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Memo Report
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RICE OBJECTIVE YIELD FEASIBILITY STUDY

INTRODUCTION

The development of an objective yield program for rice is one of the subtasks identified in the Yield Model Development Implementation Plan for AgRISTARS.1/ A feasibility study was conducted during 1980 in Arkansas by the Economics and Statistics Service (ESS). The procedures used in the study were similar to the objective yield procedures used in the operating program for wheat. Some changes were made in the procedures to accommodate research data requirements and special problems in rice fields, such as the flooded conditions.

Development of a rice objective yield program presented several known and envisioned problems not necessarily encountered in other crops. The feasibility study was conducted to evaluate the severity of and solutions to these problems. Most of the problems were due to the flooding of the rice fields. Listed below are some of the concerns associated with this study:

1. difficulty in handling survey equipment in the field,
2. excessive damage to fields and observation units,
3. enumerator safety due to snakes, mosquitoes, and high humidity,
4. difficulties with postharvest measurements, and,
5. farmer resistance.

In addition, it was necessary to determine optimum plot size, and laboratory procedures.

This paper reports on the findings of the study with implications for further development.

1/ AgRISTARS is an acronym for "Agricultural & Resources Inventory Surveys Through Aerospace Remote Sensing".

SAMPLE DESIGN

Since the purpose of a feasibility study is to develop procedures and identify problems, it was not necessary to observe a large number of fields or to randomly select those fields. Nine fields were chosen for the study by the enumerators. Criteria for selection were farmer cooperation, distribution across the grain length types, representation of both aerial and drilled sowing methods, and proximity to the enumerator.

There were two stages of plant development that were of particular interest in the study--shortly after heading and at maturity. Since maturity varies greatly throughout Arkansas, enumerators were instructed to collect data during these stages rather than on a specified date. The advantages, many of which are intertwined, of completing measurements at the heading stage were:

1. an indication of the total stalk population which might be encountered during early season visits could be obtained,

2. some impression of fruit survival could be drawn, and,

3. field procedures could be evaluated with the flooded conditions.

The measurements at maturity provides the needed measurement of final yield components.

Three units were randomly located in each field at heading. Each unit was 3-rows by 21.6 inches in size. Stalks, late boot heads, and emerged heads were counted. Emerged heads and heads in late boot were clipped in row 1 of each unit and sent to the State Laboratory. At maturity 10 units were randomly located in each field. These units measured 6-rows by 21.6 inches. Each row was broken into 7.2 inch sections in order to evaluate variability. Postharvest gleanins were collected from 3 units per field, each 3-rows by 21.6 inches. Because of deep tire tracks in many fields, it was necessary to relocate many postharvest units. This problem will be discussed in detail in a later section of the paper.

RICE CROP CHARACTERISTICS

The discussion in this section is based primarily upon information gathered from the 9 fields used in this study. The 9 fields were distributed among the 3 eastern Crop Reporting Districts in Arkansas. Due to the extreme high temperatures and lean rainfall experienced during 1980 in Arkansas, some of the results may vary from what would be observed in a more normal year.

Rice fields in Arkansas are either seeded with a grain drill or aerially. At some point after seeding, the fields are flooded to a depth averaging 2 to 4 inches. Generally, the fields remain flooded until shortly before harvest. The major advantage of flooding is weed control. The high temperatures this season caused high evaporation and made maintaining the water level difficult and expensive. Rice tillers in a similar manner as wheat. Harvest occurs about 2 weeks before the rice is fully mature. This is because the spikelets of the rice head hang loosely, in a manner similar to oats, and shatter easily once fully mature.

The fields observed in the Northeastern District of Arkansas were seeded during late May and early June. Fields were flooded within 3 weeks of seeding. The fields were harvested during late September. The East Central fields were seeded in late April. These fields were flooded 4 to 6 weeks after seeding and were harvested late in September to early October. The Southeastern fields were seeded in early June and flooded about 3 weeks later. Harvest occurred in mid October. All farmers reported considerable yield losses due to the dry, hot weather and, in some cases, lodging caused by late season storms.

OPERATIONAL FEASIBILITY

Due to standing water in the fields the rice presented several operational concerns not experienced in other objective yield crops. Experience gained in this study, and enumerator comments, have shown that most of the concerns can be resolved.

One of the major concerns was enumerator health due to snake and mosquito infestation and high humidity. The enumerators indicated that health risks may be even lower than for soybeans and cotton. This is because that despite the high humidity in rice fields, the enumerator can get more fresh air than when working under the soybean and cotton vegetation. Several enumerators indicated that the job would be far more difficult if an enumerator worked alone because of the difficulty in handling equipment in the flooded fields. However, with proper equipment and improved procedures one enumerator should be able to operate as efficiently as in any other crop.

Excessive damage to the crop and the observed units was another concern. Damage to the crop when entering the field appears to be a legitimate concern. Although any loss to the farmer is probably minor, the enumerators felt the appearance of the field would hurt future farmer cooperation. This is a problem which must be recognized, but can probably be reduced by using sampling techniques which will limit the number of paces into the field. Damage to the units was not analyzed in this study, but future studies will look at this problem since it could significantly effect forecasting procedures. The problem may be worse than for other crops because root damage, from sinking into the mud, may greatly alter future productivity of the rice in the unit.

Some equipment changes are necessary for rice. In this study the frame used for wheat was used to delineate the rice units. Since this frame sinks, it was cumbersome for two enumerators to use and would be nearly impossible for one enumerator to use correctly. In 1981, spikes will be added to the frame which will hold the frame above the water level. Equipment bags used for other crops are unsatisfactory in rice fields. Most enumerators used large buckets in 1980. The buckets worked rather well.

The largest unresolved problem is with the harvest loss measurement. Fields are usually quite soft when harvested. The harvesting equipment leave rather deep tracks. Not all of the grain can be found in a postharvest unit which falls on a tire track. This requires placing the unit between the tire tracks. However, the area between the tire tracks may contain a disproportionately high amount of harvest loss. This study helped identify the severity of this problem, but not the solution.

DATA REVIEW

As discussed previously, the purpose of this study was to evaluate operational feasibility, not to collect data for building models. However, some of the data are worth reviewing.

Table 1, contains field level yield statistics. The estimated yields are based upon 10 units per field for the biological yield and 3 units per field for harvest loss. The limited sample size prevents the making of any definate statement.

Using a multiple t-test ($\alpha_c = \alpha/2x9$), to adjust for making 9 concurrent tests, the harvested yield estimates of only 2 fields were significantly different from the farmer reported yield at α = .05. The farmer reported yields and the estimated yields were adjusted to a 12 percent moisture level. The use of farmer reported yields has its obvious problems. However, as in many studies, farmers have the best check data available.

The estimates appear to tend toward underestimating low yields and overestimating high yields. Field 7 does not follow this pattern. The farmer yield in field 7 must be questioned since the biological yield of only 3 of the 10 units was less than the farmer reported yield.

As stated earlier, harvest loss measurement is a serious problem. The harvest loss data do not provide any real clues to answering the problem. It is thought that in most fields it will be necessary to locate the gleaning units between the combine tire marks. It is expected that this area will contain a disproportionately high amount of loss, particularly if the combine is not equipped with a straw spreader. The data do not necessarily support this concept. Harvest loss in fields 4, 5 and 6 was less than 100 pounds. However, these were the only fields that reportedly were harvested with combines lacking straw spreaders. Since these three fields were enumerated by the same set of enumerators, the quality of the data must be questioned.

Analysis to determine the optimum size of a preharvest unit indicated that a 3-row by 7.2 inch unit is best under a restriction of a minimum of 3 rows. However, there is some reluctance to reduce the unit below the size used for wheat (3-rows by 21.6-inches) for fear too many blank count units will be obtained. In addition, the larger unit may provide more stable parameters for the forecasting models.

Table 2 contains field level statistics of the biological yield components. The C.V. values appear to be quite reasonable.

CONCLUSIONS AND RECOMMENDATIONS

Except for the difficulties with postharvest measurement, all other data collection concerns were found to be minor or no problem at all. Some revisions of survey equipment and procedures will enable one enumerator to complete the rice data collection with near the efficiency of other crops. The lack of concern expressed by enumerators over safety factors further supports the use of only one enumerator.

The concern that enumerators might excessively damage levies, resulting in strong farmer resistance, appears unfounded. However, if the field is flooded, pacing into the field results in a very obvious trail through the rice. The concerns with farmer relations due to this is very real. Damage to the observation units appeared to be a problem. The study was not designed to evaluate the effect of the damage. Future studies will evaluate this problem.

The recommendation to expand the study in 1981 has been approved. Approximately 100 sample fields will be observed. Half of the sample will be visited monthly beginning in early August. The remainder will receive a final preharvest visit. In fields receiving monthly visits, one unit will be visited each month and the other unit will be relocated each month. This will permit analysis of the damage to units. Postharvest units will be located in all fields. At this time, no special procedures have been developed to solve the harvest loss problems.

Table 1: Field level yield statistics

Field	Length	Variety	Estimated Biological Yield		Estimated Harvest Loss		Estimated Harvested Yield		Farmer Reported Yield	DIFF 1/
			Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.		
			Pounds Per Acre							
1	Long	Labelle	5435	362	117	16	5318	362	4780	538
2	Medium	Lebonnet	5756	218	379	163	5377	272	4319	1058*
3	Medium	Mars	4557	378	319	155	4238	408	4349	-111
4	Long	Labelle	1853	286	35	10	1818	286	3436	-1618*
5	Short	Nato	3806	372	87	30	3719	393	3820	-10
6	Long	Starbonnet	4884	246	12	5	4872	246	4226	646
7	Long	Labelle	3142	474	274	31	2868	475	1677	1191
8	Long	Starbonnet	2853	172	497	462	2356	493	2935	-579
9	Long	Labelle	4776	372	476	271	4300	460	3355	945

1/ DIFF = Estimated Harvested Yield - Farmer Reported Yield

*The difference is significantly different from zero at a 95 percent probability level using a multiple t-test.

Table 2: Field level yield component statistics

Field	Weight Per Head Mean (grams)	Weight Per Head C.V.	Final Heads Per Acre Mean (000)	Final Heads Per Acre C.V.
1	1.33	38	2040	31
2	1.87	33	1486	23
3	1.86	22	1114	21
4	.66	56	1336	28
5	2.88	15	590	22
6	2.41	12	919	9
7	1.39	38	1042	32
8	1.09	24	1238	27
9	1.73	19	1280	32