the overall distribution of funds made by the co-ordinator, upon presentation of justification of expenditures, were not acceptable for the IER soil fertility co-ordinator.
- No co-ordination procedures have been defined to set up the trials plan or joint analyze of the results achieved in each task.
- No direct relationship was established with the Agency with regard to the soil fertility aspects. This lack of guidance has led to delays and deviations with respect to the objectives.

Table A2.13
Equipment Supplies

Sheet 1 of 2

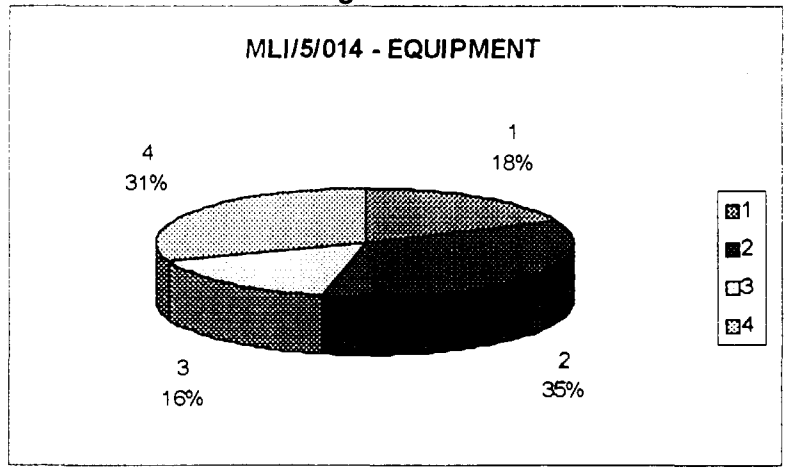
EQUIPMENT ID.	REQ. REC.	Description	ORDER DATE	ACT. REC.	TOTAL COMM.	VENDOR NAME	REMARKS
001A	29-Nov-94	SAMPLE OXIDIZER					ITEM CANCELLED
001B	29-Nov-94	OVEN					ITEM CANCELLED
001C	29-Nov-94	MILL, LABORATORY					ITEM CANCELLED
001D	29-Nov-94	MISCELLANEOUS					ITEM CANCELLED
001E	29-Nov-94	BALANCE, ELECTRONIC					ITEM CANCELLED
001F	29-Nov-94	GLASSWARE					ITEM CANCELLED
001G	29-Nov-94	ISOTOPES STABLE, NITROGEN - 15 FERTILIZER	95-03-10	95-06-01	$22,900.00	ISOTEC INC., USA	
001H	29-Nov-94	CHEMICALS					ITEM CANCELLED
002A	20-Jan-95	VEHICLES	95-02-24	95-08-23	$26,086.00	TOYOTA MOTOR CORPORATION, JPN	
003A	09-Mar-95	PUMP	95-03-24	95-06-15	$2,177.00	ACCURAMATIC, UK	
003B	09-Mar-95	BALANCE, ANALYTICAL	95-03-24	95-08-23	$1,675.00	VG ISOTECH - FISONS INSTRUMENTS, UK	
003C	09-Mar-95	LABORATORY EQUIPMENT AND SUPPLIES	95-03-24	95-06-15	$2,262.00	MERCK LTD., UK	
003C	09-Mar-95	LABORATORY EQUIPMENT AND SUPPLIES	95-05-05	96-01-21	$412.00	FISHER SCIENTIFIC CO., USA	
003C	09-Mar-95	LABORATORY EQUIPMENT AND SUPPLIES	95-03-24	95-08-23	$0.00	VG ISOTECH - FISONS INSTRUMENTS, UK	
003D	09-Mar-95	AUTOCLAVE - STERILIZER	95-03-28	96-02-02	$11,655.00	ASTELL SCIENTIFIC INTERNATIONAL, UK	
003E	09-Mar-95	WATER PURIFICATION SYSTEM	95-03-24	95-08-23	$4,649.00	BIBBY STERILIN LTD., UK	
003F	09-Mar-95	HEATING EQUIPMENT	95-03-24	95-08-23	$0.00	BIBBY STERILIN LTD., UK	
003G	09-Mar-95	LAMINAR FLOW HOOD	95-03-28	96-01-21	$9,475.00	LABCAIRE SYSTEMS LTD., UK	
003H	09-Mar-95	REFRIGERATOR	95-03-24	95-06-15	$0.00	MERCK LTD., UK	

Table A2.13
Equipment Supplies

Sheet 2 of 2

EQUIPMENT ID.	REQ. REC.	Description	ORDER DATE	ACT. REC.	TOTAL COMM.	VENDOR NAME	REMARKS
003I	09-Mar-95	PH METER	95-03-24	95-06-15	$0.00	MERCK LTD., UK	
003J	09-Mar-95	MICROSCOPE, OPTICAL TECHNICAL	95-05-05	95-06-15	$11,272.00	OLYMPUS OPTICAL CO LTD, JPN	
004A	05-May-95	LOCAL PURCHASES - UNDP ETC.	95-05-30		$20,000.00	RESIDENT REPRESENTATIVE OF THE UNITED NA... , MLI	
005A	01-Aug-95	LOCAL PURCHASES - UNDP ETC.	95-08-29		$20,000.00	RESIDENT REPRESENTATIVE OF THE UNITED NA... , MLI	
005A	01-Aug-95	LOCAL PURCHASES - UNDP ETC.	95-10-20		$10,000.00	RESIDENT REPRESENTATIVE OF THE UNITED NA... , MLI	
006A	03-Feb-96	LOCAL PURCHASES - UNDP ETC.	96-06-15		$20,000.00	RESIDENT REPRESENTATIVE OF THE UNITED NA... , MLI	

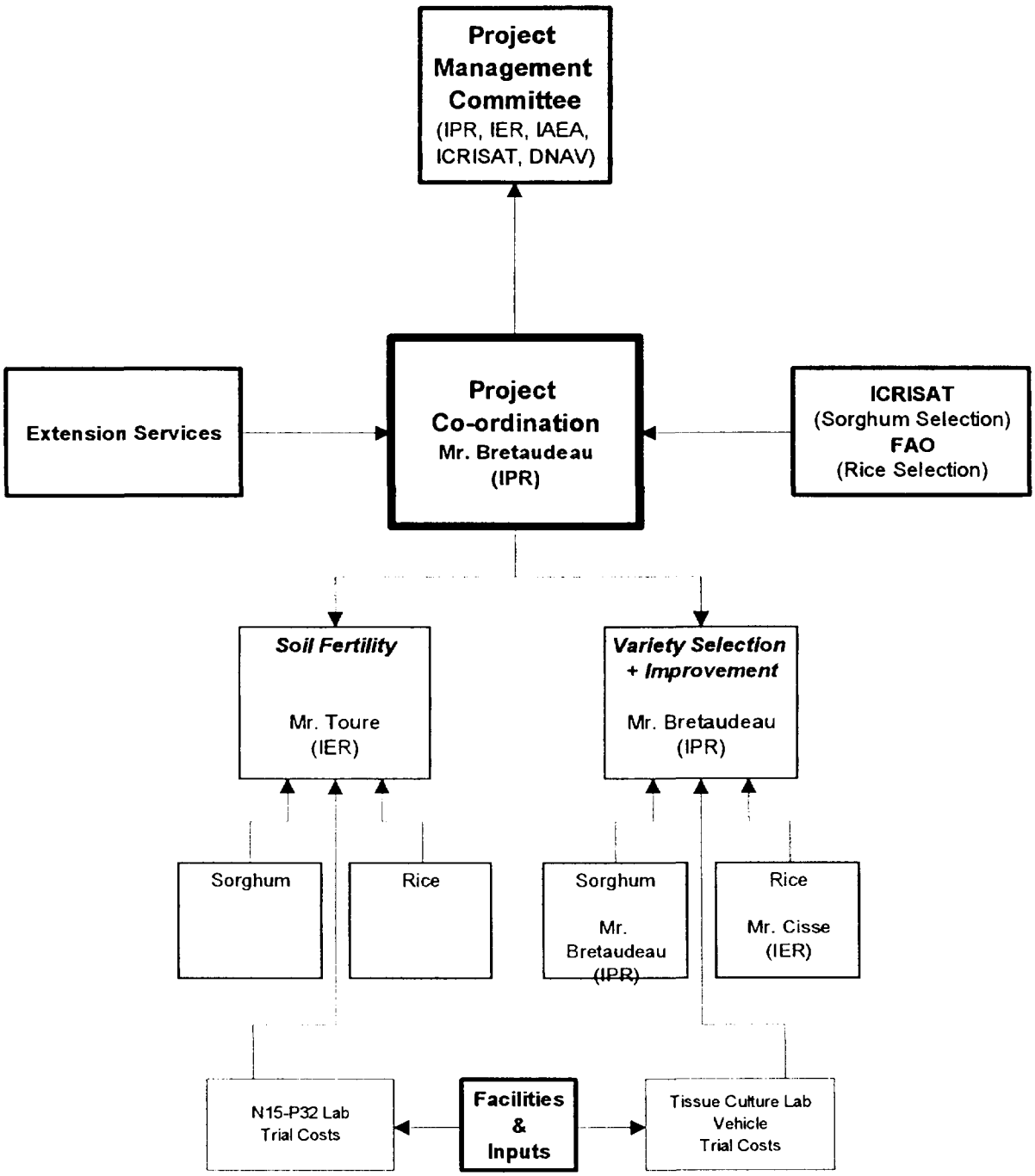
Figure A2.2



Notes:
1. VEHICLES
2. LOCAL PURCHASES - UNDP Fuel, Fertilizers, Insecticides, labor, field experiments ETC.
3. ISOTOPES STABLE, NITROGEN - 15 FERTILIZER
4. LABORATORY EQUIPMENT AND SUPPLIES

Disregarding the relevance or magnitude of the objections, previously presented in written form, the potential operational problems might eventually jeopardize the project viability.

Figure A2.3. - Project Co-Ordination Arrangements



FAO contribution to rice selection trials at Djaloube site for project TCP/MLI/4451 did not materialise due to project termination. ICRISAT has contributed to the project by performing independent selection trials on the sorghum mutants.

Some problems related to local budget implementation, also funded by the Agency, can be pointed out. The budget for trial execution was estimated on trial plans discussed

during project co-ordination meetings. However, the implementation of rice trials has not proceeded as planned, with no correspondence on justified expenditures.

The management of the institutions involved, also members of the Project Management Committee, interviewed by the evaluation mission, showed detailed knowledge and great awareness of the interest of this project.

A2.6.2. AGENCY BACKSTOPPING

The Agency technical backstopping was provided by two different sections of the FAO/IAEA Joint Division, Plant Breeding and Soil Fertility and Irrigation. Overall co-ordination was provided by the corresponding TCPM Area Officer.

The Agency's support was weak with regard to providing co-ordinated and integral advice on the different, but interrelated tasks of the project. Some examples are mentioned:

- Changes to the established work plan, such as the deletion of the Niebe assay from the work plan, in spite of its inclusion in the fellowship training programme.
- Contradictory expert advice on the tissue culture laboratory general layout, that will have financial implications on IPR.
- The soil fertility activities have had little Agency's technical support, except with regard to the application of N-15 and fertilizer.
- Weak co-ordination between variety selection and soil fertility activities is to be pointed out.

Such co-ordination weakness was also perceived by the counterparts.

Some problems were also pointed out by UNDP officer caused by little internal Agency's co-ordination (multiple communications from different Agency's responsible officers, with regard to expert missions or fellowships) as well as the time consuming effects of such lack of co-ordination.

ANNEX A3

FIELD MISSION AGENDA

PROJECT FIELD EVALUATION - MLI/5/014

"FIELD PERFORMANCE OF SELECTED MUTANTS OF SORGHUM AND RICE"

Date/ Purpose	Persons interviewed	Position	Institution
1996-05-06/ Mission presentation	Mr. Bino TEME Mr. Amadou DIARPA	Scientific Director Scientific Co-ordinator of Plant Research Programmes	IER IER
1996-05-06/ Review of project management+ Training programme	Mr. Al Housseini BRETAUDEAU[1] Mr. Abdoul Wohab TOURE Mr. Fousseyne CISSE Mr. Dore GUINDO Mr. Issaka GUINDO	Project manager In charge of sorghum selection In charge of project's fertilizer trials In charge of rice selection Rice selection researcher Extension agent	IPR IER IER IER DNA
1996-05-06/ Mission presentation	Mr. Mahamadou SIDIBE	National Director, IAEA National Counterpart	Direction Nationale de l'Hydraulique et de l'Energie
1996-05-07/ Visit to soil-plant-water lab and N15+P32 future lab site	Mr. Abdoul KARIM TRAORE Mr. Moussa BAGAYOKO	In charge of laboratory Director Laboratory	IER / Soil-Plant-Water laboratory Sotuba
1996-05-07// Visit to IPR + tissue culture laboratory// Discussion of the training programme	Mr. Mahamadou FAMANTA Mr. Gabriel DEMBELE SIDIKI Mr. Bakari TRAORE Mr. Adama TOGOLA Mr. Busmane NIANGOLY Mr. Alhassane BONCANA Mr. Tidiani FANE	Deputy Director Researcher Researcher Sorghum breeder Sorghum breeder Sorghum breeder Sorghum breeder	IPR IPR IPR IPR IPR IPR IPR
1996-05-08// Visit to IER Niano site - rice plots// Discussion of rice breeding and fertilizer trials	Mr. Mamadou M'BARE COULIBALY	Rice breeder	IER
1996-05-08// Discussion on 1995 sorghum research results	Mr. CHANTEREAU	Sorghum researcher	ICRISAT
1996-05-09// Debriefing	Mr. Bino TEME Mr. DE WEERDT Mr. Zi Zihenhuan	Scientific Director Programme Administrator Resident Representative	IER UNDP FAO

[1]Mr. Bretaudeau, Mr. Toure and Mr. Cisse assisted the evaluation mission during all interviews and field visits.