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Yield Model Development

PROJECT IMPLEMENTATION PLAN

FOR FISCAL YEAR 1983
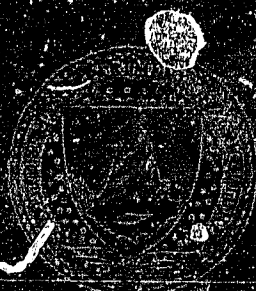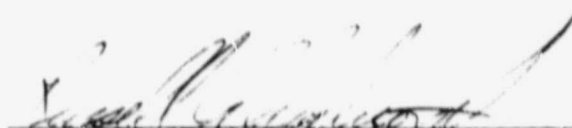
YIELD MODEL DEVELOPMENT

PROJECT IMPLEMENTATION PLAN

PREPARED BY: _____

Russell A. Ambroziak
Project Manager

APPROVED BY:

_____ DATE: 11-9-82

Charles E. Caudill
U.S. Department of Agriculture

_____ DATE: 11-5-82

William E. Rice
National Aeronautics and
 Space Administration

_____ DATE: 11-13-82

Kenneth Hadeen
U.S. Department of Commerce

_____ DATE: 11-3-82

Allen Watkins
U.S. Department of the Interior

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I. INTRODUCTION

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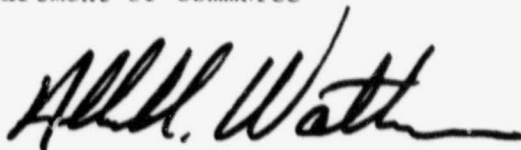
Yield Model Development is one of the eight projects of the AgRISTARS (Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing) Program, a cooperative effort of five Federal agencies: Department of Agriculture (USDA); National Aeronautics and Space Administration (NASA); Department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

The Yield Model Development (YMD) Project has supported the priority areas of the Secretary of Agriculture's initiatives described in February 1978. Tasks within the YMD project that have been completed on April 1, 1983, will be reevaluateu, redefined where necessary, and integrated into the project implementation plan of either the Domestic Commodity Assessment Research (DCAR) or the Foreign Commodity Assessment Research (FCAR) project. Plant process yield model development will be assigned to the DCAR project.

This Yield Model Development Project Implementation Plan focuses on tasks to be done in FY83. Task funding shown herein covers the entire fiscal year even though all tasks will be reassigned to one of the three (3) AgRISTARS projects by April 1, 1983. Task funding will be redistributed at that time.

B. PROJECT SUMMARY

The Yield Model Development Project (YMD) will continue to 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.

FY83 activity in YMD is not a termination of yield model development, test, evaluation, and improvement, but a reemphasis on this activity in support of Foreign Agricultural Service (FAS) and Statistical Reporting Service (SRS) in USDA.

The five tasks identified in Project Element 1, Crop Yield Model Test and Evaluation, will be completed as described by April 1, 1983. New tasks for T&E yield models will be described for emphasis on foreign or domestic use and included in the appropriate project plan. Real time T&E of plant process models will be an integral part of this activity.

Ten tasks made up Project Element 2 in FY82. Crop Yield Model Research and Development, will be continued and/or distributed as

follows. Research to quantify the impact of technology and economics on crop yields (Task 1) will continue as part of the domestic activity. Development of empirical crop yield models under Task 2 will be completed by April 1, 1983. Additional requirements under this task will be included in the DCAR project as required. Stratification alternatives (Task 3) will be included in the DCAR project. Episodic events (FY82 Task 4) is concluded. The cooperators report will be submitted before April 1, 1983. Wheat, soybean, cotton, corn and sorghum plant process model development (Tasks 4-7) will be continued by ARS under the DCAR project. Data analysis support to ARS researchers (FY82 Task 9) is deleted. The evaluation of gridded met data (FY82 Task 10) is complete with the report published by mid-December 1982.

The eight FY82 tasks included in Project Element 3, Data Acquisition, Processing and Storage, have been distributed as follows. ADP procedures (Task 1) and data dictionary (Task 6) are being documented and will only continue as a part of NOAA data processing activities. The historical monthly met data assimilation (Task 2) is complete. As monthly data sets are required, they will be assembled by the group requiring the data as part of a model development or testing task. Historical daily meteorological data assimilation (FY82 Task 3, FY83 Task 1) will continue under the FCAR project. Historical agricultural data base acquisition (FY82 Task 4, FY83 Task 2) will continue as required under the domestic project. Objective precipitation estimates incorporating satellite data (Task 5) will be complete with a final report by March 1983. Current delivery of station meteorological data (FY82 Task 7, FY83 Task 3) in real time will continue throughout the AgRISTARS project. Software for gridded agromet data extraction (Task 8) has been completed and a users guide has been published and distributed.

Of the six tasks in Project Element 4, Related Yield Research, the NOAA/NESS tasks relating to solar radiation and temperature extremes (FY82 Tasks 2, 3, and 4) are now included in the Early Warning plan. The investigation of satellite data integration into a regression estimator (FY82 Task 1) is complete. The definition of spectral data requirements for driving and testing crop growth models (FY82 Task 5, FY83 Task 1) and the evaluation of spectral information for crop yield estimation (FY83 Task 2)will continue as a part of FCAR.

Project management and support tasks under Project Element 5 will continue to April 1, 1983. Similar tasks as required will be a part of both FCAR and DCAR projects.

The YMD project is a joint agency activity supported by funds and staff from USDA, USDC and NASA. The Joint Modeling Center (USDA, NOAA, NASA) established for YMD work is located in Columbia, Missouri. USDA staff from SRS also support YMD work in Houston, Washington, D.C. and at a few ARS research sites. USDA ARS staff support YMD work at numerous research centers. USDC staff from EDIS 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 personnel are as follows:

1. Project Manager

The project manager is responsible to the Program Management Group (PMG) 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 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 PMG.

   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 PMG those changes requiring PMG approval, and coordinating and implementing those changes as necessary.

   f. Reporting overall status to the PMG 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 interface with 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.

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                    ┌─────────────────┐
                    │   YMD PROJECT   │
                    │                 │
                    │  R. AMBROZIAK   │
                    │    MANAGER      │
                    └─────────────────┘
                            ┆
  ┌─────────────────┐       ┆
  │  ITD/SR/EW/SM   │       ┆
  │    LIAISON      ┆ ─ ─ ─ ┆
  │  J. L. ROGERS   │       ┆
  └─────────────────┘       ┆
                    ┌───────────────────────────────┐
                    │ AGENCY LINE OR STAFF MANAGERS  │
                    │                                │
                    │   USDA, ARS    J. RITCHIE      │
                    │   USDA, SRS    G. HART         │
                    │   NOAA, CEAS   K. HADEEN       │
                    └───────────────────────────────┘
  ┌───────────────────┐             │
  │  PROJECT          │             │
  │   AREAS           │             │
  ├───────────────────┤             │
  │  MODEL TEST &     │             │
  │   EVALUATION      │             │
  │ - - - - - - - - - │             │
  │  MODEL RESEARCH   │             │
  │  & DEVELOPMENT    │             │
  │ - - - - - - - - - │             │
  │ DATA ACQUISITION  │    ┌──────────────────┐     ┌────────────────┐
  │  PROCESSING &     ┆ ─> │  AGENCY TASK      ┆ <─ ─│     TASK       │
  │   STORAGE         │    │  AND SUB-TASK     │     │  COORDINATOR   │
  │ - - - - - - - - - │    └──────────────────┘     └────────────────┘
  │  RELATED YIELD    │
  │   RESEARCH        │
  │ - - - - - - - - - │
  │ SUPPORT PROGRAMS  │
  └───────────────────┘
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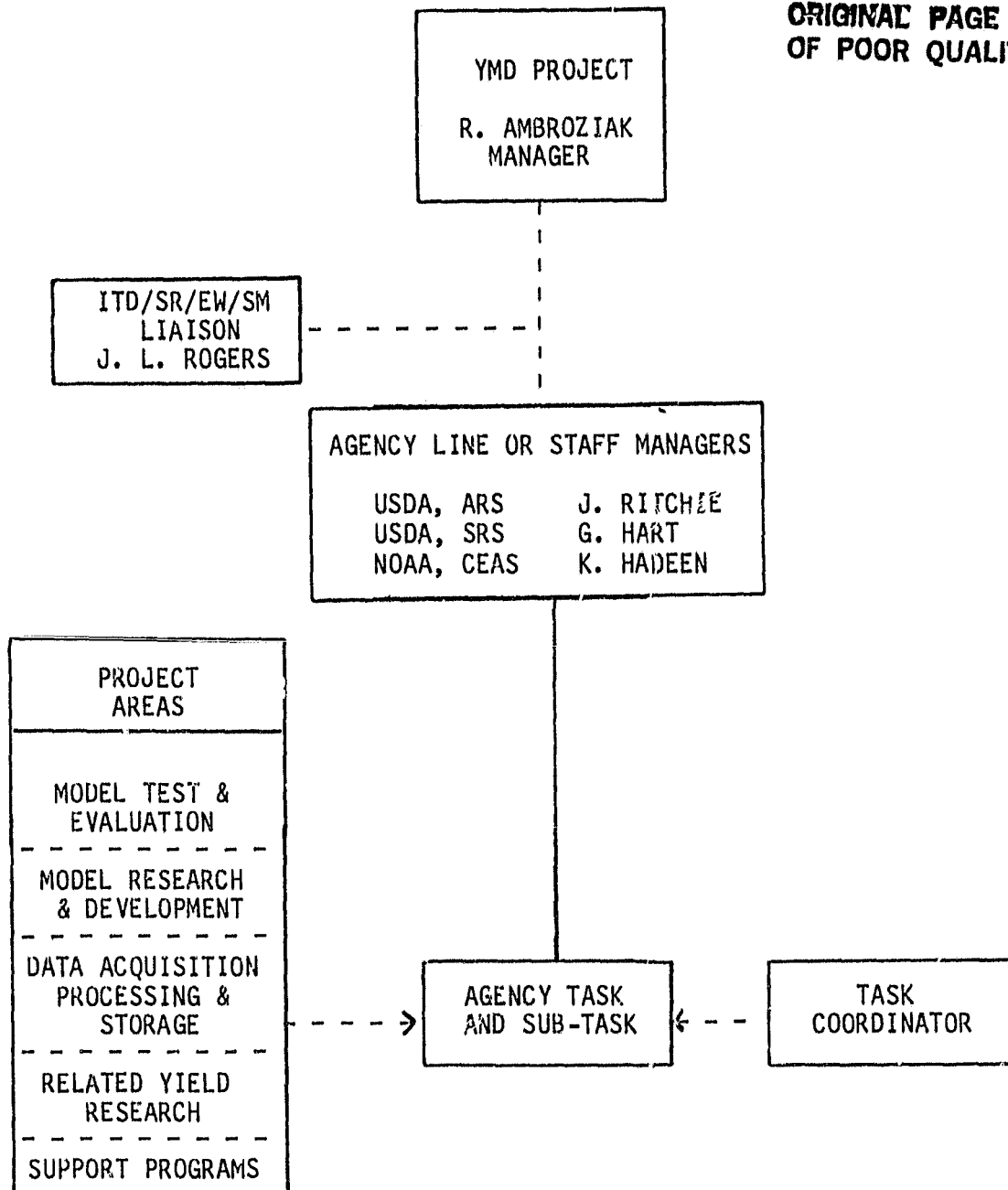
YMD PROJECT ORGANIZATION

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 there are several sub-tasks. 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

Each task or sub-task manager supplies technical leadership and is responsible for conducting tasks within the organizational structure of the participating agency line management. Specific responsibilities are:

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

b. Development of the technical approach, procedures, schedules, and implementation of the plans, assuring technical validity.

c. Preparation of reports as requested by management.

5. Project Liaison Leader

The project liaison leader is responsible for:

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

b. Reviewing agronomic and plant growth modeling research and preparing integration plans for use in plant process models.

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

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

e. Preparing reports as requested by management.

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

D. PROJECT INTERFACES

Interfaces between projects in AgRISTARS are specifically defined by
Interface Control Documents (ICD) jointly approved by the respective
project leaders. A separate ICD exists 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 ARS will develop and test techniques to estimate soil
    moisture, crop growth stages, and heat-moisture stress.
    The model development group will integrate these estimates into
    model forms. As model evaluation occurs, additional requirements
    will be isolated and referred to ARS for research and
    development.

2. Interproject Interfaces

    Within the total AgRISTARS endeavor, there are many technical and
    information interfaces between the several projects.

    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, temperature ranges, and estimation
    techniques for precipitation amounts from satellite data will be
    provided to YMD by 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 EW for precipitation, solar radiation, and temperature range estimation will be made available to SM for its use. YMD will assist in an analysis of sensitivity of yield models and crop growth to soil moisture.

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

3. JAWF Interface

Current meteorological data for operating yield models and 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.

II. YMD PROJECT OBJECTIVES

The Yield Model Development (YMD) Project, through the AgRISTARS USDA
and NOAA 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,
WMO ground stations, NOAA meteorological and environmental satellites,
NASA Landsat satellites, aircraft and other existing published sources.

The prime objective of YMD is to test, evaluate, and develop
mathematical and/or plant process models using environment and plant
measurement characteristics and their interactions to represent the
yield potential of a crop at a given level (point, state, region,
nation). Yield models will be recommended for the specific crop/country
combinations required by the Early Warning/Crop Condition Assessment and
Inventory Technology Development Projects of AgRISTARS and for direct
consideration by USDA agencies having program responsibilities in crop
yield forecasting and estimation.

A. FY83 Objectives

   1. Application of a subjective addition of NOAA series vegetative
       indices to existing crop yield models.

   2. Provide a quality controlled source of current station and
       gridded meteorological data.

   3. Develop and implement procedures to acquire and organize
       ancillary data for subjective adjustment of crop models.

   4. Establish and document a historical daily meteorological data
       base of worldwide WMO stations containing maximum-minimum
       temperatures, precipitation, snow cover, average dew point
       depression, cloud amount, and type (hi, lo, mid) and average
       wind speed.

   5. Integrate direct/indirect technological and economic variables
       into at least one empirical yield model for barley, corn,
       soybeans, and wheat.

   6. Install a feedback loop (reset capability) in at least one plant
       process model for each of four crops.

   7. Prepare specifications for a yield model using spectral inputs
       and satellite derived meteorological variables.

B. Agency Responsibilities

1. <u>General Responsibilities</u>

The general agency responsibilities are as follows:

a. USDA

   o Lead responsibility for plant process oriented yield model development (foreign and domestic)

   o Yield model acquisition, development, testing, and evaluation. Select yield models for application tests

   o Develop and verify agricultural data bases

   o Coordinate or provide needed ground data collection

b. USDC

   o Lead responsibility for statistical regression-type yield model development

   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 Participate 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	FY83($K)
NASA	-
USDC NOAA-EDIS	1196
USDC NWS-CAC	450
USDA SRS	750
USDA ARS	2500
TOTAL	4896

2. By Agency and Location

Agency/Location	FY83($K)
NASA-Columbia	-
USDC NOAA	
EDIS-Columbia	784
EDIS-Washington	322
EDIS-Houston	90
NWS-Washington	450
SUBTOTAL	1646
USDA	
SRS-Washington	390
SRS-Columbia	311
SRS-Houston	49
ARS Sites	2500
SUBTOTAL	3250
TOTAL	4896

3. By Category (FY83) $K

	Civil Servants	University	Other TBD	Total
NASA	-	-	-	-
NOAA	846	580	220	1646
USDA	3049	181	20	3250
TOTAL	3895	761	240	4896

B. STAFFING RESOURCES - FY83

	Civil Servants	University/ Other
NOAA	18.8	9.0
USDA	42.1	5.4
NASA	1.0	-
TOTAL	61.9	14.4

IV. SUMMARY OF TASKS TO BE COMPLETED

TASKS AND FUNDING BY AGENCY

		FY83($K)		
		USDC	USDA	TOTAL
ELEMENT 1 – EVALUATION OF CROP YIELD MODELS				
Task 1	Evaluation Criteria	28	70	98
Task 2	Identify Models	25	15	40
Task 3	Acquire Models	35	34	69
Task 4	T&E of Models	48	114	162
Task 5	Monitor Test Activity	50	10	60
	Subtotal	186	243	429
ELEMENT 2 – MODEL RESEARCH AND DEVELOPMENT				
Task 1	Technology Economics	–	89	89
Task 2	Empirical Models	46	94	140
Task 3	Stratification Alternatives	–	25	25
Task 4	Wheat	–	1015	1015
Task 5	Soybeans	–	675	675
Task 6	Cotton	–	100	100
Task 7	Corn and Sorghum	–	399	399
	Subtotal	46	2397	2443
ELEMENT 3 – DATA ACQUISITION PROCESSING & STORAGE				
Task 1	Historical Met Data	322	–	322
Task 2	Historic Ag Data	–	34	34
Task 3	Met Data Base	450	–	450
	Subtotal	772	34	806

	FY83($K)		
	USDC	USDA	TOTAL
ELEMENT 4-RELATED YIELD RESEARCH			
Task 1 Define Spectral Inputs	-	470	470
Task 2 Spectral Info for Yield Estimation	250	-	250
Task 3 Real Time Model Test	355	-	355
Subtotal	605	470	1075
ELEMENT 5-SUPPORT PROGRAMS			
Task 1 Support Personnel	13	44	57
Task 2 AgRISTARS Liaison	13	49	62
Task 3 New Tasks for FY83-85	11	13	24
Subtotal	37	106	143
TOTAL PROJECT	1646	3250	4896

V. MAJOR PROJECT ELEMENT #1: EVALUATION OF CROP YIELD MODELS - 5 TASKS

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$\qquad\qquad\qquad\qquad$ 12-(70)-01-(56)-01-(50)
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ -86-(06)
$\qquad\qquad\qquad\qquad\qquad\qquad$ -04-(14)-01-(14)

Yield models from the literature, developed by various scientists for other users, and developed within the AgRISTARS will be evaluated for specific applications within AgRISTARS and/or USDA. Models selected for evaluation will be described in terms of their capabilities and limitations, as defined by the YMD yield model evaluation criteria. Evaluations will also attempt to identify areas in which model deficiencies may be corrected by additional research.

A. TASK 1: CRITERIA AND PROCEDURES FOR EVALUATING CROP YIELD MODELS

1. Objective

To establish evaluation criteria and procedures which will enable evaluators to provide useful and meaningful information to potential models users, both in USDA and/or in AgRISTARS, about the models evaluated.

2. Scope

Criteria and evaluation procedures will be completed for all crop yield models to be evaluated in the YMD.

3. Duration

To be completed by April 1, 1983.

4. Anticipated Results and Products

Documents which identify the evaluation criteria and procedures to be used.

5. Subtasks

a. Subtask 1: Development of Improved Evaluation Procedures

(1) Objective

To develop improved procedures for use in the crop yield model evaluation process.

(2) Technical Approach

In cooperation with the Statistics Dept. of the University of Missouri, determine the feasibility of developing the new or improved evaluation procedures. Where such procedures are feasible, develop specifications for their use.

(3) Anticipated Results and Products

Determinations as to whether or not indicated lines of research are feasible, and specifications for the use of new or improved evaluation procedures where feasible.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Manager: Jeanne Seabaugh
USDA SRS/SRD-Columbia

b. Subtask 2: Sensitivity Analysis

(1) Objective

To investigate various types of sensitivity analysis

(2) Technical Approach

TBD

(3) Anticipated Results and Products

TBD

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Manager: Fred Baker, USDA SRS/SRD
Washington

c. Subtask 3: Revisions of YMD Yield Model Evaluation Criteria and Procedures

(1) Objective

Update the YMD yield model evaluation criteria
and procedures as indicated by (a) user needs,
(b) experiences in evaluating yield models with
the existing criteria and procedures, (c)
evaluations of different types of crop yield
models, and/or (d) the development of new or
improved evalu...'on procedures.

(2) Technical Approach

As indicated by any of the factors listed above,
review and update the YMD yield model evaluation
criteria and procedures.

(3) Anticipated Results and Products

Documented evaluation criteria and procedures
which will be more effective in the evaluation of
crop yield models and which will lead to
evaluations which will be more useful to
potential users in determining which candidate
models have the most potential for particular
applications.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Manager: Fred Warren, USDA SRS/SRD
                     Washington

6. Task Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Task Coordinator: Fred Warren, USDA SRS/SRD
                     Washington

7. Funding Requirements

a. Agency Funding   FY83($K)

    USDA SRS-Columbia   14
    USDA SRS-Washington   56
    USDC NOAA-Columbia   28
    NASA*   _____
        Total   98

*Funding for NASA personnel not included.

b. Manyear Equivalents   FY83(MYE)

    (1) Civil Servants

        USDA SRS-Washington   0.3
        USDA SRS-Columbia   1.0
        USDC NOAA-Columbia   0.3
        NASA-Columbia   .1
                Total   1.7

    (2) University

        USDA SRS, Univ. of
                Georgia   0.2
        USDC NOAA, Univ. of
                Missouri   0.2
                Total   0.4

8. Task Schedule and Milestones

    Publish new evaluation criteria--April 1983

9. Interfaces

    Other AgRISTARS projects--ITD

    Other major Project Elements--Element #2, Methods for
    Identifying 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#: 03-01-02-01-00-32-(25)-04-(25)-01-(05)
                                        -37-(20)
                          12-(15)-01-(10)-01-(10)
                                      -04-(05)-01-(05)

    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 investiga-
        tion by the YMD project.

    3. Duration

        April 1, 1983

    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

            (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

                 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 SRS/SRD

Subtask Managers: William Arends, USDA
SRS/SRD-Washington

Tom Barnett, NASA-Columbia

b. Subtask 2: Identify Potential Models

(1) Objective

Identify models with a potential for meeting the requirements described in Subtask 1.

(2) Technical Approach

From a literature review of empirical and plant process oriented models using either monthly or daily inputs, prepare a concise description of each model that meets the criteria for test and evaluation.

(3) Anticipated Results and Products

A document describing each model or model component with an evaluation of the potential the model or component has of fulfilling the user requirements.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Managers: Tom Hodges, USDC NOAA/
EDIS-Columbia

Fred Baker USDA SRS/SRD-
Washington

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

(1) Objective

Select candidate models to be evaluated for each application.

V-6

(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 SRS/SRD

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

Clarence Sakamoto, USDC NOAA-EDIS-Columbia

6. Task Organization and Responsibility

Lead Organization: USDA SRS/SRD

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

Clarence Sakamoto, USDC NOAA/EDIS-Columbia

7. Resource Requirements

a. Agency - Funding   FY83($K)

USDA SRS-Columbia	5
USDA SRS-Washington	10
USDC NOAA-Columbia	25
TOTAL	40

b. Manyear Equivalents

(1) Civil Servants   FY83(MYE)

USDA SRS-Columbia	.1
USDA SRS-Washington	.2
USDC NCAA-Columbia	.2
NASA	.2
TOTAL	.7

    (2) University

        USDC NOAA-Univ. of
                     Missouri   .2

8. **Task Schedule and Milestones**

   List of candidate models - February 1983

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-(35)-04-(35)-01-(5)
                                   -37-(30)
                    12-(34)-04-(15)-01-(15)
                           -01-(19)-01-(19)

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

    April 1, 1983

4. Anticipated Results and Products

    The detailed documentation, computer programs and necessary data sets for use by YMD in testing and evaluating crop yield models will be available.

5. Subtasks

    a. Subtask 1: Survey Literature and/or Contact Developers to Assemble Complete Model Documentation, Including Computer Programs.

    (1) Objective

        Obtain documentation and computer programs for each candidate model.

    (2) Technical Approach

        Survey available literature and as necessary contact model developers for additional information. Assemble documentation and computer programs for each model selected for testing.

    (3) Anticipated Results and Products

        Complete descriptions of each candidate model.

    (4) Test Sites - NA

(b) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Subtask Managers: Tom Hodges, University of Missouri-Columbia
Fred Baker, USDA SRS/SRD-Washington

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

(1) Objective

Obtain data sets 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 and obtain additional data sets needed. With help of model "sponsors" or independently, if necessary, prepare specifications for test and evaluation.

(3) Anticipated Results and Products

Data sets and specifications for testing candidate models will be available (Task 4).

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Managers: Wendell Wilson, USDA SRS/SRD-Columbia
Fred Baker, USDA SRS/SRD-Washington
Tom Hodges, Univ. of Missouri-Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Task Coordinators: Galen Hart, USDA SRS/SRD-Washington
Clarence Sakamoto, USDC EDIS-Columbia

7. Resource Requirements

    a. Agency - Funding   FY83($K)

USDA SRS-Columbia	15
USDA SRS-Washington	19
USDC NOAA-Columbia	35
TOTAL	69

    b. Manyear Equivalents   FY83(MYE)

        (1) Civil Servants

USDA SRS-Columbia	0.3
USDA SRS-Washington	0.4
USDC NOAA-Columbia	0.2
TOTAL	0.9

        (2) University and Others

USDC NOAA-Univ. of Missouri	0.2

8. Task Schedule and Milestones

Models Identified - December 1982
Request Documentation and Software - January 1983
Receive and Review Model Documentation - February 1983

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-(114)-01-(64)-01-(14)
                                      -37-(30)
                                      -99-(20)
                              -04-(50)-01-(50)
                      -32-(48)-04-(48)-01-(08)
                                      -37-(40)

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

   July 1, 1983

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.

      (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 SRS/SRD

Subtask Managers: Jeanne Sebaugh, USDA SRS/SRD-Columbia
Fred Baker, USDA SRS/SRD-Washington
Vikki French, Univ. of Missouri-Columbia
Tom Barnett, NASA-Columbia

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

(1) Objective

Evaluate candidate models for each application and recommend 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 which summarize test and evaluation results and recommend model(s) for further testing.

(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/SRS/SRD

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

Jean Sebaugh, USDA SRS/SRD-
Columbia

Vikki French, Univ. of Missouri
Columbia

Tom Barnett, NASA-Columbia

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

(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 capabil-
ities 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 SRS/SRD

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

Fred Baker USDA SRS/SRD-
Washington

Tom Hodges, Univ. of Missouri-
Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA SRS/SRD

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

Sharon LeDuc, USDC, NOAA/EDIS-Columbia

7. Resource Requirements

a. Agency - Funding   FY83($K)

USDA SRS-Columbia	50
USDA SRS-Washington	64
USDC NOAA-Columbia	48
NASA	-
TOTAL	162

b. Manyear Equivalents

   (1) Civil Servants   FY83(MYE)

USDA SRS-Columbia	1.0
USDA SRS-Washington	0.3
USDC NOAA-Columbia	0.3
NASA	0.2
TOTAL	1.8

   (2) University and Others

USDC NOAA-Univ. of Missouri	0.7
USDA SRS-Univ. of Columbia	0.4
USDA SRS-TBD	0.3
TOTAL	1.4

8. Task Schedule and Milestones

   a. Test Corn Model-October 1982
      Test Soybean Model-February 1983
      Evaluate and Select Applicable Models - July 1983

   b. Document Requirements for Improvements - July 1983

   c. List Research Areas - July 1983

9. Interfaces

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

   Other Major Project Elements - Element #2, feasible re-
   search 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-(10)-04-(10)-01-(10)
-32-(50)-04-(50)-01-(30)
-37-(20)

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

   Application use of models by SRS and ARS.

3. Duration

   Will be completed by July 1, 1983.

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 Ele-
   ment #1.

5. Subtasks

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

      (1) Objectives

          Review and evaluate reports provided by ITD and
          other 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 infor-
          mation. 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 SRS/SRD

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

Clarence Sakamoto, USDC NOAA EDIS-Columbia

b. Subtask 2: Identify Points of Consistency/Inconsistency Between Yield Model Evaluation and Comparison Results

(1) Objective

Identify the extent of agreement between yield model evaluation, comparison, and application test results.

(2) Technical Approach

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

(3) Anticipated Results and Products

Points of consistency/inconsistency identified.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA SRS

Subtask Managers: Jean Sebaugh, USDA SRS-Columbia

Sharon LeDuc, USDC NOAA EDIS-Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA SRS

Task Coordination: Wendell Wilson, USDA SRS-Columbia

7. Resource Requirements

    a. Agency Funding   FY83($K)

USDA SRS-Columbia	10
USDC NOAA-Columbia	50
Total	60

    b. Manyear Equivalents

        (1) Civil Servants   FY83(MYE)

USDA SRS-Columbia	0.2
USDC NOAA-Columbia	1.1
Total	1.3

        (2) University

USDC NOAA-Univ. of Missouri	0.1

8. Task Schedule and Milestones

Schedule based on reports on production error estimates due to area of yield components.

9. Interfaces

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 DEVELOP-
MENT - 7 TASKS

Research will be conducted to improve existing models and to de-
velop 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. The utilization of advanced statistical methods in
variable selection of model development will be emphasized. 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 TECHNO-
LOGICAL AND ECONOMIC FACTORS ON CROP YIELDS.

WBS#: 03-02-01-01-01-12-(89)-04-(89)-01-(64)
37-(25)

1. Objective

Develop procedures for measuring and forecasting the
impact of technological and economic factors on crop
yields, identify important factors by crop and area which
impact on yield and acquire data on these factors, analyze
the relationship between crop yields and technological and
economic factors, and develop procedures which
incorporate these factors into crop yield models.

2. Scope

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

3. Duration

To be transferred to DCAR.

4. Anticipated results and products

Reports which provide (a) a definition of technology as
related to crop yield models and a summary of pertinent
literature, (b) a theoretic basis for measuring and
forecasting technological change, and (c) an

VI-1

identification of technical and economic factors by crop
and area. A procedure to estimate and indicator(s) of
technological change and a pilot test in a yield
forecasting model. Data sets acquired, edited, and ready
for use and further analysis.

a. Subtask 1: Develop and refine procedures for
   measuring and forecasting the impact of technological
   and economic factors on crop yields.

   (1) Objective

       To continue to develop and refine procedures
       which measure and forecast the impact of
       technological and economic factors on crop
       yields.

   (2) Technical Approach

       Based on the technical and theoretical literature
       reviewed, contact with agricultural specialists
       and discussions with others concerned about
       technological and economic impacts on yields,
       develop draft research proposals; review proposed
       concepts and alternative measurement approaches
       and revise and refine as experience is gained;
       and prepare final report outlining concepts and
       approaches for measuring and forecasting the
       impact of these factors on yields.

   (3) Anticipated Results and Products

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

   (4) Test Sites - NA

   (5) Organization and Responsibilities

       Lead Organization: USDA SRS/SRD

       Subtask Manager: Merritt Padgitt, USDA SRS/SRD-
                         Columbia

b. Subtask 2: Through literature reviews, professional
   contacts, and other means, identify important
   technological and economic factors impacting on
   yields, being crop and geographic specific where
   appropriate, and make arrangements to acquire or
   access relevant data sets.

(1) Objective

To identify and obtain data on relevant economic and technological factors.

(2) Technical Approach

Review agronomic crop production literature for regional information on yield responses to technological inputs and practices and review economic and farm production literature for information on adoption and yield contribution of various inputs and practices. Also, from reviewed literature and professional contacts, identify potential data and make necessary arrangements to obtain relevant data sets for further analysis and/or inclusion in yield models.

(3) Anticipated Results and Products

A report on identifying technological and economic factors by crop, time periods, and geographic areas; reference lists of potential data sets and on-line documented data sets available for use in other modeling tasks.

(4) Test Sites - Major U.S. corn, soybean, and barley production areas based on progress and need.

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Manager: Merritt Padgitt, USDA SRS/SRD-
                  Columbia

c. Subtask 3: 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 and pilot test in a specific areas.

(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. Make pilot tests of the technological indicator in a weather yield model.

(2) Technical Approach

Based on products of Subtask 1 and using data
sets developed in Subtask 2 (Task 4, Element 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 for including their
effect in 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.
Potential substitute variable(s) for use in other
YMD tasks.

(4) Test Sites - To be determined from the major
producing states.

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Manager: Merritt Padgitt, USDA SRS/RD-
Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Task Coordinator: Merritt Padgitt, USDA SRS/RD-Columbia

7. Resource Requirements

a. Agency - Funding   FY83($K)

   USDA SRS-Columbia   89

b. Manyear Equivalents

   (1) Civil Servants   FY83(MYE)

       USDA SRS-Columbia   1.3

   (2) University and Others

       USDA SRS-Univ. of
               Columbia   1.0

8. Task Schedule and Milestones

See page VI-6

9. Interfaces

Uther AgRISTARS Projects - EW, SR and SM.
Other Major Project Elements - Element #3
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 coordin-
ated within YMD.

MPE MILESTONES AND SCHEDULES

		CY1982	CY1983
		J F M A M J J A S O N D	J F M A M J J A S O N D
1.	Evaluate Analysis Software	▲	
2.	Develop Technology for:		
3.	Corn		▲
4.	Soybeans		▲
5.	Barley		▲
6.	Test Technology Indices and Techniques for:		
7.	Corn		▲
8.	Soybeans		▲
9.	Barley		▲
10.			
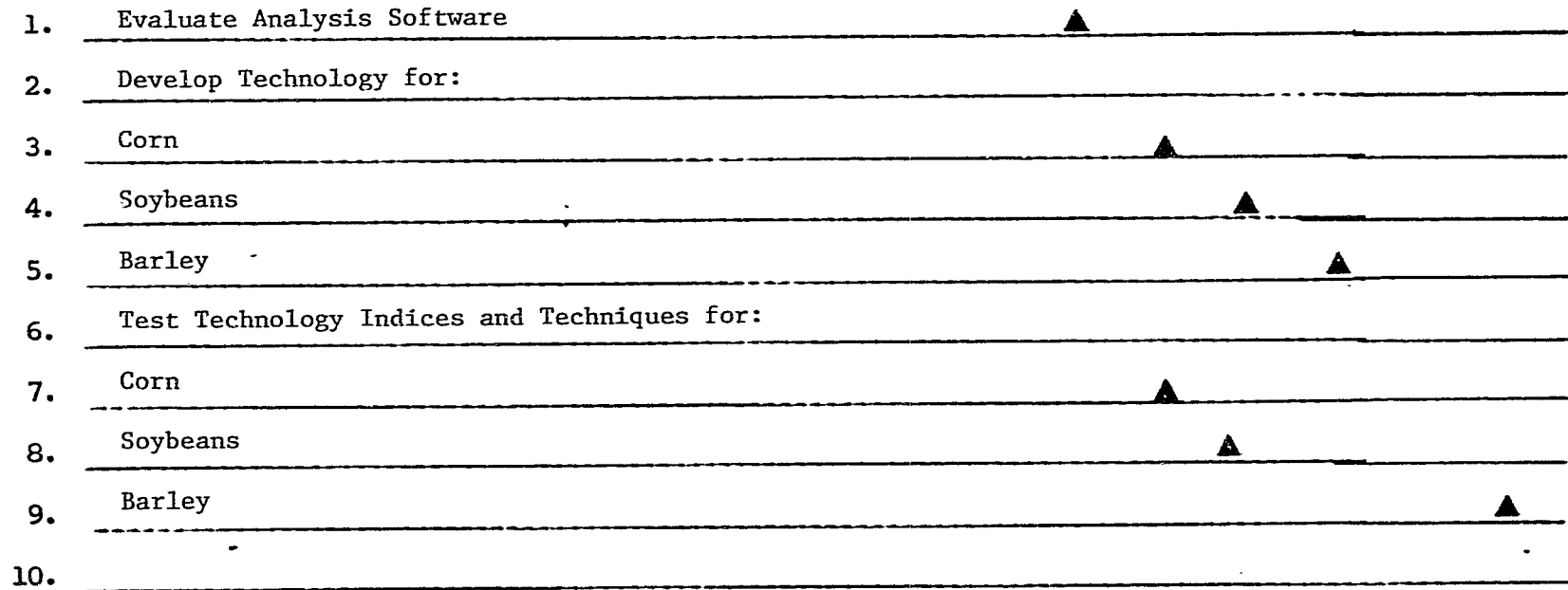
MPE 2, TASK 1

CONDUCT RESEARCH TO QUANTIFY THE IMPACT OF TECHNOLOGICAL AND ECONOMIC FACTORS

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

WBS#:   03-02-02-01-00-32-(46)-C4-(46)-C1-(16)
                                     -37-(30)
                  -12-(94)-01-(40)-37-(40)
                         -04-(54)-04-(54)

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" or "crop-state" combinations as specified by users.

3. Duration

    April 1, 1983, to be included in DCAR.

4. Anticipated Results and Products

    Modified models and additional models developed and docu-
    mented which have potential for providing improved yield
    forecasts and estimates.

5. Subtasks

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

        (1) Objective

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

        (2) Technical Approach

             Acquire new 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 SRS/SRD

Subtask Manager: Felix Kogan, USDA SRS/RD-Columbia
Clarence Sakamoto, USDC NOAA/
EDIS-Columbia

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

(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 SRS/SRD

Subtask Managers: Wendell Wilson, USDA SRS/SRD-Columbia
Clarence Sakamoto, USDC NOAA/EDIS-Columbia

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

(1)   Objective

Development and documentation of improved empirical yield models.

(2) Technical Approach

Based on project proposals, developed in Subtask 2,
domestic and foreign model needs: obtain necessary
data sets, conduct analyses and develop improved
empirical crop yield models. Technology factors
will be indirectly quantified and integrated into
empirical 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 - User specified foreign and domestic
areas.

(5) Organization and Responsibilities

Lead Organization: USDC, NOAA/EDIS

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

Felix Kogan, USDA SRS/SRD-
Columbia

d. Subtask 4: Develop Empirical and Semi-Empirical Process
Models

(1) Objective

Develop semi-empirical process models for wheat,
corn, and soybeans.

(2) Technical Approach

Using current research methods, adapt and integrate
key processes derived from published literature,
integrate models of submodels to simulate wheat,
corn, and soybean plant processes.

Daily meteorological data will be used to accumulate
growing degree days and/or photo thermal units over
planting to harvest periods. These data will be
apportioned to the key plant processes as
appropriate.

(3) Anticipated Results and Products

Documented models and computer programs.

(4) Test Sites

    (a) Wheat--North Dakota and Argentina

    (b) Corn and soybeans--Iowa, Argentina, Brazil

(5) Organization and Responsibilities

Lead Organization:	USDC NOAA/EDIS
Subtask Manager:	Sharon LeDuc, USDC NOAA/EDIS-Columbia

6. Task Organization and Responsibilities

Lead Organization: USDA SRS/SRD

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

                  Clarence Sakamoto, USDC NOAA/EDIS-Columbia

7. Resource Requirements

a. Agency Funding   FY83($K)

USDA SRS-Washington	40
USDA SRS-Columbia	54
USDC NOAA-Columbia	46
TOTAL	140

b. Manyear Equivalents

(1) Civil Servants   FY83(MYE)

USDA SRS-Columbia	1.1
USDC NOAA-Columbia	.6
TOTAL	1.7

(2) University and Others

USDA SRS, Univ. of Missouri	1.0
USDC NOAA, Univ. of Missouri	.1
TOTAL	1.1

8. Task Schedule and Milestones

TBD

9. <u>Interfaces</u>

   Other AgRISTARS Projects - SR, EW, SM and ITD.

   Other Major Project Elements - Element #1 and Element #4.

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

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

    Data acquired in MPE 2, Task 1 and MPE 3, Task 4, will be
    required for quantification of technology factors.

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

WBS#:   03-02-03-01-00-12-(25)-04-(25)-01-(25)

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

   To be included in DCAR plan for future years.

4. Anticipated Results and Products

   Evaluation of yield forecast and estimate reliability for
   various stratification procedures. Determination of stratifi-
   cation designs for foreign areas and future domestic applica-
   tions.

5. Subtasks

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

       (1) Objective

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

       (2) Technical Approach

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

(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.

(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, Illinois, Indiana, and possibly an area with less adequate meteorological data.

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

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

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

(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 ITD 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 SRS/SRD

Subtask Managers: Wendell Wilson, USDA SRS/RD-Columbia

Clarence Sakamoto, USDC NOAA/EDIS-Columbia

e. Subtask 4: Develop Algorithms for Determining Similiarity Areas for Crop Yield Model Application

(1) Objective

To provide information on potential success of model application to areas other than where model was developed.

(2) Technical Approach

Using clustering techniques, various types of attributes including agroclimatic, pedological, crop moisture, and historical production indices will be analyzed with the aid of the computer.

(3) Anticipated Results and Products

Report of methodology and factors considered for testing algorithms to establish similiarity areas.

(4) Test Site: Selected areas in U.S., Brazil, and Argentina

(5) Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

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

6. Task Organization and Responsibilities

Lead Organization: USDA SRS/SRD

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

7. Resource Requirements

a. Agency - Funding   FY83($K)

   USDA SRS-Columbia   25

b. Manyear Equivalents

   (1) Civil Servants   FY83(MYE)

      USDA SRS-Columbia   .5

8. Task Schedule and Milestones

TBD

9. Interfaces

Other AgRISTARS Projects - ITD 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: WHEAT YIELD MODEL DEVELOPMENT

WBS#: 03-02-04-01-00-13-(990)-06-(990)-01-(990)
-12-(25)-01-(25)-01-(25)

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 ARS research and field data collection efforts to support wheat yield model development and testing.

          o Coordinate ARS with SRS 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 ARS, SRS 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 20 sites in the southern, central, and northern Great Plains and Pacific Northwest.

o Research results from ARS 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 ARS

Subtask Manager: Wayne Willis, ARS-Ft. Collins, Colorado

D. Heermann (data compilation), ARS 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 xperiment which included:

(a) Field plots were planted to wheat at intervals of 4 to 6 weeks 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 ARS

Subtask Manager: Ray Jackson, ARS-Phoenix, AZ

c. Subtask 3: Determine winter wheat morphological development

(1) Objective

o To determine wheat morphological development from 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 wheat will be grown where soil water will be limiting during one or more growth stages or 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 5^0C 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 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 ARS

Subtask Manager: Darryl Smika, ARS
Akron, Colorado

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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 physio-
   logical 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 ARS

   Subtask Manager: D. N. Baker, ARS, 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, with particular emphasis
     on factors contributing to winterkill.

   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 eval-
uating a phenological winter wheat model, and
expected limits governing winterkill.

(4) Test Sites: Sidney, Montana

(5) Organization and Responsibilities

Lead Organization: USDA ARS

Subtask Manager: J. K. Aase, ARS. 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 morphologi-
cal development in relation to soil and atmospheric
environmental factors.

(3) Anticipated Results and Products

o Models for spring 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) Organization and Responsibilities

Lead Organization. USDA ARS

Subtask Manager: A. Black, A. Bauer, ARS, 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 win-
          ter 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 ARS

       Subtask Manager: R. E. Ramig, ARS, 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 for various cultivars
with water and nutrients both limiting and
non-limiting.

(2) Technical Approach

o Collect data on 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 ARS

Subtask Manager: J. T. Musick, ARS, Bushland, TX

i. 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.

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(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 ARS

Subtask Manager: J. T. Ritchie, ARS, 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 ARS wheat field sites, SRS data sets, and other sources to test confidence with which leaf area index (LAI) and green biomass, describe growth and yield, and compare these yields with yields determined by ground sampling.

o Utilize Landsat data correspondent to ARS wheat field sites, SRS 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. Analyses 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 component response estimations.

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 ARS

Subtask Manager: C. Wiegand, ARS, Weslaco, Texas

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

(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 been identified for consideration, and areas of work 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 SRS

Subtask Manager: Greg Larsen, USDA SRS, Ft. Collins, CO

1. Subtask 12: Components of Winter Wheat Potential as Related to Temperature, Water, and Spectral Parameters

(1) Objective

(a) To evaluate the components of winter wheat yield potential in relation to plant development, photosynthetic rate, temperature and water.

(b) To develop a model to estimate LAI from spectral information and including evaluation of the components of yield.

(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 be included in developing a LAI estimation model using spectral information.

(3) Anticipated Results and Products

A model to estimate LAI.

(4) Test Sites

Houston, Texas; the Evaporation Field Research Site near Manhattan, Kansas; and various locations across Kansas.

(5) Organization and Responsibilities

Lead Organization: USDA ARS

Subtask Manager: G. O. Boatwright, ARS, Houston, Texas

m. Subtask 13: Sensitivity analysis of Wheat Plant Process Models

(1) Objective

Evaluate the sensitivity of selected wheat plant process models to satellite met data as compared to met data measured at the plant growth site.

(2) Technical Approach

The plant science research personnel at each location will record phenology, planting date, rate, yield, and agronomic characteristics of each cultivar grown. These data will be sent to the wheat yield coordinator. An SRS math statistician will operate the five plant process wheat models using agronomic inputs from the coordinator with satellite derived and ground measured meteorological parameters delivered by the project liaison leader.

A sensitivity analysis will be done on each model to determine the variability in response between ground measured and satellite estimated meteorological parameters.

(3) Anticipated Results and Products

The analysis will give some insight into the applicability of satellite enhanced data to drive plant process models. Publication of results will be the perogative of the model builders and the individual researchers growing the various cultivars.

(4) Test Sites

Bushland, Texas; Ft. Collins, Colorado; Sidney, Montana; Akron, Colorado; Pendleton, Oregon; and Mandan, North Dakota

(5) Task Organization and Reesponsibilities

Lead Organization:	USDA
Subtask Manager:	G. Larson, USDA/SRS-Ft. Collins
Subtask Coordinators:	W. Willis, USDA/SRS-Ft. Collins J. Rogers, USDA-Houston

6. Task Organiztion and Responsibilities

Lead Organization: USDA ARS

Task Coordinators: Jerry Ritchie, USDA ARS, Beltsville
Galen Hart, USDA SRS/SRD, Washington, DC
Wayne Willis, USDA ARS, Ft. Collins

7. Resource Requirements

a. Agency   FY83($K)

USDA ARS - Locations	990
USDA SRS-Washington	25
TOTAL	1015

b. Manyear Equivalents

(1) Civil Servants   FY83(MYE)

USDA ARS-Locations	13
USDA SRS-Washington	0.5
TOTAL	13.5

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

E. TASK 5: SOYBEAN YIELD MODEL DEVELOPMENT

WBS#: 03-02-05-01-00-13-(640)-21-(640)-01-(640)
                           -12-(35)-01-(35)-64-(30)
                                        -01-(05)

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., SRS-Missouri data set).

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

6. Task Organization and Responsibilities

   Lead Organization: USDA ARS

   Task Manager: Doyle Peters, USDA ARS, Urbana, Illinois

   Task Coordinators: Jerry Ritchie, USDA ARS, Beltsville, MD
                       Galen Hart, USDA SRS/SRD, Washington, DC.

7. Resource Requirements

   a. Agency - Funding   FY83($K)

       USDA ARS-Locations   640
       USDA SRS/SRD-Washington   35
              TOTAL   675

   b. Manyear Equivalents

       (1) Civil Servants   FY83(MYE)

            USDA ARS-Locations   8.0
            USDA SRS-Washington   0.1
                   TOTAL   8.1

       (2) University and Others

            USDA SRS/SRD (Univ. of
                          Florida)   0.7

8. Task Schedule and Milestones

   FY82 - Develop algorithms and computer model(s).

   FY82 and FY83 - Test model(s)

   FY82 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 pro-
    cessing, distribution, nor retention requirements on other
    program elements.

F. TASK 6: COTTON GROWTH AND YIELD MODEL DEVELOPMENT

WBS#: 03-02-06-01-00-13-(100)-24-(100)-01-(100)

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, Arizona, Israel

        (5) Organization and Responsibilities

            Lead Organization: USDA ARS

            Subtask Manager: Don N. Baker, USDA ARS
                             Mississippi State, MS

6. Task Organization and Responsibilities

Lead Organization: USDA ARS

Task Coordinators: Jerry C. Ritchie, USDA ARS,
Beltsville, MD

Galen Hart, USDA SRS/SRD, Washington, DC

7. Resource Requirements

a. Agency Funding   FY83($K)

   USDA ARS-Mississippi   100

b. Manyear Equivalents

   (1) Civil Servants   FY83(MYE)

       USDA ARS-Mississippi   1

8. Task Schedule and Milestones

FY82 and 83 - Summary 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.

G. TASK 7: CORN AND SORGHUM GROWTH AND YIELD MODEL DEVELOPMENT

WBS#: 03-02-07-01-00-13-(300)-15-(300)-01-(300)
                      12-(99)-01-(99)-01-(49)
                                -10-(50)

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 establishment 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

      (1) Objective

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

      (2) Technical approach

          (a) Test the corn model with variety of data
              available from literature sources and interested
              cooperators.

          (b) Add nitrogen balance in the soil and plants to
              the existing model.

          (c) Select experimental data from field studies in
              Temple for designing critical relationships
              needed in the model, but not available from
              literature.

          (d) Select experimental data from growth cabinets
              regarding the influence of temperature and
              photoperiod on ontogoly and development of various
              corn genotypes.

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(e) Develop model for estimating soil-water and nutrient parameters for the corn model using available soil classification information.

(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 ARS

Subtask Manager: Joe Ritchie, USDA ARS, Temple, TX

b. Subtask 2: Investigation of Corn Simulation Models for Large-Area Yield Estimation

(1) Objective

To determine the applicability of plant growth simulation models to making reliable large-area yield forecasts and estimates for corn.

(2) Technical Approach--the areas of work will include:

(a) Feedback

Develop and incorporate "feedback" variables into existing corn models. Feedback needs to be included in the current state-of-the-art plant process models for these models to be of use to the SRS operating program. Feedback contains both growth and development information at the time of measurement and this information must be built upon so that model yield converges to the observed final yield.

(b) Validation Data

Make available existing data sets, establish specifications for data to be collected by SRS for model validation.

(c) Sensitivity Testing

After the incorporation of "tc⸗∵ ∶ck", conduct
sensitivity analysis on input variables, model
parameters, and pertinent interactions. The
purpose of sensitivity testing is to provide
information to the model developer on sensitivity
of his model to the actual corn growth and
development process and how well his model mimics
this biological process.

(3) Anticipated Results and Products

(a) A number of validation data sets would be
prepared and available on the SRS Network
Processing System for corn model evaluation.
Also, statistics would be generated to evaluate
at least two presently existing input variable
simulation alternatives for internal and
comparative analysis.

(b) Complete model documentation including the
implementation of software on the SRS Network
Processing System would be accomplished.

(4) Test Site

Temple, Texas.

(5) Organization and Responsibilities

Lead Oreganization: USDA SRS

Subtask Manager: William Iwig, USDA/SRS

c. Subtask 3: Improve and enhance the SORGF simulation model
               for sorghum

(1) Objective

Improve and enhance the SORGF simulation model for
sorghum

(2) Technical Approach

(a) Perform the following enhancements or
modifications to SORGF:

o improve light intercept∵⸗ ⸗:gorithms

o improve dry matter accumulation algorithms

o improve soil water subroutine

o improve phenology algorithms

o improve leaf area development algorithms

o evaluate the benefit of including yield components

o implement water stress effects on leaf area development, phenology and yield components (if needed)

o incorporate nitrogen uptake and affects on growth and development

(b) Validate model with above modifications using field data sets availiable from cooperating scientists and/or USDA/SRS

(c) Document modified model

(3) Anticipated Results and Products

Document describing the enhancements and improvements to SORGF.

(4) Organization and Responsibilities

Lead Organization: USDA/SRS

Subtask Manager: Jerry Arkin, Texas A&M University

6. Task Organization and Responsibilities

Lead Organization: USDA, ARS

Task Coordinator: Jerry C. Ritchie, USDA ARS, Beltsville, Maryland

Galen Hart, USDA SRS/SRD-Washington

7. Resource Requirements

a. Agency - Funding   FY83($K)

USDA ARS, Temple, TX   300
USDA SRS-Washington   99
              TOTAL   399

b. Manyear Equivalents

    (1) Civil Servants   FY83(MYE)

USDA ARS-Temple, TX	3.0
USDA SRS-Washington	1.0
TOTAL	4.0

    (2) University and Others

        USDA SRS, Texas A&M   1.8

8. Task Schedule and Milestones

FY82 - Test and documentation of nutrient input version of corn model

FY82 - Conduct necessary experiments for collecting missing data

FY82-83 - 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 -

Within 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.

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

Agricultural and meteorological data sets will be acquired, pro-
cessed 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: ACQUIRE AND PROCESS DAILY HISTORICAL SYNOPTIC
              METEOROLOGICAL STATION DATA FOR FOREIGN COUNTRIES

WBC#:   03-03-01-04-00-32-(322)-01-(322)-01-(102)
                                       99-(220)

1.   Objective

     Acquire quality controlled historic daily maximum,
     minimum temperatures and total precipitation and other
     elements as designated for all regularly 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, will continue as part of FCAR plan.

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 1974-1980 station
     data. Phase 2 will include 1966-73. Countries will be
     per user requirements.

6. Task Organization and Responsibilities

Lead Organization: USDC NOAA/EDIS

Task Manager: R. Ambroziak, NOAA/EDIS-DC

Task Coordinators: Sharon LeDuc, USDA NOAA/EDIS-
                     Columbia
                     R. Ambroziak, USDC, NOAA/EDIS-
                     DC

7. Resource Requirements

a. Agency - Funding Requirements   FY83($K)

   USDC NOAA/EDIS-Washington   322

b. Manyear Equivalents   FY83(MYE)

   (1) Civil Servants
       USDC NOAA/EDIS-Washington   3.8
   (2) University and Others
       USDC NOAA/NCC Asheville   4.0

8. Task Schedule and Milestones

Not available

9. Interfaces

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

With other organizations: FAS FCCAD

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).

B. TASK 2: MAINTAIN, UPDATE, ACQUIRE AND BUILD HISTORIC
AGRICULTURAL DATA BASES.

WBS#: 03-03-02-01-00-12-(34)-04-(29)-01-(29)
-01-(05)-01-(05)

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

To be included in DCAR plan for future years.

4. Anticipated Results and Products

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

5. Subtasks

a. Subtask 1: Maintain and Update Domestic
Agricultural Data Bases.

(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 SRS/SRD

Subtask Manager: TBD, USDA SRS/SRD-Columbia

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

(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 SRS/SRD

Subtask Manager: James Cotter, USDA SRS/SRD
Columbia

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

(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 SRS/SRD

Subtask Manager: James Cotter, USDA SRS/SRD
                  Columbia

d. Subtask 4: Maintain and Update Computerized Catalog
        Reference System for Available Data Bases

(1) Objective

To maintain and update a computerized reference catalog of available data bases and research related to evaluation of plant process models which will be available to all AgRISTARS scientists.

(2) Technical Approach

The AgRISTARS Catalog Reference System (ACRS) has been developed for interactive access on the Martin-Marietta data system. Information about some data sets, including those currently used by the Yield Research Branch, SRD/USDA, has been entered. Information about additional data sets and evaluation related research is being abstracted from the literature and entered. Also, documentation regarding the use of ACRS needs to be formalized.

(3) Anticipated Results and Products

(a) A YMD report which documents the nature and use of ACRS.

(b) A more complete inventory of available data sets.

(4) Test Sites - NA

(5) Organization and Responsibilities

Lead Organization: USDA SRS/SRD

Subtask Manager: Fred Baker, USDA SRS/SRD-Washington, DC

6. **Task Organization and Responsibilities**

Lead Organization: USDA SRS/SRD

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

7. **Resources Requirements**

a. Agency - Funding   FY83($K)

USDA SRS-Columbia   29
USDA SRS-Washington   5
    Total   34

b. Manyear Equivalents

Civil Servants   FY83(MYE)

USDA SRS-Columbia   .6
USDA SRS-Washington   .1
    Total   .7

8. Task Schedule and Milestones

   TBD

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.

C. TASK 3: METEOROLOGICAL DATA BASE PREPARATION

WBS#:   03-03-03-04-00-33-(450)-04-(450)-01-(450)

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 daily
    meteorological data elements (max/min temp, precip, snow
    depth, dewpoint depression for max/min, average wind
    speed, max wind gusts) 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: Fred Finger, NWS/CAC-Washington

7. Resource Requirements

    a. Agency - Funding Requirements   FY83($K)

        USDC NOAA/NWS-Washington   450

    b. Manyear Equivalents   FY83(MYE)

        University/Other (TBD)

        USDC NOAA/CAC, Washington   4.0

8. Task Schedule and Milestones

   TBD

9. Interfaces

   With other AgRISTARS projects: All

   With other organizations: FAS FCCAD, SRS, and JAWF

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 - 3 TASKS

This program element will address the potential use of satellite data or products as input to crop yield models. USDA ARS will define spectral and/or remote sensing inputs into 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 experiments in the application of satellite spectral products and monitor other research results for potential use in crop yield models.

A. TASK 1: DEFINE SPECTRAL AND/OR REMOTE SENSING DATA REQUIREMENTS AND DEVELOP INPUT THAT CAN BE USED TO DRIVE OR TEST CROP GROWTH/YIELD MODELS

   WBS#: 03-04-01-01-00-13-(470)-07-(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

      Will be continued under FCAR project plan.

   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 ARS 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 ARS locations as needed.

6. Organization and Responsibilities

Lead Organization: USDA ARS

Task Manager: Craig Wiegand, USDA ARS, Weslaco

7. Resource Requirements

a. Agency-Funding Requirements   FY83($K)

   USDA ARS - Weslaco,   470
      Phoenix, Beltsville

b. Manyear Equivalent

   (1) Civil Servants   FY83(MYE)

      USDA ARS, Weslaco,   6.0
         Phoenix, Beltsville

   (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

FY82 to 85 - Input of spectral and remotely sensed data to crop growth/yield models, early warning alarms and crop condition assessments.

FY82 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

B. TASK 2: EVALUATION OF SPECTRAL INFORMATION FOR CROP YIELD
ESTIMATION

WBS#: 03-04-02-01-01-32-(250)-04-(200)-01-(30)
-37-(170)
-02-(50)-01-(50)

1. Objective

Develop crop yield estimation techniques using digital
spectral data.

Compare spectral reflectance of Landsat to NOAA series
satellites.

Correlate spectral response from both satellites to specific
crop yields.

2. Scope

Four sample segments in Missouri and sixteen in North Dakota.

3. Duration

Data collection and model form development in FY82 and 83.
Follow-on with Landsat D and NOAA 7 in FY84 and 85. Will
continue under FCAR project.

4. Anticipated Results and Products

This experiment should provide information on the relationship
of seasonal variation of spectral response as it relates to
yield of barley, corn, soybeans, and wheat. A relationship
will be established between spectral response (vegetative
indices) of Landsat and NOAA 6. A subjective model form
relating periodic spectral response to corn, soybean, barley
and wheat yields.

5. Technical Approach

Landsat and NOAA 6 digital data for crop years 1980 and 1981
will be acquired for North Dakota and Missouri areas
surrounding the 20 sample segments. Vegetative indices (band
7-band 5 for Landsat and band 2-band 1 for NOAA 6) will be
computed for each 25x25 nm I, J grid in which each segment
falls.

Ground truth data collected by ITD for crop years 1980 and
1981 will be acquired along with county, CRD and state yield
data for corn and soybeans in Missouri and wheat and barley

in North Dakota from USDA SRS. Statistical analysis of the
spectral value/crop stage/yield relationship will be done.
This statistical analysis and subjective judgments will be the
basis for a model form to be developed.

Landsat and NOAA series digital data will be collected in crop
years 1982 and 1983 for further development and testing of the
model form on a real-time (every 9 or 18 days) basis. Year
end evaluations will be done each year to verify in year
tracking results.

This technique will be evaluated for possible use on USSR
grains and Argentina corn and soybeans in 1983 and 1984.

6. Organization and Responsibities

   Lead Organizations: NASA and NOAA

   Task Managers: Tom Barnett, NASA-Columbia
                         Mike Helfert, NOAA EDIS-Houston

7. Resource Requirements

   a. Agency Funding   FY83($K)

      USDC NOAA-Columbia   200
      NASA-Columbia   -
      USDC NOAA-Houston   50
            Total   250

   b. Manyear Equivalents   FY83(MYE)

      (1) Civil Servants
          NASA-Columbia   0.4
          USDC NOAA-Houston   1.0
          USDC NOAA-Columbia   2.0
                Total   3.4

      (2) University or Others

          USDC NOAA-Univ. of
                    Columbia   1.0

8. Task Schedule and Milestones

   See schedule, page VIII-6

9. Interfaces

   SR for Landsat data.
   ITD for segment ground truth.
   EW and FAS for NOAA 6 and 7 data.
   SRS for county, CRD, and stage yield data.

MPE MILESTONES AND SCHEDULES
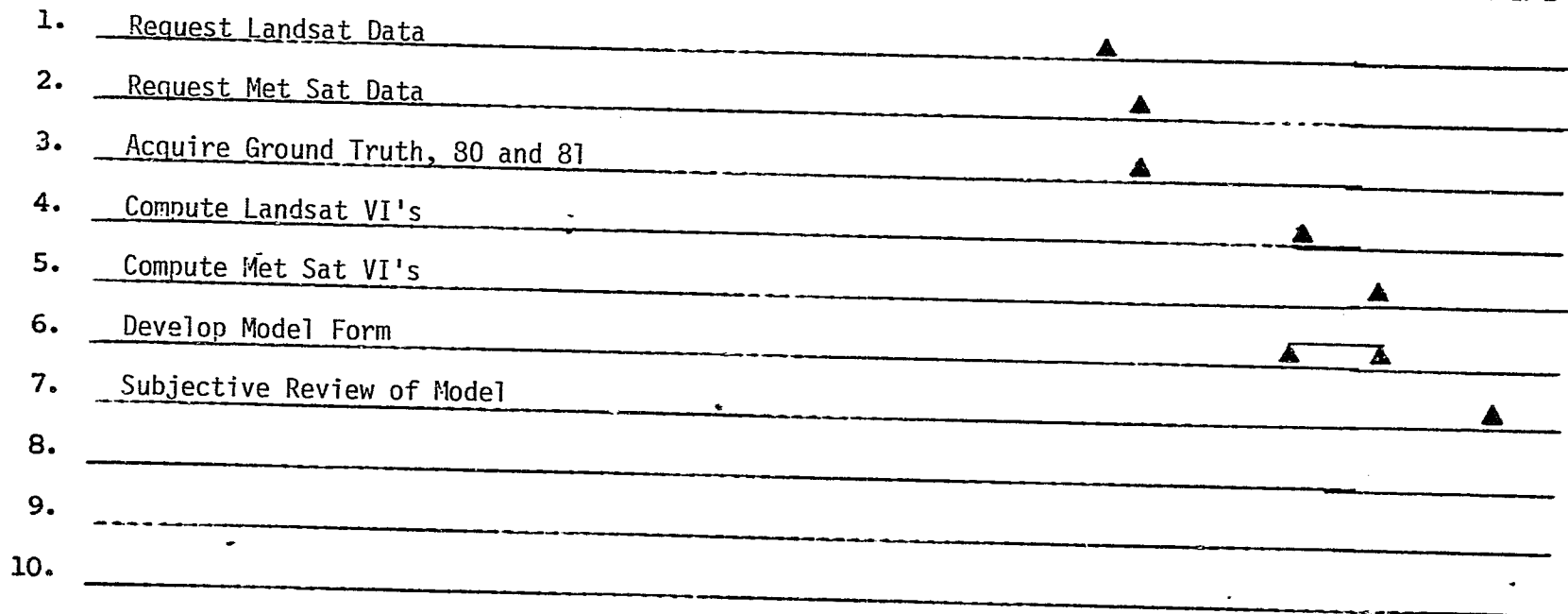
		CY1982	CY1983
		J F M A M J J A S O N D	J F M A M J J A S O N D

1. Request Landsat Data
2. Request Met Sat Data
3. Acquire Ground Truth, 80 and 81
4. Compute Landsat VI's
5. Compute Met Sat VI's
6. Develop Model Form
7. Subjective Review of Model
8.
9.
10.

MPE4, TASK 2

EVALUATION OF SPECTRAL INFORMATION FOR CROP YIELD ESTIMATION

10. <u>Data Acquisition, Preprocessing, Distribution, and Retention</u>

Landsat digital data will be required for all acquisitions for
Missouri and N. Dakota, and no segments for 1980 and 1981 crop
years. This requirement will continue through 1982 and 1983.
NOAA 6 digital data will be required over the same area for
1980 and 1981. NOAA series digital data will be required
through 1982 and 1983. All of the digital data will require
processing to compute vegetative indices for each image for
each acquisition. Software exists in the Early Warning
project to accomplish this task.

C. TASK 3: REAL TIME TEST AND EVALUATION OF WHEAT PLANT PROCESS
               MODELS

WBS#: 03-04-03-01-01-32-(355)-04-(315)-01-(65)
                                        -37-(250)
                              -02-(40)-01-(40)

1. Objective

    Evaluate the utility of wheat plant process model(s) in a real
    time environment.

2. Scope

    Seventy winter wheat and eighty spring wheat grid cells in
    eastern Europe and USSR.

3. Duration

    One crop year for actual model operation plus an additional
    year for evaluation and model adjustment.

4. Anticipated Results and Products

    A comparison of the utility of two to four wheat plant process
    models for real time prediction of phenology and yield
    potential in relation to a base year. Products will be a
    biweekly output of predictions from up to four different what
    process models.

5. Technical Approach

    A base year (crop year 1982) will be run using gridded
    meteorological data from GWC, USAF as meteorological data
    input. Crop year 1983 will be run every two weeks using real
    time data from GWC, USAF, up to the data of model operation.
    The same met data used for the base year will be input from
    the current date through the end of season.

    The base year model output for each model will be used to
    compare to known results for that year and minor correcting
    may be made to model parameters. A final iteration of each
    model will be done for use as the base years output and model
    baseline. Periodic iteration results of the models for the
    current crop year will be compared to the base year output for
    use as a crop condition comparison. This current year output
    will also be compared against vegetative indices for the same
    grid cell, crop stress model outputs, crop condition reports,
    etc., to determine the utility of the model output.

6. Task Organizatioin and Responsibilities

    Lead Organizations   Crop Modeling Center
                                          USDA/SRS and NOAA/EDIS

Task Manager   Tom Hodges
                                      University of Missouri

7. Resource Requirements

   a. Agency Funding   FY83($)

      USDC NOAA-Columbia   315
      USDC NOAA-Houston   _40_
            Total   355

   b. Manyear Equivalents   FY83(MYE)

      (1) Civil Servants

          USDC NOAA-Columbia   2.9
          USDC NOAA-Houston   _1.0_
                Total   3.9
      (2) University

          USDC NOAA-Univ. of
                   Missouri   2.5

8. Task Schedule and Milestones

   See schedule next page.

9. Interfaces

   Models will be operated by the Crop Modeling Center in
   Columbia, Missouri, using NOAA computer facilities in the
   World Weather Building, Suitland, Maryland. Gridded daily
   meteorological data and initial soils, soil moisture data, and
   planting dates will be furnished by FCCAD/FAS.

   Biweekly outputs will be furnished FCCAD as they are produced.

10. Data Acquisition and Processing

    Input data acquisition and processing for transmission to
    NOAA/EDIS is funded by FCCAD/FAS

MPE MILESTONES AND SCHEDULES

CY1982   CY1983

J F M A M J J A S O N D   J F M A M J J A S O N D
                Spring   Winter

1. Extract 1982 Crop Year Data

2. Prepare Soils Data Input

3. Determine Agronomic Variables

4. Prepare Base Year Output

5. Review Model Performance for Base Year

6. Operate Winter Wheat Models Real Time

7. Operate Spring Wheat Models Real Time

8.

9.

10.
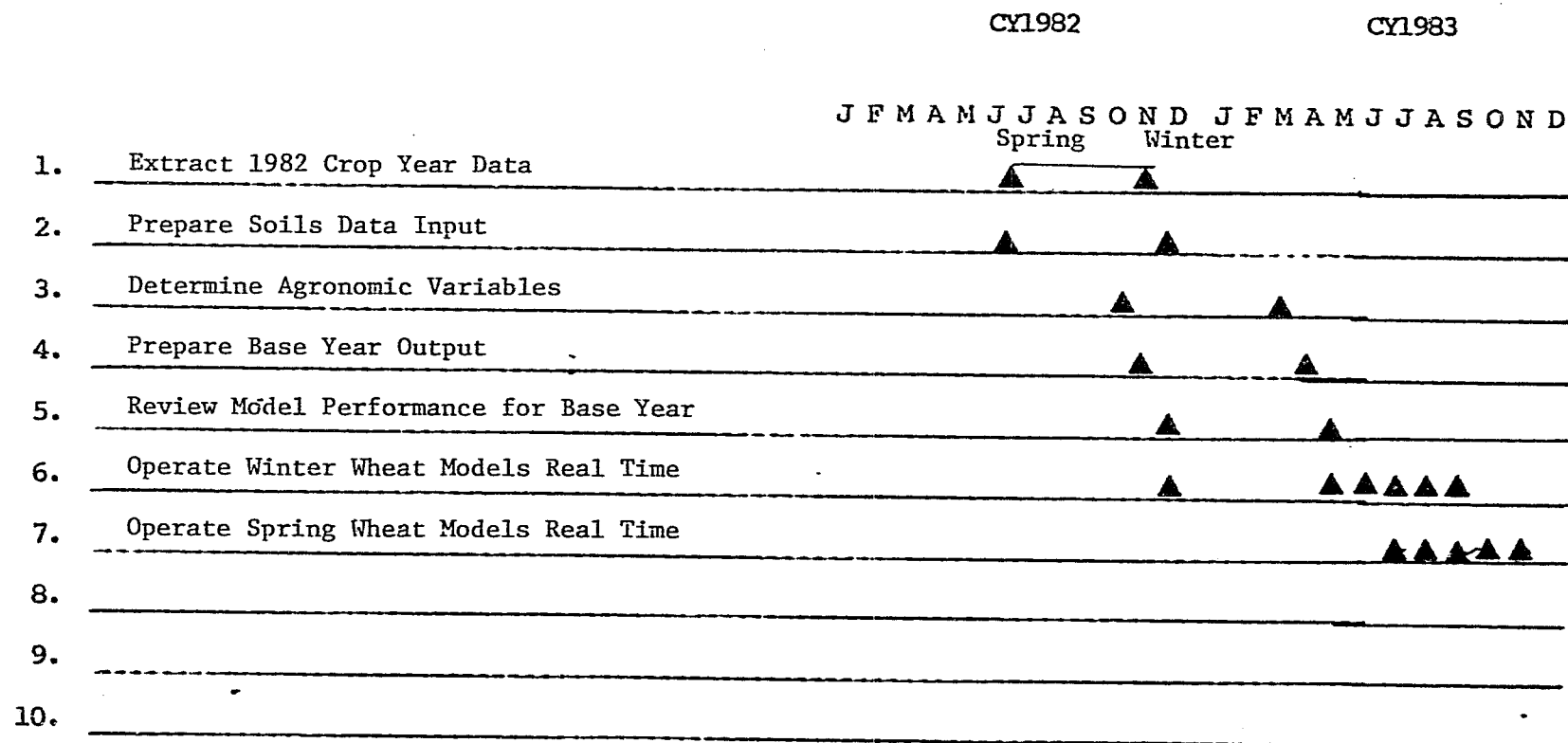
MPE 4, TASK 3

REAL TIME TEST AND EVALUATION OF WHEAT PLANT PROCESS MODELS

VIII-10

IX. **MAJOR PROJECT ELEMENT #5: PROJECT MANAGEMENT AND SUPPORT** - 3 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 ARS and SRS-Washington.

A. TASK 1: SUPPORT PERSONNEL AND PROJECT MANAGEMENT

WBS#: 03-05-01-04-00-32-(13)-04-(13)-01-(13)
12-(44)-01-(24)-01-(24)
-04-(20)-01-(20)

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 SRS/SRD, Washington
Jerry Ritchie, USDA ARS, Washington
Russ Ambroziak, USDC/NOAA,CEAS/EDIS, Washington

7. Resource Requirements

a. Agency - Requirements   FY83($K)

USDC NOAA-Washington	13
USDA SRS-Washington	24
USDA SRS-Columbia	20
TOTAL	57

b. Manyear Equivalents

(1) Civil Servants   FY83(MYE)

USDC	NOAA-Columbia	0.5
USDA	SRS-Washington	0.5
USDA	SRS-Columbia	0.4
	TOTAL	1.4

8. <u>Task Schedule and Milestones</u> - NA

9. <u>Interfaces</u>

With other AgRISTARS projects: EW/CCA, ITD, SR, SM, PMG
With other project elements: All
With other organizations: FAS/FCCAD, SRS, ARS, NOAA-
                           EDIS, NOAA-NESS

10. <u>Data Acquisition, Preprocessing, Processing, Distribution and Retention Requirements</u> - NA

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

    WBS#: 03-05-02-04-00-32-(13)-04-(13)-01-(13)
                             12-(49)-02-(49)-01-(49)

    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 pro-
        jects. 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 improve-
        ments 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 quantifi-
        cation 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 im-
        provement of yield model capabilities will be submitted to the
        project management team to task the proper project with tech-
        nique 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, FAS/FCCAD, and GWC/USAF 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   FY83($K)

      NASA, Columbia   —
      USDC NOAA, Columbia   13
      USDA SRS, Houston   49
                          TOTAL   62

   b. Manyear Equivalents

      (1) Civil Servants   FY83(MYE)

          NASA, Columbia   0.1
          USDC NOAA, Columbia   0.5
          USDA SRS, Houston   1.0
                          TOTAL   1.6

8. Task Schedule and Milestones

   NA

9. Interfaces

   a. ITD 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.

IX-4

d. SM to review techniques to model and predict 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.

g. FCCAD to access meteorological data received in Houston from JAWF and GWC, USAF.

h. GWC,USAF, to maintain up-to-date descriptive and definition of USDA derived gridded agromet data.

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

C - 2

C. TASK 3: NEW TASKS FOR FY83-85

WBS#: 03-05-03-01-00-12-(13)-01-(13)-01-(13)
                        32-(11)-04-(11)-01-(11)

1. Objective.

To initiate research, development and test tasks in an orderly
progression and expansion of yield model development.

To support yield estimation requirements of other AgRISTARS
projects and USDA operational requirements.

2. Scope

The exact nature of these tasks will be specified as required to
accomplish YMD objective of this task.

3. Duration

Through FY85.

4. Anticipated Results and Products

An orderly, efficient progression and expansion of the Yield
Model Development project effort. The FY83 plan and changes in
FY82 plan will reflect this effort.

5. Test Sites - As specified.

6. Organization and Responsibilities

Lead Organization: USDA ARS

Task Coordinators: Russ Ambroziak, NOAA EDIS, Washington
                    Fred Warren, USDA SRS/SRD, Washington
                    Jerry Ritchie, USDA ARS, Beltsville

7. Resource Requirements

    a. Agency - Funding   FY83($K)

        NOAA EDIS, Washington   11
        USDA SRS, Washington   13
                TOTAL   24

b. Manyear Equivalents   FY83(MYE)

        NOAA EDIS, Washington   0.4
        USDA SRS, Washington   0.2
                TOTAL   0.6

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

    Will be defined in each individual task as it is developed.