AgRISTARS

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NASA-CR-160951

A Joint Program for Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing

March 1981

Yield Model Development

PROJECT IMPLEMENTATION PLAN FOR FISCAL YEARS 1981 AND 1982

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Lyndon B. Johnson Space Center
Houston, Texas 77058

E81-10211
CR-160957

YIELD MODEL DEVELOPMENT PROJECT

(YMD)

PROJECT IMPLEMENTATION PLAN

PREPARED BY: _____

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I. INTRODUCTION

A. BACKGROUND

Yield Model Development is one of the eight projects of the AgRISTARS Program. AgRISTARS is the program for Agriculture and Resources Inventory Surveys through Aerospace Remote Sensing and is a cooperative effort of five Federal agencies. These agencies are Department of Agriculture (USDA), National Aeronautics and Space Administration (NASA); Department of Commerce (USDC), Department of Interior (USDI); and Agency for International Development (USAID).

AgRISTARS specifically addresses the seven information requirements identified in the Secretary of Agriculture's Initiatives. These were described in a document dated February 1978, and entitled Joint Program of Research and Development of Uses of Aerospace Technology for Agricultural Programs.

The Yield Model Development Project will support the two priority areas of the Secretary's Initiatives - Early Warning/Crop Condition Assessment and Commodity Production Forecasting. The overall objective of the Yield Model Development Project is to develop mathematical models using environmental and plant measurement characteristics that represent the yield potential of a crop. Models that have utility for both forecasting and estimation will be developed for the crop/country combinations specified by the USDA. Previous work has demonstrated that climate/crop yield models can successfully provide early, mid, and late season (at harvest) yield estimates with varying degrees of accuracy. These yield estimates can be combined with independently derived area estimates to produce total production for a selected region. The participating AgRISTARS agencies will initiate work to extend and enhance current capability through development of new technology and applications of existing technology to achieve improved accuracy.

The following Yield Model Development Project Implementation Plan focuses on activities and tasks for fiscal years 1981 and 1982. This plan will be reviewed and updated on an annual basis.

B. PROJECT SUMMARY

The Yield Model Development Project (YMD) will support USDA crop production forecasting and estimation by

1. Testing, evaluating and selecting crop yield models for application testing.

2. Identifying areas of feasible research for improvement of models.

3. Conducting research to modify existing models and to develop new crop yield assessment methods.

The YMD work will utilize the current state-of-the-art yield models for providing estimates in FY 1981 and develop new yield models for later years. The YMD will be a program to systematically integrate new technology to provide improved estimates for the early, mid, and late season periods during FY 82 - 85 for use in pilot and LSAT testing.

The YMD will select yield models from the literature and those developed by various research tasks for performance tests and evaluation. Models selected for application testing will be described in terms of their capabilities and limitations. As a result of the model tests, areas of feasible research for model improvement will be identified. Feedback from application testing will be provided to guide research and development efforts. The research will be conducted to improve existing models and to develop alternative modeling concepts.

Work to develop new crop yield modeling technology will be accomplished by use of a combination of expertise from scientists from cooperating government agencies, private industry and universities through cooperative agreements, contracts or grants. Special effort will be directed towards determining the utility of satellite derived data without and/or in combination with surface based data sources.

The YMD Project Implementation Plan describes five project areas composed of a total of 32 tasks to be worked in the FY 81-82 timeframe. The five project areas are:

1. Crop Yield Model Tests and Evaluation - 5 tasks
2. Crop Yield Model Research and Development - 9 tasks
3. Data Acquisition, Processing and Storage - 7 tasks
4. Related Yield Research - 7 tasks
5. Support Programs - 4 tasks

The YMD project is a joint agency activity supported by funds and staff from USDA, USDC and NASA. The Joint USDC, USDA, NASA Modeling Center established for YMD work is located in Columbia, Missouri. USDA Staff from ESS also support YMD work in Houston, Washington, D.C. and a few SEA/AR research sites. USDA SEA/AR staff support YMD work at numerous research centers. USDC Staff from EDIS, NWS, and NESS support YMD work at JSC, Houston, Texas.

C. PROJECT ORGANIZATION

The organizational structure within the AgRISTARS Yield Model Development project is illustrated in Figure I-1. The management structure includes a project manager, participating agency line managers, user evaluation team, project liaison leader, task coordinators, and task managers within each program area. Functional responsibilities of the project management are as follows:

1. Project Manager

The project manager is responsible to the Program Management Team (PMT) through his line organization for planning and managing activities within his project. To ensure that project objectives will be met within allotted resources, these responsibilities also include defining project content, identifying problems, making change recommendations, planning and defining tasks, and participating with other project managers in the integration of the various projects. Specifically, the project manager is responsible for.

a. Preparing and maintaining a project implementation plan for his project.

b. Supporting program planning, including the coordination and integration of inputs from all participating agencies or project elements.

c. Identifying resource requirements to the PMT.

d. Coordinating with other project managers to ensure appropriate flow of requirements, status information, and results among projects.

e. Assessing the need for changes in the project implementation plan, submitting to the PMT those changes requiring PMT approval, and coordinating and implementing those changes as necessary.

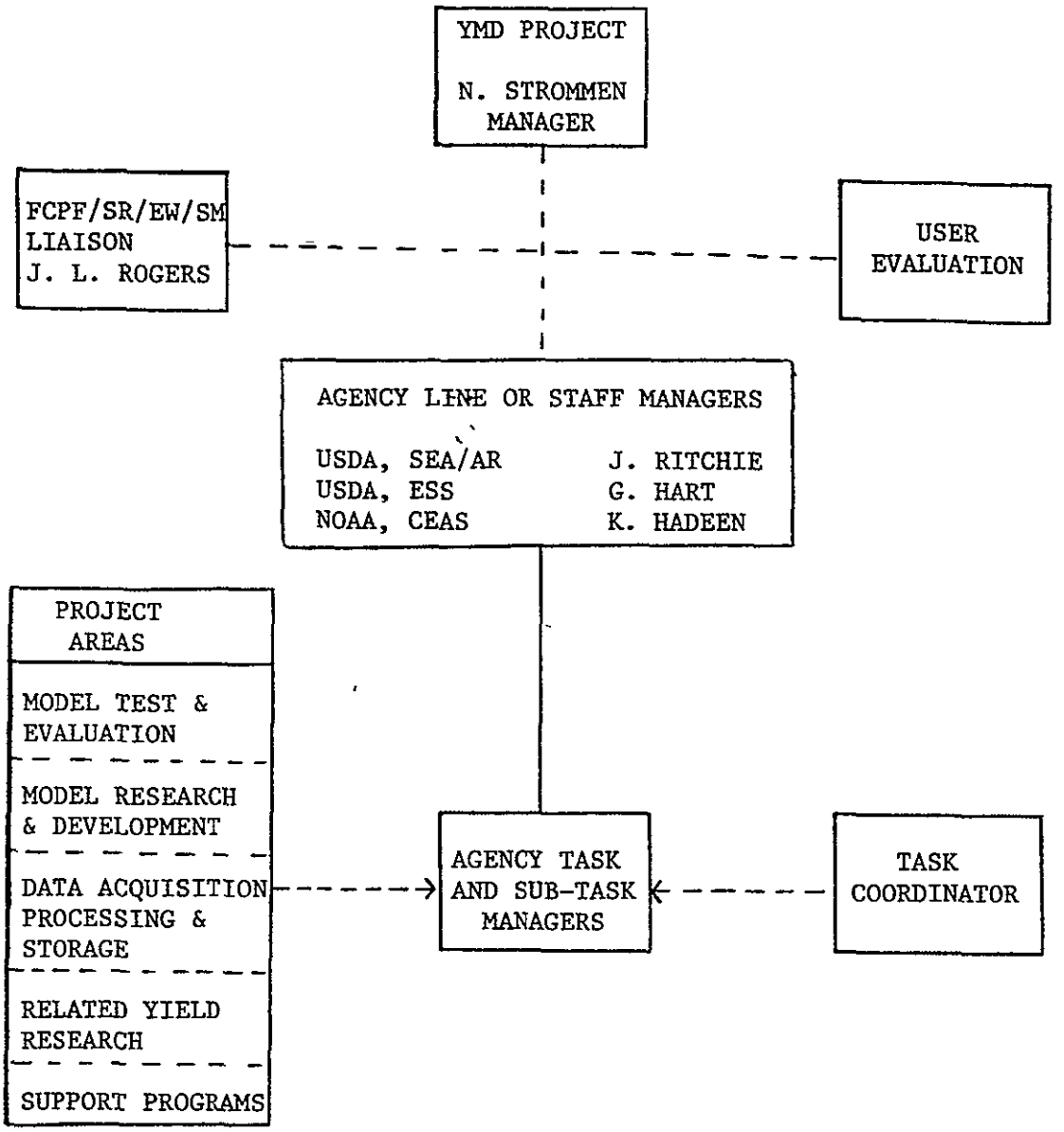
f. Reporting overall status to the PMT and identifying need for management guidelines.

2. Agency Line or Staff Managers

These managers have budget and/or management control of those responsible for carrying out the research identified in the tasks of this implementation plan. They are the interface to agency resources and are responsible for the conduct of the research. Specific responsibilities are to.

a. Develop the program of research.

b. Assess the technical integrity and adequacy of work performed.



YMD PROJECT ORGANIZATION

Figure I-1

c. Prepare agency budget submissions for AgRISTARS.

d. Provide inputs for preparing and maintaining project implementation plans.

e. Provide inputs for status reporting.

3. Task Coordinators

The task coordinators are the focal point to assure efficient, nonoverlapping research for multiphased tasks; in particular, where several sub-tasks are involved. Specific responsibilities are to

a. Provide technical and/or supervisory leadership for task research within the participating agency line or staff management structure.

b. Provide agency line or staff managers with status reports, updates and other changes to the project implementation plan.

c. Ensure coordination with other task managers.

4. Task and Sub-task Managers

The Task or Sub-task Managers' responsibilities are task planning and task management. Each manager supplies technical leadership and is responsible for conducting tasks within the organizational structure of the participating agency line management. Specific responsibilities are·

a. Supports higher level management in technical task planning and participates in all updating of the overall plan as requested.

b. Develops the technical approach, procedures, schedules, and implements the plans and assures technical validity.

c. Prepares reports as requested by management.

5. User Evaluation Team

USDA has established a User Evaluation Team for the AgRISTARS Program. This team is comprised of senior personnel within the various participating USDA agencies who are familiar with remote sensing technology, USDA requirements, and operational programs.

The User Evaluation Team will develop performance criteria based on end-user agency requirements. This implies that performance criteria may change depending upon individual end-users.

6. Project Liaison Leader

The project liaison leader is responsible for.

a. Preparing and maintaining interface control documents with other AgRISTARS projects.

b. Review agronomic and plant growth modeling research and prepare integration plans for use in plant process models.

c. Supports the project manager in coordinating with other project managers to ensure appropriate flow of requirements, status information, and results among projects.

d. Coordinates and assists task managers in ensuring that requirements and results are appropriately exchanged among other projects.

e. Prepares reports as requested by management.

f. Supports task, project, and agency managers as requested.

D. PROJECT INTERFACES

Interfaces between projects in AgRISTARS will be specifically defined by Interface Control Documents (ICD). These ICD's will be jointly approved by the respective project leaders. A separate ICD will be prepared defining interfaces between YMD and each project which requires interfaces.

1. Intraproject Interfaces

Several interfaces between the participating organizations within YMD will be required and accomplished during the project life. USDA SEA/AR will develop and test techniques to estimate soil moisture, crop growth stages, and heat-moisture stress. NOAA-NESS will develop techniques for using GOES and Polar Orbiting Satellites data to estimate spatial measurements of solar radiation, precipitation amounts and temperature ranges. The model development group will integrate these estimates into model forms. As model evaluation occurs additional requirements will be isolated and referred to NESS or SEA/AR for research and development.

2. Interproject Interfaces

Within the total AgRISTARS endeavor, there are many technical and information interfaces between the several projects. YMD will develop, test, evaluate and operate yield models for all crops required for foreign commodity production forecasting (FCPF) pilot tests. These yield forecasts and reliability estimates will be provided to FCPF as specified in an ICD.

The Supporting Research (SR) project will develop and test technology for crop growth models, soils, and crop stress effects. Techniques developed will be provided to YMD for integration into yield models.

The Early Warning/Crop Condition Assessment (EW) project will develop techniques for relating leaf area, bio-mass, crop species, plant pests and disease, winterkill, and moisture stress to biological yield. These techniques will be provided to YMD for integration into yield models. Techniques developed to estimate solar radiation, precipitation amounts, and temperature ranges will be provided to EW.

The Soil Moisture (SM) project expects to model and predict soil moisture throughout the soil profile. Algorithms and model components estimating soil profile and root zone soil moisture will be furnished to YMD for evaluation and possible inclusion in yield models. Techniques developed in YMD for precipitation, solar radiation, and temperature range estimation will be made available to SM for its use. YMD will assist in a sensitivity analysis of yield models and crop growth to soil moisture.

Interfaces to other AgRISTARS projects will be identified and developed as project plans are developed.

3. JAWF Interface

Current meteorological data for operating yield models, crop calendars, and for evaluating techniques developed will be provided by the Joint Agricultural Weather Facility (JAWF). Continuing interface with JAWF will be required to maintain current meteorological data requirements.

E. PROBLEM AREAS

Several problem areas have been identified for solution in the Yield Model Development Project. Related problem areas (operational procedures and basic research questions) are being worked in other AgRISTARS projects. The extent to which solutions are found will determine the degree of performance improvements accomplished in yield model development and estimation capability.

- Timely acquisition of quality controlled current daily meteorological data
- Acquisition of historical agricultural and meteorological data for yield model development and testing
- Definition and determination of phenological growth stages
- Simulation of available soil moisture (surface and total profile)
- Social and political phenomena

- Economic relationship of yield to technology inputs
- Quantification of the extent of and plant response to farming practices (fallow, irrigation, double cropping, no till, etc.)
- Spatial measurement and estimation of solar radiation, precipitation amount and temperature ranges
- Establish critical heat (cold) stress tolerances for various crop stages

II. YMD PROJECT OBJECTIVES

The Yield Model Development (YMD) Project through the AgRISTARS USDA line management is responsible for the development, testing, and evaluation of crop yield models to support USDA's objective of improved crop production forecasting and estimation. The YMD project will be directed toward improving existing crop yield models, developing new models and incorporating satellite and other non-standard data into the model process.

The YMD project will utilize data acquired from USDA ground collection, NOAA meteorological ground stations and environmental satellites, NASA Landsat satellites, aircraft and other existing published sources.

The prime objective of YMD is to test, evaluate, and develop mathematical models using environment and plant measurement characteristics that represent the yield potential of a crop at a given level (state, region, nation). Yield models will be recommended for specific crop/country combinations to support Early Warning/Crop Condition Assessment and Foreign Commodity Production Forecasting Projects of AgRISTARS and for direct consideration by line USDA agencies having program responsibilities in crop yield forecasting and estimation.

A. FY81 Objectives

1. Evaluation of available wheat, barley, corn and soybean yield models using monthly weather data as input.

2. Acquire and store in computer compatible form historical daily temperature, precipitation and snow cover for the past ten years.

3. Acquire selected wheat, barley, corn, and soybean yield models utilizing daily weather data.

4. Specifically recommend to FCPF Project Manager best yield model for production forecasting for each of four crops (wheat, barley, corn and soybeans) in selected states of the U.S.

5. Identify relevant technological and economic factors and document their impact on crop yields.

6. Develop and document empirical yield models for corn, soybeans, wheat and barley by APU for two states.

7. Establish a data base of county monthly average temperature and precipitation for two states.

8. Document recommendations for yield model stratification in U S. and foreign areas.

9. Install one crop growth model that generates phenological growth stages as an interim step toward predicting crop yield for each

of five crops (wheat, soybeans, cotton, corn, and grain sorghum) and acquire the data necessary to test these models over several areas of the U.S.

10. Acquire historical agricultural data for at least ten years for major crops in USSR, Australia, Argentina and Brazil at the state or oblast level.

11. Provide quality controlled current meteorological data for 2500-3000 stations worldwide on a daily basis.

12. Using meteorological satellites, estimate incoming solar radiation and max-min temperatures at surface points in the Western Hemisphere and assess the accuracy of these estimates.

13. Define spectral input requirements feasible for yield estimation.

14. Deliver required yield estimates for wheat, barley, corn and soybeans to FCPF.

B. FY82 Objectives

1. Evaluate at least two yield models utilizing daily or aggregated daily data inputs for each of five crops (wheat, barley, corn, soybeans and cotton).

2. Quantify technological inputs to crop yield and develop subroutines for incorporation in yield models.

3. Expand county level meteorological data base for five to ten additional states.

4. Develop methodology for estimating incoming solar radiation and max-min temperatures from polar orbiting satellites.

5. Document and test crop growth models for wheat, corn, soybeans, cotton and grain sorghum.

C. Agency Responsibilities

1. General Responsibilities

The general agency responsibilities are as follows.

a. USDA

- Lead responsibility for plant process oriented yield model development (foreign and domestic)
- Yield model acquisition, development, testing, and evaluation. Select yield models for application tests
- Develop and verify agricultural data bases

- o Coordinate or provide needed ground data collection

b. USDC

- o Lead responsibility for statistical regression-type (using existing data series) yield model development (primarily foreign)
- o Yield model acquisition, development, testing and evaluation
- o Develop and verify meteorological data bases
- o Develop or refine meteorological measurements from environmental satellites
- o Participates in adapting spectral data for model input

c. NASA

- o Assist in yield model development and evaluation
- o Provide Landsat data acquisition and RD&T data base development
- o Provide RD&T spectral inputs to yield models

d. USDI

- o Provide Landsat data storage, retrieval and dissemination

III. RESOURCE SUMMARY

A. DOLLAR RESOURCES

1. By Agency

Agency	FY81($K)	FY82($K)
NASA	-	-
USDC NOAA-EDIS	1196*	1407**
USDC NOAA-NESS	205*	200**
USDA ESS	1118	1275
USDA SEA/AR	2500	2770
TOTAL	5019	5652

2. By Agency and Location

Agency/Location	FY81($K)	FY82($K)
NASA-Columbia	-	-
USDC NOAA		
Columbia-EDIS	641	855
Washington-NESS	205	200
Washington-EDIS	555	555
SUBTOTAL	1401	1610
USDA		
Washington-ESS	609	647
Columbia-ESS	509	628
SEA/AR Sites	2500	2770
SUBTOTAL	3618	4045
YMD TOTAL PROJECT	5019	5652

3. By Category (FY81) $K

	Civil Servants	Contractor	University	Other	Total
NASA	-	-	-	-	-
NOAA	481	205	210	505	1401
USDA	3108	100	410	-	3618
TOTAL	3589	305	620	505	5019

* 574K is not included in these figures, but covers overhead, travel, and equipment for all NOAA personnel in AgRISTARS for FY81.

** 418K is not included in these figures, but covers overhead, travel, and equipment for all NOAA personnel in AgRISTARS for FY82.

B. STAFFING RESOURCES - FY81

	Civil Servants	Contractor
NOAA	9.0	20.5
USDA	48.1	14.1
NASA	1.0	-
TOTAL	55.1	34.6

IV. SUMMARY OF TASKS TO BE COMPLETED

TASKS AND FUNDING BY AGENCY

		FY81($K)			FY82($K)		
		USDC	USDA	TOTAL	USDC	USDA	TOTAL
ELEMENT 1- MODEL TESTS AND EVALUATION							
Task 1	T&E Criteria	10	34	44	15	34	49
Task 2	Identify Models	10	22	32	10	22	32
Task 3	Acquire Models	15	90	105	30	90	120
Task 4	T&E of Models	45	209	254	50	209	259
Task 5	Monitor Test Activity	3	4	7	5	4	9
	Subtotal	83	359	442	110	359	469
ELEMENT 2-MODEL RESEARCH AND DEVELOPMENT							
Task 1	Technology Economics	0	109	109	0	109	109
Task 2	Empirical Models	100	63	163	90	63	153
Task 3	Stratification Alternatives	23	70	93	23	70	93
Task 4	Episodic Events	83	0	83	83	0	83
Task 5	Wheat	-	1097	1097	-	1157	1157
Task 6	Soybeans	-	675	675	-	785	785
Task 7	Cotton	-	109	109	-	109	109
Task 8	Corn and Sorghum	-	349	349	-	449	449
Task 9	Data Analysis Support	0	27	27	0	105	105
	Subtotal	206	2499	2507	196	2847	3043
ELEMENT 3-DATA ACQUISITION PROCESSING & STORAGE							
Task 1	Data Base Procedure	16	9	25	16	8	24
Task 2	Monthly Met Data	95	-	95	80	-	80
Task 3	Daily Met Data	205	-	205	205	-	205
Task 4	Historic Ag Data	-	117	117	-	80	80
Task 5	Aggregate Met Data	85	37	122	85	37	122
Task 6	Data Dictionary	95	-	95	117	-	117
Task 7	Current Met Data	350	-	350	564	-	564
	Subtotal	846	163	1009	1030	162	1192

IV. SUMMARY OF TASKS TO BE COMPLETED (Cont'd)

		FY81($K)			FY82($K)		
		USDC	USDA	TOTAL	USDC	USDA	TOTAL
ELEMENT 4-RELATED YIELD RESEARCH							
Task 1	Integrate Satellite Data	0	22	22	0	22	22
Task 2	Solar Radiation	95	-	95	100	-	100
Task 3	Temperature Extremes - MetSat	110	-	110	100	-	100
Task 4	NESS Task Monitoring	3	-	3	3	-	3
Task 5	Define Spectral Inputs	-	470	470	-	550	550
Task 6	Monitor Spectral Research	-	-	-	-	-	-
Task 7	Temperature Extremes - Synoptic	20	0	20	30	-	30
	Subtotal	228	492	720	233	572	805
ELEMENT 5-SUPPORT PROGRAMS							
Task 1	Support Personnel	20	40	60	20	40	60
Task 2	AgRISTARS Liaison	10	55	65	10	55	65
Task 3	Yield Output to FCPF	3	-	3	3	-	3
Task 4	New Tasks for FY 82-85	5	10	15	5	10	15
	Subtotal	38	105	143	38	105	143
TOTAL PROJECT		1401	3618	5019	1607	4045	5652

V. MAJOR PROJECT ELEMENT #1. CROP YIELD MODEL TESTS AND EVALUATION - 5 TASKS

Yield models from the literature and those developed by various scientists for other users and in other research projects will be subjected to performance tests and evaluations. Models selected for applications testing in the AgRISTARS program will then be described in terms of their capabilities and limitations. As a result of the model tests, areas of feasible research on component improvement for noted model deficiencies will be identified.

A. TASK 1: REVIEW TEST AND EVALUATION CRITERIA FOR EVALUATING CROP YIELD MODELS AND DEVELOP IMPROVED METHODS FOR THEIR APPLICATION.

WBS: 0301010100-32-10-04-10-01-10
12-34-04-34-01-13
37-21

1. Objective

Make improvements in test and evaluation criteria based on a review of their application. Develop improved methods for their application in testing and evaluating crop yield models.

2. Scope

Review criteria and their use in testing various crop yield models.

3. Duration

Four to five years

4. Anticipated Results and Products

Revised documents identifying criteria and procedures to be employed in their use. Specifications for existing procedures and specifications for additional methods developed.

5. Subtasks

a. Subtask 1 Assemble and review information gained from experience in conducting test and evaluation of yield models.

WBS#: 0301010100-32-05-04-05-01-05
12-08-04-08-01-03
-37-05

(1) Objective

Assemble information gained from experience in testing and evaluating models and review information for opportunities and problems.

(2) Technical Approach

Based on experience in conducting test and evaluation of models, assemble pertinent information and list possible problems and opportunities.

(3) Anticipated Results and Products

List of potential problems and opportunities.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers: Jeanne Sebaugh, USDA ESS/SRD-Columbia

Sharon LeDuc, USDC NOAA/EDIS-Columbia

b. Subtask 2 Identify important problems and opportunities in model testing and propose alternative methods.

WBS#. 0301010100-32-03-04-03-01-03
12-08-04-08-01-03
-37-05

(1) Objective

Identify the most important problems and opportunities in model testing and propose improved methods.

(2) Technical Approach

Using the list compiled in Subtask 1, review each identified potential problem and opportunity and determine its relative impact on model evaluation. Propose improved methods addressing the more important opportunities and problems.

(3) Anticipated Results and Products

Identification of more important problems and opportunities and outline of proposed methods.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Manager. Wendell Wilson, USDA ESS/SRD-Columbia

c. Subtask 3: Develop additional specifications for existing procedures and specifications

WBS#. 0301010100-12-18-04-18-01-07
-37-11
32-02-04-02-01-02

(1) Objective

Develop more useful and detailed specifications for existing procedures. Develop initial specifications for new methods identified.

(2) Technical Approach

For proposed methods developed in Subtask 2, develop initial specifications for their application. Prepare additional specifications for more effective and efficient use of existing procedures.

(3) Anticipated Results and Products

More detailed specifications for applying existing procedures and initial development of methods for applying new methods in testing and evaluating crop yield models.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Subtask Manager: Jeanne Seabaugh
USDA ESS/SRD-Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Task Coordinator: Wendell Wilson
USDA ESS/SRD-Columbia

7. Funding Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA ESS-Columbia	34	34
USDC NOAA-Columbia	10	15
NASA*		
TOTAL	44	49

*Funding for NASA personnel not included.

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDA ESS-Columbia	.3	.3
USDC NOAA-Columbia	.2	.3
NASA	.2	.2
TOTAL	.7	.8

(2) University and Others

USDA ESS-Univ. of Missouri	.6	.6

8. Task Schedule and Milestones

Complete review of test on regression models - May 1981
Review of Revised T&E Procedures - Sep-Dec 1981
Publish new test and evaluation procedures - March 1982

9. Interfaces

Other AgRISTARS Projects - FCPF

Other Major Project Elements - Element #2, Methods for identification of feasible research areas.

Within Project Element #1 - all other tasks.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Documents will be available for distribution to related AgRISTARS projects and for use and retention by YMD.

B. TASK 2: REVIEW CROP YIELD MODELS AND IDENTIFY CANDIDATE MODELS FOR ACQUISITION AND TESTING.

WBS#: 0301020100-32-10-04-10-01-10
12-72-01-13-01-13
04-09-01-09

1. Objective

Review potentially useful crop yield models and identify the most promising models for acquisition and subsequent testing.

2. Scope

All potential crop yield models for crops under investigation by the YMD project.

3. Duration

Four to five years.

4. Anticipated Results and Products

Listing of the potentially useful crop yield models and identification of most promising models. Decision on selection of candidate models for testing and evaluation.

5. Subtasks

a. Subtask 1: Describe Model Applications in Detail

WBS#: 03-01-02-01-00-12-03-01-03-01-03

(1) Objective

Describe applications for which crop yield models are needed in detail. Define both domestic and future foreign aspects of each application.

(2) Technical Approach

In concert with FCPF project and others determine requirements for each application and mutually determine objectives of the application.

(3) Anticipated Results and Products

Document describing each application for which crop yield models are needed.

(4) Test Sites

AgRISTARS regions for application tests

(5) Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Subtask Managers: Fred Baker, USDA ESS/SRD-Washington

Tom Barnett, NASA-Columbia

b. Subtask 2: Identify Potential Models

WBS#: 03-01-02-01-00-12-03-10-03-01-03
32-05-04-05-05-05

(1) Objective

Identify models which have some potential for meeting the requirements of each application.

(2) Technical Approach

Based on descriptions of each model and limitations imposed by the applications, develop a list of models which would conceivably be suitable.

(3) Anticipated Results and Products

Development of a restricted list of potentially useful models for each application.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Managers Clarence Sakamoto, USDC NOAA/EDIS-Columbia

Fred Warren, USDA ESS/SRD-Washington

c. Subtask 3: Select Candidate Models for Testing and Evaluation

WBS#. 03-01-02-01-00-12-16-01-09-01-09
04-07-01-07
32-03-04-05-01-05

(1) Objective

Select candidate models that will be tested and evaluated for each application.

(2) Technical Approach

Utilize internal project document, "Criteria for Identifying Candidate Yield Models" to select models for testing and evaluation with full consideration of application descriptions.

(3) Anticipated Results and Products

Selection of candidate models for testing and evaluation.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers: Wendell Wilson, USDA ESS/SRD-Columbia

Clarence Sakamoto, USDC NOAA-EDIS-Columbia

6. Task Organization and Responsibility

Lead Organization: USDA ESS/SRD

Task Coordinators: Wendell Wilson, USDA ESS/SRD-Columbia

Clarence Sakamoto, USDC NOAA/EDIS-Columbia

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA-COU	9	9
USDA-DCA	13	13
USDC-COU	10	10
TOTAL	32	32

b. Manyear Equivalents

(1) Civil Servants	FY81($K)	FY82($K)
USDA ESS-Columbia	.2	.2
USDA ESS-Washington	.3	.3
USDC NOAA-Columbia	.2	.2
NASA	.2	.2
TOTAL	.9	.9

8. Task Schedule and Milestones

Identify daily data input models for test - June 1981

List of candidate models - August 1981

9. Interfaces

Other AgRISTARS Projects - EW and SR.
Other Major Project Elements - None
Within Project Element #1 - Task 1, 3 and 4.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements.

Documents will be maintained within YMD Project.

C. TASK 3: ACQUIRE DETAILED DOCUMENTATION, COMPUTER PROGRAMS AND NECESSARY DATA SETS FOR CANDIDATE MODELS.

WBS#: 03-01-03-01-00-32-15-04-15-01-15
12-90-04-63-01-13
19-50
01-27-01-27

1. Objective

Acquire documentation, computer programs and data sets needed to allow testing and evaluation of candidate yield models.

2. Scope

All candidate models identified in Task 2

3. Duration

Four to five years.

4. Anticipated Results and Products

Availability of detailed documentation, computer programs and necessary data sets for use by YMD in testing and evaluating crop yield models.

5. Subtasks

a. Subtask 1 Survey Literature and/or Contact Model Developers to Assemble Complete Model Descriptions.

WBS#: 03-01-03-01-00-12-09-01-05-01-05
04-04-01-04
32-10-04-10-01-10

(1) Objective

Obtain descriptions of each candidate model.

(2) Technical Approach

Survey available literature and as necessary contact model developers for additional information. Assemble complete descriptions of each model selected for testing.

(3) Anticipated Results and Products

Complete descriptions of each candidate model.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Managers Clarence Sakamoto, USDC NOAA/EDIS-Columbia

Fred Warren, USDA ESS/SRD-Washington

b. Subtask 2: Acquire Detailed Information Needed Before Candidate Crop Yield Models Can Be Tested.

WBS#. 03-01-03-01-00-12-81-01-22-01-22
04-59-01-09
-19-50
32-05-04-03-01-05

(1) Objective

Obtain detailed information needed to test each candidate crop yield model.

(2) Technical Approach

Using information obtained by surveying the literature or that provided by model developers, identify additional information needs. With help of model "sponsors" or independently, if necessary, develop complete model specifications so that models can be executed in a testing mode.

(3) Anticipated Results and Products

Sufficiently complete description of each candidate model so that it can be effectively and efficiently tested in Task 4.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers Wendell Wilson, USDA ESS/SRD-Columbia

Fred Baker, USDA ESS/SRD-Washington

6. Task Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Task Coordinator: Galen Hart, USDA ESS/SRD-Washington

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA ESS-Columbia	63	63
USDA ESS-Washington	27	27
USDC NOAA-Columbia	15	30
NASA	-	-
TOTAL	105	120

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDA ESCS-Columbia	.3	.3
USDA ESCS-Washington	.6	.6
USDC NOAA-Columbia	.2	.3
NASA	-	-
TOTAL	1.1	1.2
(2) University and Others		
USDA ESS (KSU)	1.5	1.5

8. Task Schedule and Milestones

Models Identified - June 1981
Request Documentation and Software - July 1981
Receive and Review Model Documentation - October 1981

9. Interfaces

Other AgRISTARS Projects - EW and SR.
Other Major Project Elements - None
Within Project Element #1 - Task 2 and 4.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Acquisition of model descriptions, documentation, computer programs and necessary data sets. Information and data sets for each model are retained for use in model testing and evaluation and for future use in model development.

D. TASK 4 CONDUCT TEST AND EVALUATION OF CANDIDATE CROP YIELD MODELS

WBS#: 03-01-04-01-00-12-209-01-117-01-27
47-40
04-92-99-50
01-53
37-39
-32-45-04-45-01-45

1. Objective

Select crop yield models for various application tests in the AgRISTARS program, describe the capabilities and limitations of models evaluated and identify areas of feasible research for improvement of both selected and non-selected models.

2. Scope

Test and evaluation of all candidate models for each application.

3. Duration

Four to five years.

4. Anticipated Results and Products

Selection of models for application tests. Reports describing tests, evaluation, and selection of models which also provide a description of each model's limitations and capabilities and identify feasible research areas.

5. Subtasks

a. Subtask 1. Conduct Tests of Individual Candidate Yield Models for Each Application.

WBS#. 03-01-04-01-00-12-93-01-61-01-11
-99-50
-04-32-01-18
-37-14
-32-20-04-20-01-20

(1) Objective

For each candidate model, carry out tests as described in the project document, "Crop Yield Model Test and Evaluation Criteria," and apply other methods developed in Task 1.

(2) Technical Approach

Utilize the project document developed in Task 1 and additional specifications, to carry out tests for each individual candidate model.

(3) Anticipated Results and Products

Test results for each candidate model.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers: Jeanne Sebaugh, USDA ESS/SRD-Columbia

Fred Baker, USDA ESS/SRD-Washington

Sharon LeDuc, USDA NOAA/EDIS-Columbia

Tom Barnett, NASA-Columbia

b. Subtask 2 Comparatively Evaluate Candidate Yield Models for Each Application and Provide Recommendations

WBS#: 03-01-04-01-00-12-92-01-51-01-11
-47-40
-04-41-01-24
-37-17
-32-20-04-20-01-20

(1) Objective

Evaluate all candidate models for each application and provide recommendations of the best models(s) for use in application testing. Describe model capabilities and limitations.

(2) Technical Approach

Using test results developed in Subtask 1 compare the results for each candidate model and comparatively determine the best model for an application. Prepare written reports summarizing test and evaluation results and recommending the selected model(s).

(3) Anticipated Results and Products

Reports on test and evaluation results. Recommendation of models to use in application tests. Descriptions of model capabilities and limitations.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA/ESS/SRD

Subtask Managers: Fred Baker, USDA ESS/SRD-Washington

Jean Sebaugh, USDA ESS/SRD-Columbia

Sharon LeDuc, USDC NOAA/EDIS-Columbia

Tom Barnett, NASA-Columbia

c. Subtask 3: Identify Areas of Feasible Research Based Upon Test and Evaluation Activities.

WBS#: 03-01-04-01-00-12-24-01-05-01-05
04-19-01-11
01-11
37-08
-32-03-04-05-01-05

(1) Objective

Identify areas for feasible research

(2) Technical Approach

Based upon test and evaluation results developed in Subtasks 1 and 2, summarize findings about individual models and identify most promising possibilities for future research. The areas identified will be those that seem to have the greatest potential for improving model capabilities by modifications related to current model form and use.

(3) Anticipated Results and Products

Areas of feasible future research identified.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers: Wendell Wilson, USDA ESS/SRD-Columbia

Fred Warren, USDA ESS/SRD-Washington

Clarence Sakamoto, USDC NOAA/EDIS - Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Task Coordinator Wendell Wilson, USDA ESCS/SRD-Columbia

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA ESS-Columbia	92	92
USDA ESS-Washington	117	117
USDC NOAA-Columbia	45	50
NASA	-	-
TOTAL	254	259

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA ESS-Columbia	1.2	1.3
USDA ESS-Washington	.6	.5
USDC NOAA-Columbia	.5	.6
NASA	.3	.3
TOTAL	2.6	2.7

(2) University and Others

USDA ESS-Columbia		3.0
USDA ESS-Washington	3.0	
TOTAL	3.0	3.0

8. Task Schedule and Milestones

a. Test Wheat and Barley Models - Jan 1981
   Evaluate and Select Applicable Model - Jan, Mar 1981
b. Test Corn and Soybean Models - Feb 1981
   Evaluate and Select Applicable Models - Feb, Apr 1981
c. Document Requirements for Improvements - June 1981
d. List Research Areas - July 1981

9. Interfaces

Other AgRISTARS Projects - EW, SR, SM and for FCPF, selected models for use in application tests identified.

Other Major Project Elements - Element #2, feasible research areas

Within Project Element #1 - All tasks.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Selected data on test and evaluation retained by YMD for possible additional testing and model development.

E. TASK 5: MONITOR APPLICATION TESTING ACTIVITIES

WBS#: 03-01-05-01-00-12-04-04-04-01-04
-32-03-04-03-01-03

1. Objective

Monitor application testing activities and compare results with initial yield model tests (in YMD) and consider the potential impact of these results on other tasks in Major Project Element #1.

2. Scope

All FCPF conducted application tests and selected application use of models by others.

3. Duration

Four years.

4. Anticipated Results and Products

Comparisons between application test results and yield model tests conducted in YMD. Identification of potential impact of application test results on other tasks in Project Element #1.

5. Subtasks

a. Subtask 1: Receive, Review, and Evaluate Reports on Application Testing Activities for Potential Impact on other Tasks.

WBS#: 03-01-05-01-00-12-02-04-02-01-02
-32-01-04-01-01-01

(1) Objectives

Review and evaluate reports provided by FCPF and others on application tests results. Determine potential impact of application tests results on other Project Element #1 tasks.

(2) Technical Approach

Receive reports on application test results and review. As necessary, request additional information. Based on the results of Subtask 2, consider the potential impact on other tasks in the project element.

(3) Anticipated Results and Products

Reports on application testing activities reviewed and evaluated. Results available for further analysis. Potential impact of application test results identified.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers: Wendell Wilson, USDA ESS/SRD-Columbia

Clarence Sakamoto, USDC NOAA EDIS-Columbia

b. Subtask 2 Identify Points of Consistency/Inconsistency Between Yield Model Tests and Application Tests.

WBS#: 03-02-05-01-00-12-02-04-02-01-02
-32-02-04-02-01-02

(1) Objective

Identify the extent of agreement between results from yield model tests (conducted in YMD) and application test results (conducted by FCPF and others).

(2) Technical Approach

Based on the review of application tests results and results from yield model testing and evaluation activities, identify areas of agreement and disagreements.

(3) Anticipated Results and Products

Points of consistency/inconsistency between yield model tests and application tests identified.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Managers Jean Sebaugh, USDA ESS/SRD-Columbia

Sharon Le Duc, USDC NOAA/EDIS-Columbia

6. Task Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Task Coordinator: Wendell Wilson, USDA ESS/SRD-Columbia

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA ESS-Columbia	4	4
USDC NOAA-Columbia	3	5
NASA	-	-
TOTAL	7	9

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA ESS-Columbia	.1	.1
USDC NOAA-Columbia	.1	.2
TOTAL	.2	.3

8. Task Schedule and Milestones

Receive Evaluation Reports on FCPF Production Estimates

Wheat - December 1981
Barley - January 1982
Corn - February 1982
Soybeans - March 1982

Review Reports - December 1981 - June 1982
Evaluation Report on Model Performance - September 1982

9. Interfaces

Other AgRISTARS Projects - FCPF
Other Major Project Elements - None
Within Project Element #1 - all other tasks.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

NONE, except as identified in this task.

VI. MAJOR PROJECT ELEMENT #2· CROP YIELD MODEL RESEARCH AND DEVELOPMENT - 9 TASKS

Research will be conducted to improve existing models and to develop alternative modeling concepts. As deficiencies are noted and research is conducted, those topics requiring further research support will be identified. Basic model components known to need further research efforts include work on the impact of production inputs (technology), soil moisture and heat stress, insect and plant diseases; and the use of crop calendar and spectral imagery information. Model development will progress from less complex forms which can be readily assembled from available data to more complex forms which will require extensive research and the collection of detailed plant observations for a wide range of growing conditions. Refinement of each model form will continue as new variables, improved measurement procedures and additional processes are understood.

A. TASK 1: CONDUCT RESEARCH TO QUANTIFY THE IMPACT OF TECHNOLOGICAL AND ECONOMIC FACTORS ON CROP YIELDS.

WBS#. 03-02-01-01-01-12-109-04-109-01-49
37-60

1. Objective

Review pertinent literature, develop concepts for modeling the impact of technological and economic factors on crop yields, acquire data sets required, analyze the relationship between crop yields and technological and economic factors and methods for successfully incorporating these factors into crop yield models.

2. Scope

Efforts will be concentrated on factors affecting corn and soybean yields in the U.S. midwest and adjoining areas. Foreign areas will be considered based upon progress.

3. Duration

Four to five years.

4. Anticipated results and products

Review of pertinent literature completed and summarized. Insight gained as to the more important economic and technological factors impacting on crop yields. Concepts for modeling impact of these factors on crop yields developed. Initial data sets acquired, edited and ready for use in analyses. Analyses of the relationship between crop yields and technological and economic factors conducted and findings reported.

a. Subtask 1: Review Pertinent Literature and Assemble Information needed to Identify Relevant Technological and Economic Factors and Gain Insight of Their Impacts on Crop Yield.

WBS#· 03-02-01-01-01-12-27-04-27-01-12
37-15

(1) Objective

Conduct literature review and summarize information that is helpful in identifying relevant technological and economic factors and their impact on crop yield.

(2) Technical Approach

Review crop yield modeling, agricultural economic and agricultural research publications for information on economic and technological factors. Summarize most pertinent findings from the literature review

(3) Anticipated Results and Products

A report identifying technological and economic factors impacting crop yields and summarizing the most pertinent research findings relative to their yield impacts.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Subtask Manager Merritt Padgitt, USDA ESS/SRD-Columbia

b. Subtask 2 Develop Concepts for Modeling the Impact of Technological and Economic Factors on Crop Yields.

WBS# 03-02-01-01-01-12-33-04-33-01-15
37-18

(1) Objective

Development of concepts which define the subject area and provide useful approaches to modeling the impact of technological and economic factors on crop yields.

(2) Technical Approach

Based on literature reviewed, contact with agricultural specialists and discussions with others concerned about technological and economic impacts on yields, develop initial draft proposals. Review proposed concepts and modeling approach and revise and refine as experience is gained Prepare final report outlining concepts and approaches for modeling the impact of these factors on yields.

(3) Anticipated Results and Products

Report on concepts and approaches for modeling the impact of technological and economic factors on crop yields

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization USDA ESS/SRD

Subtask Manager· Merritt Padgitt, USDA ESS/SRD-Columbia

c. Subtask 3: Acquire and Edit Necessary Data Sets on Technological and Economic Factors

WBS#. 03-02-01-01-12-22-04-22-01-10
37-12

(1) Objective

To have necessary data sets on technological and economic factors available for use in Subtask 4.

(2) Technical Approach

Identify sources of data sets potentially useful in this task, determine data sets which will be most useful and proceed to acquire these data sets in an efficient manner. Review and edit data sets and arrange for subject matter specialists' review where necessary.

(3) Anticipated Results and Products

Necessary data sets acquired and prepared for use in Subtask 4.

(4) Test Sites - U.S. Midwest and adjoining areas. (Also possibly for foreign areas.)

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Manager: James Cotter, USDA ESS/SRD-Columbia

d. Subtask 4: Perform analyses of the relationship between crop yields and technological and economic factors, and develop indices or other means of incorporating these factors into crop yield models.

WBS#: 03-02-01-01-01-12-27-04-27-01-12
37-15

(1) Objective

Based on analyses determine relationships between crop yields and technological and economic factors and develop indices or other means for incorporating these factors into crop yield models. Present results of this research.

(2) Technical Approach

Based on products of Subtask 1 and 2 and using data sets developed in Subtask 3, perform analyses of relationships between economic and technological factors and crop yields. Identify and quantify the most important relationships, conduct indepth research to enhance understanding of the impact of critical factors and develop methods to include their effect into crop yield models.

(3) Anticipated Results and Products

Report of research findings and enhanced understanding of the relationship of crop yields to various technological and economic factors.

(4) Test Sites - U.S. Midwest and adjoining areas. (Also possibly for foreign areas.)

(5) Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Subtask Manager Merritt Padgitt, USDA ESS/SRD-Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Task Coordinator: Merritt Padgitt, USDA ESS/SRD-Columbia

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
USDA ESS-Columbia	109	109

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDA ESS-Columbia	1.1	1.1
(2) University and Others		
USDA ESS-Columbia	2.4	2.4

8. Task Schedule and Milestones

See Figure VI-1

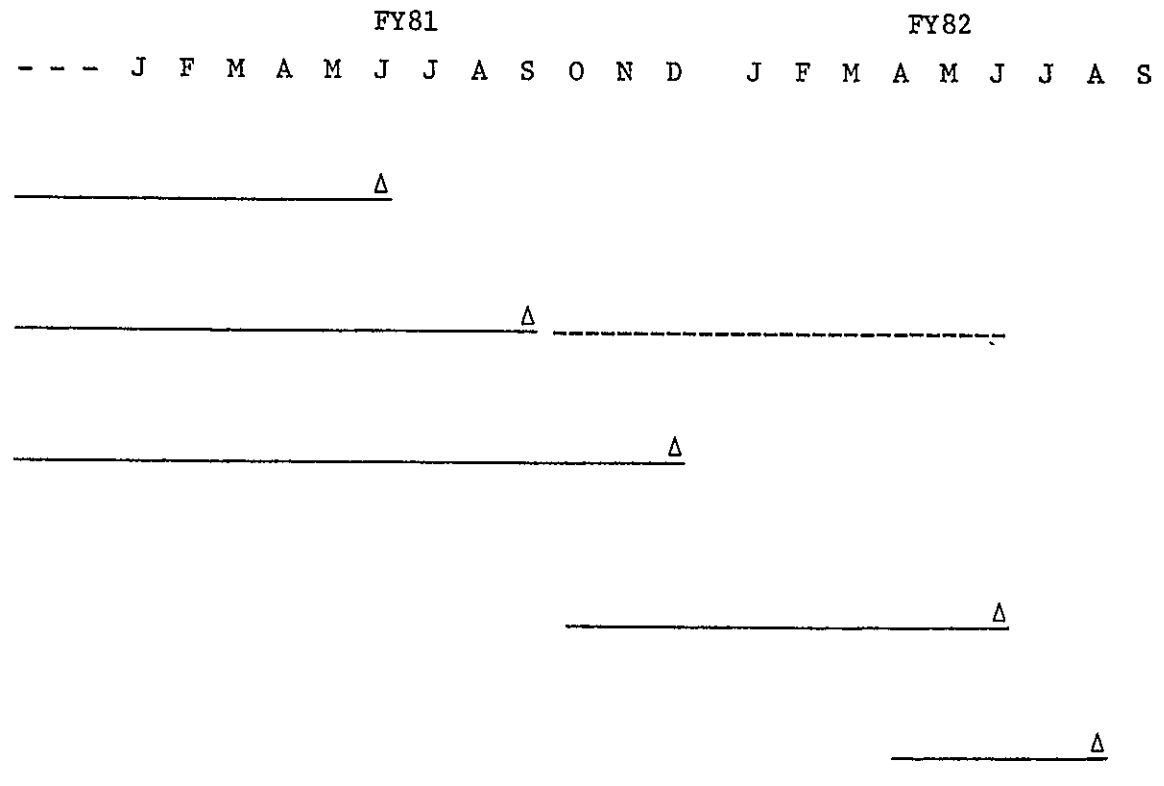
9. Interfaces

Other AgRISTARS Projects - EW, SR and SM.
Other Major Project Elements - None
Within Project Element #2 - Related to all research and development.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

All data will be collected by the investigators or by cooperating institutions working with YMD. Processing, distribution and retention requirements will be coordinated within YMD.

Task Schedule and Milestones for Task 1: Conduct Research to Quantify the Impact of Technological and Economic Factors on Crop Yields



B. TASK 2: CONDUCT RESEARCH TO DEVELOP AND DOCUMENT ADDITIONAL OR MODIFIED EMPIRICAL CROP YIELD MODELS.

WBS#: 03-02-02-01-00-32-100-04-100-01-100
12-63-04-63-37-45
01-18

1. Objective

The development and documentation of additional or modified empirical crop yield models with improved forecasting and estimation capabilities.

2. Scope

Empirically based crop yield models for various "crop-country" combinations as specified in AgRISTARS Technical Program Plan.

3. Duration

Four to five years.

4. Anticipated Results and Products

Modified models and additional models developed and documented which have potential for providing improved yield forecasts and estimates.

5. Subtasks

a. Subtask 1: Review Current Operational and Research Methods Utilized in Forecasting and Estimating Crop Yields.

WBS# 03-02-02-01-00-12-30-04-30-01-03
37-27
32-10-04-10-01-10

(1) Objective

To provide a review of current methods utilized in forecasting and estimating yields.

(2) Technical Approach

Acquire literature on current operational and research methods used in the U.S.S.R., U.S.A and other selected countries. Review literature, identify most promising methods and seek additional information required to fully describe the methods.

(3) Anticipated Results and Products

Description of promising operational and research methods referenced to the literature reviewed.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization USDA ESS/SRD

Subtask Manager: Felix Kogan, USDA ES/SRD-Columbia
Clarence Sakamoto, USDC NOAA/
EDIS-Columbia

b. Subtask 2· Based on Model Test and Evaluation Identification of Feasible Research Areas, Determine Supporting Research Needs and Propose YMD Research Projects.

WBS#: 03-02-02-01-00-12-07-04-07-01-07
32-10-04-10-01-10

(1) Objective

Determination of supporting research needs and development of proposed research to be conducted within the YMD project.

(2) Technical Approach

For each research area that is identified based on model tests and evaluation, identify subjects which can be successfully researched within YMD and those which require more intensive supporting research efforts. Propose specific research projects to be performed within the YMD project.

(3) Anticipated Results and Products

Supporting research needs identified. YMD research projects identified and proposals developed.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA ESCS/SRD

Subtask Managers. Wendell Wilson, USDA
ESS/SRD-Columbia

Clarence Sakamoto, USDC
NOAA/EDIS-Columbia

c. Subtask 3: Conduct YMD Research Projects to Develop and Document Improved Empirical Crop Yield Models.

WBS#: 03-02-02-01-00-12-23-04-23-01-05
37-18
32-70-04-70-04-70

(1) Objective

Development and documentation of improved empirical yield models.

(2) Technical Approach

Based on project proposals, developed in Subtask 2, and crop country model needs. obtain necessary data sets, conduct analyses and develop improved empirical crop yield models. Document models for their use in future research and development efforts, and to facilitate their test and evaluation.

(3) Anticipated Results and Products

Development and documentation of improved empirical crop yield models.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDC, NOAA/EDIS

Subtask Manager: TBD, USDC NOAA/EDIS-Columbia

Felix Kogan, USDA ESCS/SRD-Columbia

d. Subtask 4: Review Supporting Research Results (from the Supporting Research Project and Others) and Integrate These Results in YMD Research.

WBS#: 03-02-02-01-00-12-03-04-03-01-03
32-10-04-10-01-10

(1) Objective

Integrate useful supporting research results into YMD research and development efforts.

(2) Technical Approach

Obtain and review supporting research results reports, identify results which may be of use to the

YMD project and plan the integration of the most useful results into the YMD research and development effort.

(3) Anticipated Results and Products

Supporting research results for integration into YMD research efforts are identified and plans are made for their further use.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization USDC NOAA/EDIS

Subtask Managers. Clarence Sakamoto, USDC NOAA/EDIS-Columbia

Wendell Wilson, USDA ESS/SRD-Columbia

6. Task Organization and Responsibilities

Lead Organization USDA ESS/SRD

Task Coordinators Wendell Wilson, USDA ESS/SRD-Columbia

Clarence Sakamoto, USDC NOAA/EDIS-Columbia

7. Resource Requirements

a. Agency Funding

	FY81($K)	FY82($K)
USDA ESS-Columbia	63	63
USDC NOAA-Columbia	100	90
TOTAL	163	153

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA ESS-Columbia	.4	.4
USDC NOAA-Columbia	1.7	1.5
TOTAL	2.1	1.9

(2) University and Others

USDA (Univ. of Missouri)	.6	.6

8. Task Schedule and Milestones

TBD

9. Interfaces

Other AgRISTARS Projects - SR, EW, SM and FCPF.
Other Major Project Elements - Element #1 and Element #4.
Within Project Element #2 - Related to all research and development.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

TBD

C. TASK 3· INVESTIGATE STRATIFICATION ALTERNATIVES FOR EMPIRICAL CROP YIELD MODELS

WBS# 03-02-03-01-00-32-23-04-23-01-23
12-70-01-22-01-22
04-48-01-18
37-30

1. Objective

To investigate various stratification alternatives for crop yield models, evaluate procedures for forming strata and assess the impact on yield model reliability for large areas.

2. Scope

Selected domestic and foreign crop growing regions.

3. Duration

Two to four years

4. Anticipated Results and Products

Evaluation of yield forecast and estimate reliability for various stratification procedures. Determination of stratification designs for foreign areas and future domestic applications.

5. Subtasks

a. Subtask 1: Investigate the Impact on Crop Yield Model Performance of Stratification by Mutually Determined Domestic Agrophysical Units (APU's).

WBS#: 03-02-03-01-00-12-6-01-6
32-20-04-20-01-20

(1) Objective

Investigate the impact on model performance of stratification by mutually determined APU's as compared to stratification by crop reporting districts (CRD's) and no stratification (state level models).

(2) Technical Approach

Execute empirical crop yield models by APU's, CRD's and at the state level for corn and soybeans in Iowa, and wheat and barley in North Dakota. Possibly extend corn and soybean coverage to Illinois and Indiana and wheat and barley coverage to Minnesota.

Evaluate yield forecast and estimate performance for no stratification and with the two types of stratification. Performance will be evaluated primarily at the state and region level.

(3) Anticipated Results and Products

Determination of the impact on model performance of three alternative methods of stratifying crop areas.

(4) Test Sites - Iowa, North Dakota and possible Illinois, Indiana and Minnesota.

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Manager: Clarence Sakamoto, USDC NOAA/EDIS-Columbia

b. Subtask 2: Evaluate Various Stratification Alternatives for Their Impact on Crop Yield Model Reliability.

WBS# 03-02-03-01-00-12-52-01-22-01-22
04-30-37-30

(1) Objective

Identify methods of stratification which produce more reliable yield estimates.

(2) Technical Approach

Investigate methods of stratification which may produce internally more homogeneous strata for model input variables, relationships modeled and/or yield. Evaluate the reliability of large area yield forecasts and estimates when various stratification procedures are used.

(3) Anticipated Results and Products

Reports describing methods of stratification used and their impact on reliability of large area yield estimates and forecasts.

(4) Test Sites - Iowa, North Dakota, and possibly an area with less adequate meteorological data.

(5) Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Subtask Managers Fred Warren, USDA ESS/SRD-Washington

Wendell Wilson, USDA ESS/SRD-Columbia

c. Subtask 3. Participate in the determination of stratification designs for foreign areas and future domestic applications.

WBS#: 03-02-03-01-00-12-12-04-12-01-12
32-03-04-03-01-03

(1) Objective

Determine stratification designs for foreign areas and in future domestic applications which include full consideration for both yield model reliability and crop area estimation, and are thus targeted for maximum reliability in forecasting and estimating production.

(2) Technical Approach

Confer with FCPF and others designing application tests and participate in determining stratification designs.

(3) Anticipated Results and Products

Mutual determination of stratification designs for foreign areas and future domestic applications.

(4) Test Sites - TBD

(5) Organization and Responsibilities

Lead Organization USDA ESS/SRD

Subtask Managers Wendell Wilson, USDA ESS/SRD-Columbia

Clarence Sakamoto, USDC NOAA/EDIS-Columbia

6. Task Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Task Coordinator Wendell Wilson, USDA ESS/SRD-Columbia

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA ESS-Columbia	48	48
USDA-ESS-Washington	22	22
USDA-NOAA-Columbia	23	23
TOTAL	93	93

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA ESS-Columbia	.5	.5
USDA ESS-Washington	.4	.4
USDC NOAA-Columbia	.3	.3
TOTAL	1.2	1.2

(2) University and Others

USDA (Univ. of Missouri)	0.4	0.6

8. Task Schedule and Milestones

See Figure

9. Interfaces

Other AgRISTARS Projects - FCPF and SR, mutual determination of stratification designs.

Other Major Project Elements - Element #3, Task 2, 4, 5, & 6; Element #1, Task 4.

Within Project Element #2 - Related to all research and development

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Acquisition in suitable format of historic meteorological and agricultural data. Acquisition of ancillary data needed to conduct stratificaton.

D. TASK 4: IMPACT OF EPISODIC EVENTS ON CROP YIELD

WBS#: 03-02-04-01-00-32-83-04-83-01-03
19-80

1. Objective

a. To document episodic events by crops, growth stage and area, the impact of these events on crop yield as reported in the literature.

b. Investigate techniques to estimate crop yield losses resulting from social and natural episodes.

2. Scope

In FY81, models that relate yield losses to episodic events will be initiated for U.S. AgRISTARS Crops (corn, soybeans, wheat and barley). Initial search of the literature for foreign areas will begin and continue through FY82.

3. Duration

Four to five years

4. Anticipated Results and Products

If completed, this task will lead to a suggested method to adjust modeled estimates of crop yield where the model does not make provisions for episodes. This task will also provide a summarized data set that describes the impact of episodes over large areas and provide field researchers with information on needed research to more accurately quantify the impact of episodic events.

Products to be developed

a. A data set of documented episodes, the nature, description of damage, occurrence date and yield impact.

b. A candidate approach to adjust modeled estimates of crop yield for episodes.

5. Technical Approach

The literature, including government reports and contacts with scientists will be surveyed to maximize the quantitative and qualitative information content about these events as it impacts crop yields. Crop yield data from USDA, meteorological data from NOAA and also insurance actuary data will be analyzed. Since historical information and data are to be used, the technique will also involve a study of statistical approach and theory in maximizing the information.

6. Task Organization and Responsibilities

Lead Organization. USDC NOAA/EDIS

Task Coordinator: Clarence Sakamoto, NOAA/EDIS/CEAS-Columbia

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
USDC, NOAA/EDIS-Columbia	83	83

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDC NOAA/EDIS-Columbia	.1	.1
(2) University and Others		
USDC NOAA/EDIS (KSU)	1.5	1.5

8. Task Schedule and Milestones

a. Complete acquisition of data sets for publication-Nov 1980

b. Initiate Model building -Dec 1980

c. Complete documentation of data base -Dec 1980

d. Initiate Foreign areas literature search -Apr 1981

e. Complete preliminary model for episodic events -Jun 1981

f. Test and evaluation of preliminary model -Jul 1981

g. Proposal for further work -Aug 1981

h. Quarterly Reports -Dec 1980, Mar, Jun, Sept 1981

9. Interfaces

a. With other AgRISTARS Projects EW/CCA, SR, FCPF

b With other project elements: All

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

E. TASK 5: WHEAT YIELD MODEL DEVELOPMENT

WBS#: 03-02-05-01-00-13-990-06-990-01-990
12-107-01-107-01-62
-19-45

1. Objective

To develop physiological and phenological yield models for wheat.

2. Scope

For major wheat growing areas of the United States with probable extension to foreign areas.

3. Duration

Three to five years.

4. Anticipated Results and Products

Physiological and phenological wheat yield models to provide wheat yield estimates for the United States and potentially for foreign areas.

5. Subtasks

a. Subtask 1 Research coordination and integration for the development of physiological and phenological yield models for wheat.

(1) Objective

- o Research on the development of physiological and phenological wheat yield models.
- o Coordinate SEA/AR research and field data collection efforts to support wheat yield model development and testing.
- o Coordinate SEA/AR with ESS so that models developed can be utilized and integrated for improved crop forecasting and estimation.

(2) Technical Approach

- o Aid in collecting field data for use in testing and validating yield model development.
- o Data compilation from field sites.
- o Develop algorithms for a model from existing data and new data to simulate wheat growth and yield.

- o Test and validate yield models.

- o Coordinate with SEA/AR, ESS and NASA the sites to integrate research findings into model development.

(3) Anticipated Results and Products

- o Field data base on representative wheat growth from seven sites in the Central Great Plains.

- o Research results from SEA/AR sites to support wheat model development.

- o Development of algorithms to support a wheat growth and development model.

- o Operative phenological-based wheat yield model.

(4) Test Sites· Fort Collins, Colorado

(5) Organization and Responsibilities

Lead Organization: USDA SEA/AR

Subtask Manager: Wayne Willis, SEA/AR-Ft. Collins, Colorado

D. Heermann (conceptual model and coding, and data compilation), SEA/AR, Ft. Collins, Colorado

b. Subtask 2· Determine basic relationships of remotely sensed crop reflectance data as related to the wheat growth cycle.

(1) Objective

- o To determine basic relationships between remotely sensed canopy temperatures and reflectances as related to growth stage, biomass, leaf area index and other plant parameters under several water stress and environmental conditions, and to make these relationships independent of time of day, time of year, and latitude.

- o To cooperate and assist in developing a wheat yield model.

(2) Technical Approach

- o Analysis of extensive data sets from an experiment which included

(a) Field plots were planted to wheat at intervals of 4 to 6 weeks throughout an 18-month period. Each plot was subdivided into 4 subplots which were irrigated differently to create 4 different conditions of water stress. After the fifth plot was planted the field contained wheat at 5 different growth stages and 4 different water stress conditions, yet at any one time, they were all under the same soil and atmospheric environmental conditions.

(b) Meteorological and reflectance measurements, which were collected on a scheduled basis, on the field plots.

(c) Plant samples were taken from each plot twice each week. Biomass, leaf area index, plant height, growth stage, and other plant parameters were measured. Soil water content was monitored three times per week in each plot at 20 cm. intervals to a depth of 160 cm

(3) Anticipated Results and Products

Analysis of the experiment should provide basic data on the relationships between environmental, soil, and plant conditions and the spectral reflectance and radiometric temperatures of wheat. Planting wheat at different times of year caused similar environmental stresses (heat, water, etc.) to occur simultaneously to crops at different growth stages. This information should be useful in meteorological yield models. The time sequence of radiometric measurements for wheat under these various conditions should provide information that will aid in the detection and identification of crop stresses utilizing satellite data.

(4) Test Sites: The U.S. Water Conservation Laboratory, Phoenix, Arizona

(5) Organization and Responsibilities

Lead Organization USDA SEA/AR

Subtask Manager: Ray Jackson, SEA/AR Phoenix, AZ

c. Subtask 3: Determine winter wheat morphological development

(1) Objective

- o To determine wheat morphological development from two field sites for use in development and/or testing of algorithms for winter wheat yield prediction models.
- o To collect field data to assist in developing relationships between crop status and remotely sensed data, and in providing validation of wheat yield models.
- o To assist in the development of wheat yield models.

(2) Technical Approach

Hard red winter wehat will be grown under irrigated conditions so that soil water conditions can be controlled. Wheat will be grown where soil water will be limiting during one or more growth stages and where water will never be limiting. Hot winds will be artificially applied via a wind tunnel during jointing, boot, heading, flowering, and grain filling growth stages for periods 1, 2, 4 and 12 hours (time permitting for 12) at velocities of 32 and 64 km/h with temperature at ambient and increases of 5 ^{o}C above ambient. Plant water potential, dew point temperature, saturation deficit, and relative humidity will be monitored during each test. Leaf and tiller abortion will be recorded following each test and head number per unit area, kernel number per head, and kernel weight will be determined at maturity.

Collect data for wheat yield model at two field locations.

(3) Anticipated Results and Products

- o Determine the effect of duration and different wind velocities at various growth stages and different temperatures on crop condition and yield.
- o Effect of humidity on crop condition and yield at various growth stages.
- o Collect field data for model validation.

(4) Test Sites U.S. Central Great Plains Research Station, Akron, Colorado

(5) Organization and Responsibilities

Lead Organization: USDA SEA/AR

Subtask Manager. Darryl Smika, SEA/AR, Akron, Colorado

d. Subtask 4. Develop and assess parameters for input to a physiological wheat yield model.

(1) Objective

Conduct basic research on the physiological aspects of wheat to complete the development of a physiological process oriented wheat yield model.

(2) Technical Approach

Collect field data and conduct research using SPAR units to obtain physiological wheat data for analysis, development, and testing of a yield model.

(3) Anticipated Results and Products

An operational physiological process wheat model.

(4) Test Sites: Mississippi State, Mississippi

(5) Organization and Responsibilities

Lead Organization: USDA SEA/AR

Subtak Manager: D.L. Baker, SEA/AR, Mississippi

e. Subtask 5. Research to support the development of a phenological-based winter wheat model.

(1) Objective

Establish field and laboratory experiments for the collection of wheat growth data to support the development and validation of a phenological-based winter wheat model.

(2) Technical Approach

- o Collect data for phenological-based winter wheat model at two locations.
- o Determine growth and morphological development of wheat for use in developing and testing algorithms for a wheat yield prediction model.

- o Evaluate the use of a three-band radiometer to predict dry matter accumulation in wheat as influenced by micro-climatic parameters associated with crop residue and soil management variables.

(3) Anticipated Results and Products

A validation data set for use in testing and evaluating a phenological winter wheat model.

(4) Test Sites: Sidney, Montana

(5) Organization and Responsibilities

Lead Organization: USDA SEA/AR

Subtask Manager: J. K. Aase, SEA/AR, Sidney, Montana

f. Subtask 6: Develop and/or test various spring wheat development and yield models.

(1) Objective

- o Develop and/or test various models describing spring wheat development and yield.
- o Evaluate the efficiency of a three-band radiometer to predict dry matter accumulation in spring wheat cultivars.
- o Evaluate the effects of air temperature and soil fertility on inflorescence development in spring wheat.
- o Evaluate the effects of water stress and nitrogen fertility on development of spring wheat.

(2) Technical Approach

Collect and evaluate data on spring wheat morphological development in relation to soil and atmospheric environmental factors.

(3) Anticipated Results and Products

- o Models for sping wheat development and yield.
- o Data base for model testing.
- o Information to aid mitigation of stress effects on wheat growth and yield.

(4) Test Sites Mandan, North Dakota - 5 sites

(5) Organization and Responsibilities

Lead Organization: USDA SEA/AR

Subtask Manager A. Black, A. Bauer, SEA/AR, Mandan North Dakota

g. Subtask 7: Research to support winter wheat yield model development from physiological measurements and satellite imagery.

(1) Objective

Test developed models for predicting crop yield from physiological measurements and satellite imagery.

(2) Technical Approach

- o Determine phenological development of wheat at three precipitation zone sites for the testing and development of a winter wheat yield model to describe dry matter and grain yields.
- o Evaluate the efficiency of a three-band radiometer for estimating green biomass accumulation in winter wheat, and other management or microclimatic factors that affect radiation balance.

(3) Anticipated Results and Products

A winter wheat yield model for the Northwest U.S. wheat area

(4) Test Sites: Three sites in different precipitation zones within the dry-farmed agriculture region of eastern Oregon and Washington.

(5) Organization and Responsibilities

Lead Organization USDA SEA/AR

Subtask Manager: R. E. Ramig, SEA/AR, Pendleton, Oregon

h. Subtask 8: Crop Water Stress Assessment

(1) Objective

- o To evaluate water deficits on grain yield.
- o To provide data to assess model prediction of soil water balance under deficit conditions.

- o To evaluate thermal IR and spectral reflectance to assess plant water stress.

- o To assess yield components with water and nutrients both limiting and non-limiting.

(2) Technical Approach

- o Collect data on two CR5 instrumented sites in the southern part of the winter wheat growing region.

- o Assess how water deficits reduce actual yields below potential by influencing developing yield components during successive development stages. Yield components will include plants per m^2, tiller and head number per plant and per m^2, spikelets per head, grain number per spikelet, per head and per m^2, and grain weight.

(3) Anticipated Results and Products

Improved information on the relationship between water and nutrient deficits and wheat yield for incorporation into a winter wheat yield model.

(4) Test Sites: Bushland, Texas

(5) Organization and Responsibilities

Lead Organization USDA SEA/AR

Subtask Manager: J. T. Musick, SEA/AR, Bushland, TX

1. Subtask 9: Development of ecological based wheat yield models and improved wheat crop calendar.

(1) Objective

- o Develop, test and document ecological based wheat yield models that include genetic, management and soils details.

- o Improve the accuracy of the wheat crop calendar.

(2) Technical Approach

- o Field and phytotron studies to determine climate, genetic interactions as related to crop calendars for use in accurately defining the time of events in crop yield models.

- o Determine critical relationships between climate, management, and genetic characteristics as related to crop yield components used in crop yield models.

(3) Anticipated Results and Products

- o Improved wheat crop calendar.
- o Ecological-based wheat yield models.

(4) Test Sites: Temple, Texas

(5) Organization and Responsibilities

Lead Organization. USDA SEA/AR

Subtask Manager: J. T. Ritchie, SEA/AR, Temple, TX

j. Subtask 10. Relationships Among Spectral Data, Plant Components and Agronomic Variables

(1) Objective

- o Assist in analyzing Landsat 2 and 3 digital data for seven test wheat fields and to use them to further develop and test wheat models.
- o Assemble and analyze data from experiments dealing with response of spring and winter wheat to irrigation, vernalization, photoperiod, and temperature.
- o Establish soil background lines for handheld radiometer data; calibrate green biomass vegetative cover, and LAI to spectral indices derived from crop canopy measurements.

(2) Technical Approach

- o Utilize Landsat data correspondent to SEA/AR wheat field sites, ESCS data sets, and other sources to test confidence with which leaf area index (LAI) and green biomass, and compare these yields with yields determined by ground sampling.
- o Utilize Landsat data correspondent to SEA/AR wheat field sites, ESCS data sets, and other sources to determine relationships with plant components and agronomic variables. Where possible, agromet and spectromet models will be developed. Initially, research will be conducted utilizing present data

bases for selecting vegetative indices and establishing their mean and range as that helps determine year-to-year patterns. Analysis will include regression of selected vegetation indices, and agronomic and environmental factors against yields and yield components.

(3) Anticipated Results and Products

- o Expressions to relate vegetation indices to plant components and agronomic variables which show year-to-year changes in crop condition. Relationships to be used for crop condition assessment and yield components response estimation.
- o Calibrations of LAI and biomass in terms of satellite observations, so that yield models can be extended to many fields.
- o Procedures for expressing handheld field spectrometer data in terms of Landsat (top of atmosphere) digital counts and vice-versa. This capability enables ground measurements to fill in between satellite overpass dates for additional detail, and to provide missing data when clouds obscure satellite observations.
- o Expressions relating Landsat spectra to parameters like biomass, leaf area index, ground cover, and soil water that may be useful for inferring crop condition.

(4) Test Sites Weslaco, Texas

(5) Organization and Responsibilities

Lead Organization USDA SEA/AR

Subtask Manager C. Weigand, SEA/AR, Weslaco, Texas

k. Subtask 11: Investigation of Wheat Simulation Models for Large Area Yield Estimation.

WBS#: 03-02-01-01-00-12-107-01-107-01-62
-19-45

(1) Objective

To determine the success of plant growth and development simulation models for making reliable large area yield estimates.

(2) Technical Approach

Five plant growth models using different approaches and levels of complexity have initially been identified for consideration, and areas of work will include:

(a) Examination of input requirements of models to see if parameters are estimable and if data are economically obtainable with the required degree of accuracy.

(b) Sensitivity analysis of primary variables, parameters and functions to determine which factors are of the greatest relative importance. This analysis will also indicate whether model response is consistent with current scientific knowledge.

(c) Evaluation of functional relationships, subprograms and entire models using available plant and climate data. Methods which perform well will be retained while those which don't will be modified or replaced.

(d) Large scale testing will follow the development of an operative plant model.

(3) Anticipated Results and Products

A wheat simulation model that can be used to supplement current objective methods which use sampling techniques, or can be used in foreign areas where objective data are limited or unavailable.

(4) Test Sites· Fort Collins, Colorado

(5) Organization and Responsibilities

Lead Organization· USDA ESS

Subtask Manager. Greg Larsen, USDA ESS, Ft. Collins, CO

1. Subtask 12. Effect of Temperature and Water Availability on the Yield Potential of Winter Wheat.

(1) Objective

To evaluate the components of yield potential of wheat in relation to plant development and photosynthetic rate. To develop the partitioning section of a wheat yield model.

(2) Technical Approach

Research will be conducted to define the influence of environmental stress on yield components such as number of spikes, spikelets per spike, kernels per spikelet and mean kernel weight. Canopy photosynthesis, temperature, soil moisture and development stages will be monitored; resultant data will then be used to develop the partitioning part of a wheat yield model.

(3) Anticipated Results and Products

Partitioning section of a wheat yield model.

(4) Test Sites

Houston, Texas. The Evaporation Field Research Site near Manhatten, Kansas and various locations across Kansas.

(5) Organization and Responsibilities

Lead Organization. USDA SEA/AR

Subtask Manager· G. O. Boatwright, SEA/AR, Houston, Texas

6. Task Organiztion and Responsibilities

Lead Organization: USDA SEA/AR

Task Coordinators Jerry Ritchie, USDA SEA/AR, Beltsville
Galen Hart, USDA ESS/SRD, Washington, DC
Wayne Willis, USDA SEA/AR, Ft. Collins

7. Resource Requirements

a. Agency

	FY81($K)	FY82($K)
USDA SEA/AR - Locations	990	1050
USDA ESS-DCA	107	107
TOTAL	1097	1157

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA SEA/AR-Locations	15	15
USDA ESS-DCA	1.4	1.0
TOTAL	16.4	16.0

(2) University and Other

USDA ESS-DCA (KSU)	.6	.6

8. Task Schedule and Milestones

TBD

9. Interfaces

With other AgRISTARS projects: EW/CCA, SR, SM

With all other project elements: Element #4, Task 5

With other tasks within element. None

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

TBD

F. TASK 6: SOYBEAN YIELD MODEL DEVELOPMENT

WBS#: 03-02-06-01-00-13-640-21-640-01-640
12-35-01-35-64-35

1. Objective

To develop a physiological/phenological soybean growth/yield model(s) to accurately simulate the growth, development, and yield of soybeans.

2. Scope

To develop a physiological/phenological soybean growth/yield model for the U.S.

3. Duration

Three to five years.

4. Anticipated Results and Products

This research should result in the development and testing of soybean growth and development models that can be used to follow plant growth and development under varying climatic and stress conditions and to predict yield.

Products.

a. Soybean growth and development models.

b. Better understanding of soybean physiology and phenology.

c. Documentation of results.

5. Technical Approach

a. To develop the conceptional framework and necessary algorithms for developing a model that will simulate soybean growth and yield.

b. To set up experiments and collect data necessary to define the physiological and phenological concepts necessary for the development of a soybean model.

c. To test soybean models with available field data to determine accuracy (i.e., ESS-Missouri data set).

d. Test Sites: Urbana, Illinois; Mississippi St., Mississippi; Gainesville, Florida, Ames, Iowa.

6. Task Organization and Responsibilities

Lead Organization: USDA SEA/AR

Task Manager Doyle Peters, USDA SEA/AR, Urbana, Illinois

Task Coordinators: Jerry Ritchie, USDA SEA/AR, Beltsville, MD
Galen Hart, USDA ESS/SRD, Washington, DC.

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA SEA/AR-Locations	640	750
USDA ESS/SRD-Washington	35	35
TOTAL	675	785

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USEA SEA/AR	9	9
(2) University and Others		
USDA ESS/SRD (Univ. of Florida)	.8	.8

8. Task Schedule and Milestones

FY81 - Develop algorithms and computer model(s).

FY81 & FY82 - Test model(s)

FY81 to FY83 - Physiological and phenological research

FY84 - Summary Report

9. Interfaces

None

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

All data will be collected by investigators. There are no processing, distribution, nor retention requirements on other program elements.

G. TASK 7: COTTON GROWTH AND YIELD MODEL DEVELOPMENT

WBS#: 03-02-07-01-00-13-100-24-100-01-100
12-09-01-09-01-09

1. Objective

To test and improve GOSSYM as a process level model for simulating growth, development, and yield of cotton.

2. Scope

To test GOSSYM under different climatic conditions.

3. Duration

Two to four years.

4. Anticipated Results and Products

Evaluation of the forecasting and estimating capabilities of the GOSSYM cotton yield model.

5. Subtasks

a. Subtask 1. Simulation Testing of GOSSYM

(1) Objective

Simulation testing of the GOSSYM cotton yield model.

(2) Technical Approach

(a) GOSSYM will be tested using available data sets to determine how well it simulates different processes.

(b) Experiments will be designed to better define the physiological processes in GOSSYM.

(3) Anticipated Results and Products

This research should result in wider testing of GOSSYM and improvement of the model.

(4) Test Sites

Mississippi State, Mississippi, Tucson and Phoenix, Arizona, Israel

(5) Organization and Responsibilities

Lead Organization: USDA SEA/AR

Subtask Manager: Don N. Baker, USDA SEA/AR
Mississippi State, MS

b. Subtask 2: Evaluation of GOSSYM

WBS#: 03-02-07-01-00-12-09-01-09-01-09

(1) Objective

Evaluate GOSSYM as a model for forecasting and estimating cotton yields.

(2) Technical Approach

Analysis of GOSSYM through the use of the 1978 ESS Data set.

(3) Anticipated Results and Products

A determination of the feasibility of using GOSSYM for forecasting and estimating cotton yield.

(4) Test Sites

ESS selected fields in Mississippi

(5) Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Subtask Manager: Fred Baker, USDA/SRD - Washington

6. Task Organization and Responsibilities

Lead Organization. USDA SEA/AR

Task Coordinators: Jerry C. Ritchie, USDA SEA/AR, Beltsville, MD

Galen Hart, USDA ESS/SRD, Washington, DC

7. Resource Requirements

a. Agency Funding

	FY81($K)	FY82($K)
USDA ESS/SRD-Washington	9	9
USDA SEA/AR-Mississippi	100	100
TOTAL	109	109

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDA ESS/SRD-Washington	.2	.2
USDA SEA/AR-Mississippi	1	1
TOTAL	1.2	1.2

8. Task Schedule and Milestones

Subtask 1:

FY81 - Model improvement and documentation
FY82 & 83 - Summary Report

Subtask 2·

January 1981 - Preliminary Report

9. Interfaces

No specific interface with other program element is required.

10. Data Acquisition, Preprocessing/Processing, Distribution, and Retention Requirements

All necessary data will be collected or compiled by investigators. There are no processing, distribution, nor retention requirements on other program elements.

H. TASK 8: CORN AND SORGHUM GROWTH AND YIELD MODEL DEVELOPMENT

WBS#: 03-02-08-01-00-13-300-15-300-01-300
12-49-01-49-37-45
01-04

1. Objective

To develop and test ecological models to simulate growth, development, and yield of corn and sorghum in the United States, with potential application to foreign areas.

2. Scope

Major corn growing areas of the United States

3. Duration

Three to five years

4. Anticipated Results and Products

This research should result in the establishement and testing of corn growth and development models that can be used to follow plant growth and development under climatic and stress conditions and to predict yield. Updated sorghum model.

5. Subtasks

a. Subtask 1: Develop corn models

WBS#: 03-02-08-01-00-12-02-01-02-01-02

(1) Objective

To develop ecological models to accurately simulate growth, development and yield corn.

(2) Technical approach

(a) To develop the conceptional framework and necessary algorithm for models that simulate crop growth and yield.

(b) To set up experiment and collect data necessary to define general relationship necessary for the development of a corn and sorghum model.

(c) To test model(s) with available field data to determine accuracy.

(3) Anticipated Results

This research should result in the development of corn growth and development models that are useful for large area estimation of yield, for farm management decisions, and for policy analysis.

(4) Test Sites

Temple, Texas

(5) Organization and Responsibilities

Lead Organization. USDA SEA/AR

Subtask Manager: Joe Ritchie, USDA/SEA/AR, Temple, TX

b. Subtask 2. Quantifying water stress effects on growth, development and yield of corn.

WBS#: 03-02-08-01-00-12-47-01-47-01-02
37-45

(1) Objectives

(a) To examine existing methods of quantifying water stress effects on growth, development and yield of corn.

(b) To determine which of these methods are best suited to quantify water stress conditions in the humid areas of the midwest.

(2) Technical Approach

(a) The first objective will be achieved from examining existing literature to determine various methods of quantifying water stress. The assumptions of each method will be examined as to their validity. Since most work on quantification of water stress has been done in arid or semiarid regions, subjective judgment to some degree will be employed as to which of these methods should be tried in the more humid regions.

(b) When a series of candidate methods are chosen, the differential soil moisture installation (DSMI) will be used as an experimental site to test these methods. The DSMI is a site where pits 200' by 24' and drain tile and depth of topsoil (12", 18", 24" 30" and 36"). An area immediately adjacent to the pits was left undisturbed as a check plot. The soil of the

check plot is of the Putnam-Mexico series; which is typical of the middle and northern Missouri areas. These pits restrict the soil moisture reservoir. By a rough calculation, the 12" pit should experience some degree of water stress eight days after a rain or irrigation.

The basic experimental design is to follow the dry matter accumulation, phenology and components of yield for each plot (Pit) and the adjacent control area. Dry matter accumulation is measured by a serial sampling technique where each plant is partitioned and dried. All nondestructive phenological stages will be observed. The approximate times of tassel initiation will be noted from the dry matter work. Black layer formulation will also be observed. When physiological maturity has occurred, individual ears will be harvested and the number of kernel rows, number of kernels and the total kernel weight will be taken for each ear.

No attempt will be made to control the time and duration of the water stress during the first year of this study. This may be controlled during the subsequent years of study.

Other physiological parameters to be measured in order to promote a better understanding of the components of water stress are yet to be determined.

(3) Anticipated Results and Products

(a) Results concerning the effects of water stress should be obtained on dry matter accumulation, on partitioning of dry matter to various plant parts, on the development rate of the crop, and on component yields.

(b) A literature review of existing methods for quantifying stress.

(c) Data to evaluate and an evaluation of the better methods.

(d) Data and results to incorporate into existing crop models concerning the effects of water stress.

(4) Test Sites

Agronomy Research Center, Columbia, Missouri

(5) Organization and Responsibilities

Lead Organization: University of Missouri-Columbia, Missouri

Subtask Manager: M. Keener, University of Missouri

Co-manager: Galen Hart, USDA ESS/SRD-Washington

6. Task Organization and Responsibilities

Lead Organization: USDA, SEA/AR

Task Coordinator. Jerry C. Ritchie, USDA SEA/AR, Beltsville, Maryland

Galen Hart, USDA ESS/SRD-Washington

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA SEA/AR, Temple, TX	300	400
USDA ESS-Washington	49	49
TOTAL	349	449

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA SEA/AR-Temple, TX	3	4
USDA ESS-Washington	.1	.1
TOTAL	3.1	4.1

(2) University and Others

USDA ESS (Univ. of Missouri)	.9	1.4

8. Task Schedule and Milestones

Subtask 1: FY81 - Test and documentation of first version of corn model
FY81 & 82 - Literature review of data sets for corn models and conduct necessary experiments for collecting missing data
FY83-83 - Research and updating of critical relationship used in corn model
FY84-85 - Summary report

Subtask 2: TBD

9. Interfaces

Other AgRISTARS Projects - EW/CCA

Other major project elements -

Winthin Project Element # -

10. Data Acquisition, Preprocessing, Distribution and Retention Requirements

All data will be collected by investigators. There are no processing, distribution nor retention requirements on other program elements.

I. TASK 9: DATA ANALYSIS SUPPORT

WBS#: 03-02-09-01-00-12-27-01-27-01-27

1. Objectives

Provide experimental design and statistical analysis support to SEA/AR researchers examining questions related to yield modeling and early warning. This will include colocating mathematical statisticians with SEA/AR crop model development teams for the crops of wheat, soybeans, corn and cotton.

2. Scope

Utilize the Yield Research Branch staff of ESS to provide statistical expertise in the experimental design and data analysis.

3. Duration

Co-location generally would be for a minimum of two years. The analysis support for duration of project.

4. Anticipated Results and Products

Data analysis completed in a timely and usable fashion for a research report. Data sets used in analysis available to the general research community.

5. Technical Approach

The Yield Research Branch staff members will be available for analysis support to SEA/AR scientists. Publishing rights of the original research questions are the duty of the research scientists. An acknowledgement of analysis assistance would be expected. Data sets used in this manner would be catalogued and available for additional analysis by the same or other researchers.

Yield Research Branch staff would also be available as consultants to researchers for the development of improved experimental and survey designs to acquire required data for experimental purposes.

Yield Research Branch will co-locate people with SEA/AR yield modeling groups. These statisticians will provide direct statistical support in survey design, experimental design, data analysis, and model development. The Branch will augment that support as necessary.

Test Sites Anticipated co-location sites would include Fort Collins, Co (wheat); Urbana, IL or Gainesville, FL (soybeans); Temple, TX (corn), and Starkville, MS (cotton).

6. Task Organization and Responsibilities

Lead Organization. USDA ESS/SRD

Task Manager: TBD, USDA ESS/SRD-Washington

7. Resource Requirements *

a. Agency	FY81($K)	FY82($K)
USDA ESS-Washington	27	105

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDA ESS-Washington	0.6	2.0

8. Task Schedule and Milestones

TBD

9. Interfaces

With other AgRISTARS projects: Early Warning

With other major project elements: None

Within project element #2: TBD

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

a. Data Acquisition Requirements

The data will be specified and acquired by the research scientist being supported with analysis.

b. Data Preprocessing/Procesing Requirements

The preprocessing and processing requirements will be determined before analysis begins. Funds are available to process data for analysis.

c. Data Distribution and Retention

- o Data Types TBD
- o Products distribution: Results of data analyzed provided to cooperating researchers.
- o Origin of Data: Provided by cooperating researcher.

- o Data Retention: Three years with limited access depending upon approval of cooperating researcher. Data will be available sooner if a report is published.

* Funding and manyears allocated to colocation are specified with crop being modeled.

VII. MAJOR PROJECT ELEMENT #3 - DATA ACQUISITION, PROCESSING AND STORAGE - 7 TASKS

Agricultural and meteorological data sets will be acquired, processed and stored in computer files for use in model development, testing, and operating of selected models as required by YMD and other projects. Procedures to store, acquire and use these data sets will be developed and documented for use.

A. TASK 1: DEVELOP PROCEDURES FOR ACQUISITION AND USE OF DATA SETS

WBS# 03-03-01-01-00-32-16-04-16-01-16
12-09-04-09-01-09

1. Objectives

a. To maintain documentation standards for acquisition of data sets.

b. To maintain documentation standards for data sets.

c. To develop standards and procedures for acquiring new data sets and inventorying old data.

2. Scope

Documentation procedures developed in accordance with FIPS Pub 38 will be maintained as required. Methods will be developed and documented for acquiring new data sets and for inventorying existing data.

3. Duration

One to two years.

4. Anticipated Results and Products

A document outlining procedures and/or standards for acquiring, documenting, storing and using data sets.

5. Subtasks

a. Subtask 1· Development of Procedures for the Acquisition of new AgRISTARS Data Sets

WBS#· 03-03-01-01-00-32-04-04-04-01-04

(1) Objective

To establish a standard procedure for the acquisition of new data sets.

(2) Technical Approach

A procedure will be established to convert existing data sets (agricultural and meteorological) to a standard format for use in AgRISTARS.

(3) Anticipated Results and Products

A decrease of time to acquire new data sets; a reduction of cost by lessening duplicate acquisitions; central control of acquisition process.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization. USDC NOAA/EDIS

Subtask Manager. Tom Phillips, USDC NOAA/EDIS Columbia

b. Subtask 2. Inventory and Convert Data Sets Within USDC (NOAA)

WBS#: 03-03-01-01-00-32-12-04-12-01-12

(1) Objective

To inventory and standardize met data existing within NOAA and put it in a standard format usable for yield model development and testing.

(2) Technical Approach

Convert existing records into data sets according to standards developed in this task.

(3) Anticipated Results and Products

The creation of data sets of met data which can be used by all AgRISTARS projects. This will include a User's Guide to existing data sets.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization USDC NOAA/EDIS

Subtask Manager. Tom Phillips, USDC NOAA/EDIS Columbia

6. Task Organization and Responsibilities

Task Coordinators: Clarence Sakamoto
USDC NOAA/EDIS-COU

Wendell Wilson
USDA ESS/SRD-COU

Lead Organizaton: USDC NOAA/EDIS

7. Resource Requirements

a. Agency - Funding Requirements

	FY81($K)	FY82($K)
USDC NOAA/EDIS-Columbia	16	16
USDA ESS/SRD-COU	9	9
TOTAL	25	25

b. Manyear Equivalents

	FY81(MYE)	FY82(MYE)
USDC NOAA/EDIS-COU	.5	.5
USDA ESS/SRD-COU	.2	.2
TOTAL	.7	.7

8. Task Schedule and Milestones

See Figure

9. Interfaces

With other AgRISTARS Projects - FCPF, SR, EW, SM and Data management team.

Within other major Project Elements - #1, #2

Within Project Element #3 - all tasks

10. Data Acquisition, Preprocessing, Processing, Distribution, and Retention Requirements

TBD

Task Schedule and Milestones

Project Element #3, Task 1: Develop Procedures for Acquisition and Use of Data Sets

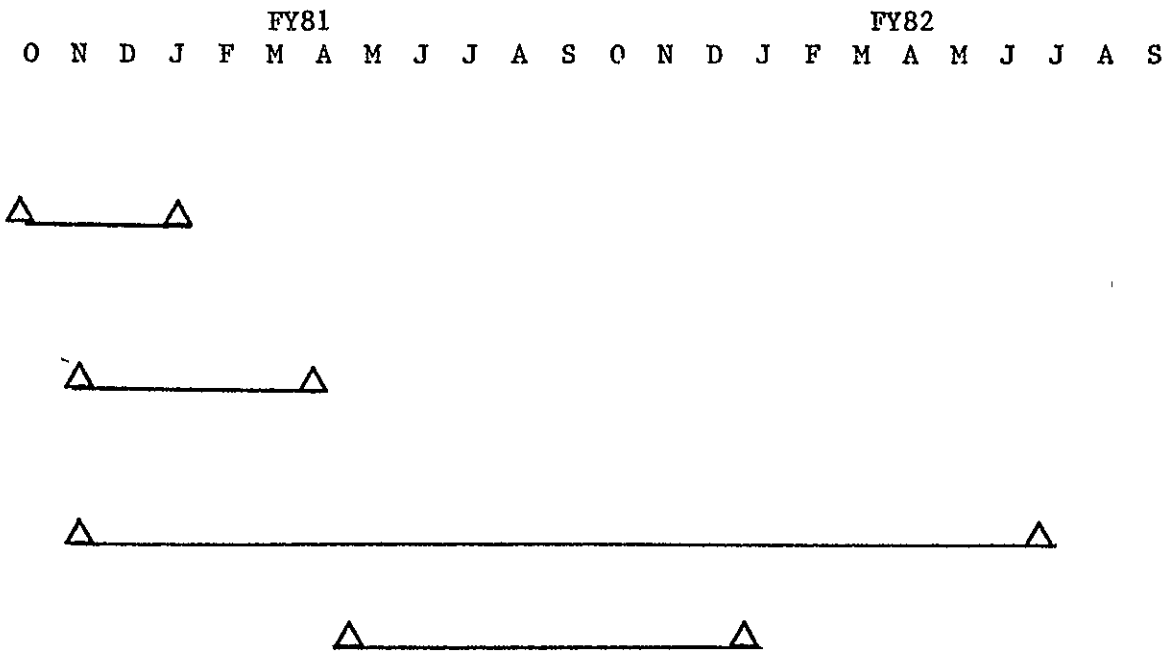


Figure VII-1

B. TASK 2: MONTHLY METEOROLOGICAL DATA FOR U.S. AND FOREIGN COUNTRIES

WBS#: 03-03-02-01-00-32-95-04-95-01-25
-99-70

1. Objective

To acquire and process in computer useable form, meteorological data for crop gowing areas in AgRISTARS countries.

2. Scope

In those AgRISTARS crop regions of Argentina, USSR, and US.

3. Duration

Two years.

4. Anticipated Results and Products

Quality controlled data base in card-punched and tape form of temperature and precipitation.

5. Subtasks

a. Subtask 1: Agrophysical Unit (APU) Meteorological Data Base for Indiana and Illinois

WBS#: 03-03-02-01-01-32-03-04-03-01-03

(1) Objective

Develop and document a monthly (and daily) non-aggregated and aggregated APU climatological data base for Indiana and Illinois.

(2) Technical Approach

From known sources of data, including National Climate Center, State Climatologist Office and scientists, obtain selected station data in both states and surrounding areas for the period 1948 through 1980. These data will be checked for consistency and reliability and placed on a tape. Documentation of the data will be provided.

(3) Anticipated Results and Products

A data base by station and county level to include monthly mean maximum and mean minimum

temperatures and total precipitation for Indiana and Illinois from 1948 through 1980.

Products to be Delivered

A tape of the above variables, a hard copy of the data; a documentation of the tape and data set.

(4) Test Sites

Illinois and Indiana

(5) Organization and Responsibilities

Lead Organization. USDC NOAA/EDIS

Subtask Manager Sharon LeDuc, NOAA/EDIS Columbia

b. Subtask 2: Historical Meteorological Data Base by Oibasts for USSR

WBS#: 03-03-02-01-06-32-05-04-05-01-05

(1) Objective

To extend the meteorological data base by oblasts for the Soviet Union.

(2) Technical Approach

All available source of climatological data, including WMO data, published reports, and maps will be used to provide average temperature and total precipitation for the month in each oblast of the wheat, corn and sunflower growing areas of the Soviet Union.

(3) Anticipated Results and Products

An improved data set which replaces an operational data set estimated from fewer reporting stations.

Products to be developed:

1. Mean temperature and total precipitation table for each month beginning from January 1977 through current.

2. Documentation of procedures used to estimate the above meteorological variables.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization USDC, NOAA/EDIS

Subtask Manager· Susan Callis, NOAA/EDIS-Columbia

c. Subtask 3. Development of a monthly meteorological data base for the wheat, corn and soybean areas of Argentina.

WBS#: 03-03-02-01-10-32-15-04-15-01-15

(1) Objective

(a) Select, quality control and process monthly station data of mean maximum and mean minimum temperatures and total precipitation for Argentina from 1931-1979.

(b) Aggregate for each crop reporting region monthly temperatures and precipitation for the corn, wheat and soybean regions.

(2) Technical Approach

Available meteorological data from CEAS data bank will be re-evaluated with respect to the station distribution and coverage. Additional needed data will be obtained through various possible sources including the National Climatic Center and contracts through the Servicio Meteorologico Nacional of Argentina. The data base should include the most recent available data years commensurate with available crop data years. The corn, wheat and soybean production areas will be included.

(3) Anticipated Results and Products

Completed monthly data set for selected stations in Argentina for an extended period commensurate with available and reliable crop data. Card-punched and computer tape data set of monthly meteorological data for selected stations in Argentina's wheat, corn and soybean growing areas.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Manager: Clarence Sakamoto, NOAA/EDIS-Columbia

d. Subtask 4: Meteorological Data for Rice and Cotton Growing Areas of the U.S.

WBS#: 03-03-02-01-04-32-72-04-72-01-02 -99-70

(1) Objective

To acquire and process in computer useable form monthly meteorological data for the rice and cotton growing areas specified in AgRISTARS in the U.S.

(2) Technical Approach

Through files at NCC and the State Climatologist office for respective states develop a historical data base commensurate with the length of agricultural data.

(3) Anticipated Results and Products

Quality-controlled station data for monthly periods from about 1948 to present in card-punched and tape form for temperature and precipitation.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS-Columbia

Subtask Manager: Royce Kirk, USDC NOAA/EDIS-Columbia

6. Task Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS-Columbia

Task Coordinator: Sharon LeDuc USDC NOAA/EDIS-Columbia

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
USDC, NOAA/EDIS	95	80

b. Manyear Equivalents	FY81(MYE)	FY82(MYE)
(1) Civil Servants		
(2) USDA, NOAA/EDIS	1.0	.8
(3) University/Others		
Support Contractor - TBD	3.0	2.0

8. Task Schedule and Milestones

Commensurate with project needs and its milestones

9. Interfaces

a. With other projects - TCPF, EW

b. With other program elements - all

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

This is a data acquisition and processing task

C. TASK 3: ACQUIRE AND PROCESS DAILY HISTORICAL METEOROLOGICAL STATION DATA FOR THE U.S. AND FOREIGN COUNTRIES

WBS#. 03-03-03-04-00-32-205-04-55-01-155
-33-150-65-50

1. Objective

Acquire, quality controlled historic daily maximum, minimum temperatures and total precipitation and other elements as designated for all regularlly reporting stations.

2. Scope

Daily maximum and minimum temperatures and total precipitation will be assembled for all regularly reporting WMO stations in AgRISTARS areas of interest. Additional data elements (daily incoming solar radiation, average wind speed, relative humidity, cloud amount and type, etc.) will be gathered where feasible.

3. Duration

Four to six years.

4. Anticipated Results and Products

Quality controlled climatic elements including daily maximum and minimum temperatures and total precipitation stored in specified format, delivered by the contractor.

5. Technical Approach

The ETAC DATSAV files at NCC, Asheville will be unpacked into two files. File 1 will contain max-min temperatures and 24 hour precipitation and snow depth. File 2 will contain cloud cover,wind direction and velocity, dew point and sea level pressure. Data will be unpacked in three phases. Phase 1 will include 1973-1980 station data. Phase 2 will include 1970-72 and Phase 3-1965 to 1969. Australian data is now being worked. Remaining countries will be per NOAA EDIS representative to NASA, JSC, EOD Letter on Priorities.

6. Task Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS -

Task Manager: Mike Helfert,USDC NOAA/EDIS-Houston.

7. Resource Requirements

a. Agency - Funding Requirements	FY81($K)	FY82(4K)
USDC NOAA/EDIS-Columbia	205	205
b. Manyear Equivalents	**FY80(MYE)**	**FY81(MYE)**
(1) Civil Servants		
USDC NOAA/EDIS-Columbia	.3	.3
(2) University and Others		
University of Oklahoma	1.5	1.5
USDC NOAA/NCC Asheville	3.0	3.0
Total	4.5	4.5

8. Task Schedule and Milestones

9. Interfaces

With other AgRISTARS projects: EW, SR, FCPF and SM

With other organizations: FAS CCAD

10. Data Acquisition, Quality Control, Processing, Distribution and Retention Requirements

Involves acquisition of historical data sets from national and international data centers and current data from WMO-GTS system.

Quality control includes assembling data by station, checking for homogeneity of record and consistency with surrounding station observation.

Distribution to AgRISTARS project will require ICD for coordination and to document time period constraints for users.

Retention requirements are long term (duration of project).

D. TASK 4· MAINTAIN, UPDATE, ACQUIRE AND BUILD HISTORIC AGRICULTURAL DATA BASES.

WBS#. 03-03-04-01-00-12-117-01-52-01-27
-99-25
-04-65-01-65

1. Objective

Provide accurate historic agricultural data bases for use in model testing and evaluation and in research and development efforts.

2. Scope

AgRISTARS crop and country combinations. Historical data for an appropriate time period and at a level of detail consistent with project objectives.

3. Duration

Four to five years.

4. Anticipated Results and Products

Accurate historic agricultural data bases, containing the latest revisions and completely documented, are available for use.

5. Substasks

a. Substask 1. Maintain and Update Domestic Agricultural Data Bases.

WBS#. 03-03-04-01-00-12-68-01-52-01-27
-99-25
-04-16-01-16

(1) Objective

Maintain up-to-date and accurate historical agricultural data bases.

(2) Technical Approach

On a regular basis, obtain agricultural publications which contain the latest revisions and update existing agricultural data bases. Reflect status of updating activity in data base documentation.

(3) Anticipated Results and Products

Up-to-date and accurate existing historic agricultural data bases are maintained.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization: USDA ESCS/SRD

Subtask Manager: TBD, USDA ESCS/SRD-Columbia

b. Subtask 2: Acquire, Develop and Build Technological and Economic Factor Data Bases.

WBS#: 03-03-03-01-00-12-23-04-23-01-23

(1) Objective

Provide accurate and useful technological and economic factor data bases to support research in Task 1 of Project Element #2.

(2) Technical Approach

Obtain information on technological and economic factors from various sources and build data sets which are as accurate and complete as possible. Participate in efforts to assure accuracy of these data bases and provide documentation to facilitate their use.

(3) Anticipated Results and Products

Technological and economic factor data bases that are as accurate and complete as possible are documented and available for use.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization: USDA ESCS/SRD

Subtask Manager James Cotter, USDA ESCS/SRD Columbia

c. Subtask 3: Acquire, Analyze and Build Suitably Accurate foreign Historic Agricultural Data Bases.

WBS#: 03-03-04-01-00-12-26-04-26-01-26

(1) Objective

To provide accurate foreign historic agricultural data bases needed for yield model development and testing.

(2) Technical Approach

Identify potential sources of agricultural information for selected foreign areas, obtain publications and/or existing data sets for these areas, and document such sources within the YMD project. Identify data sets that are actually needed, build initial data set computer files and analyze them for completeness and reliability. As necessary, seek additional information and clarification about suspect data. Review data for reliability and, if necessary, submit the data to subject matter specialist for review. Document all resulting data sets, including any reservations as to their accuracy and completeness.

(3) Anticipated Results and Products

Suitably accurate and complete foreign historic agricultural data bases are documented and available for use.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organiztion: USDA ESCS/SRD

Subtask Manager. James Cotter, USDA ESCS/SRD Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA ESCS/SRD

Task Coordinator: James Cotter, USDA ESCS/SRD-Columbia

7. Resources Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA ESCS-Columbia	65	65
USDA ESCS-Washington	52	52
Total	117	117

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDA ESCS-Columbia	1.5	1.5
USDA ESCS-Washington	.6	.6
Total	2.1	2.1

(2) University and Others

USDA ESCS-Columbia - TBD	1.0	1.0

8. Task Schedule and Milestones

See Figure

9. Interfaces

Other AgRISTARS Projects - Various other AgRISTARS projects, depending upon where data sets are available and can be obtained.

Other Major Project Elements - Support major project elements #1, #2 and #4.

Within Project Element #3 - Relates to meteorological data sets obtained in various tasks in the level of aggregation/disaggregation.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Data sets developed will be maintained within the YMD project. Data acquisition will depend upon availability of data sets and with specific details to be determined over the life of this task.

D. Task 5: OBJECTIVE METHODS OF AGGREGATING METEOROLOGICAL DATA WHICH INCLUDES SPATIAL AND TEMPORAL CONSIDERATION.

WBS#: 03-03-05-01-00-12-37-01-37-10-12
-99-25
-32-85-04-85-41-80
-01-05

1. Objective

To enhance the spatial and temporal distribution of surface meteorological reports including temperature and precipitation.

2. Scope

This task continues the work initiated in April, 1980, to include the areas of a semi-arid (Kansas) and a humid (Illinois) area. Daily, weekly and monthly data will be analyzed in FY81, work will be initiated to include satellite for spatial coverage.

3. Duration

Two to three years.

4. Anticipated Results and Products

Objective methods of optimizing current meteorological network stations and supplemental satellite data to enhance spatial and temporal accuracy of temperature and precipitation reports.

5. Subtasks

a. Subtask 1: Error Estimate of Objective Precipitation Estimates.

WBS# 03-03-05-01-00-32-23-04-23-41-20
01-03

(1) Objective

To estimate the "error" for selected methods of objectivity estimating precipitation for a crop reporting district level.

(2) Technical Approach

Selected statistical methods will be tested to provide a gridded data input based upon a

C-2

predetermined station network density. The error will depend upon the type of storm or synoptic pattern and, therefore, the climate.

(3) Anticipated Results and Products

For both a semi-arid and humid climate and for each month of the year, values of estimated error will be provided. This error term, in turn, will be used to provide a sensitivity analysis of the candidate crop models. A report to include a survey of objective methods, advantages, limitations, table of error terms for each month in a semi-arid and humid climate.

(4) Test Sites

Kansas and Illinois.

(5) Organization and Responsibilities

Lead Organization USDC NOAA/EDIS

Subtask Manager. Sharon LeDuc, NOAA/EDIS Columbia

b. Subtask 2: Spatial Enhancement of Surface Meteorological Report with Satellite Imagery.

WBS#. 03-03-05-01-00-32-62-04-62-41-60 01-02

(1) Objective

To objectively include satellite information with surface meteorological reports and enhance the spatial representation of these quantitative reports.

(2) Technical Approach

Comparison will be made to determine if improvements in precipitation estimates are achieved over an aggregated area such as a crop reporting district, as compared with conventional aggregation, including averaging and other objective anlaysis.

(3) Anticipated Results and Products

Estimates of mean and standard deviation of error enhancement from meteorological satellite images as compared with other methods based upon surface reporting. A report that includes the application of satellite to enhancement of precipitation over temporal and spatial scale, methodology, results including limitations, estimates of compared methods and improvements, if any.

(4) Test Sites

Kansas and Illinois

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Manager: Sharon LeDuc, NOAA, EDIS Columbia

c. Subtask 3: Error Estimate of Large Area Yield Forecast Based on Density of Weather Network

WBS#: 03-03-05-01-00-12-37-01-37-10-12 99-25

(1) Objective

a. Estimate error in modeled large area yield estimate resulting from density or observing networks.

b. Technical Approach

The spatial variability of a single weather element - rainfall - would be investigated. A crop simulation model that is highly sensitive to moisture conditions would be run for a number of growing seasons. Soil water conditions for these seasons would be generated by an areal rainfall simulator which is capable of producing rainfall events on all dimensional scales. The statistical distributions of the rain showers generated by the simulator can be manipulated to approximated observed distributions for an area. Two types of large-area yield estimates would be produced by the corp simulation model - one that

accounts for the actual areal distribution of rainfall and another which is derived from executing the crop model on a network of grid locations within the area. Comparison of these yield estimates would allow a quantification of the error due to the capability of the observing network to capture the variability of weather over the area.

(3) Anticipated Results and Products

A portion of the design of weather and crop yield modeling validation system.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization. USDA/ESS, Washington

Subtask Manager: Fred Warren, USDA/ESS Washington

6. Task Organization and Responsibilities

Lead Organization· USDC NOAA/EDIS

Task Coordinator Sharon LeDuc, NOAA/EDIS/CEAS

7. Resource Requirements

a. Agency - Funding

	FY81($K)	FY82($K)
USDA, NOAA/EDIS/COU	85	85
USDA, ESS/Washington	37	37
Total	122	122

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDC, NOAA/EDIS/Columbia	.1	.1

(2) University and Others

USDC, NOAA/EDIS/Columbia		1.0
USDA/ESS/Washington - TBD	1.3	
USDC, Columbia (University of Wisconsin)	1.5	1.5
Total	2.8	2.5

8. Task Schedule and Milestones

a.	Complete acquisition of met data	9/80
b.	Complete software for analysis	10/80
c.	Initiate acquisition of satellite data	11/80
d.	Complete sub-task 1 for Kansas and Illinois	3/81
e.	Complete initial algorithm for including satellite information with ground reports	4/81
f.	Complete comparison of other aggregation methods	5/81
g.	Complete quarterly reports (Nov. 1980, Feb. 1981, May 1981, Aug. 1981, Nov. 1981, Feb. 1982)	
h.	Final report	

9. Interfaces
   a. With other AgRISTARS Project. EW, SR.
   b. With other major project elements: Crop Yield Model Research and Development.

10. Data Acquisition, Distribution and Retention Requirments

TBD

F. TASK 6: DATA DICTIONARY/DIRECTORY OF DATA HOLDINGS

WBS# 03-03-06-01-00-32-95-01-95

1. Objective

To provide a reference medium for data holdings wihtin the Modeling Center/NOAA/USDC/AgRISTARS.

2. Scope

All digitized meteorological data holdings within the Modeling Center/NOAA/USDC/AgRISTARS.

3. Duration

Two to three years.

4. Anticipated Results and Products

A computerized Data Dictionary/Directory, which describes the characteristics of the Modeling Center data holdings and references to existing data set documentation.

5. Subtasks

a. Subtask 1: Define the structure of the Data Dictionary/Directory

WBS# 03-03-06-01-00-32-20-64-20-61-20

(1) Objective

To define a framework within which the data characteristics may be maintained.

(2) Technial Approach

Collecting data characteristics

Job analysis techniques

(3) Anticipated Results and Products

Definition of the inputs and output of a functional data dictionary/directory.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization USDC NOAA/EDIS

Subtask Manager: David Clark, USDC/NOAA/EDIS, Columbia

b. Subtask 2: Inventory of Digitized Data within Modeling Center USDC (NOAA/EDIS-Columbia)

WBS#: 03-03-06-01-00-32-30-04-30-01-30

(1) Objective

To provide data characteristics of existing data

(2) Technical Approach

Dumps

Tape maps

Investigative research

(3) Anticipated Results and Products

Data characteristics and formats which may be used as input to data dictionary/directory.

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Manager: Susan Callis, USDC NOAA/EDIS Columbia

c. Subtask 3: Data Set Documentation

WBS#: 03-03-06-01-00-32-25-04-25-01-25

(1) Objective

To provide written documentation of data set characteristics and formats.

(2) Technical Approach

Use NOAA/EDIS/CEAS-Columbia Data Set

Documentation Standards

(3) Anticipated Results and Products

Data set documents

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization. USDC NOAA/EDIS

Subtask Manager: Mary Joshua, USDC/NOAA/EDIC Columbia

d. Subtask 4: Implementation of the Computerized Data Dictionary/Directory

WBS#: 03-03-06-01-00-32-20-04-20-01-20

(1) Objective

To provide Modeling Center Staff with a computerized tool by which data characteristics, formats, and location may be referenced.

(2) Technical Approach

Entering the input to the data dictionary/directory program system.

(3) Anticipated Results and Products

A computerized data dictionary/directory

(4) Test Sites

N/A

(5) Organization and Responsibilities

Lead Organization· USDC NOAA/EDIS

Subtask Manager. David Clark, USDC NOAA/EDIS Columbia

6. Task Organization and Responsibilities

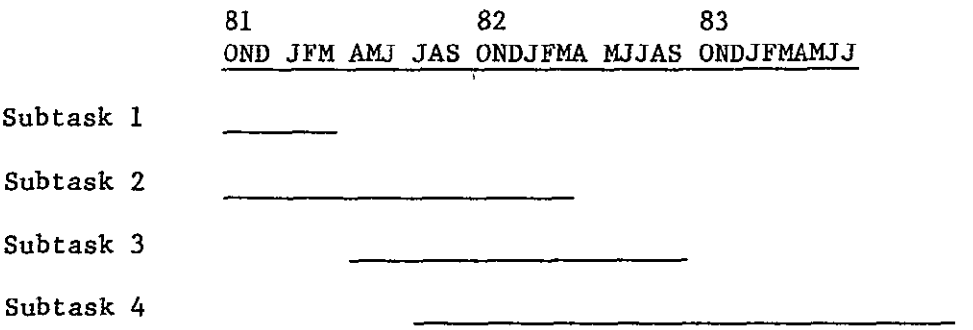
Lead Organization: USDC NOAA/EDIS

Task Coordinators: Thomas Phillips, USDC NOAA/EDIS Columbia

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
USDC NOAA/EDIS-Columbia	95	80
b. Manyear Equivalents		
USDC NOAA/EDIS-Columbia	2.0	1.5

8. Task Schedule and Milestones



9. Interfaces

With the AgRISTARS Projects: All

With other project elements. All

10. Data Acquisition Preprocessing, Processing, Distribution and Retention Requirements

F TASK 7 METEOROLOGICAL DATA BASE PREPARATION

WBS# 03-03-07-04-00-33-35-04-350-01-350

1. Objective

To develop an automated system of current global daily, weekly and monthly summaries of U.S. and foreign meteorological station data.

2. Scope

Meteorological station data for U.S. and foreign countries of interest to AgRISTARS from selected station data.

3. Duration

Length of project

4. Anticipated Results and Products

An automated, accessible data base of current meteorological data elements for use by AgRISTARS projects

5. Technical Approach

Current U.S. and foreign data (three and six hourly WMO Reports) will be processed on a current basis to provide real time meteorological data for AgRISTARS use. This data will be processed by the Climatic Analysis Center, NWS, and made available through the JAWF. Missing and questionable data will be reviewed, entered or corrected, and quality controlled by a NWS meteorologist

6. Task Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Task Manager: Norton Strommen, USDA/ESS, Washington

7. Resource Requirements

a. Agency - Funding Requirements	FY81($K)	FY82($K)
USDC NOAA/DCA	350	564

b. Manyear Equivalents	FY80(MYE)	FY81(MYE)
University/Other (TBD)		
USDC NOAA/CAC, Washington	3 0	5.0

8. Task Schedule and Milestones

TBD

9. Interfaces

With other AgRISTARS projects: All

With other organizations FAS CCAD, ESCS

10. Data Acquisition, Preprocessing, Processing, Distribution, and Retention Requirements

Data will be retained by JAWF. On-line and off-line data will be disseminated by JAWF.

VIII. MAJOR PROJECT ELEMENT #4· RELATED YIELD RESEARCH - 7 TASKS

This program element will address the potential use of satellite data or products as input to crop yield models. USDA SEA/AR will define spectral and/or remote sensing inputs into it crop growth models; NOAA/NESS will use meteorological satellite data to estimate solar radiation and maximum and minimum temperatures. Precipitation estimates from satellite are under the Early Warning Project. YMD will conduct pilot experiments in the application of satellite spectral products and monitor other research results for potential use in crop yield models.

A. TASK 1: INVESTIGATE POTENTIAL FOR INTEGRATING SATELLITE PRODUCTS INTO CROP YIELD MODELS

WBS#: 0304010100-12(22)01(22)01(22)

1. Objective

a. Evaluate the use of Landsat data and ground collected biological yield indications in crop yield models.

b. Develop and analyze a regression estimator that uses Landsat data and ground collected biological yield indications in estimating crop yield.

2. Scope

Testing of the methodology will be performed at sub-state levels in the U.S. Depending on data processing capacities, methodology could be applied at national levels.

3. Anticipated Results and Products

A published report will be completed on the analysis of each available data set. (Iowa 1978 and Missouri 1979). These reports will document and evaluate the methodology developed for using Landsat data in forming crop yield estimates. Recommendations for further study of this technology may also be made.

4. Test Sites

ESCS selected fields in:

Iowa - 1978
Missouri - 1979
Iowa - 1981
Kansas - 1981

5. Technical Approach

Field specific Landsat data near harvest and ground collected biological yield indications will be (or have been) collected in the following areas for the crops specified:

Iowa 1978	corn and soybeans
Northern Missouri 1979	corn and soybeans
Kansas 1981	wheat
Iowa 1981	corn and soybeans

In addition, all Landsat data classifications for the particular crop(s) for the particular area will be obtained. A regression estimator will be developed and evaluated in comparison to estimates formed from ground data only.

6. Organization and Responsibilities

Lead Organization: USDA ESS/SRD

Task Manager Bill Iwig, USDA ESS/SRD
Washington

7. Resource Requirements

a. Agency - Funding Requirements

	FY 81 ($K)	FY 82 ($K)
USDA ESCS-Washington	22	22

b. Manyear Equivalents

	FY 81 (MYE)	FY 82 (MYE)
(1) Civil servants		
USDA ESCS-Washington	.5	.5

8. Task Schedule and milestones

9. Interfaces

With other organizations: Remote Sensing Branch/SRD
With other AgRISTARS Projects: Early Warning
With other project elements: Element #2, Task 10
Within Project Element #4. None

10. Data Acquisition, Preprocessing, Distribution, and Retention Requirements

TBD

B. TASK 2: SOLAR RADIATION INCIDENT AT THE SURFACE

WBS#: 0303020100-31-95-03-95-99-35
01-60

1. Objective

a. Provide estimates of daily total incident solar radiation at the surface for selected crop growing regions of the Western Hemisphere.

b. R&D into improved techniques for producing radiation estimates from GOES data.

c. Research for techniques to estimate insolation from polar-orbiter data.

2. Scope

a. Western Hemisphere insolation estimates will be produced experimentally at the NESS/NWS dat processing facility from GOES data and made available to users subject to the following conditions·

(1) Insolation will be produced only during the growing season at a selected locality (techniques will not work if ground is snow covered).

(2) Daily total insolation will be initially produced on a 1° lat-long grid or other suitable area to be determined.

(3) NESS will provide as much quality control as practical within resource limitations. If data of sufficient quality and quantity are unavailable, no product will be produced. Particularly, insolation estimate requires a reliable VISSR Data Base containing at least five earth-locatable visible GOES pictures per day.

b. R&D on new and improved techniques will continue as resources budgeted to radiation allow until products of sufficient accuracy are achieved or until feasibility of estimating insolation from polar orbiters is determined. Year around R&D techniques - TBD.

3. Duration

a. Western Hemisphere insolation estimates will be produced experimentally over eastern two-thirds of the United States beginning in 1980. Other regions will be added as software is developed. Task will continue through 1985.

b. R&D will continue in 1981 and 1982 as needed (see 2.b).

4. Task Definition

a. Arrays of daily total insolation estimates at grid points for selected crop growing regions in the Western Hemisphere.

b. Identification and evaluation of techniques to estimate insolation from polar orbiter data. If sufficiently accurate technique is identified, it would be tested operationally.

5. Technical Approach

a. Western Hemisphere insolation

GOES data from the NESS VISSR Data Base (VDB) would be used to estimate insolation. The technique initially used would be regression against mean visible brightness of targets centered on lat-long grid points. Hourly insolation would be derived from approximately five pictures per day and summed to get a daily total. Procedures to estimate target brightness under cloud-free conditions and ground truth data from pyrometers are required to support the regression technique.

Hourly and daily total insolation as well as target radiances and standard deviations would be archived at selected pyrometer stations for comparison with ground truth, derivation of regression coefficients, and study of new techniques. Ground truth would be collected from USDA and NOAA pyrometer stations. Hourly and daily readings from about 15 well-calibrated pyrometers distributed over the eastern two-thirds of the United States are needed.

Extension of insolation estimates to South American crop growing regions will require some additional research to account for different terrain and vegetative cover, and to compensate for a lack of ground truth. Pyrometer data from South America would be useful.

b. Global insolation from polar-orbiting satellites

A first approach to global coverage from polar orbiters would be to estimate insolation using cloud cover information derived from heat budget products. A coincident TOVS, heat budget, and pyrometer data set covering the eastern United States would serve for R&D and to test the feasibility of any global insolation technique.

6. Organization and Responsibilities

Lead Organization: USDC NOAA/NESS

Task Manager: Dan Tarpley, USDC NOAA/NESS, Suitland

Task Coordinator: Clarence Sakamoto, USDC, NOAA/EDIS, Columbia

7. Resource Requirements

a. Agency - Funding Requirements

	FY81($K)	FY82($K)
USDC NOAA/NESS-DCA	95	100

b. Manyear Equivalents

	FY81(MYE)	FY82(MYE)
(1) Civil Servants		
USDC NOAA/NESS-DCA	.5	.5
(2) Universities and Others		
USDC NOAA/NESS-DCA	2.0	2.0

8. Task Schedule and Milestones

See Figure X-2

9. Interfaces

With other AgRISTARS projects: EW/CCA, FCPF, SR
With other project elements: Elements #1, #2, and #4.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Ground truth pyrometer data are needed to quality check and improve satellite-estimated insolation from GOES data and R&D into techniques to estimate insolation from polar-orbiting satellites. Hourly integrated pyrometer measurements are required to update regression coefficients, to account for sensor calibration changes, to adjust the coefficients after a new satellite is put into use.

To serve this purpose, hourly and daily total insolation measurements are needed from 15 to 20 well-calibrated pyrometers evenly distributed over the eastern two-thirds of the United States. These instruments should not be located near large bodies of water or in highly urbanized areas.

Data must be collected, processed (quality checked, digitized, and put in digital format) and forwarded to NESS within a few weeks of measurement. This timely transfer of data could be accomplished via the GOES Data Collection System (DCS) or other transmission systems.

MPE 4, TASK 2: SOLAR INSOLATION

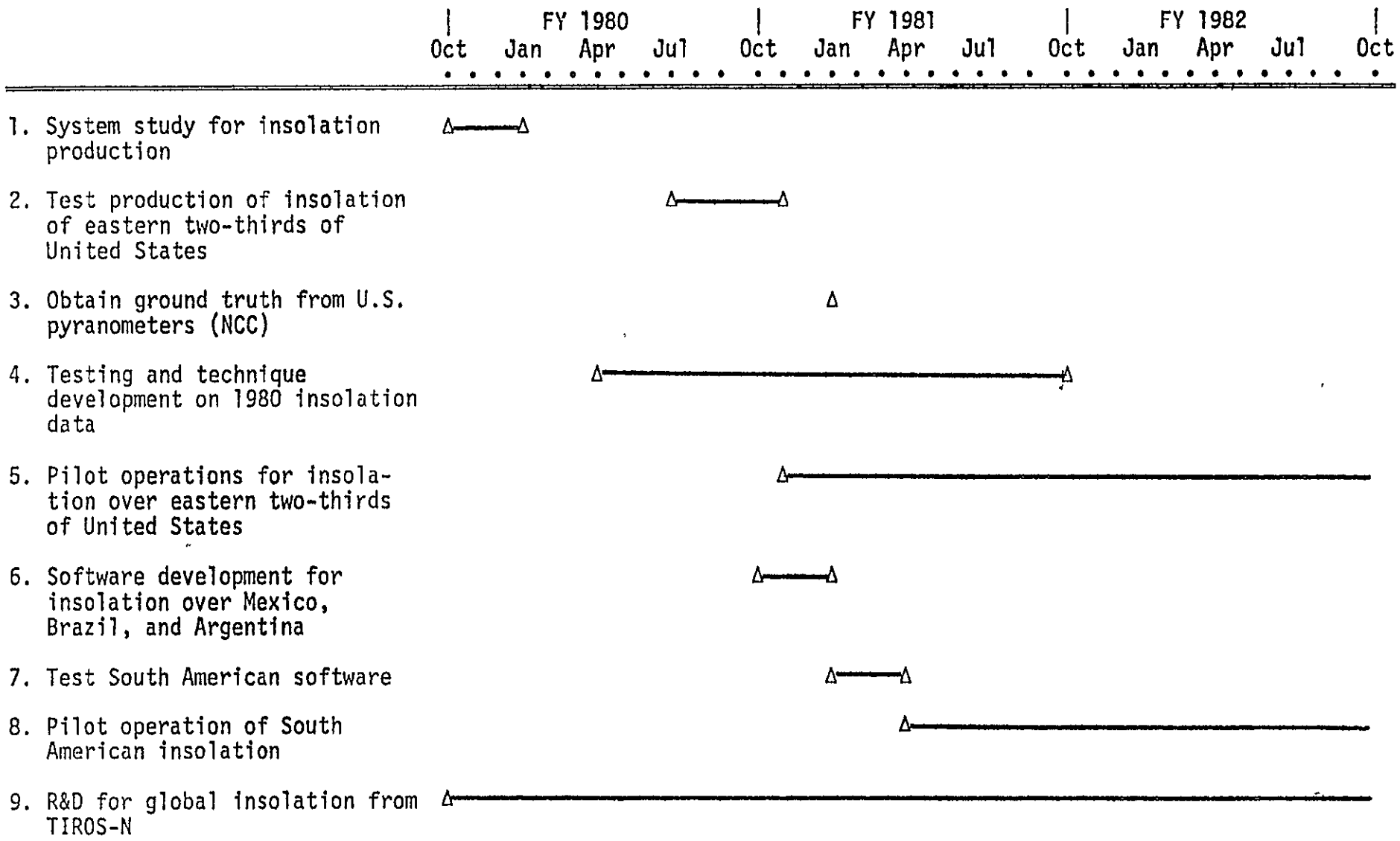


Figure X-2

C. TASK 3: DAILY TEMPERATURE EXTREMES

WBS#: 0304030100-31-110-03-110-01-10
99-100

1. Objective

Provide estimates of daily maximum and minimum surface temperature for selected crop growing regions of the world.

2. Scope

R&D will be undertaken to determine the best techniques for estimating max/min temperature from TIROS-N data. When a technique is identified, experimental programs will be constructed to retrieve and make available max/min temperature observations subject to the following conditions.

a. Max/min temperature observations will only be produced over selected crop growing regions of the world.

b. NESS will provide as much quality control as practical within resource limitations. If data of sufficient quality and quantity are unavailable, no product will be produced.

3. Duration

R&D and experimental data collection began in 1980 and will continue as needed until 1985. Productions of max/min temperatures should begin in 1981 and continue through 1985.

4. Anticipated Results and Products

A set of maximum-minimum temperature observations would be made available to JAWF on demand for freeze warning in the Eastern Hemisphere.

5. Technical Approach

Moisture corrected surface temperatures (skin temperature) are produced at about 0300, 0730, 1500, and 1930 local times as a by-product of retrieving atmospheric temperature soundings from the TIROS-N Operational Vertical Sounder (TOVS). The 0730 and 1500 observations are near the times of occurrence of most daily minimum and maximum temperatures. These observations, in conjunction with TOVS-derived cloud cover, would be used to infer maximum and minimum temperature.

Experimental data sets consisting of coincident TOVS retrieval products and conventional measurements of daily temperature

variations will be constructed for technique development and quality checking of the derived product. Relationships between shelter temperature and satellite-derived surface temperature will be investigated.

When a sufficiently accurate technique is found, max/min temperature observations would be produced daily from the 24-hour TOVS product file. Since the maximum observations would not be coincident, they would have to be interpolated to a common grid point.

6. Organization and Responsibilities

Lead Organization·	USDC NOAA/NESS
Task Manager.	Dan Tarpley, USDC NOAA/NESS, Suitland
Task Coordinator	Clarence Sakamoto, USDC NOAA/EDIS, Columbia

7. Resource Requirements

a. Agency - Funding Requirements

	FY81 ($K)	FY82 ($K)
USDC NOAA/NESS-DCA	110	100

b. Manyear Equivalents

	FY81 (MYE)	FY82 (MYE)
Civil Servants	.2	.2
Universities and Others		
USDC NOAA/NESS-DCA	2.0	2.0
Total	2.2	2.2

8. Task Schedule and Milestones

See Figure X-1

9. Interfaces

a. Environmental Data and Information Service (EDIS) to provide expected daily temperature variations for different crop growing regions of the world. Need to know expected diurnal temperature curve under different cloud conditions and as a function of solar zenith angle.

b. Need hourly surface temperature observations from eastern two-thirds of United States. These data can be obtained from EDIS, but may be easier to collect from NMC via 360/195.

c. With other AgRISTARS projects: EW/CCA, SR

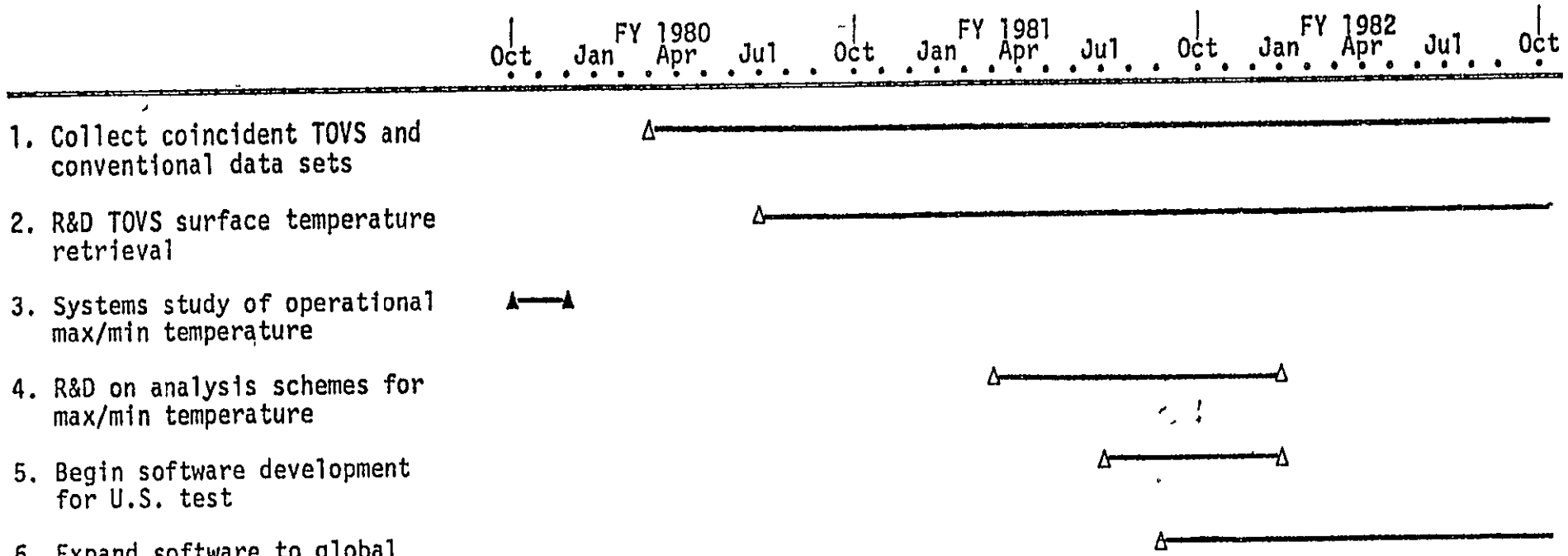
d. With other organizations: FAS/CCAD

e. With other project elements Elements #1, #2, and #4.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

Meteorological satellite data for use in this task will be acquired by NOAA NESS. This is a data acquisition, processing and distribution task.

MPE 4, TASK 3· DAILY TEMPERATURE EXTREMES



WTT-ox

Figure X-1

D. TASK 4: MONITOR, FOR YIELD MODEL APPLICATIONS, NOAA NESS TASKS IN SOLAR RADIATION, TEMPERATURE AND PRECIPITATION

WBS#: 03-04-03-01-00-32-03-04-03-01-03

1. Objective

a. Monitor progress of NESS satellite service estimates of daily maximum and minimum temperatures and solar radiation for selected crop regions.

b. Monitor progress of NESS satellite derived estimate of daily rpecipitation amounts for selected crop regions (a task in EW/CCA).

c. Appraise potential for use of GOES and polar-orbiting satellite estimation for use in yield models.

2. Scope

Test estimation data will be provided for selected U.S. crop regions for evaluation with respect to established accuracy criteria.

3. Duration

R&D began in 1980 and will continue until accuracy criteria is achieved over selected test regions.

4. Anticipated Results and Products

Appraisal of potential use of meteorological satellite products in yield models.

5. Technical Approach

Continuously monitor NOAA/NESS tasks and as products are developed or further specified, appraise their potential for use in yield models.

6. Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Task Manager: Clarence Sakamoto, USDC NOAA/EDIS, Columbia

Task Coordinator. Norton Strommen, USDA/WFAOSB, Washington

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
USDC NOAA/EDIS-COU	3	3

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDC NOAA/EDIS-COU	.1	.2

8. Task Schedule and Milestones

TBD

9. Interfaces

With other AgRISTARS Projects: EW/CCA and SM
With other major elements. Element #2
Within Project Element #4 Tasks 2 and 3
Define temperature and precipitation needs, etc., TBD

10. Data Acquisition, Preporcessing, Processing, Distribution and Retention Requirements

TBD

E. TASK 5: DEFINE SPECTRAL AND/OR REMOTE SENSING DATA REQUIREMENTS AND DEVELOP INPUT THAT CAN BE USED TO DRIVE OR TEST CROP GROWTH/ YIELD MODELS

WBS#: 03-04-05-01-00-13-470-01-470

1. Objective

To determine the basic relationships between remotely sensed canopy data and crop growth, biomass, leaf area index and other crop growth and condition variables that can be used in crop growth/yield models.

2. Scope

To test satellite and other spectral data for input for crop growth/yield models, implication for early warning and crop condition alarms and assessment and responses to crop management variables.

3. Duration

Five to six years.

4. Anticipated Results and Products

These experiments should provide the basic data needed for incorporating spectral and other remotely sensed data into the crop growth/yield models being developed, and for better understanding plant canopy bidirectional reflectance and emittance at incomplete plant cover.

Products will be.

a. Comparison of seasonal spectra of different crops along with agronomic and physiological interpretations.

b. Remotely sensed data inputs to crop growth/yield models.

c. Documentation of the effects of specific stress canopy on temperatures, biomass and yield.

d. Test of model performance for LAI, biomass, and yield using direct observation and spectral surrogates.

5. Technical Approach

a. Small plots and fields at SEA/AR and other model test sites will be monitored with hand-held radiometers and ground based radiometers to document reflective and thermal responses of plants to environmental conditions and specific stresses.

b. Hand-held radiometer, aircraft, and satellite data will be obtained for well documented crop and test sites to determine model parameters such as LAI, biomass, green number. These data will be provided to modelers for comparison of crop yield/growth model performance, using direct observation and spectral surrogates.

c. Small plot and field experiments will be conducted to develop spectral indicators of stress and for development of spectral inputs for models.

d. Test sites will be Weslaco, Texas; Phoenix, Arizona; Beltsville, Maryland; and other SEA/AR locations as needed.

6. Organization and Responsibilities

Lead Organization: USDA SEA-AR

Task Manager. Craig Wiegand, USDA SEA-AR, Weslaco

7. Resource Requirements

a. Agency-Funding Requirements

	FY81($K)	FY82($K)
USDA SEA-AR - Weslaco, Phoenix, Beltsville	470	550

b. Manyear Equivalent

(1) Civil Servants

	FY82(MYE)	FY82(MYE)
USDA SEA-AR, Weslaco, Phoenix, Beltsville	6.0	6.0

(2) University and others - not determined at this time.

8. Task Schedule and Milestones

FY81 to 82 - Determination of spectral response of crops and effects of management variables

FY80 to 85 - Input of spectral and remotely sensed data to crop growth/yield models, early warning alarms and crop condition assessments.

FY81 to 85 - Models or descriptions of plant canopy bidirectional reflectance and temperature at incomplete plant canopy.

9. Interfaces

Close interface with modeling efforts is necessary to determine input needs of model. Close coordination is needed with many early warning tasks.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

TBD

F. TASK 6· MONITOR RESEARCH IN APPLICATION OF SPECTRAL DATA TO YIELD ESTIMATION

WBS#. 03-04-06-01-00-20-00-08-00-01-00

1. Objective

Maintain awareness of the research and development taking place in the scientific community directed toward using spectral data in estimating crop yield.

2. Scope

Advance crop yield estimation methods.

3. Duration

Four to five years.

4. Anticipated Results and Products

New concepts for improving yield models using spectral data along with conventional data sources.

5. Subtasks

a. Subtask 1: Monitor for Potential Applications of Spectral Data to Yield Models

(1) Objective

Monitor research toward use of spectral data in yield models.

(2) Technical Approach

Maintain awareness of the research and development activities by AgRISTARS and outside investigators toward direct or indirect use of spectral data in yield models. Assemble results and reports as they become available. Recommend applications or areas of future research/development.

(3) Anticipated Results and Products

Reports and recommendations for applications.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization· NASA/JSC-Columbia

Subtask Manager Tom Barnett NASA/JSC-Columbia

b. Subtask 2: Monitor for Applications of Spectral Data to Crop Calendar Models

(1) Objective

Monitor research toward use of spectral data in crop calendar which appears to have value in yield model development.

(2) Technical Approach

Maintain awareness of the research and development activities by AgRISTARS and outside investigators toward direct or indirect use of spectral data in estimating crop development stage. Assemble results and reports as they become available. Recommend applications or areas of future research/development.

(3) Anticipated Results and Products

Reports and recommendations for applications.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: NASA/JSC - Columbia

Subtask Manager: Tom Barnett NASA/JSC - Columbia

c. Subtask 3: Monitor Applications of Spectral Data to Area Estimation

(1) Objective

Monitor research toward use of spectral data in area estimation of potential use for yield estimation.

(2) Technical Approach

Maintain awareness of the research and development activities by AgRISTARS and outside investigators toward use of spectral data in estimating factors of use in yield estimation, e.g. harvested vs. planted acreage, percent of fields irrigated, stand quality or stress, etc. Assumable results and reports as they become available. Recommend applications on areas of future research and development.

(3) Anticipated Results and Products

Reports and recommendations for applications.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization NASA/JSC - Columbia

Subtask Manager: Tom Barnett NASA/JSC - Columbia

6. Task Organization and Responsibilities

Lead Organization: NASA/JSC - Columbia

Task Coordinator: Tom Barnett NASA/JSC - Columbia

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
NASA/JSC - Columbia	*	*

b. Manyear Equivalents	FY81(MYE)	FY82(MYE)
NASA/JSC - Columbia	.2	.2

8. Task Schedule and Milestones

TBD

9. Interfaces

Other AgRISTARS Projects SR, EW, SM, and FCPF

Other major Projects elements.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

TBD

G. TASK 7 ESTIMATING DAILY TEMPERATURE EXTREMES FROM SYNOPTIC DATA

WBS#: 03-04-07-01-00-32-20-04-20-01-20

1. Objective

a. To develop a procedure for estimating the maximum and minimum temperature from daily WMO Global Telecommunications System.

b. To provide the magnitude of the error of those estimates.

2. Scope

The analysis will be performed in a dry and moist climate in the U.S. (Kansas vs. Illinois) and in the Soviet Union with daily synoptic reports.

3. Duration

4. Anticipated Results and Products

Candidate models that will provide minimum errors for estimating max and min temperatures for synoptic reports.

Products to be developed - Report that documents the analysis and results of the study for the U.S. and U.S.S.R.

5. Technical Approach

Using various methods of fitting the 3-hourly or 6-hourly synoptic reports, estimates will be made of the highest and lowest temperature estimate. These will be compared with observed station max and min temperature for estimates of mean daily, weekly and monthly error in different climatic regime.

6. Organization and Responsibilities

Lead Organization USDC NOAA/EDIS-COU

Subtask Manager: Clarence Sakamoto, USDC NOAA/EDIS-COU

7. Resource Requirement

a. Agency - Funding

	FY81($K)	FY82($K)
USDC NOAA/EDIS-COU	20	30

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
USDC NOAA/EDIS-COU	.4	.5

(2) Support Contractor - none

(3) Task to be completed in-house

8. Task Schedule and Milestones

Development of model in Kansas	September 1980
Document Kansas and Illinois	November 1980
Initiate USSR model	December 1980
Document USSR	May 1981

9. Interfaces

With other projects. EW
With other program elements: CCAD

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements

TBD

IX. MAJOR PROJECT ELEMENT #5: PROJECT MANAGEMENT AND SUPPORT - 4 Tasks

The YMD project management will be accomplished through coordination with assigned task managers reporting to the project leader. Task managers will participate in the major project reviews as necessary. The senior USDA and/or NOAA task leaders at Columbia will participate in all planning efforts with designated representation from SEA/AR and ESS-Washington.

A. TASK 1: SUPPORT PERSONNEL AND PROJECT MANAGEMENT

WBS#: 03-05-01-04-00-32-20-04-03-01-03
01-17-01-17
12-40-01-27-01-27
04-13-01-13

1. Objective

   a. To provide statistical, clerical and other support to Yield Project personnel.

   b. To provide overall project management, planning, budget and other management support to project personnel.

2. Scope - NA

3. Duration

   Continuous for length of project.

4. Anticipated Results and Products - NA

5. Technical Approach - NA

6. Organization and Responsibilities

   Lead Organization: NOAA, USDA

   Task Managers, USDA: Galen Hart, USDA ESS/SRD, Washington
   Jerry Ritchie, USDA SEA/AR, Washington
   Norton Strommen, USDA/WFAOSB, Washington

7. Resource Requirements

a. Agency - Requirements	FY81($K)	FY82($K)
USDC NOAA-COU	3	3
USDC NOAA-DCA	17	17
USDA ESS-DCA	27	27
USDA ESS-COU	13	13
TOTAL	60	60

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDC NOAA-COU	.1	.1
USDC NOAA-DCA	.3	.3
USDA ESS-DCA	1.0	1.0
TOTAL	1.4	1.4

8. Task Schedule and Milestones - NA

9. Interfaces

With other AgRISTARS projects:	EW/CCA, FCPF, SR, SM, PSS
With other project elements:	All
With other organizations:	FAS CCAD, ESS, SEA-AR, NOAA-EDIS, NOAA-NESS

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements - NA

B. TASK 2: LIAISON WITH AND MONITORING OF RESEARCH ACTIVITIES IN OTHER AgRISTARS PROJECTS

WBS#: 03-05-02-04-00-32-10-04-10-01-10
12-55-02-55-07-55

1. Objective

a. Provide required support to other AgRISTARS projects through liaison and maintenance of Interface Control Documents (ICD).

b. Monitor research conducted in all AgRISTARS projects to assure early technology transfer for improving yield model performance.

2. Scope

Interface Control Documents will be prepared and maintained with all other AgRISTARS projects where required. Continuing liaison at the project management level will be maintained to monitor research activities within YMD and with the other projects. This monitoring will include technical assistance in evaluating techniques developed that can be used to improve yield model performance.

3. Duration

Liaison and monitoring activities will continue through FY85.

4. Anticipated Results and Products

It is expected that several yield model components or improvements will be developed as a result of research efforts of the eight AgRISTARS projects. These should include adjustable crop calendar models for several crops, techniques for estimating solar radiation, temperature extremes, precipitation amounts, available soil moisture, plant evapotranspiration and quantification of technological inputs and their effect on crop yield. ICD's developed in FY80 will be updated as required.

5. Technical Approach

A representative of project management will be designated to maintain liaison with other AgRISTARS projects. This activity will include preparation and maintenance of ICD's with each project where an ICD is required. Needs identified for improvement of yield model capabilities will be submitted to the project management team to task the proper project with technique development.

Qualified technical personnel (agronomists, ag. meteorologists, statisticians, etc.) will be assigned as required to monitor

research in phenological/physiological yield relationships, soil moisture estimation/simulation, satellite derivation of spatial estimate of solar radiation, temperature extremes, and precipitation amounts; spectral estimates of LAI, biomass, phenology, reflectance and their relationship to biological yield.

Liaison with JAWF will be maintained to assure quality controlled current meteorological data for yield model evaluation and operation.

6. Organization and Responsibilities

Lead Organization: USDA

Task Manager. J. Rogers, USDA YMD, Houston

7. Resource Requirements

a. Funding Requirements

	FY81($K)	FY82($K)
NASA-COU	-	-
USDC NOAA-COU	10	10
USDA ESS-HOU	55	55
TOTAL	65	65

b. Manyear Equivalents

(1) Civil Servants

	FY81(MYE)	FY82(MYE)
NASA-COU	.1	.1
USDC NOAA-COU	.2	.2
USDA ESS-HOU	1.0	1.0
TOTAL	1.3	1.3

8. Task Schedule and Milestones

NA

9. Interfaces

a. FCPF for joint description of yield strata for crops and areas. Furnish recommendations on yield models for pilot test. Deliver yield estimates to support production forecasts.

b. Supporting Research to review and monitor technology for crop growth models, soils, and crop stress effects.

c. EW to review and monitor techniques for relating leaf area, biomass, crop species, plant pests and disease, winterkill and moisture stress to biological yield. Furnish EW techniques for spatial estimation of solar radiation and temperature extremes. Monitor techniques for estimating precipitation amounts.

d. SM to review techniques to model andpredict soil moisture in plant root zone areas. Deliver techniques for spatial estimation of solar radiation and temperature extremes.

e. JAWF to keep updated definition of requirements for current meteorological data.

f. Data management team for data requirements.

10. Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements - NA

C. TASK 3· YIELD OUTPUT SUPPORT TO OTHER AgRISTARS PROJECTS

WBS#· 03-05-03-04-00-32-03-04-03-01-03

1. Objective

To operate the crop/country models as requested by the projects in AgRISTARS for those models that have been tested and determined acceptable for use.

2. Scope

AgRISTARS specified priority crops and countries.

3. Duration

Five to six years.

4. Anticipated Results and Products

Yield estimates at requested schedules by the project.

5. Subtasks

None

6. Organization and Responsibilities

Task Organization: USDC NOAA/EDIS

Task Manager: Clarence Sakamoto, USDC NOAA/EDIS, Columbia

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
USDC NOAA/EDIS-COU	3	3

b. Manyear Equivalents

(1) Civil Servants	FY81(MYE)	FY82(MYE)
USDC NOAA/EDIS-COU	.1	.1

8. Task Schedule and Milestones - NA

9. Interfaces

With other AgRISTARS projects FCPF

With other major elements· Element #1, #2, #3

10. Data Acquisiton, Preprocessıng, Processing, Dıstrıbution, and Retentıon Requırements

a. Real-tıme data acquisition ıs required.

b. Processıng will be accomplished ın Columbıa.

c. Dıstrıbution of results FCPF.

D. TASK 4· NEW TASKS FOR FY82-85

WBS#: 03-05-07-01-00-12-10-01-10-01-10
32-05-04-05-01-05

1. Objective

To initiate research, development and test tasks in an orderly progression and expansion of the initial FY80 effort.

2. Scope

It is premature to specify the exact nature of these tasks until some progress and a better understanding of the needs of the users gained in FY80 and 81.

3. Duration

Continuing

4. Anticipated Results and Products

An orderly, efficient progression and expansion of the Yield Model Development project effort. The FY82 plan and changes in FY81 plan will reflect this effort.

5. Test Sites - NA

6. Organization and Responsibilities

Lead Organization: USDA SEA/AR

Task Coordinator: Clarence Sakamoto, NOAA EDIS, Columbia
Fred Warren, USDA ESS/SRD, Washington
Jerry Ritchie, USDA SEA/AR, Beltsville

7. Resource Requirements

a. Agency - Funding	FY81($K)	FY82($K)
NOAA EDIS-COL	5	5
USDA ESS-DCA	10	10
USDA SEA/AR Locations	-	-
TOTAL	15	15

b. Manyear Equivalents	FY81(MYE)	FY82(MYE)
NOAA EDIS-COL	.2	.2
USDA ESS-DCA	.2	.2
USDA SEA/AR Locations	-	-
TOTAL	.4	.4

8. Task Schedule and Milestones

TBD

9. Interfaces

Interfaces will result from the composition of the proposed tasks.

10. Data Acquisition, Preprocessing/Processing, Distribution and Retention Requirements

TBD

Distribution List	CYS
Dr George S Benton NOAA Department of Commerce Rm 5808, Main Commerce Bldg Rockville, MD 20852	(1)
Dr Gordon S Law Office of the Secretary Department of the Interior Washington, DC 20240	(1)
Dr Anthony J Calio NASA Hqs/E Washington, DC 20546	(1)
William G Lesher Assistant Sec for Economist USDA, SEC Rm 227-E, Adm Bldg Washington, DC 20250	(1)
Dr Charles K Paul AID Code SA18 Washington, DC 20523	(1)
William E Kibler USDA/ESS Rm 5863 Sg Ag Bldg Washington, DC 20250	(1)
Pitt G Thome NASA Hqs/ER2 Washington, DC 20546	(1)
Dr G E Thorley, Chief Office of Earth Sciences Applications U S Geological Survey Reston, VA 22070	(1)
T D Potter NOAA/EDIS Department of Commerce Washington, DC 20235	(1)
Charles E Caudill USDA/ESS Rm 4839 S Ag Bldg Washington, DC 20250	(10)
William E Rice Johnson Space Center/SA Houston, TX 77058	(1)
L E Hyatt S/OP4 National Earth Satellite Service WWB Rm 601 Washington, DC 20233	(5)
A Watkins U S Geological Survey Department of the Interior Sioux Falls, SD 57198	(1)
G O Boatwright USDA 1050 Bay Area Blvd Houston, TX 77058	(1)
H J Curfman Code 272 Langley Research Center Langley Station Hampton, VA 23365	(1)
W Wilson USDA Rm 200, Federal Bldg 600 E Cherry St Columbia, MO 65201	(15)

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J D Erickson Johnson Space Center/SH Houston, TX 77058	(1)
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R D Allen USDA/ESS Rm 4832 S Ag Bldg Washington, DC 20250	(1)
F P Weber USDA/FS 1050 Bay Area Blvd Houston, TX 77058	(1)
N Strommen USDA/WFAOSB Rm 3506 S Ag Bldg Washington, DC 20250	(1)
R Ambroziak CIAD NOAA/EDIS Page 2, Rm 140 3300 Whitehaven St , NW Washington, DC 20235	(30)
J C Ritchie USDA/SEA/NPS Rm 239A, Bldg 005 BARC-West Beltsville, MD 20705	(1)
T Barr USDA/WFAOSB Rm 3598 S Ag Bldg Washington, DC 20250	(3)
H Hogg NASA Hqs/ERL2 Washington, DC 20546	(5)
G Metz EROS Data Center Department of the Interior Sioux Falls, SD 57198	(5)
V Salomonson NASA GSFC/920 Greenbelt, MD 20771	(1)
D W Mooneyham Direct, ERL Bldg 1100 NSTL Station, MS 39529	(1)
J M Deerwester Ames Research Center Moffett Field, CA 94035	(1)
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R B Erb Johnson Space Center/SK Houston, TX 77058	(2)
AgRISTARS/PSS Johnson Space Center/SK Houston, TX 77058	(30)
SH3/Documentation JM6	(5) (3)