PD-AAJ-106

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CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) – PART I

Report Control Symbol U-447

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
Improved Nutritional Quality of Wheat (University of Nebraska Contract AID/ta-C-1091)	931-0471.11	S&T/AGR

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 81-55

Terminal, ☐ REGULAR EVALUATION ☒ SPECIAL EVALUATION 10/19/81

5. KEY PROJECT IMPLEMENTATION DATES			6. ESTIMATED PROJECT FUNDING		7. PERIOD COVERED BY EVALUATION
A. First PRO-AC or Equivalent	B. Final Obligation Expected	C. Final Input Delivery	A. Total	$	From (month/yr.) 6/66
FY 66	FY 77	FY 79	B. U.S.	$ 3,866,000	To (month/yr.) 12/79
					Date of Evaluation Review 11/14/80

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
This is a terminal evaluation. No further project-related monitoring or implementation actions are required.	–	–
Although not a part of the project design, AID's Research Advisory Committee though it would be useful to follow up on the project to see whether the improved varieties developed thought this project were, in fact, being utilized in LDCs. S&T/AGR concurs in the desirability of such an impact study and will, subject to the availability of funds, see if it can be programmed in FY 1983.	S&T/AGR	N/A

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS — NONE

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☐ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☐ Other (Specify) _____
- ☐ Other (Specify) _____

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT — NONE

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☐ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

S&T/AGR/AP:RIJackson _____ Date: 9/30/81
S&T/AGR/AP:JHYohe _____ Date: 10/5/81
S&T/AGR:MMozynski _____ Date: 10/16/81
S&T/AGR:JWalker _____ Date: 20 oct 81
S&T/PO:FCampbell _____ Date: 10/5/81

12. Mission/AID/W Office Director Approval

Signature

Typed Name S&T/AGR Ben McDermott, Acting Dir.

Date 10/19/81

AID 1330-15 (3-78)

PROJECT EVALUATION SUMMARY

Improved Nutritional Quality of Wheat
Project No. 931-0471.11
Contractor: University of Nebraska
Contract No.: AID/ta-C-1093

BCKGROUND: This project began in 1966 and terminated in December 1979. Its purpose was "To make available to developing countries high-yielding, nutritious germplasm of wheat with multiple resistance to moisture and temperature stresses, disease and insects, together with improved practices for their cultivation". The project was based on an unsolicited proposal from the University of Nebraska which was designed at a time when there was a great deal of enthusiasm for research on protein and protein quality, arising from the development of high lysine corn. Thus, the research objectives were to increase the protein content of wheat, as well as to increase the percentage of amino acid (lysine) in the protein while, at the same time, avoiding losses in yields or perhaps even increasing yields. The project was favorably reviewed by AID's Research Advisory Committee (RAC) prior to AID approval of funding.

EVALUATION METHODOLOGY: For about one year, RAC has been undertaking reviews of terminated or completed projects which the RAC had critiqued prior to final PP approval by AID. In this case, a "Final Report of Research Findings" had been prepared for AID by the University of Nebraska; this report was reviewed by a sub-committee of RAC consisting of: Dr. Maurice Peterson, Dept. of Agronomy and Range Science, Univ. of California/Davis; Dr. Dale Moss, Dept. of Agronomic Crop Science, Oregon State Univ.; Dr. B. S. Schweigert, Dept. of Food Sciences and Technology, Univ. of California/Davis; and, Dr. Earl Swanson, Professor of Ag. Economics, Univ. of Illinois. The sub-committee report was presented at the RAC meeting in Washington, D.C. in November 1980, and is attached to this PES, as are the minutes of the discussion which followed the presentation.

PROJECT ACCOMPLISHMENTS: The RAC sub-committee reported that "The Staff at the University carried out their work in a highly professional and scientifically sound manner. In general, this was a successful project." The sub-committee report noted, however, that not all objectives were met; specifically, the research was not able to find or develop varieties with increased protein content and increased percentage of lysine in the protein. However, varieties were found that had increased protein and increased lysine per unit of grain, which is itself significant in the nutritional improvement of wheat. Moreover, the project did dispel one notion that was prevalent at the time it was designed, i.e., that there is an inverse relationship between yield and protein content. Project research has produced genetic material with both increased protein content and improved yield characteristics.

The "quantifiable outputs" of the project (see attached logframe) have generally been met. They are broadly identified in the sub-committee report and are specifically detailed in the University report (which is too bulky to attach to this PES but which is available from DIU).

EXTERNAL FACTORS: One of the project design outputs for this project was the establishment of effective linkages with developing country agencies. The response to this was the establishment of a network of International Winter Wheat Performance Nurseries (IWWPN) which began in 1969 and which, in 1980, totaled 68 test sites in 38 countries. Additionally, project research linkages were established with CIMMYT, ICARDA, FAO and the USDA/SEA/AR. Within the project scope, the University of Nebraska also organized four international wheat conferences: 1972 - Ankara, Turkey; 1974 - Porto Alegre Brazil; 1975 - Zagreb, Yugoslavia; and, 1980 - Madrid, Spain.

There was an implied criticism during the RAC review that too many of the IWWPN test sites were in countries not listed in the "need" category, and that there was little evidence supplied by the University of Nebraska of the use or impact of the research information developed. Sub-committee member Moss, however, reported that from his own personal knowledge, gained through the international wheat conference in Spain in 1980, that LDCs were using the IWWPN material. He also pointed out that, given the time span necessary for varietal development and diffussion, the impact of the project on LDCs has had little time to show up.

Finally, a part of the review concerned a request by the University of Nebraska for one-year funding to continue the IWWPN through December 1980. The issue was not fully addressed by AID representatives at the RAC meeting but, in fact, AID did not fund the extension.

LESSONS LEARNED: The sub-committee report stated that AID and RAC should be more discriminating when considering the continuation of projects which have already served their primary purpose. In the instant case, it was fairly clear by 1975 that large differences in genetic control of protein would not be found, and that only small differences in lysine as a percent of protein had been discovered. That would have been the time to narrow the objectives and concentrate on the exploitation of those findings, even though they were less dramatic than anticipated. Instead, other objectives were added on - with AID and RAC concurrance - but not enough time given in the project extension to make any real progress.

ATTACHMENTS:
1. {sub-committee report
   {RAC meeting minutes
2. logframe

[redacted] XD-NAT-106-A68-

PES - ATTACHMENT 1.
(EXTRACT FROM THE MINUTES OF THE RAC MEETING, 11/14/80.)

9310471100 68

Genetic Improvement of Productivity and Nutritional Quality of Wheat - University of Nebraska

Dr. Peterson, chairman of the subcommittee that also included Drs. Moss, Schweigert and Swanson was pleased that AID was beginning to look at completed projects and carry out terminal reviews of research projects.
Dr. Peterson's report follows:

I. SUBCOMMITTEE REPORT

The basic objectives of this project were to increase the protein content of wheat, as well as to increase the percentage of lysine in the protein, this amino acid being deficient in terms of nutritional balance. These objectives were to be accomplished without a yield loss and hopefully, improved yields.

The contractor was the University of Nebraska, but with active participation of USDA/ARS which has maintained a wheat breeding program at Nebraska for many years. The usual AID objectives of training conferences, graduate student training, and operation of an international winter wheat nursery were an important part of the project.

The project was initiated in March of 1966 and continued through 1978 with total lifetime funding of a little under $4,000,000. An extension for one year was requested for $90,000 to continue the international winter wheat performance nurseries. It was not clear from the documents whether this extension was funded by AID or whether the contractor agreed to the extension at no cost. The documents provided to the subcommittee show a proposal by the University of Nebraska to continue for a period of three years, a technical assistance contract to operate the International Evaluation of Winter Wheat through two types of nurseries. One was a replicated International Winter Wheat Performance Nursery and the other a High Protein - High Lysine Observation Nursery. The funding request was for $314,539. If this was approved, the funding extends to December 31, 1981.

It might be useful to recall that at the time of the initial funding of this project in 1966, there was a great deal of enthusiasm for research on protein and protein quality, arising from the discovery of the high lysine corn, and from the general perception that protein deficiency in humans was a serious worldwide problems. The concept of protein deficiency for adults was later questioned by nutritionists who concluded that protein standards for adults were in excess of needs.

The project was strongly supported in the original RAC reviews and for several subsequent reviews. However, at a RAC meeting on May 8-9, 1975, a proposal to extend from April, 1975 to March, 1978 generated considerable discussion. It was apparent by this time that improvement of protein quality in wheat would be very difficult. This was apparently recognized by the contractor and the extension proposal de-emphisized protein quality somewhat and some new, and, controversial objectives were added. These were to study nitrogen metabolism, photosynthic efficiency, and nitrogen-fixing organism associated with wheat. One member of the subcommittee, who was unable to attend, provided a letter opposing the extension because he believed that the primary hypotheses had been adequately researched, and that a whole new set of objectives were being added. However, the extension was approved as proposed.

With the above comments as background, the review comittee makes the following comments in response to questions raised in Dr. Rechcigl's letter.

1) WAS THE PROJECT, AS IT WAS ACTUALLY CARRIED OUT, BASED ON SOUND ASSUMPTIONS AND A SCIENTIFIC PROTOCOL? WERE RAC RECOMMENDATIONS FOLLOWED?

The hypothesis that heritable differences in protein and lysine content may exist was certainly a valid assumption at the start of the project. Most agronomists and plant breders have encountered great difficulties in separating genetic from external factors affecting protein content. Nearly all plant breeders have found a negative correlation between protein content of cereal grains and yield. Additionally, as crop yields of cereals have increased overtime as a result of plant breeding, protein percentages have declined.

The Nebraska project found genetic variability in protein content of 5 percent and of lysine content 0.5 percent, but these differences are among cultivars whose yields also differ. At least three genetic lines for high protein and three for lysine have been identified from a systematic analysis of around 22,000 wheats from the world collection. However, the amount of lysine is influenced by the amount of protein. As protein contents increase, the percent of lysine per unit of protein decreases, but the amount of lysine per unit of grain increases. Therefore, the researchers concluded that breeding for increased protein was a valid approach to nutritional improvement of wheat. The final report of April, 1978 states;

> "Although high grain yield in many production environments is associated with depressed grain protein, there is no genetic linkage between high yield and low protein content. High yielding varieties that produce grain with higher protein content than other equally productive varieties can be and have been developed."

The report cites as an example the variety "Lancota" released in 1975 that possesses excellent productivity and processing quality with rust resistance and genetic potential for 1.5 to 2.0 percentage points higher protein than other wheats. However, it is a variety adapted to the U.S. winter wheat belt.

The question of whether or not RAC recommendations were followed, can be answered positively but RAC failed to provide very effective guidance during the final two years of the project.

2) DID THE PROJECT ACCOMPLISH ALL OF ITS OBJECTIVES AS DESCRIBED IN THE PROJECT PAPER? CAN IT BE CONSIDERED A SUCCESSFUL RESEARCH PROJECT?

The staff at the University carried out their work in a highly professional and scientifically sound manner. In general, this was a successful project. However, it probably can be stated that all objectives were not met as insufficient variability in lysine content was located to make the breeding for high lysine as a percent of protein a viable breeding objective. This is not a failure on the part of the staff but the fact that significant differences in lysine did not exist.

3) WHAT WELL DEFINED END PRODUCTS RESULTED FROM THE RESEARCH?

End products of the research included:

i. Identification of several lines each for high protein and higher lysine

ii. Breeding and release of "Lancota" for commercial production in Nebraska, Kansas, Texas and South dakota. It combines good yield with 1.0-2.0 percent higher protein.

iii. Identification of the Russian variety called "Bezostaya 1" as a high yielding variety for Turkey and several other Middle East countries.

iv. "Bolal" variety, developed at Nebraska and now grown in Turkey.

v. Identification of a French and Hungarian variety for high yield in Afghanistan.

vi. Holding of three international wheat conferences.

vii. About 65 publications since 1966.

viii. Training of ten students and trainees.

Nothing in reports of the contractor indicate the location and the present responsibilities of the ten scientists who have received training under this program. We believe that at least some of them came from developing countries and it would be useful to know if the training received is furthering the objectives of this project, or at least some other related development project. It would be useful if AID would retain records and contacts with all graduate students or post graduate scholars supported by them on various development projects.

Except for the above mentioned variety "Bolal" bred in Nebraska and grown in Turkey, we have found no references to any varieties for high protein or lysine coming from the Nebraska program that have been released and grown in a developing country. However, many such lines were in the "pipeline" when AID support for the breeding program was terminated.

4) DO THE RESULTS HAVE THE POTENTIAL TO BE IMMEDIATELY USEFUL TO LDCs OR TO AID'S DEVELOPMENT ASSISTANCE PROGRAM? WHAT SPECIAL STEPS MIGHT BE TAKEN TO EXPEDITE THE DISSEMINATION AND USE OF THE RESULTS?

The primary product of the 12 years of research is genetic stocks or varieties with improved protein content. The international nurseries were the vehicle for distribution to LDCs. The nurseries did provide the means for the identification of several of the high yielding varieties previously mentioned. Consequently, the continued funding of the nurseries under a technical assistance project, probably will be useful for future release of materials with improved nutritional quality.

5) ARE THERE ANY PRECAUTIONS THAT THE AGENCY SHOULD TAKE IN MAKING USE OF RESEARCH RESULTS?

The Agency and RAC should be more discriminating in continuation of projects that have served their primary prupose. It was fairly clear by 1975 that (1) large differences in genetic

control of protein would not be found, and (2) only small differences in lysine as a percent of protein had been discovered. This would have been the time to narrow the objectives and concentrate on the exploitation of those findings, even though they were less dramatic than anticipated. Instead, AID with RAC approval, continued funding the project with enlarged objectives, which could not be achieved during the two-year extension. Furthermore, some of the objectives were dubious (nitrogen fixation, e.g.) and were being investigated under a different project. These appeared to be "add ons" to make continuation of the project justifiable.

It is the opinion of this subcommittee that the breeding of varieties must be done in the environment where they were used, although there are a few notable exceptions such as those cited above. Therefore, the most useful part of the Nebraska wheat project was the identification of heritable, desirable characteristics and to provide parent materials and segregating generation populations for selection in the LDCs.

There is very little documentation to indicate if or to what extent materials made available through the international nurseries were in fact used in furthering breeding programs in the cooperating countries. Several very detailed research bulletins were published showing the results of the international winter wheat performance nurseries. There is good evidence of diligence in most cases in planting the nursery, recording the required data and reporting it to the principal investigators so that statistical analyses could be done.

We appreciate the fact that the next step beyong running the nursery trials and summarizing and reporting the data, falls beyond the responsibility or control of the contractor but it should have been within his interest and responsibility to find out if these materials were being used in crosses and if something useful is coming out of it. In fact, if the nurseries are still being operated and funded by AID, we suggest that the contractor make a systematic effort to determine if this decade of breeding work is resulting in development of improved cultivars.

Some of the international nurseries (in fact most of them) were in countries not listed in the need category. It is reasonably certain that if breeders in the U.S. (12 nurseries), England (2 nurseries), Europe (19 nurseries), etc. would make use of any materials identified by them as useful. The real test of the usefulness of this project is whether or not materials in nurseries in Afgahistan, Jordan, Syria, Iraq, etc. were being used in breeding programs and have proven useful.

The subcommittee also believes it would be important from an evaluative standpoint to have some quantitative estimates of the acreages of the varieties that were identified in this network. For example, it is noted that the variety Belinda now occupies a relatively small but important acreage in South Africa. However, it is difficult to make a general evaluation of the role of the IWWPN in terms of the increase in acreages planted to identified varieties. The process of diffusion of these varieties may have occurred in the absence of IWWPN. There is little data to assess the impact in terms of actual adoption of selected varieties. In a similar vein, it would be useful to know if there is an estimate of the use of Atlas 66 and its high protein derivatives by developing countries.

II. SUBCOMMITTEE COMMENTS

Dr. Moss also a member of the subcommittee, reported that he was more positive in his evaluation of the project than Dr. Peterson was. Dr. Moss's comments follow:

The rationale for establishing this project appears to be the success which plant breeders had in making a significant change in the lysine composition of protein in maize. Since lysine is low, relative to the other amino acids, in wheat protein it was felt that the nutritional value of wheat as a human food could be enhanced if the amino acid balance were made more nearly to correspond with the required balance for good human nutrition.

The project began in 1964. Contract funding was completed early in 1979 and a non-funded extension was given until December 31, 1979, to complete a report. The project was strictly a plant breeding project. This is important in analyzing the results, because the unavoidable lapse in time between making a cross between two parent plants of known attributes, growing out of generations to arrive at homogenous lines, testing these lines for yield, stabililtyl, and disease resistance in various environments and years, and finally choosing a line and increasing the seed to commerical quantities, requires a minimum of 10 to 12 years. Thus it is impossible to know, at this time, what the outcome and benefits of the Nebraska program will be. Only time will tell.

May I point out the problem the Nebraska group faced when they began this work. They did not know whether useable genetic diversity could be found for amino acid composition in wheat. They began by searching the world collection of wheat for such diversity. That search alone would require several years of

intensive effort. If they had found significant genetic diversity somewhere along the way and started to use it immediately, it is probable that results in terms of varieties could not have been produced before 1988 or 1990. Thus, under the best of conditions we would be a decade away from being able to evaluate this project in terms of results.

The Nebraska project is easier to deal with in this instance because Nebraska was not successful in identifying large enough differences in amino acid composition to lead them to believe they would be able to breed wheat which had a better amino acid balance. Thus, they could say by 1974 that the original goals were not reachable, because at the end of ten years' searching they had not identified useful genetic diversity for the desired trait. At that point in time AID and RAC could have said (and essentially did say) that further effort did not seem to be justified. Still the time frame covered by the project was short, even for a first step in the building process--the search for genetic diversity.

A secondary goal of the Nebraska project was to increase the protein content of wheat without regard to its amino acid balance. They were in much better position to pursue the secondary goal because they knew at the beginning that significant variation existed for protein content among genetically pure lines of wheat. In the area of protein content in wheat, an attribute important in bread-making as well as nutrition, the contributions of the project have been impressive.

Note: An international winter wheat evaluation network, currently involving 68 test sites in 38 countries, which was established in 1969, has been an effective vehicle for early identification of new high-yielding winter varieties with high performance stability and broad international adaptation.

The potential value of Bezostaya 1 as a commercial variety for production in Thrace and Western Anatolia in Turkey was initially identified by its performance in the International Winter Wheat Performance Nursery (IWWPN). Bolal, a stem rust-resistant variety selected in Nebraska and also tested in the IWWPN, now is a leading variety on the Anatolian Plateau of Turkey, and, together with Bezostaya 1, significantly contributing to more stable and increased wheat production in Turkey.

Lancota, a productive, high protein rust-resistant hard winter wheat selected in Nebraska and tested in the IWWPN, was released jointly by Nebraska, Kansas, Texas, South Dakota, and the USDA in 1975. Its protein advantage over other productive hard winter varieties ranges from 0.5 to 2 percentage points.

Superior performance in the IWWPN os Sava and Partizanka from Yugolslavia, Kavkaz and Aurora from the USSR, Talent from France, Yubiley from Bulgaria, and Centruk from Nebraska has led to their extensive use by breeders as parent varieties in crosses. Lancota, Dacia, Favorit, Bacha, Moldova and Sentinel were identified as moderately productive varieties with higher-than-normal grain protein content based on their performance in the IWWPN.

Belinda, a productive stem rust-resistant wheat from the Nebraska breeding program, was named and released in the Republic of South Africa in 1971. It occupies a relatively small but important acreage in higher elevation production areas of South Africa.

An experimental line derived from an Atlas 66 cross and selected in the German Democratic Repbulic combines high productivity with high grain protein content under German production conditions. It is currently undergoing evaluation in official GDR state trials for possible registration.

NE 7060, selected in Nebraska from the complex cross Favorit-/5/Cirpiz/Jang Kwang/4/Atlas 66/Comanche/3/Velvet, is currently being evaluated in the IWWPN. It possesses an attractive combination of winter hardiness, productivity, large seed, high grain protein content, acceptable milling and baking properties, disease resistance (rusts and mildew) and short straw. It is being extensively utilized as a parent variety by breeders in several countries.

Short-statured winter and spring experimental lines from the third cycle of protein breeding in Nebraska in which elevated protein and lysine have been combined with high productivity and other desirable agronomic traits, are distributed annually to breeders in developing and developed countries in a High Protein-High Lysine Observation Nursery. The nursery, which was initiated in 1975, currently is distributed each year to 55 cooperators.

Research results from the project were published in 113 technical papers and in 22 reports.

Four international wheat conferences and an international workshop on seed protein were organized by project personnel. The conferences were held in Ankara, Turkey (1972), Porto Alegre, Brazil (1974), Zagreb, Yugoslavia (1975), and Madrid, Sapin (1980); the seed protein workshop was held in Washington, D.C. in 1974. Proceedings were published and distributed from each of the conferences.

Thirteen graduate students associated with the project received Ph.D. degrees; six students received the M..S. degree. Seven of the graduate students were from developing countries. Ten agricultural scientists from seven foreign countries received non-degree training on the project for periods of six months to one year.

Genetic studies indicate that Atlass 66 carries two or more major genes for protein, one of which is linked with a gene for adult plant leaf rust resistance. The Atlas 66 genes affect the level of protein in the starchy endosperm, the portion of the wheat kernel that is milled into white flour. Chromosome 5D of Atlas 66 carries a major gene for protein and chromosome 5A a gene with less effect.

The above results are important. One of the interesting aspects of successful plant breeding programs is that the new, higher yielding plants increase the income of farmers who, in turn, then pay higher taxes. Thus, the product increases the standard of living of the world's poor, adds stability to governments, and, where there is significant spin-off in the U.S. as there has been from the Nebraska project, returns to Uncle Sam more, in many cases, then the project cost to begin with.

Dr. Schweigert also found it useful to critique finished projects. He felt that the investigator should critique projects after they were finished. The project manager should also critique his projects. The synthesis of the three over time could be an extremely useful document for future research.

Dr. Schweigert wondered where the ten scientist who have been described as receiving training under this program was now located. He was aware that several where from less developed countries and he thought the knowledge of their current position and responsiblity would be useful in accessing the utility of this project. His second point related to the discussion on the importance of carrying out the breeding studies in countries where the application is to be made. He felt that determining the feasibililty of the approach in the United States is logical. But exploring the application at an early stage in a developing country is extremely important.

Dr. Schweigert felt that this type of exploratory work had not been carried early enough in the Nebraska project. He thought it was difficult to evalate the full impact of the program since several of the promising lines are still in the pipeline in program activities. He suggested that AID

would find it useful in their evaluation analysis to specifically to review again the impact of this program about three years from now when more results from technical assistance phase are available.

Dr. Swanson the fourth member of the subcommittee reported as follows:

It should be expected that the objective of this large-scale long-term project would change during its lifetime. The objectives in the final report (nine in all) are not only different from earlier versions but also somewhat more operational than they are fundamental.

First of all, it appears that it was recognized rather early that (1) the lysine present in wheat is less than one-half the amount required for nutritional balance and (2) that the scope for increasing the lysine content of wheat is very limited. Given these two observations there is little hope that wheat could, in itself, ever be a "complete food" in terms of the amino acid lysine. Therefore, it seems that early in the life of the project there should have been a more explicit shift from increasing lysine to the simpler one of increasing yields by improving such traits as disease resistance and other factors which go along with yield maintenance. In short, it seems as though the goal of high increases in lysine, at least to the point where significant impacts could be made on the human diet were simply not in the cards. This, of course, does not mean that much useful work did not come out of the project. For example, the establishment of the fairly large scope for improvement of total grain protein (as contrasted to lysine) appears to be an important finding and this should be of interest to plant breeders.

The identification of new high-yielding winter varieties through the International Winter Wheat Evaluation Network is a useful activity. However, it would be important from an evaluative standpoint to have had some quantitative estimate of the acreages of the varieties that have been identified through the network. For example, it is noted that the variety Belinda now occupies a relatively small but important acreage in South Africa. However, it is difficult to make a general evaluation of the role of IWWPN in terms of the increase in acreages planted to the identified varieties. The process of diffusion of these varieties may have occurred in the absence of IWWPN. There is little data available to assess the impact in terms of actual adoption of the selected varieties.

In a similar vein, we note that the bioassays involving human subjects provided evidence that Atlas 66 and its high protein derivatives offer a significant advantage over ordinary wheats in terms of nutrition of consumed on a whole grain basis. Again, it would be useful to know if there is an estimate of the degree to which Atlass 66 and its high protein derivatives are actually being consumed. Earlier statements indicated that there would be no problem in terms of changing the preference patterns of consumers.

In my judgment, the publications and reports that have come out of the project appear to have been rather complete in their coverage of the project activities. Further, the training of both U.S. and foreign students together with the conferences and workshops seem to have been an important part of the dissemination of results.

It should be noted that, in the view of the Nebraska scientists, the "forced termination of this activity for lack of funds would not be in the best intersts of U.S and international agriculture." It would be useful to learn during our RAC discussion of this project the extent to which possibilities have been explored for turning this kind of activity over to one or more of the international centers.

III. GENERAL DISCUSSION

Dr. Wishik asked the four reviewers of the project if varieties could be marked and followed as they were planted. Could this be done in order to trace to what extent varieties were being utilized in the practical world.

Dr. Peterson responded that it would be difficult to identify from the grain which varieties would be used. He was surprised that Dr. Moss thought that his report came through as negative. He meant it to be positive. He thought the Nebraska wheat project had been a good project.

Dr. McDermott, from the AID staff, remarked that of the graduate students who had participated in the Nebraska wheat project, about half were from less developed countries. He was not sure where the graduates students from LDCs were located at present or what their positions were. However, most were under an obligation to return to their country to three to five times the length of their training.

Dr. McDermott pointed out that this project in fact used its own product and both the trainees as well as varieties produced were used in developing countries.

Dr. Peterson asked if the nursery which had been developed was continued as it was supposed to be.

Dr. McDermott said not to his knowledge the nursery had not been continued.

Dr. Smuckler pointed out to the AID staff that Dr. Schweigert's suggestion should not be lost - that projects should be terminally reviewed by the researcher as well as AID staff.

PES - ATTACHMENT 2.

II

AID 320-28 (11-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 66 to FY 78
Total U. S. Funding —
Date Prepared: Feb 23, 1976

Project Title & Number: Genetic Improvement of Productivity and Nutritional Quality in Wheat
AID/ta-c-1093

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To increase quantity and nutritional value of food crops in developing countries.	Measures of Goal Achievement: 1 Significant increase in per capita production of major food crops in developing countries. 2. Improvement of nutritional quality of major developing country food crops.	1. Official production and population statistics (FAO, Foreign Agricultural Service estimates). 2. Nutritional quality survey in developing countries.	Assumptions for achieving goal targets: 1. Developing countries will attempt to expand food crop production. 2. Nutritional quality can be improved without major constraints on yield.
Project Purpose: To make available to developing countries high-yielding, nutritious varieties of wheat with multiple resistance to moisture and temperature stresses, diseases and insects, together with improved practices for their cultivation.	Conditions that will indicate purpose has been achieved: End of project status. 1. New, superior varieties available to farmers in developing countries. 2. Research and development activities in wheat effectively assumed by developing country agencies and international institutions and linked by communications network.	1. Publication and reports of developing country governmental agencies; on-site inspections of seed supply. 2. On-site inspection and review by AID/W personnel and consultants.	Assumptions for achieving purpose: 1. Solutions can be found to major constraints. 2. Agriculture extension services are able and willing to promote proven practices. 3. Developing country research institutions develop adequate capabilities.
Outputs: 1. Identification of superior germplasm. 2. Incorporation of desirable traits into broadly-adapted varieties suitable for developing country use. 3. Evaluation of improved varieties and practices in developing countries. 4. Training of developing country personnel in wheat research. 5. Establishment of effective linkages with developing country agencies.	Magnitude of Outputs: 1. Not quantifiable. 2. At least 2 superior varieties for each major agroclimatic region. 3. At least 1 test location in each major winter wheat growing developing country. 4. Total of 5 developing country trainees completing training. 5. Linkages with 2 international centers and at least 5 developing country institutions.	1. Reports by contractor. 2. Reports by contractor, USAIDs, developing countries, cooperators, and international agencies. 3. Same. 4. Contractor reports. 5. Contractor reports, communications and reports from developing countries and international agencies.	Assumptions for achieving outputs: 1. Developing countries and USAIDs will request technical assistance; research findings will be available. 2. Cooperation of developing countries. 3. Interest and resources exist in developing countries. 4. Collaboration of international institutions. 5. Sufficient interest among developing countries and qualified personnel.
Inputs: 1. AID/W provides financial support and project guidance. 2. Contractor provides qualified personnel and backstopping facilities. 3. Participating personnel and cooperation provided by 1) developing countries, 2) USAIDs, and 3) international organizations.	Implementation Target (Type and Quantity) 1. AID/W funding at approximately $550,000. 2. 72 worker months/year technical personnel; adequate laboratory facilities; 10 or more acres field research area. 3. Not directly quantifiable.	1. AID/W records. 2. Contractor reports, on-site insepections. 3. USAID reports, on-site verification.	Assumptions for providing inputs: 1. AID/W funding will be available on schedule and in quantity agreed upon. 2. Contractor will have necessary qualified personnel; university facilities will be available to project. 3. International organizations, USAIDs, and developing countries will have personnel and resources to support this activity.