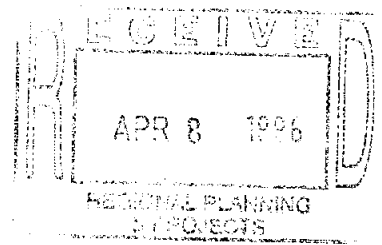


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**A Survey of Rice Farmers  
Along the Colorado River**

**William Eugene Roberts, Jr.**

Lyndon B. Johnson School of Public Affairs  
The University of Texas at Austin

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## **ABSTRACT**

### **A SURVEY OF RICE FARMERS ALONG THE COLORADO RIVER**

by

**William Eugene Roberts, Jr., M.S.C.R.P.**

**The University of Texas at Austin, 1994**

**SUPERVISOR: Kent Butler**

The report is based upon a mail survey of rice farmers who contract with the Lower Colorado River Authority (LCRA) for their irrigation water. The survey gathered information in four main areas: farmer personal characteristics, farming practices, farmer opinion on the performance of the LCRA, and attitudes toward the LCRA's decision to charge for water on a volumetric basis.

The report begins with a background discussion of the two irrigation districts operated by the LCRA. All farmers within these two districts who contract with the LCRA were included in the survey. The following sections include an extensive discussion of published research on the adoption of conservation practices by farmers and in survey methodology. The results of the survey are then presented and analyzed. Some statistical analysis was done on the results using cross-tabulation and Pearson chi-square calculations.

The survey's main findings were that farmers were generally satisfied with the performance of the LCRA but were apprehensive about being charged for water on a volumetric basis. The apprehension derived mainly from a belief that water delivery measurement was inaccurate.

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## Chapter 1. Introduction

### LCRA Irrigation Districts

The Lower Colorado River Authority (LCRA) was established in 1934 as a conservation and reclamation district. The LCRA manages water storage and withdrawal along the lower Colorado River, operates the Highland Lakes system, produces electricity, and owns two irrigation districts--the Gulf Coast and Lakeside Irrigation Districts.

The Gulf Coast Irrigation District is located around Bay City, Texas. The Lakeside irrigation district is located around Eagle Lake, Texas. The two districts were first granted water rights in 1900 and 1901. In 1953 the LCRA purchased the Gulf Coast district and in 1983 it purchased the Lakeside district.

The LCRA operates a system of canals in the districts through which it provides water from the Colorado River to farmers operating within the districts' boundaries. The majority of this water is used for rice farming but other crops are also represented. A total of slightly over 50,000 acres was irrigated by this system in 1992 (LCRA, 1993).

The LCRA has recently implemented a three-part program to reduce the amount of water used for agriculture by the two irrigation districts in order to stabilize and increase water supplies for other users in the Lower Colorado River Basin (i.e. industrial and municipal).

The first component of the water conservation program consists of rehabilitation of the approximately 650 miles of canals in the irrigation districts. Large amounts of water were being lost to evaporation because of the wide, shallow canals and transpiration due to abundant plant life along the edges of the canals.

The second component of the LCRA's water conservation program is the transfer of conservation technology to the farmers. The third component of the program is the transition to a volumetric pricing system for irrigation water. Previously, farmers paid the LCRA a flat rate, based on the amount of acreage farmed, to cover the operation of the canal system.

Water has become a scarce resource in the region and the LCRA will begin basing the farmers' water bills on the amount of water used. This strategy is designed to discourage wasteful practices and promote those that conserve water.

Farmers will continue to pay a flat rate to cover fixed costs the LCRA incurs in operating the irrigation system. Another portion of the farmers' bills will cover the costs that the LCRA incurs from storing water in the Highland Lakes system. Stored water is that which has been retained in the Highland Lakes system at an operational cost to the LCRA. This second, variable part of the bill will reflect the amount of stored water the farmers are using.

In 1992, the LCRA began measuring the amount of water delivered by the irrigation system. However, farmers were still billed according to the old rate structure. The 1993 season was the first season that farmers were billed using the new rate structure including the portion calculated on a volumetric basis.

### Policy Research Project Survey

The Policy Research Program in the LBJ School of Public Affairs at The University of Texas at Austin is a seminar in which graduate students at The University work on real projects as opposed to pursuing purely



academic studies. A Policy Research Project (PRP) was set up and coordinated by Professor David Eaton with the LCRA as a client. The students in the seminar were to provide the LCRA with an independent evaluation of its water conservation programs.

One aspect of the PRP's investigation of the LCRA's project was a survey of the farmers who purchase irrigation water from the LCRA. The LCRA and the farmer community were interested to learn the results of the survey.

An initial analysis of certain aspects of the survey constitute a chapter in the full report of the program evaluation by the PRP members. The chapter addressed the farmers' evaluation of the LCRA's performance in numerous areas as well as opinions on the new billing system.

### **Extent of the Professional Report**

This professional report is a significant extension of the work produced for the PRP. This report uses the database gained from the survey of the farmers but performs much additional analysis on the survey data, adds information on the existing literature about the adoption of conservation techniques, and contains an extended discussion of the theory of mail survey methodology.

The report extends the discussion to the results of all questions on the survey. It also examines numerous cross tabulations and compares and contrasts the characteristics of farmers who answered differently to significant questions. This report also compares the findings from this survey to the existing literature on farmer attitudes and demographics. Finally, the report makes recommendations to the LCRA with the aim of promoting water conservation and improving relations with the farmers.

## Chapter 2. State of the Field: Previous Studies

### Adoption of Conservation Techniques

Many previous studies on farmer attitudes and factors associated with the adoption of conservation techniques have focused on soil conservation and specifically the use of minimum tillage techniques, not on water conservation.<sup>1</sup> Therefore, what follows is mostly a discussion of the adoptions of conservation tillage.

Investigations of the factors affecting adoption and use of soil conservation practices began in the 1950s. The North Central Farm Management and Land Tenure Research Committee (1952) discussed six factors which may act as obstacles to adoption of conservation techniques. Most of the factors are economic. The first was a lack of information on the costs and benefits of new practices. Another factor was the organization and income constraints on small farms. The reluctance to forego short-term benefits for uncertain long-term gain was cited as a factor as well as debt constraints.

Two non-economic factors were cited as possible obstacles to conservation practice. First, farm operators would be reluctant to change familiar methods of farming. Second, rental arrangements, or ownership of the land by someone other than the tiller, might inhibit the adoption of conservation practices by the farmer.

Blase (1960) found three factors were statistically significant in explaining reductions in soil loss. As in the North Central study, a majority of the factors are economic. One is off-farm income. This outside income allowed farmers to overcome the financial constraints that may be felt by those deriving all their income from the farming enterprise. Related to the first factor was a second which was the ability to borrow funds. The third factor was the perception of soil erosion as a problem. Two out of the three factors were economic in nature while the third was attitudinal.

More recent investigations have been stimulated by Section 208 of the 1972 Amendments to the Federal Water Pollution Control Act. These investigations have expanded the range of variables to include the personal characteristics of farmers. Current research favors the investigation of these personal factors while studies stressing economic variables appear with less frequency.

Research has become somewhat divided into two camps. Some authors examine the economic constraints that operate in the adoption of conservation techniques while others concentrate more on the socio-psychological situation of the farmers. Fortunately, some authors (Lee and Stewart, 1983; Gould *et al.*, 1989) note the importance of a range of factors including economic, geographic, land use, and operator related variables. They call on other researchers to be open enough in their studies to recognize the influence of all these variables on adoption decisions.

The proponents of the economic constraint model (Heffernan, 1972; Aikens *et al.*, 1975; Flora and Rodefeld, 1978; Goss, 1979; Buttrell and Newby, 1980; Flinn and Buttrell, 1980; Lancelle and Rodefeld, 1980; Hooks *et al.*, 1983) argue that economic constraints frequently prevent individuals from acting and deserve more research attention. Using an econometric model, Rahm and Huffman (1984) found that determinants of conservation tillage adoption efficiency could be predicted and varied widely across sample farms. Factors such as soil characteristics, the cropping system, and the scale of operation significantly affected the probability of adopting reduced tillage in Iowa corn enterprises.

Lichtenberg and Lessley (1992) attempted to determine whether the required capital investment for conservation techniques acted to discourage adoption. They found that the adoption of best management practices (BMPs),

defined as farming practices that reduce soil and nutrient losses at reasonable cost, was not affected significantly by the offer of cost-sharing on the part of government agencies.

Reasons why farmers may not participate in cost-sharing programs are difficult to identify. One possible explanation is that farmers are already using the runoff control measures that are profitable for them. While cost-sharing may reduce the loss they would incur if they adopted additional BMPs, the fact that adoption is voluntary means they would still save money by not adopting the techniques.

Transaction costs could be another discouraging factor for farmers. Small, part-time farmers especially may see governmental paper work and procedure as a major impediment since they may have little spare time, be unfamiliar with the workings of government agencies, and have less to gain from the program.

Lichtenberg and Lessley felt that the major reason farmers did not adopt BMPs or take advantage of cost-sharing was because of a lack of understanding as to the extent or seriousness of water quality problems. While the farmers recognized that water quality is a problem, they tended to perceive it as someone else's problem.

Behavioral research concentrates on the personal characteristics of the farmers and the institutional setting within which they make their decisions. One theoretical model from this line of reasoning is termed the diffusion-farm structure perspective (Napier *et al.*, 1983; Napier and Camboni, 1988; Napier and Napier, 1988).

The diffusion component of the theoretical model asserts that psychosocial perceptions and past learning experiences affect adoption of innovations. It assumes that before a farmer will make a change in technique, they must become aware that a problem exists. Therefore, the greater access the farmer has to information, the more likely they are to adopt new techniques. Information access has been shown to be a very important predictor according to several studies (Lionberger, 1960; Rogers and Shoemaker, 1971; Taylor and Miller, 1978; Nowak and Korsching, 1980; Rogers, 1983).

The diffusion component also contends that farmers must have internalized favorable attitudes toward the techniques in question (Napier and Camboni, 1993).

The farm structure component stresses that the current state of the farm enterprise and farm policy enter the decision making process and affect the outcome. Farm structure can influence the ability of farmers to adopt innovations. Potential adopters must possess not only the economic means to install new practices but also the skill to use them.

The structure and organization of the farm can be related to the adoption of conservation techniques (Carlson *et al.*, 1977; Pampel and van Es, 1977; Choi and Coughenour, 1979; Earle *et al.*, 1979; Ervin and Ervin, 1982; Miranowski, 1982; Nowak and Korsching, 1982; Rogers, 1983). These studies show that acreage and income, two important indicators of farm structure, can be especially important to adoption when the new practice requires a financial investment. In a study of 7,649 cropland observations, Lee and Stewart (1983) found that the corporate structure of the farm operation did not significantly influence the adoption decision.

Other studies have also found farm size and conservation not to be correlated. Napier and Forster (1982) found that farm size was not significantly related to the adoption of soil erosion control practices but did find that indicators of the complexity of a farm operation were inversely related to adoption of minimum tillage techniques. Butrell *et al.* (1981) found farmers with larger farms tended to be concerned less about the environment than persons who farmed smaller acreage though adoption of conservation techniques could still be due to economic gain factors and not the farmer attitude toward the environment.

While farm size appears to be correlated with adoption of conservation tillage, it may not be as determining a factor as the managerial skill of the farmer. Large farms may have a higher adoption rate because the farmers have the skill to coordinate the more complex operations required for conservation tillage (Korsching *et al.*, 1983).

Numerous studies have found age and education to be associated with the adoption of new farming techniques. Younger and better educated farmers are more efficient in the decision to adopt conservation techniques (Carlson and McLeod, 1977; Choi and Coughenour, 1979; Earle *et al.*, 1979; Rogers, 1983). Younger and better educated farmers are thought to be more knowledgeable about new farming practices as well as more prone to risk taking. In addition, the younger farmers will have a longer payoff time.

Bultena and Hoiber (1983) tested for the factors of youth, education, and risk taking and found support for the traditional view of these farmers adopting conservation practices more efficiently. Korsching *et al.* (1983) found that the younger farmers were not necessarily more likely to change to conservation techniques but noted that the particular innovation or technique in question may be a factor. The study did find a relationship between education and adoption of conservation techniques with higher education associated with greater innovativeness.

Napier and Napier (1991) surveyed 371 Ohio farmers and found that levels of knowledge were correlated with conservation practices. The study asked farmers about the Conservation Title of the Food Security Act of 1985. Farmers who indicated that they were more knowledgeable of compliance details were more favorable toward the legislation. The authors surmised that more knowledgeable individuals were better able to assess the potential impacts of the program on their farming operations. On the other hand, persons not adequately informed of the program may have over-estimated the costs and under-estimated the benefits. Napier and Napier concluded that unrealistic fears of adverse impacts of such programs can be reduced by information provided by contact with farm program agency personnel.

Farmer attitudes were found to be the best predictors of whether farmers were favorable toward a particular soil conservation program in a study by Napier and Camboni (1988). The authors of this study found that nearly all variance in the farmers' attitudes toward the conservation program was attributable to farmers' attitudes toward: land operators' rights, extent of soil erosion in the county of residence, the party responsible for paying the costs of erosion control, and risk.

In conclusion, economic and structural factors are going to play a part in the decision making of the farmer when it comes to employing conservation techniques. Attitudes, personal characteristics, and knowledge have also been shown to play an important role in the adoption of conservation techniques. Conservation advocates are not able to change the personal characteristics of farmers but education and instruction can alter levels of knowledge and attitudes.

Some reservations toward conservation can be addressed with cost-sharing programs, but as Lynne, Shonkwiler, and Rola (1988) found, stronger attitudes favoring conservation raise the levels of effort. If attitudes can be strengthened enough, there will be a reduced dependence on technical assistance and other net income-enhancing programs such as cost-sharing and tax incentives. While education may never totally replace economic incentives, any method to increase the ecological soundness of farming should be pursued to help insure future resources.

## Notes

1. The author searched several electronic databases: GeoRef, Economic Literature Index, AGRICOLA, Academic Periodicals Index; as well as a certain amount of manual searching through professional journals for resources. It is especially noteworthy that the Journal of Soil and Water Conservation contains so little work on the adoption of water conservation techniques by farmers. It does, however, contain work on the types of techniques available. Also, water conservation specialists at both the Texas Water Resources Institute and the Texas Department of Agriculture's Rice Experiment Station were consulted in the search for reports on water conservation studies.

### **Chapter 3. The Survey Instrument**

Water conservation in irrigated rice agriculture cannot succeed without the enthusiastic and active involvement of the farmers, reflecting a belief that more rice can be produced with less water. Canal rehabilitation, water measurement, volumetric pricing, and training will not be successful in promoting irrigation water conservation unless the farmers believe in the program's motives and methods.

One way to access the attitudes and knowledge of farmers who work the land in the Gulf Coast and Lakeside Irrigation Districts is to survey them directly. This chapter describes the development, implementation, and results of a survey of all 230 persons farming at the irrigation districts with active accounts for irrigation water.

Survey results can be used to evaluate farmer knowledge and attitudes toward irrigation water conservation. Farmers are the LCRA's irrigation customer base; because the LCRA is a public entity, farmers are its constituents. A survey allows the LCRA to gauge farmers' opinions about how well the LCRA does its job. Survey results can help the LCRA focus its resources and improve its performance. The survey also may indicate topics for which communication between the LCRA and the farmer can be improved. Finally, this survey can be a means for farmers to affect the LCRA's policies, as it can mirror their thoughts and concerns.

Project members selected a survey as a means for determining the farmers' attitudes and beliefs because a survey is a more representative means for obtaining information about farmer concerns than methods which rely upon farmer initiative. For example, farmer phone calls, letters, or visits to the LCRA offices are not necessarily representative of all farmers' concerns. A survey initiated by a third, independent party can obtain information that is representative of the entire farmer population.

#### **Survey Theory and Methodology**

The researcher has the choice between personal interview or mail surveys. Mailed surveys have traditionally been unfavorably compared with scheduled interviews because of poor response rates (Helmstadter, 1970; Leik, 1972). Numerous textbooks assumed response rates would be below 50 percent for mail surveys (Boyd and Westfall, 1964; Labovitz and Hagedorn, 1971; Babbie, 1973; Kerlinger, 1973; Meyers and Grossen, 1974; Black and Champion, 1976; Orenstein and Phillips, 1978; and Kidder, 1981). However, since 1960 much progress has been made in mail interview methodology (Harvey, 1987). Response rates to mail surveys now often rival, or surpass, response rates for personal interviews (Neuhauser, 1976; Brook, 1978; Goyder, 1985).

More recently authors have stated that returns of 70 percent have been achieved (True, 1983; Cole, 1980) with 60 percent (Sanders and Pinhey, 1983) being noted as an average. Weisberg and Bowen (1977) and Miller (1977) have achieved a consistent rate of 70 percent from the general public, not members of clubs or special groups. One researcher reported that while response rates for personal interviews have fallen, mail interviews appear to be free from this drop (Goyder, 1985).

The rest of this chapter describes the process through which the survey was developed. A mail survey was selected as the most appropriate for this project. The reasoning in this decision is discussed first. Mail surveys have several advantages but they also have some disadvantages. The relative importance of these advantages and disadvantages is discussed. The steps in developing the survey instrument itself is next. Finally, the types of questions present on the survey are outlined.

### Advantages of Mail Surveys

Mail surveys have several advantages over personal interviews. They also have several disadvantages. These are summarized in Table 3.1.

**Table 3.1**  
**Advantages And Disadvantages Of Mail Surveys to Personal Interviews**

<b>Advantages</b>	<b>Disadvantages</b>
Can cost much less than interviews.	Mailing list is necessary.
Can provide a time savings.	Respondent cannot ask clarifying questions.
Respondent may complete at his/her convenience.	Prevent researcher from asking clarifying questions.
May achieve more truthful replies.	No obvious check on veracity of information provided.
Allows centralized control of survey process.	
Respondent may be guaranteed anonymity.	

*Mail surveys can cost much less than interviews.* Although the questionnaire in a mailed study may be more expensive than the survey form used in an interview study, with higher quality printing, envelopes, and postage, a mailed study may cost far less than an interview study with the same sample size. This is true even if first class postage is used for the survey instrument and several follow-up mailings are used as reminders.

The lower cost of the mail survey leads to another advantage: wider distribution. Because of relatively lower cost of mail surveys, the often wide geographic distribution of the sampled population is not a factor. In fact, the wider the geographic distribution of a sample, the greater the savings by employing a mail survey.

*Mail surveys can provide a time savings.* Most surveys will be returned within one to two weeks with very little effort put in by the researcher. Obviously, as the sample size and geographic distribution increase, so does the time benefit of a mail survey.

*The respondent is free to complete a mail survey at his/her convenience.* This may be late at night or at other times and locations that would be difficult or impossible for an interviewer to replicate. As a result, the respondent may spend more time on the survey. This convenience allows them to consider more difficult questions over a longer period.

*Mail surveys may achieve more truthful replies* (Erdos, 1970; Bailey, 1982). There are two main reasons for this generalization. The first is the reduction of interviewer bias. Even the best interviewer can bias responses due to voice inflection, accent, ethnic background, dress, and mannerisms, or other factors. The questions on a mail survey can be carefully scrutinized to avoid leading questions or offensive terms. The second reason is that a mail survey is more controlled than an interview as the same form can be sent to all respondents. This eliminates any interference due to mood, time of day, or similar factors.

*A mail survey allows centralized control of the process.* One researcher, or at most a few, can construct the survey, mail it out, collect the returns, and enter the data in the database. Fewer people involved typically lowers the chance of error and makes it easier to maintain a high level of quality control.

*The respondent may be guaranteed anonymity.* It has generally been assumed that ensuring someone's anonymity may induce them to give a more truthful answer to certain sensitive questions.<sup>1</sup>

### Disadvantages of Mail Surveys

Though mail surveys certainly have many advantages over personal interviews, they have some disadvantages as well.

*A mailing list is necessary before a mail survey can be carried out.* In some instances a list may not be available. The cost of constructing a mailing list could exceed the cost of conducting personal interviews. In such a case, the mail survey no longer benefits from one its strongest advantages. In other occasions, only an incomplete, unreliable, or biased mailing list may exist. This situation will result in sample bias and/or a high non-response rate due to such things as undeliverable survey forms.

An example of a biased mailing list would be the subscribers to a particular magazine. Any survey done using this list would not necessarily be representative of the entire or desired population. The survey would only cover those individuals who have one common characteristic—subscribing to a certain magazine. While this is not a problem of mail surveys *per se* but of sampling method, it should be kept in mind when obtaining addresses.

*The respondent cannot ask clarifying questions.* To some extent this problem can be controlled by ensuring that survey questions are as clear and concise as possible. However, some subject matter is complex to the extent that it is difficult or impossible to present the questions in a manner which is sure to be understood by all respondents. Whereas an interviewer can adjust his/her presentation to each respondent, a mail survey will generally send the exact same wording to all respondents. If a respondent does not fully understand a mail survey question usually the only choice is to take a best guess. This inability to clarify a question can lead to error if a respondent misses the meaning and provides incorrect information. The researcher may not be aware of this error and therefore the results would mislead.

*The mail survey prevents the researcher from asking clarifying questions as well.* If a respondent's answer to a particular question is unclear or obviously in error the data will have to be discarded. In an interview situation a researcher can recognize this difficulty and rephrase a question or ask the respondent to be more precise with an answer.

This survey attempted to achieve clarity of questioning. However, as indicated below, some of its questions were interpreted in different ways by different respondents.

*The mail researcher is at the mercy, so to speak, of the respondent more than the interviewer.* While it is possible to ask so-called filter questions on a mail survey, questions that elicit information without the respondent necessarily being aware of it, there is no reason a wealthy person could not claim low income, an uneducated person claim advanced education, or any combination of these or similar characteristics. With the researcher present in a personal interview, a respondent may feel compelled to provide correct information on subjects which would be obvious to the interviewer but not obvious to a mail researcher. In cases where the researcher has good reason to believe inaccurate information has been provided, there is often no choice but to discard the data altogether. Fortunately, respondents rarely provide false information intentionally.<sup>2</sup>

Goode and Hatt (1952) contend that mail surveys are not an effective research tool because they will usually be biased in some way. However, McDonagh and Rosenblum (1965) compared the results of a mailed questionnaire and interviews by studying persons who responded to the questionnaire and persons who failed to respond. They found no statistically significant difference between the two groups.

Other researchers have suggested additional drawbacks to mail surveys. For example, a mail survey allows no control over the order in which questions are answered (Bailey, 1981). It may also be difficult to separate an incorrect address from non-response (Lansing and Morgan, 1971).

### **Creating the Questionnaire**

After considering all of these factors, the PRP team members in charge of gathering this information decided to employ a mail survey rather than a personal interview survey. Before questions could be designed, it was necessary to determine exactly what information was desired. The first step was to become familiar with the operations of the irrigation districts.

Several meetings were held with LCRA personnel from both the Austin and Bay City offices. Documents of the LCRA and other entities such as the Texas A&M Rice Experiment Station were reviewed for an understanding of the issues involved and the management structure employed. Finally, a site visit to the irrigation districts was performed to attend a farmer meeting and observe the operations of the district.

After an understanding of the issues was achieved and the information to be gathered from the survey was determined, the actual survey questions were developed. As the development of the questionnaire began, the following objectives were kept in mind (paraphrase of Erdos, 1970):

- (1) The questionnaire should include questions on all subjects which are essential to the project.
- (2) The questionnaire must be clear, professionally done, and easy to complete.
- (3) The respondent must be made to feel that the time and energy put into the questionnaire is worthwhile (in other words, that their participation is important and they have something to gain by completing the form).
- (4) The questionnaire should not contain any questions which could bias the answers.
- (5) It must be designed to elicit clear and concise answers to all questions.
- (6) The structure of the form must be designed with the easy tabulation of results in mind.

### **Design of Questions**

The construction of the questions to be included on the survey form may seem fairly easy to those who have not attempted it. The development of 50 or more quality questions is no small matter. Many pitfalls need to be avoided if all the criteria mentioned above are to be satisfied.

The survey writer must be careful to avoid two questions posed as one. For example, the question, *Do you meet with the LCRA and other farmers to discuss possible water conservation practices?* may not be possible to answer. What if the farmer does discuss the matter with other farmers but not the LCRA? If the farmer answered positively we would be led to believe the farmer also discussed the matter with the LCRA which is inaccurate. On the other hand, a negative answer would indicate that the farmer spoke to neither group about the matter, also untrue. Questions with the words *and* or *or* were checked to avoid this problem.

Questions may also be ambiguous. The use of slang terms should be avoided as non-standard English may have an undefined meaning or may mean different things to different respondents. Even non-slang words can be open to different interpretations. One question on the survey asked, *Did you receive any technical information from the LCRA last year?* It is possible that what qualifies as technical information to one farmer may not qualify as technical to another. For example, did the farmer inquire about a new farming technique or did the LCRA send



the farmer information about the state of the Highland Lake levels? Both types of data may be considered technical information. Another example of variability in word definition would be the use of the word *progressive* in regards to farming technology. While some farmers may consider himself/herself progressive because they have the latest equipment and use the newest fertilizers and pesticides, another farmer may consider themselves progressive because the use of artificial fertilizers and specialized equipment is avoided. Therefore, the question, *Do you practice progressive farming techniques?*, may elicit positive responses from diametrically opposed philosophies.

The desire to keep the questionnaire length to a minimum also leads to the exclusion of long or even moderate-length explanations. The shorter the explanation for certain issues, the more likely it is to be interpreted in more than one way. For example, the question, *Do you rotate crops?* may seem very clear, requiring a yes or no response. On closer examination, other factors complicate the question. Some farmers may rotate their crops on an annual basis while others may rotate their crops only every few years. In addition, most farmers in the survey area plant more than one crop per year. How will we know if they rotate after every planting or only on an annual basis?

Another concern is the level of wording of the questions. This includes not only the difficulty of the vocabulary but also the degree of formality and the use of colloquialisms. Even while the terms used may have the same basic meaning, specific terms can elicit different feelings in the respondents (Schuman and Duncan, 1974; Fee, 1981; Smith, 1987; Rasinski, 1989). For example, a common practice in one of the districts is to use a stream to keep the water level in the field at a constant level. This stream is typically called a "cheater" stream but the use of this term may make the respondent less likely to admit to its use than the less judgmental feeder stream.

A common pitfall in question wording is the leading question. The question should be carefully worded to avoid leading the respondent and thus artificially increasing the probability of a particular response. Leading questions may result not only from obvious bias on the side of the writer but by the citation of authorities. For example, the question, *Do you agree with most experts that . . . ?* may put the respondent in the position of appearing uninformed or stupid.

The decision was made to employ closed-ended questions on the majority of the survey form. This was done mostly to ensure ease of tabulation and a more accurate quantifying of the results allowing for statistical analysis. The one exception was the final question which was an essay style question allowing the respondents to write about whatever they wanted.

Some criticism has been brought against essay or open-ended type questions (Craig, 1985; Stanga and Sheffield, 1987) based on the belief that people may not respond to these questions because they are not articulate enough to put forth an answer. If this were the case, open-ended questions would be measuring, in part, people's education level, not their attitudes. Others (RePass, 1971; Kelley, 1983; Wattenberg, 1984; Geer, 1988) support the use of open-ended questions as a way to allow the expression of heterogeneous attitudes and prevent the respondent from being forced to conform their answer to a stock reply. Because of this latter point it was considered important to include a section on the survey which allowed the respondents to have complete freedom to express feelings, beliefs, and attitudes.

Many of the questions on the survey form asked for quantitative information. The development of the response choices for these questions was relatively straightforward. For example, the answer choices to the question, *How many assistants do you employ?* would be something like: zero, one, two, three or more. This scale would be considered a ratio measurement since there is a meaningful distance between variables and a zero point can be meaningfully designated.

Questions about more personal issues such as the age, income, and education of the farmer could be quantitative. However, a respondent may be sensitive about giving out exact information. In cases of sensitive subjects,

ranges are frequently used. The hope is that while the precision of the information may be reduced, non-response will be reduced, and accuracy will remain the same.

Other questions on the survey sought attitudinal information, such as perceptions of the performance of the LCRA. To obtain this type of data an ordinal scale was usually employed. Ordinal scales are used when it is possible to rank or order all categories according to some criterion. For example, the question, *How would you rate the LCRA's attempts to inform you of its proposed volumetric rate structure?* offered the choices of *very adequate, adequate, inadequate*. Clearly, there is a relative distinction that very adequate is "better" but we do not know how much better. There is not an absolute scale by which we can measure the relative differences.

### **Length**

Researchers have long assumed that all other things being equal, shorter surveys will have a higher response rate than longer ones (Berdie, 1973). However, this assumption is not supported by any empirical studies.

One early study done by Sletto (1940), sent out questionnaires of 10, 25, and 35 pages. The 10 page form had a 68 percent response rate, the 25 page form had a 60 percent response rate, and the 35 page form had a 63 percent response rate. This would indicate that length and response rate may not be related.

In a more recent study by Champion and Sear (1969) questionnaires of three, six, and nine pages were sent out. Significantly, the nine page forms had a higher response rate than the three page ones. Champion and Sear concluded that the relationship between length and response rate is more complex than had been originally anticipated.

Berdie (1973) tested for a relationship between length and response rate by sending out questionnaires of two, three, and four pages. He did not find a statistically significant difference in the response rates of the various lengths.

Research on this subject conducted by Clausen and Ford (1947), Mason *et al* (1961), Scott (1961), Brown (1965), Dillman *et al* (1974), Sheth and Roscoe (1975), Paliwoda (1981), Goyder (1982), and Cartwright (1986) suggests that the number of questions may not affect the response rate.

The empirical evidence thus suggests that there is not a certain relationship between response rate and length. Perhaps some respondents perceive an importance factor for a long survey versus a short one and this offsets the extra time required to fill out a longer survey. While someone receiving a short survey may not feel that the form is worth bothering with, someone receiving a long form may be impressed by the obvious amount of work the survey writer did and the expense involved. This potential respondent could conclude that the survey must be one of importance and therefore worth filling out and returning. Some potential respondents may be pleased to be chosen for a study and appreciate the chance to state their views.

One relationship which definitely exists and that is between length and cost. The longer the questionnaire, the higher the cost of printing and postage. This project settled on a length of 50 questions as appropriate. This required six page faces which were then copied two-sided, to reduce the total questionnaire to three pages, excluding a cover letter.

### **Anonymity**

Whether the survey was to promise anonymity or not needed to be determined. As mentioned above, a respondent's identity is sometimes left unknown to prevent the action of providing the answer the interviewer

wants to hear, a tendency known as *social desirability bias*. This bias is not the result of a respondent engaging in a conscious, deliberate attempt to mislead the interviewer but rather a non-deliberate tendency of which the respondent may not be aware (Anastasi, 1968; Edwards, 1957).

However, the problem of social desirability bias is not necessarily one which would be prevented by anonymity. A respondent may answer a question in a desirable way to a person sitting in front of them but there is no reason to believe they would also answer in a socially desirable manner just because their identity is indicated on a questionnaire. The bias occurs mostly because of a personal interaction between two people. Numerous researchers (Olson, 1936; Corey, 1937; Fischer, 1946; Gerberich and Mason, 1948; Evans, 1949; Elison and Haines, 1950; Ash and Abramson, 1952; Hamel and Reif, 1952; and Rosen, 1960; Pearlin, 1961; Rosen, 1963; Butler, 1973; Fuller, 1974; Futrell and Swan, 1977; Matteson and Smith, 1977; Futrell *et al.*, 1978) have examined the effect of anonymity and its effect on the type of answers given on questionnaires. No consistent relationship has been shown to exist. Futrell and Swan (1977) attribute this lack of consistency to several factors: relative sensitivity of the items on the questionnaire, whether confidentiality was promised, relationship between the sponsor and the respondent, and the characteristics of the respondents. Without the control of these factors the benefits of anonymity appear to be minimal.

For this survey it was decided to attempt the use of anonymity in the hope of obtaining a more accurate response in regards to the LCRA and its performance in certain areas.

### **Drafts and Pre-testing**

The survey went through several drafts, each of which was examined by the members of the larger PRP group. Any questions that were not clear to group members were re-worded to achieve greater clarity. Ideas for entirely new questions were also discussed. Several group members had specific information that they wanted the survey to address and several new questions resulted from this process. For example, one of the group members was studying the possibility of conjunctive use of groundwater and surface water for irrigation. The group member requested a question relating to the percentage of irrigation water the farmer currently obtained from surface sources and the amount from ground sources.

After these initial reviews, the input of various LCRA officials was sought. Officials from both the Austin and Bay City offices made suggestions in regards to the wording of questions and the types of questions asked. The Austin officials were particularly helpful with questions which discussed the new water rate structure. Such discussion with LCRA staff was helpful because a survey would lose credibility instantly if it asked questions which exhibited a lack of understanding of the situation. For example, a question which asked whether the farmer had been invited to any meetings with the LCRA staff in the past year would be ridiculous if the LCRA had in fact never had any such meetings. Or, if a survey should ask whether a farmer is apprehensive about the implementation of the new rate structure in the coming year if, either (a) the new rate structure had already been implemented or (b) it would not be implemented for several more years. It was important to avoid such errors for the success of the survey.

After it was certain that the survey did not make any theoretical or factual errors in regards to LCRA policy or the water conservation program, the survey was sent to the local officials for further testing. The local officials also checked for theoretical errors about the LCRA's operations but their main job was to ensure that language of the survey accurately reflected the meaning and intent of the PRP class. The local LCRA officials, specifically the so-called "water bosses", played a role in this area. The water bosses are the LCRA employees who are responsible for the opening and closing of the gates on the LCRA's canals. These gates regulate water flow to the farmers' fields. As a result, the water bosses are intimately familiar with the farmers and their attitudes. The water bosses could thus tell if a particular term could offend some farmers or if they may not be familiar with a certain phrase.

As the PRP class wanted the farmers to feel comfortable with the survey, testing was a necessary step to avoid words or terms unfamiliar to farmers or that sounded overly formal and strained.

The finalized survey was composed of three basic sections.<sup>3</sup> The first section contained questions generally about farming, such as number of acres farmed and the employment of various farming techniques and practices. The second section asked about the personal characteristics of the respondent such as age and education. The final section sought to acquire attitudinal information about two related subjects. The first of these subjects concerned the farmers relations with, and opinions of, the LCRA. The second subject was the proposed volumetric price structure for water.

Finally, space was provided for the respondent to express in free form any concerns not addressed in the survey properly. Forty-two of the seventy-nine respondents, or 54 percent, took advantage of the opportunity to express their thoughts in this section.

### **Accompanying Documents**

The questionnaire itself was not the only item needed to complete a successful survey. While it is possible to send only a questionnaire to those being surveyed, several additional tools were developed to increase response rate for mail surveys.

### **Advance Notice**

Advance notice is a technique employed to reduce non-response in mail surveys while retaining the economics of the mailed questionnaire survey design. Pre-contact can be either by phone or by an advance postcard informing the addressee that the survey will be arriving soon.

Numerous studies have been done examining the response rate impact of pre-contact by letter or postcard. Pre-contact letters resulted in a much higher response rate for Heaton (1965), Ford (1967), Myers and Haug (1969), Pucel *et al* (1971), Smith and Hewett (1972), Marks (1981), and Martin *et al* (1989). Other studies using letters for pre-notification have achieved higher response rates but the increases were not as significant (Kephart and Bressler, 1958; Scott, 1961; Fuller and Hare, 1974; Chebat and Picard, 1984). For example, Parsons and Medford (1972) conducted a study with two groups; while pre-notification increased the response rate by 6 percent in one group, in the other group the pre-notification was associated with lower response.

Studies using postcard pre-notification by Eisinger *et al* (1974) and Dommermuth *et al* (1981) reported significantly higher response rates from the pre-contact groups.

Other research has been performed on the value of pre-notification by telephone as opposed to postcards or letters. Stafford (1966) showed large increases in response rate as a result of telephone pre-contacts. Waisanen (1954) had shown a doubling of response rate in a small scale study. Allen *et al* (1980) also showed that telephone pre-contact enhanced response rate. However, Hornik (1982) indicated that telephone pre-contact had a variable effect on response rates in his study in Chicago.

Several researchers have compared the effect of telephone versus mailed pre-notification. Kerin (1974) reported significantly higher response rates using telephone pre-contact over pre-contact by letter. Stafford (1966) achieved significantly higher response rates from a telephone pre-contact group over a letter pre-contact group, although both the pre-notified groups responded at much higher rates than the control group which was not pre-notified in any way.

Schlegelmilch and Diamantopoulos (1991) found that pre-notification does significantly increase the response rate and that for all forms the average improvement is approximately 13 percent. They also note that telephone pre-notification achieved an improvement of nearly twice this average. The results of their study also showed that pre-notification does not always work. The researcher is faced with a cost-benefit dilemma between spending on response-inducement techniques or increasing the size of the initial mailout. Therefore, in cases where it is imperative to reach a substantial proportion of a limited population, pre-notification of some type should be pursued. On the other hand, if the population is not limited the researcher may want to consider simply increasing the mailout size instead.

If it is thought that non-response bias will be small or that a response stimulating technique will not reduce the bias by any substantial amount, the researcher may want to use the technique with the lowest cost per usable return. Walker and Burdick (1977) found that using no advance correspondence would produce the largest number of returns within a fixed budget. They also note that this does not mean the number of returns will always be maximized by not using a response stimulating technique. The PRP decided to employ pre-notification using a postcard.<sup>4</sup>

### Cover Letter

In a typical mail survey, the researcher wants something from the respondent--specifically the completion of the survey form. The researcher is prompted to make several types of appeals to the respondent to encourage completion and return of the questionnaire. Appeals may be needed in the cover letter which accompanies the questionnaire.

Normal practice is to include in the cover letter an appeal for assistance along with an indication of the importance of the research. Linsky (1965) found that there were substantial differences in response rates between respondents who received a cover letter with an explanation of the importance of the respondent in comparison with those who did not. Likewise, Hornik (1981) showed that response rate is influenced by cover letter cues.

Of the types of appeals which might work most effectively, Champion and Sear (1969) found that egoistic types seem to more readily received by respondents than altruistic ones. However, Houston and Nevin (1977) found that the type of appeal and the response it gets depends to some degree on the sponsor of the survey. For example, an appeal based on the social utility of the research is most effective for a university, whereas an appeal emphasizing the opportunity for the respondent to express opinions is most effective for a commercial sponsor.

The PRP cover letter stressed the fact that the LBJ School of Public Affairs was conducting the survey and not the LCRA.<sup>5</sup> It was hoped that this fact would elicit a higher response rate since a third party would presumably be more objective in its analysis of the results. The cover letter also stressed the importance of the research and the fact that this was the respondents' chance to have his/her opinions heard.

### Reminder

An important technique to stimulate response is the reminder notice. Abundant research has been done on reminding survey participants to complete the survey (Sletto, 1940; Eckland, 1965; Robin, 1965; Watson, 1965; Francel, 1966; Nichols and Meyer, 1966; Myers and Haug, 1969; Hochstim and Athenosopoulos, 1970; Dillman *et al.*, 1974; Etzel, 1974; Hinrichs, 1975; Goulet, 1977; Herberlein and Baumgartner, 1978; Goyder, 1982). Numerous strategies have been tested by these authors; the result is, the more one reminds the respondent, the higher the response rate.

Eckland (1965) found that the more intensive the reminding, the better the response rate. Goulet (1977) used up to three reminders and found a significant increase in response rate as judged by an independent test of proportions. Telephone reminders were reported to be the most effective (Roscoe *et al.*, 1975).

Hinrichs (1975) believes the fact that a researcher keeps track of a respondent through reminders communicates to a respondent that their role in the study is important enough to be singled out. Reminders may instill a sense of obligation and prior commitment.

The PRP Group sent a reminder postcard to the farmers approximately two weeks after the survey itself was sent out.<sup>6</sup> The postcard was sent to all persons on the mailing list not just those who had not returned the questionnaire. The postcard was mailed to all farmers to avoid the task of determining which farmers had or had not returned the survey yet. The postcard simply reminded the farmer of the survey and asked them to return it. The postcard also provided a toll free number which could be called if a copy of the survey was lost or never received. It was hoped that this willingness on the part of the researcher to pay for the phone call and send more copies would communicate to farmers the commitment of the researcher and the importance of the information thus increasing the response rate.

### **Non-Response Bias**

All surveys, not just mail surveys, are subject to the problem of bias. Non-response bias occurs when the persons who respond differ significantly in their answers from those who do not respond. If non-response bias is present, the results would not directly allow one to say how the entire sample would have responded. This problem could prevent the generalization of the sample data to the entire population. In fact, unless the response rate is 100 percent, a surveyor can never be sure that some non-response distortion has not occurred. In other words, only when non-response is 0 percent is the sample data certainly representative of the population.

The best defense against non-response bias is, of course, the reduction of non-response itself through the use of response stimulating techniques. Another strategy is to resample the non-respondents. Reid (1942) chose a 9 percent subsample from his non-respondents, surveyed again, and obtained responses from 9 percent of them.

A cheaper, but potentially more difficult, strategy is to estimate the effects of non-response (Daniel, 1975; Hendricks, 1949). Some researchers maintain that estimation is difficult to the point of impossibility (Hochstim and Athanasopoulos, 1970; Ellis, 1970; Lansing and Morgan, 1971; Ognibene 1971). Fillion (1976), on the other hand, reanalyzed data from Ellis (1970) and found that estimation did help. Clausen and Ford (1947), Pearl and Fairley (1985), and Erdos (1970) also feel that estimation using statistical techniques can be a valid strategy.

Four methods of estimation are described in the literature. These are: comparisons with known values for the population, subjective estimates, differential weighing of data, and extrapolation. (Pace, 1939; Politz and Simmons, 1949; Stephan, 1958; Kish, 1965; Pearl and Fairley, 1985)

Comparisons with values which are known for the population, such as age or income, can be compared to determine with the sample results to determine whether there is a significant difference. If no difference is present in these known areas it may be assumed that there are no differences in other areas as well.

Subjective estimates are judgments made by knowledgeable persons as to the direction and extent of bias. Armstrong and Overton (1977) found that such judgements were valid in most cases for the prediction of the direction of non-response bias especially for items which were significantly biased. The use of a consensus among the judges furthered the accuracy of this technique.

Pace (1939) and Politz and Simmons (1949) used a technique which gave a greater weight to respondents who took longer or were more difficult to bring into the sample on the assumption that they more closely resembled

the non-respondents.

Pearl and Fairley (1985) proposed a more rigorous statistical method by linking response rate to the strength of feeling about an issue. It has been shown that persons who feel more strongly about an issue are more likely to respond to a questionnaire (Baur, 1947; Donald, 1960; Scott, 1961; Armstrong and Overton, 1977). They used this fact to attempt to predict what the answers would be from non-respondents. In some cases they were successful, but not in all of them. It appeared that factors other than just strength of feelings were at work.

Armstrong and Overton (1977) also tested an extrapolation technique. They attempted to predict bias in a third wave of surveys based on information from the first two. They were correct 89 percent of the time using this technique.

The PRP Group decided not to attempt the use of any of these prediction techniques for two reasons. First, the highly theoretical and often subjective nature of these techniques makes them difficult to use successfully. Second, the mixed results which have been obtained by previous researchers makes the justification of these techniques rather difficult.

### **Logistics of Getting out the Survey**

Normally, when performing a survey, a sample is taken from the population with the assumption that the sample results would match those for the population as a whole. The number of farmers in the Gulf Coast and Lakeside districts was small enough to dispense with the need for taking a sample in this study. Survey forms were sent to the entire population.

The LCRA provided the PRP with the names and addresses of all of its customers in both the Gulf Coast and Lakeside Irrigation Districts. This list was entered in a microcomputer to generate address labels.

In January, 1993, a postcard was sent to the entire population informing them of the survey and attempting to elicit their support. One week later, the survey was mailed to the farmers. A pre-addressed, postage paid envelope was included to encourage the farmers to return the survey. A postage paid postcard was also included which the farmer could return separately from the survey if the farmer wished to receive copies of the survey results.

A cover letter was included explaining the purpose of the survey, indicating the anonymity of the respondent, and pointing out that the study was being conducted by the LBJ School of Public Affairs at The University of Texas at Austin, and not the LCRA. As the survey was being conducted by an independent third party, the PRP group thought the response rate would be higher because farmers would have more confidence that their opinions would be taken seriously.

Two weeks after the day the surveys were mailed, the number being returned began to decline greatly. At this time a reminder postcard was mailed to all survey participants. After this reminder, 23 more surveys were received for a total of 79.

### **Strengths and Weaknesses**

Two aspects of the survey situation not related to the questionnaire or accompanying documents worked to strengthen it. The first was the ability to send surveys to the entire population instead of only a sample of the population. This was made possible by the relatively small size of the population, 230 persons.

The second factor working in the survey's favor was that it was sponsored by an independent third party. Sponsorship can affect a respondent's willingness to return a mailed questionnaire by convincing him or her of the study's legitimacy and value (Hammond, 1959; Scott, 1961; Roeher, 1963; Vocino, 1977; Labreque, 1978; Harvey, 1987). Sponsorship by scientific, governmental, university, or well-known nonprofit agencies indicates some legitimacy. On the other hand, sponsors who might seem to have an ulterior motive such as commercial organizations or regulators, like the LCRA, often have difficulty in achieving satisfactory response rates. In this case, farmer confidence was apparent from the excellent response rate of 35 percent.

The PRP's procedure was not perfect. For example, possible bias existed in the mail survey. Even though surveys were mailed to all farmers, some surveys were not returned. The chance exists that the responses on the unreturned surveys would have been different, as a group, from those which were returned. For example, an argument could be made that the persons who did not return the surveys may be less active in their relations with the LCRA. These same farmers may have also been less likely to attend an LCRA-sponsored farmer meeting. If this were to be true, the number of persons indicating that they had been invited and attended the meeting would not accurately reflect the entire farmer population. However, as mentioned earlier, research by McDonagh and Rosenblum (1965) found no statistical difference between the answers of those who did respond to a mail survey and those who did not. Various techniques designed to combat this were discussed above along with the reasons for not employing them.

A second problem is item non-response. Item non-response occurs when a particular question on a survey is not answered. A respondent may not answer a particular question for several reasons. The respondent may consider the question a private matter. Another reason for item non-response is that the question does not apply to the respondent. An example of the latter reason were the questions about the value of the water conservation demonstration projects and the value of farmer meetings. If the farmer did not attend either of these functions, they may not feel qualified to answer on its value, and thus would skip the question.

The several questions on the survey that had significant non-response were of the second type.<sup>7</sup> The question on the value of farmer meetings had a 16.5 percent non-response rate. The question on the value of the water conservation demonstration projects had a 33 percent non-response rate. The question which asked for the helpfulness of the LCRA staff when they are asked questions about water deliveries had a 15.2 percent non-response rate. The remaining questions averaged a non-response rate of less than or equal to 10 percent.<sup>8</sup>

Another weakness of the survey was a mistake in the phrasing of some response choices. In questions where the choices were: *very helpful*, *helpful*, and *not helpful*, the choice of *helpful* should have been *somewhat helpful*. Several related questions suffered the same problem, only in these other questions the choices were *fair*, *adequate*, and *accurate*. The choices should have been *somewhat fair*, *somewhat adequate*, and *somewhat accurate*. The results are still valid but the existing questions become close to binary choices. However, the questions do provide more information than a pure binary response choice since we are able to resolve which respondents are very satisfied with a particular situation by examining the number of respondents that indicated the extreme positive response.

A final potential weakness to the survey data is the possible effect of political motives when answering the questionnaire. The LCRA and the farmers have many years of historical interaction. On some occasions, relations between the two groups has been rather strained. At other times, the relations have been better. The possibility exists that when answering the questions about the performance of the LCRA, a farmer's responses would reflect past farmer/LCRA interactions. Specifically, there may be a concern that the farmers would intentionally, or unintentionally downgrade the LCRA's performance.

The fear appears not to have materialized however, as the results to the questions on the LCRA's performance show a strong majority of the farmers are satisfied with the LCRA's performance. Currently, the relationship between the farmers and the LCRA appears to be positive on balance. One farmer remarked that relations were



the best they had been in many years.<sup>9</sup> This situation could change in the future as the past has been marked by alternating times of improved relations and deteriorating ones.

### Summary

The PRP decided to survey the farmers to obtain information about the LCRA's performance and attitudes about the new rate structure. Three types of survey are available: personal interviews, telephone interviews, and mail surveys. A mail survey was chosen for its multiple advantages including its low cost. The strategy of ensuring anonymity was examined and was determined appropriate for this survey. This chapter also describes the specific steps taken to administer the survey.

The following section recounts the development of the survey form and examines the various aspects of a mail survey, as discussed in the published literature. Open-ended and closed-ended questions were considered and both types were finally included. Closed-ended questions allowed for consistency and ease of tabulation. Open-ended questions were included to allow the farmers to address issues the questionnaire had missed.

Various response stimulating techniques were analyzed including advance notification, cover letters, and follow-up notification. All of these techniques were used as they have been shown to increase response rates.

Non-response bias was addressed as were several techniques to cope with it. Because of the theoretical difficulties of successful bias adjustment and the difficulty of defending the practice, it was not used in this survey.

### Notes:

1. This issue of respondent anonymity is discussed at greater length below.
2. See the section about anonymity below.
3. Appendix A contains a copy of the final survey.
4. Appendix A contains a copy of the pre-notification postcard.
5. Appendix A contains a copy of the cover letter.
6. Appendix A contains a copy of the reminder postcard.
7. The following percentages are based on the surveys that were returned.
8. The number and percentage of farmers who did not respond to any question, along with all raw survey data, can be found in the raw data presented in Appendix B.
9. Much of this improvement may be attributable to the efforts of Bruce Hicks, the LCRA's Manager of Irrigation Operations for the two districts.

## Chapter 4. Data Management and Analysis Performed

### Initial Tabulation of Results

The first step in the analysis of the survey was to enter them into a computer database. For this project, the results for each survey were entered into the spreadsheet program *Lotus 1-2-3*. This program was used as a database and translation program. The program was used as a translator program because its great popularity means many other specialty programs are capable of exchanging files with it. With the results in the *Lotus* program, it was possible to transfer the data into any other specialty program as needed.

To tabulate the results, a spreadsheet was set up in the *Lotus* program. Spreadsheets use computer files which form a large matrix with *rows* running horizontally and *columns* running vertically to make a table.

The first row was designated for *field* names. Therefore each column represented a different field. Subsequent rows were each reserved for one respondent. Each row after the first contained information on one respondent only. Field names were a code name given for a response on the questionnaire.

In most instances, each question was represented in one column. However, certain questions, specifically ones which allowed multiple responses, required multiple columns. For example, the response to the question on the number of fields farmed could be contained within one column, the answer being a single number from 0 to 5. The question for the types of crops raised required one column for each potential crop. This question needed one column for rice, one for corn, one for soybeans, etc. Since one farmer could grow more than one crop at a time, it was necessary to be able to indicate this on the spreadsheet. Multiple columns, one for each crop, allowed the coding of a positive or negative response for each crop independent of the others.

Questions that elicited a simple *yes* or *no* were coded numerically with a *yes* represented by a *1* and a *no* response being indicated by a *0*. Assigning alpha responses a numeric value made data entry, the statistical analysis, and simple frequency calculations possible.

Many of the questions on the survey did not contain simple binary answers but instead the choice of responses was given in a range. In this case, each response was assigned a number and this number was entered in the database as the answer. For example, for the question on age, five possible choices were presented to the respondent. The response *less than 30* was assigned the number *1*. The response *30-40* was assigned the numeral *2*, and so on. If a farmer indicated he/she was *30-40*, numeral *2* would be entered into the database.

Some questions presented a range of subjective responses, such as *very adequate*, *adequate*, and *inadequate*. These responses were quantified by using numbers. For example, the response, *very adequate*, was coded with the numeral *1*, the response, *adequate*, was coded with the numeral *2*, and the response, *inadequate*, was coded with the number *3*.

### Statistical Analysis

The data was transferred to the application *SPSS* for statistical analysis. This was done by loading the *Lotus* file onto the hard drive of a computer. *SPSS* was opened and *SPSS* retrieved the data file in the *Lotus* format.

It would have been possible to perform the initial data tabulation in *SPSS*. This was not done for two reasons.

One, when the initial tabulation was being performed, it was not clear which statistical or other programs would be appropriate for the data. The *Lotus* program was used to enter the data, because it could be used to transfer the data to other formats.

*SPSS* was used to compute frequencies, percentages, cross tabulations, and chi-square analysis. Frequencies were calculated by selecting the field or column which represented the question for which a frequency was desired. The program was instructed to calculate the respective number of times which a particular response occurred in the column. The results would be the frequency of each answer for a question.

Percentages were gained in the same manner as frequencies. The program was instructed to present the results in percent of total rather than simple frequency of occurrence.

Cross tabulations were run on a large number of questions. A cross tabulation compares the responses from two questions by setting up a contingency table. The rows of the table represent the possible responses to one question and the table's columns represent the possible answers to the other question. The program then calculates the number of responses which belong in each cell of the table. Each cell represents the combination of answers to both questions. From this data the researcher can tell how many individuals (numbers or percentage) gave one response to the first question and another response to the second question. For example, on a cross tabulation of place of birth and education, one could tell how many respondents are native to the area *and* have only a high school education (see Table 4.1).

**Table 4.1 Contingency Table:  
Farmers Native to Area by Level of Education  
(Number and Percentage of Respondents)**

	High School	College	Graduate School	Total
Non-Native	3 (4%)	3 (4%)	3 (4%)	9 (12%)
Native	26 (33%)	38 (49%)	5 (6%)	69 (88%)
Total	29 (37%)	41 (53%)	8 (10%)	78 (100%)

Source: Policy Research Project Survey.

Cross tabulations can be linked to the chi-square test of independence. The chi-square distribution is used for testing hypotheses of the independence of two variables. Two variables may be inferred to be independent if the probability that a case falls into a given cell of the table is simply the product of the marginal probabilities of the two categories defining the cell (Norusis, 1992). A chi-square test computes probabilities and compares the expected number of cases in a particular cell to the observed number of cases in the cell. If the observed number of cases in the cell is sufficiently different from the expected number, the two variables are considered to be related in some way, or *not independent*.

The chi-square test of independence was applied to numerous pairs of questions on the farmer survey to determine if the variables showed a statistical association. Using the cross tabulation example above, the probability that a case falls into the cell native *and* graduate school is the product of the probability of a respondent being a native and the probability of a respondent having attended graduate school. The table shows that 88 percent of the respondents are native and 10 percent of the respondents have attended graduate school.

Thus, if level of education and native status are independent, the probability of a respondent being a native who has attended graduate school is estimated to be:

$$P(\text{native}) P(\text{graduate school}) = 0.88 \times 0.10 = 0.088$$

The expected number of cases in the respective cell is 6.9, which is 8.8 percent of the 78 cases in the sample. From the table, the observed number of natives who have attended graduate school is 5, which is 2 less than expected if the two variables are independent. To construct a statistical test of the independence hypothesis, the above calculations are repeated for each cell in the table.

After calculating the expected number of responses in each cell, the Pearson chi-square statistic can be used to determine whether the two variables were independent. The Pearson chi-square statistic is calculated by summing the squared residual for all cells divided by the expected frequency for all cells. The calculated chi-square is compared to the theoretical chi-square distribution to produce an estimate of how likely, or unlikely, this calculated value is if the two variables are in fact independent.

In the example of native status and level of education, the Pearson chi-square value is 6.04. If native status and level of education are independent, the probability that a random sample would result in a chi-square value of at least that magnitude is 0.048. If the probability is small enough<sup>1</sup>, the hypothesis that the two variables are independent is rejected. Since, in the example, the statistic of 0.048 is below 0.05, the hypothesis that native status and level of education are independent is rejected. Therefore, an association is assumed to exist between whether a farmer is native to the area and the level of education they attain.

The chi-square test cannot determine whether the two variables are related or what the relationship might be. The test can only be used as a basis to infer that there exists a likelihood that the numbers in the table are not due to random sampling error alone. Small variation by the actual number from the expected could be due to mere chance. Usually a probability that the actual frequencies differ from the expected frequencies of less than 5 percent is considered strong enough to claim that the variables are not independent. This would mean that if 100 tests were done using these two variables, chance would account for the difference between expected and observed value 95 times and the other 5 times the difference would be due to some type of relationship.

Numerous chi-square tests of independence were performed on the survey data. In most cases no relationship was found or, to be more precise, the assumption of independence could not be rejected. In some cases the assumption of independence of variables could be rejected and an association between the two could be inferred. The specific situations where the assumptions of independence were rejected are discussed in Chapter 5.

## Notes

1. The normally accepted values are 0.05 and 0.01. This report used the value of 0.05.

## Chapter 5. Results of Analysis

### Response to the Survey

Response to this survey was better than previous LCRA sponsored surveys of the farmers (see Table 5.1) Farmers in the Lakeside Irrigation District returned 40 of 102 surveys, for a rate of 39 percent. Farmers in the Gulf Coast Irrigation District responded at a lower rate with 38 of 128 returning surveys for a 30 percent total. Therefore, even though the Lakeside district is the smaller of two in population, it is represented more highly in the survey. Overall, the response was 79 of 230, for a rate of 35 percent, with 51 percent of the total responses from Lakeside and 49 percent from Gulf Coast. Results will usually be discussed with the data for the two districts combined. Only when a significant difference exists between the two districts will responses be separated.

The following sections will discuss data which is related to farming practices, farmer personal characteristics, farmer relations with the LCRA, and opinions about the new volumetric rate structure and its implementation.

Table 5.1  
Response Rates for Survey

District	Response Rate	Percentage
Gulf Coast	38/128	30
Lakeside	40/102	39
Total	79/230	35

Source: Policy Research Project Survey.

### Demographics

Most of the farmers who responded to the survey operate on a relatively small scale and do not run a farming organization. Information on the number of hired workers the farmers' employ reveals this fact. Approximately half, 45.6 percent, reported that they work their farms without the assistance of any field hands. Another 29.1 percent employ only one aid. Therefore, a total of 75 percent of the farmers employ one employee or less.

The farmers ranged in age from less than 30 years old to more than 60 years. If this range is broken down into ten year increments, the most common age group is 41-50 years old, with 28 percent of the farmers indicating they are in this age group. The distribution is bell shaped, with a slight exaggeration in the top group of *greater than 60*.

The farmers are a stable population. Most of the farmers are natives of the area. Only 11.5 percent reported that they were not native to the region. They also appear to have been rice farming their entire lives. When asked how many years they had been farming in the area, 42.9 percent reported it to be longer than 20 years and 71.5 percent had farmed there for more than 10 years. Only about one quarter of the farmers reported that

they had been farming the area less than 10 years.

According to farmer responses, the group is well educated. All farmers indicated they finished high school. A majority, 52.6 percent, of the farmers responding indicated that they have completed college and 10.3 percent reported having completed graduate school. Together, these numbers indicate 62.9 percent of the farmers have completed post-secondary education. This seems rather remarkable given the rural nature of the work and the fact that a degree is not a minimum job requirement, as is often the case in urban settings. U.S. Census data indicates the average rates for the State of Texas are 19 percent for completion of college and 6.5 percent for completion of graduate school. This is a combined total of 25.5 percent. For the entire U.S., 19.3 percent have completed college and 7.2 percent have completed graduate school for a combined 26.5 percent (U.S. Census Bureau, 1990). Therefore, the survey respondents reported a higher level of education than either the average for the State of Texas or the U.S. In fact, whereas the averages for Texas and the U.S. are very close, the farmers more than double this rate.

The size of the farmer families was fairly tightly clustered around 3 persons with the average being 3.2 persons. The average size of a U.S. family is also 3.2 persons. For Texas, the average is 3.3 persons (U.S. Census Bureau, 1990). The most common size was two persons with 29.9 percent of the respondents indicating this size of family. Very few (3.9 percent) farmers reported being single; that same amount reported having a family of six or more.

Income was reported by ranges (see Figure 5.1). The most frequently cited range was \$40,000-\$60,000 per year. Twenty-six percent of the farmers reported over \$60,000 per year of income. The total family income of the farmers may be higher than the average family income in the U.S., as the median income for a family of four in the U.S. is \$35,225 per year (U.S. Census Bureau). One way to assess average income would be to work with simplified components. If the mid-point for each income range is used, except for \$0-\$10,000 (use \$10,000), and for over \$60,000 (use \$70,000), the weighted average is \$46,301. This amount is about 30 percent higher than that of the average U.S. The average for the state of Texas is even lower at \$31,553 (U.S. Census Bureau, 1990). This situation is in contrast to statements made by many farmers in the essay portion that they were operating very close to the point of not be able to continue farming because of rising costs and shrinking profit margins.

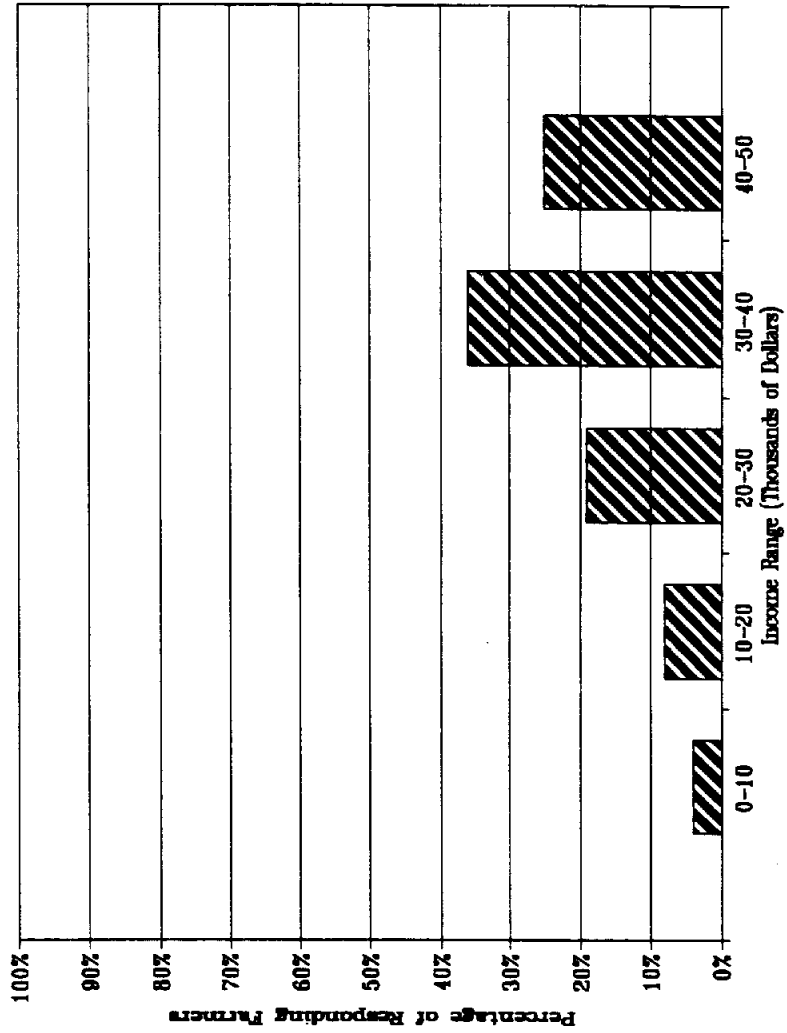
### **Farming Practices**

Rice was, by far, the crop farmed by the most respondents with 100 percent indicating that they grew this crop. However, rice is not the only crop grown. Several other crops were reported (see Figure 5.2). The majority of these other crops were grown in the Gulf Coast district with few Lakeside farmers indicating that they farmed anything other than rice. Even in Gulf Coast the percentage of farmers raising another crop in addition to rice was never over 9 percent.

The average number of acres of rice being farmed was 554. The farms in the Lakeside district averaged about twice the size of those in the Gulf Coast district. The Lakeside district reported a larger average rice crop size at 744 acres while Gulf Coast rice farms averaged 356 acres. If other crops are included with rice for total acres farmed, the average acreage farmed is 636 for the total survey (see Figure 5.3)

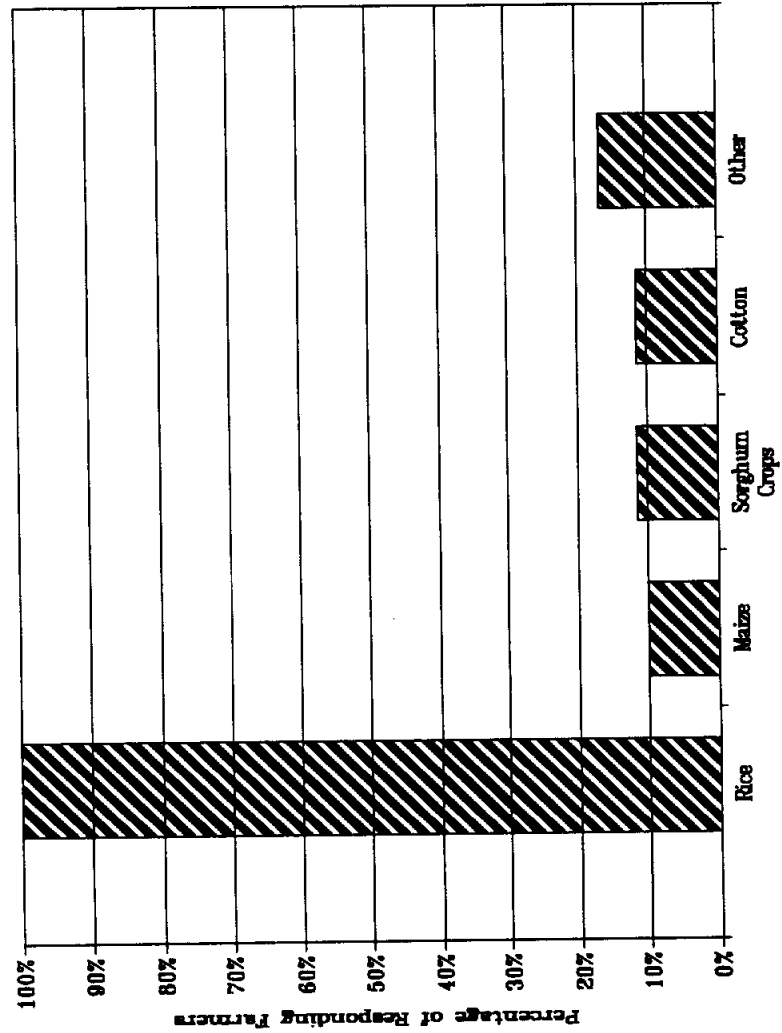
The farmers' legal relation to the land they farm, or land tenure, could have an impact on the farming practices employed by that farmer. Whether the farmer owns the land, is leasing it, or is in some type of cooperative agreement with the land owner, could very well determine the amount of capital investment the farmer is willing to make in the land. Someone who does not own a particular piece of land will not normally be willing to invest significant amounts of money in the upgrading of the land since he or she will not benefit from the increased value of the land. The only possible benefit to the leasing farmer from improvements that increase water efficiency would be if the water saved could reduce irrigation costs. In the past, the LCRA charged for

**Figure 5.1**  
**Annual Family Income**



Source: Policy Research Project Survey

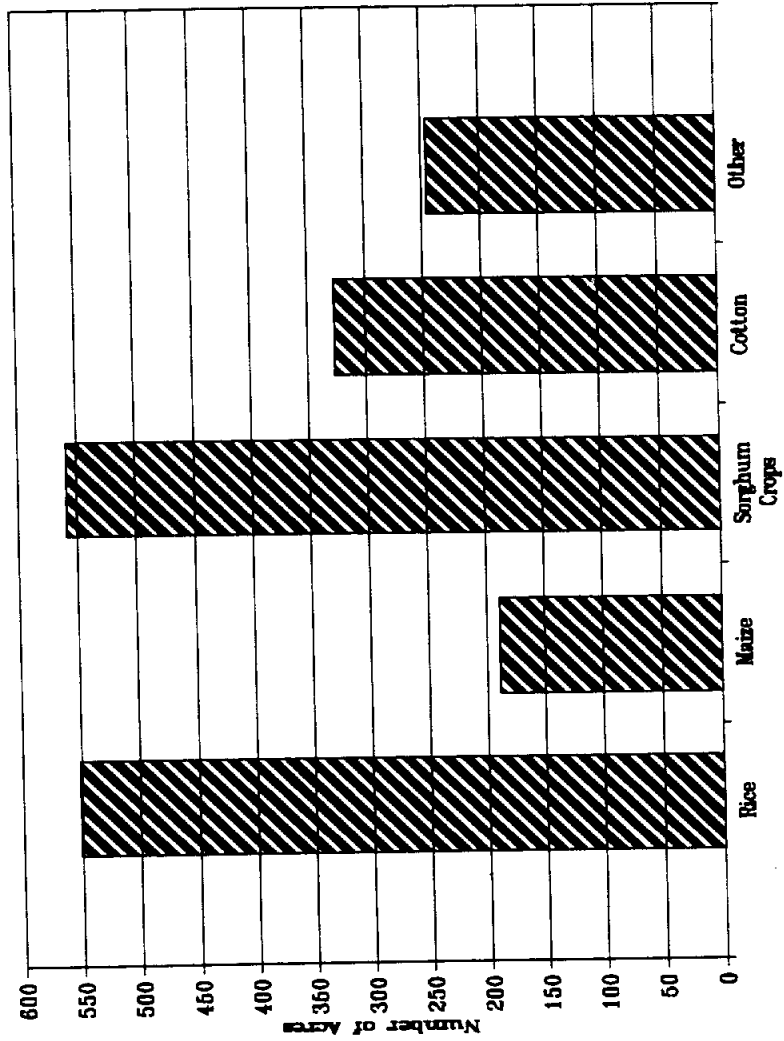
**Figure 5.2**  
**Farmers Raising Specific Crops**



Source: Policy Research Policy Project Survey



Figure 5.3  
Average Acres Farmed by Crop



Source: Policy Research Project Survey

water on a *per acre* basis not, on a volumetric basis. As a result, heretofore, neither incentive has existed for the farmers who do not own the land to make efficiency improvements.

The owners of the land that is being leased may consider investing in capital improvements to increase efficiency if they could recoup this investment through higher lease prices. However, it is unlikely that farmers would be willing to pay the increased leases if they were unable, in turn, to save money by using less water. With the traditional pricing system the farmer could not save money by using less water.

The new volumetric pricing system could give an incentive to invest in the water efficiency of the land. Land owners could charge higher lease prices for more efficient land. Both land owning and non-land owning farmers could save money on water bills if they implemented improvements.

To understand the relative importance of each of the land relationships discussed above, the farmers were asked their legal relation to the land. It appears that land ownership may historically have been a limiting factor in making capital improvements in the land, as only 28 percent reported that they owned between 81-100 percent of the land they farmed. A majority of 56.5 percent reported that they owned between 0-20 percent of the land they farmed. Of those who did not own land that they farmed, 85 percent reported that they leased it. Thirteen percent reported that they were in a cooperative arrangement with the owner of the land.

A technique employed by many of the farmers is one known as a maintenance or "cheater" stream. This technique keeps a predictable rate of water in the field at all times but is considered to be wasteful of water. The survey attempted to determine the percentage of farmers using such a stream and their motivations for doing so. A knowledge of these factors should make it easier to successfully discourage the farmers from using this technique in the future.

Fifty-five percent of the farmers reported using a cheater stream. Figure 5.4 shows the reasons given by the farmers for their use of the stream. The most frequently reported reason was that it takes too long for water to arrive once it is ordered by the farmer. Thirty percent of the farmers who use a cheater stream gave this as their reason for using them. If water delivery time could be shortened, perhaps the usage of cheater streams could be reduced.

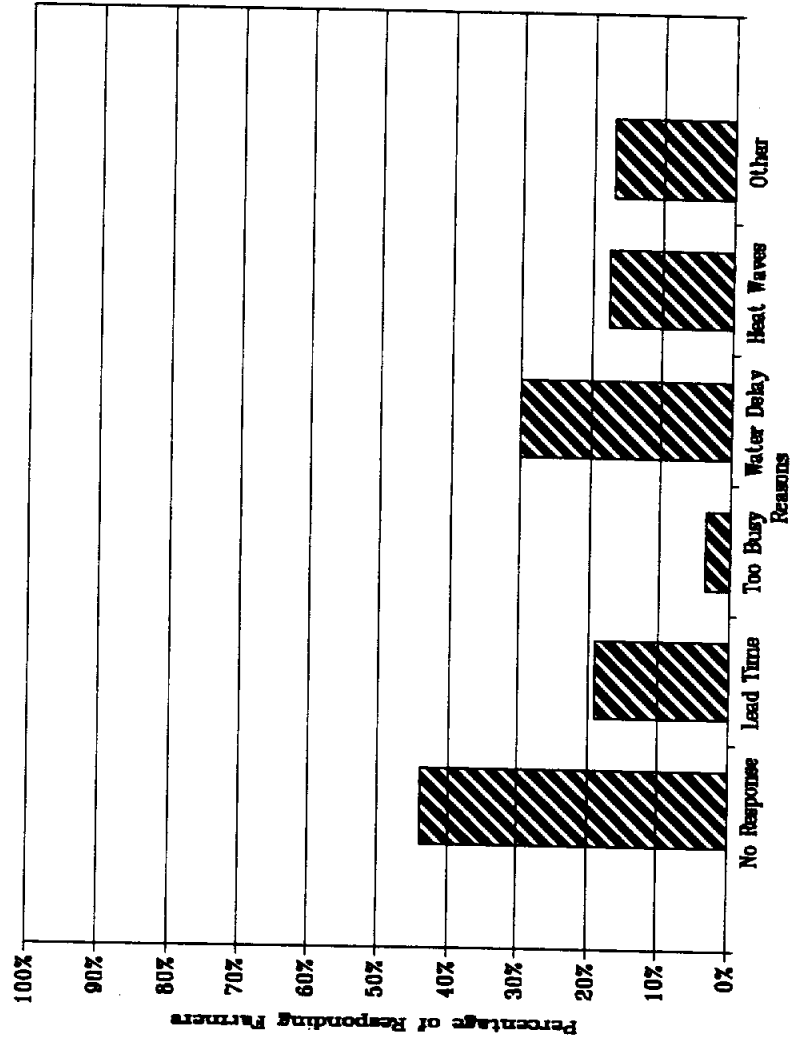
The number of miles traveled each day in order to manage the fields may be related to the number of fields farmed. Travel could affect the quality of water management since a large number of smaller fields, rather than fewer larger fields, would require more travel. A farmer may be less likely to manage the fields on a daily basis if long distances are involved.

To determine if these factors may need more attention in the future, farmers were asked for information regarding the number of fields farmed and the number of miles travelled to manage the fields. Cross tabulations were run but the results were not statistically significant. In spite of the logical connection and water boss reports that travel affects water management, it appears from the farmers' responses that travel and the number of fields may not be related.

Numerous farming techniques exist which can increase efficiency and thereby conserve water. These techniques range from those which are labor intensive to those which are capital intensive. Labor intensive techniques are ones which require relatively more time and energy on the part of the farmer. The benefit to these techniques is that they require less financial input. The main cost is the time of the farmer. An example of a labor intensive technique is field records. The only equipment required for the maintenance of field records is a notebook.

Capital intensive techniques do not require the farmer to put in many hours of labor, but they are relatively expensive. The benefit of capital intensive techniques is normally a reduction in labor inputs. An example would be the precision leveling of a field. The process may be expensive to perform; but, once done, the

**Figure 5.4**  
**Reasons for Using Cheater Streams**



Source: Policy Research Project Survey

efficiency of the field is increased indefinitely without any additional farmer input. Farmers were asked to choose from a list of water conservation techniques the methods they employ in their fields. This was done in order to learn what are the more or less popular techniques. This information can be analyzed to determine future policies about the encouragement of the various techniques. The frequencies with which the farmers employ the various techniques can be seen in Figure 5.5.

The most frequently practiced techniques were canal maintenance (72.2 percent of farmers, see *canals* in figure), improved levees (72.2 percent of farmers, see *imp. levees* in figure), and multiple delivery points (70.9 percent of farmers, see *delivery* in figure).

The least popular technique listed was underground pipes at 21.5 percent (see *pipes* in figure). Other techniques used included precision leveling (see *leveling* in figure), field records (see *records* in figure), shallow flood (see *flood* in figure), and permanent levees (see *perm. levees* in figure). The farmers were also given a chance to indicate any other techniques they employed that were not listed; 5.1 percent said they used some other technique.

Perhaps the biggest surprise is that only 41.8 percent of the farmers reported using field records. Field records will not save as much water as techniques such as precision leveling and underground pipelines, but they have two benefits. Field records are an inexpensive method by which to improve farming efficiency and they help farmers examine practices in a more objective and systematic manner.

The greatest percentage of farmers reported using a total of four of the water conservation techniques listed in the survey question. The average number of techniques was 4.2.

Overall, the difference between the number of conservation techniques used in the two districts was not significant, but some differences did occur in regard to which techniques were employed in each district. In the Lakeside district, 80 percent reported they use multiple delivery points, while 60 percent of those in Gulf Coast reported their use. For precision leveling, 57.5 percent of those in Lakeside reported their use while only 26 percent in Gulf Coast use this technique. Lakeside also used underground pipes more with 30 percent reporting their use to 13 percent in Gulf Coast.

The farmers were asked to report the number of acres of land that had been precision leveled. Counting both districts, 41.8 percent indicated that they had precision leveled land. This leaves 58.2 percent who do not use this technique.

A slight discrepancy exists between the responses to the question on conservation techniques used and the number of acres precision leveled. Twenty-three percent of the farmers indicated they had between 50 and 300 acres precision leveled. Twenty-three percent also said they had over 300 acres that had been precision leveled. This gives a total of 46 percent who reported some precision leveled land versus 42 percent in the previous question. The discrepancy is small and probably the result of an oversight by a few farmers.

This data identifies three groups: those with no acres precision leveled, those with relatively few acres precision leveled, and those with many acres precision leveled. The last two groups are the same size and added together just about equal those in the first group.

To discover the current situation regarding groundwater use, the farmers were asked to estimate the portion of their irrigation water that comes from surface sources (the LCRA canal system) and the portion that comes from groundwater wells. In all, 32.9 percent of the farmers reported the use of at least some amount of groundwater in the irrigation of their crops. Of those who did report the use of groundwater, the average amount as a percentage of total water usage was 41.6 percent. The most common portion reported was 50 percent. Therefore, of those who do use groundwater, 23.1 percent use it for half of their water supply. This represents

**Figure 5.5**  
**Farmers Using Conservation Techniques**



Source: Policy Research Project Survey

7.6 percent of all farmers.

A large majority of the farmers (78.1 percent) claim to experiment with new farming techniques. A cross tabulation was run on this question and the number of conservation techniques used by the farmers. It is logical to assume that farmers who use more conservation techniques would correspond to those who claim that they use new techniques. Conversely, it would seem that farmers who do not employ many conservation techniques would correspond to those who claim not to use many new techniques. Strangely, there was not a statistically significant association between the way that farmers answered both questions.

### Relations with the LCRA

A major portion of the survey was aimed at determining farmer attitudes toward the LCRA. The questions in this section deal with the job performance of the LCRA as perceived by the farmers.

Farmers were asked to evaluate the job that the LCRA staff has done when the farmers have questions on various topics. One topic was billing. The farmers were asked to rate the job of the LCRA staff when they had questions about their water bill (see Figure 5.6). A combined<sup>1</sup> 97.2 percent of the farmers reported that the LCRA is at least *helpful* in regards to such questions and 35.2 percent said the LCRA is *very helpful*. Only 2.8 percent rated the staff as *not helpful* in this situation.

The farmers were also asked to rate the LCRA's performance when they had questions about water conservation (see Figure 5.7). A combined 89.6 percent said the LCRA was at least *helpful*, while 17.9 percent said they were *very helpful*, and 10.4 percent said the LCRA staff was *not helpful* in answering such questions.

In regards to questions about water deliveries, a combined 94.4 percent felt the LCRA was at least *helpful* with 26.4 percent feeling the LCRA was *very helpful* in answering such questions (see Figure 5.8). Only 5.6 percent reported the LCRA as *not helpful* in answering questions about water deliveries.

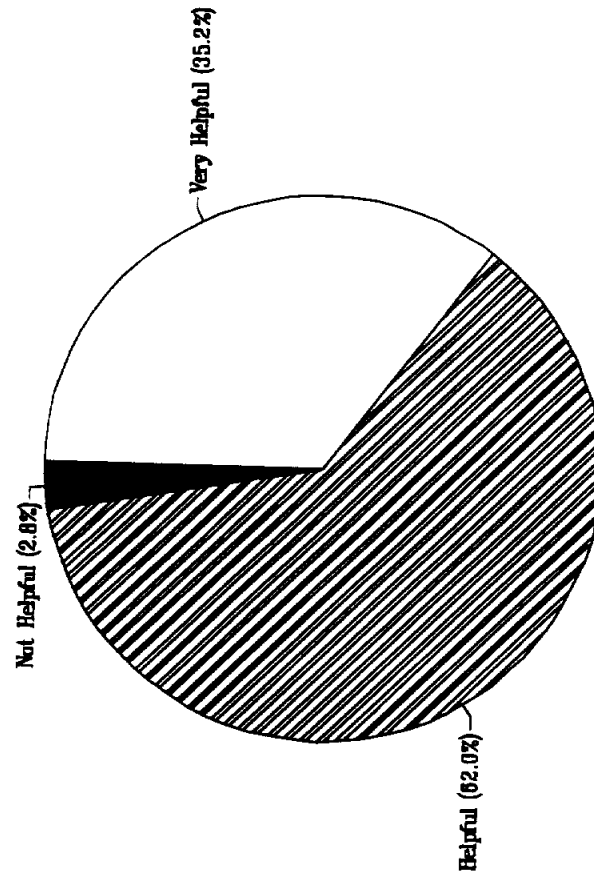
While farmers felt that the LCRA did a good job in answering questions about water deliveries, they were not so positive when it came to the deliveries themselves. Figure 5.9 shows that while a combined 54.2 percent felt the deliveries were at least *accurate*, 45.8 percent felt that they were *not accurate*. This question takes on significance with the introduction of the new volumetric pricing system for water. For the new rate structure to be fair, the amount of water delivered must be accurately measured. The farmers' concern over this issue is understandable.

The farmers were asked a series of questions about farmer meetings. The first was whether they had been invited to a farmer meeting in the past year. Nearly all, 97.4 percent, reported they had been invited and 2.6 percent reported they had not been invited. The LCRA appears to have done a good job informing the farmers of the meetings.

Farmers were then asked if they had attended the meeting. A majority, 80.3 percent, of farmers reported having attended a meeting in the past year. District of residence was also examined to determine if farmers from one district were more likely to attend the meetings. The district of residence was found to be statistically significant with farmers from the Lakeside district more likely to attend.<sup>2</sup> In the Lakeside district, 89.5 percent of the farmers reported attending a meeting. In the Gulf Coast district, 71.1 percent attended (see Figure 5.10).

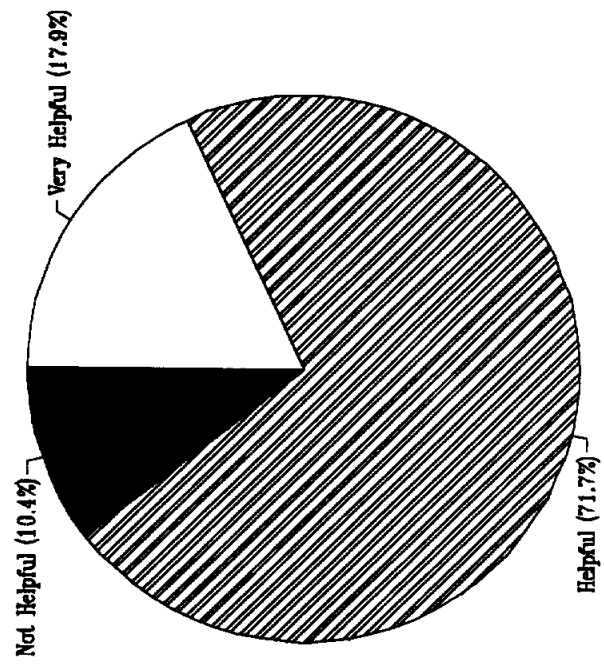
This results would seem to indicate that the farmers in the Lakeside district are more involved and politically active in relation to the LCRA than are the farmers in the Gulf Coast district. The LCRA may need to give special attention to motivating the Gulf Coast farmers to become more involved. The greater the number of farmers that can work more closely with the LCRA, the greater the chance the LCRA has of achieving its goals.

**Figure 5.6**  
**LCRA's Response to Billing Questions**



Source: Policy Research Project Survey

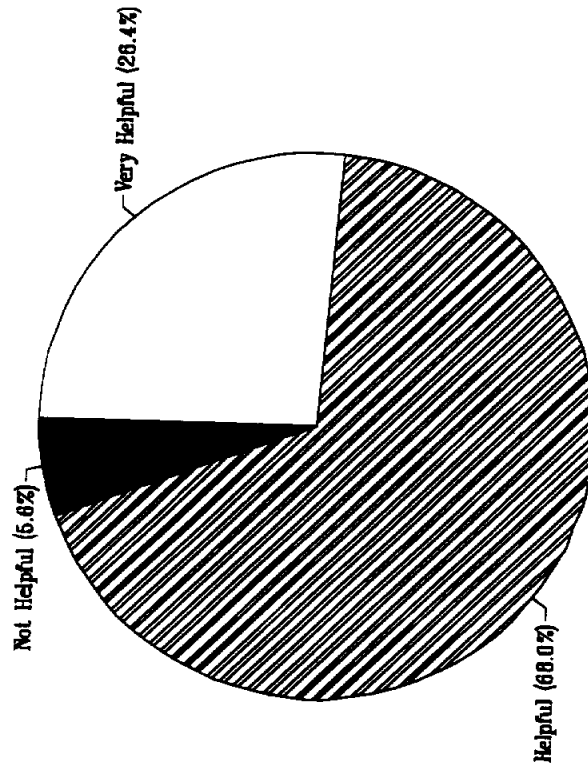
**Figure 5.7**  
**LCRA's Response to Conservation Questions**



Source: Policy Research Project Survey

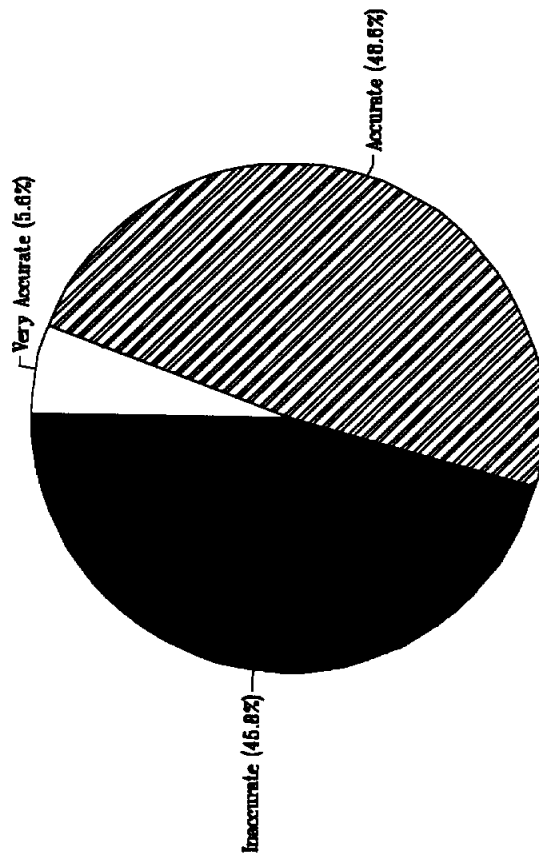


**Figure 5.8**  
**LCRA's Response to Water Delivery Questions**



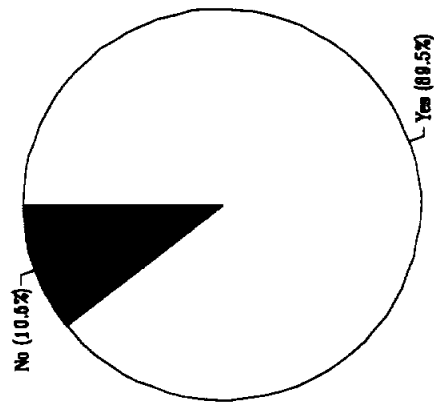
Source: Policy Research Project Survey

**Figure 5.9**  
**Accuracy of the LCRA Water Deliveries**



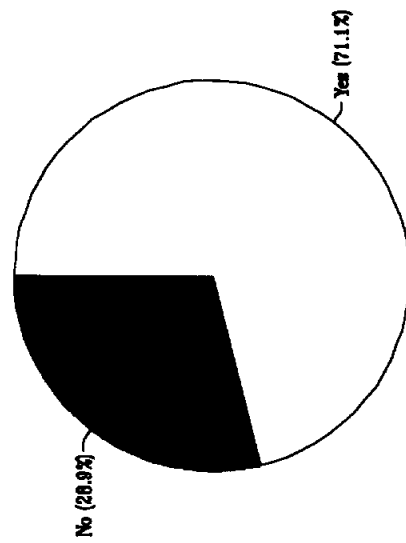
Source: Policy Research Project Survey

**Figure 5.10**  
**Attended Farmer Meeting in the Past Year**  
**Lakeside District**



**Figure 5.10 (continued)  
Attended Farmer Meeting in the Past Year**

**Gulf Coast District**



Source: Policy Research Project Survey

The final question about farmer meetings asked the farmer to rate the value of the meetings that they attended. As Figure 5.11 shows, 81.8 percent of the farmers felt that the meetings were at least *useful*, while 18.2 percent felt that they were *not useful*. In light of the positive response, every effort should be made in the future to persuade those who did not attend previous meetings to attend future meetings.

The LCRA has conducted water conservation demonstration projects in the area. Farmers were asked two questions about these projects: whether they were invited and what was their value. Most farmers, 88.2 percent, reported being invited to such a demonstration. Three-quarters (75.4 percent) of farmers who attended these demonstrations gave them favorable ratings and 9.4 percent even rated them as *very helpful*. However, a significant number did report that they found the demonstrations to be *not helpful* (see Figure 5.12). The LCRA should attempt to improve such projects with the aim of relating water saving techniques to the farmers.

In a question related to the above projects, farmers were asked whether the LCRA had offered them any technical advice in the past year. One half, 50.7 percent, of the farmers reported receiving technical advice from the LCRA in the past year. There is no information on whether or not the farmers implemented any of this advice. The question stated, "*did the LCRA offer you any technical<sup>3</sup> advice . . .?*", so the advice may have been offered as a response to questioning by the farmer and was not necessarily instigated by the LCRA.

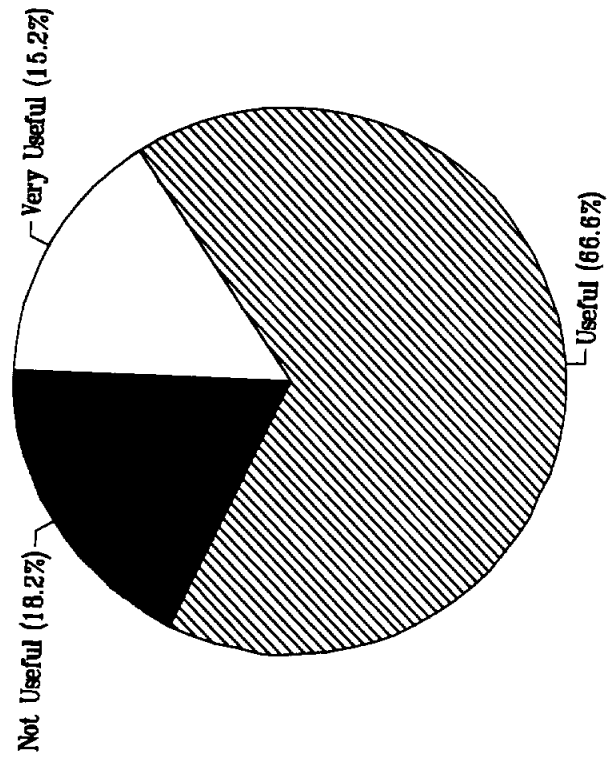
The Policy Research Group wanted to gain insight into farmer attitudes toward regulation in general. This might indicate whether the LCRA is working against a general bias against increased emphasis on water conservation as measured by attitudes on regulation. It was found that a small percentage (5.5) of farmers felt that groundwater and surface water should *always be regulated* (see Figure 5.13). In addition to those who felt the sources should always be regulated, a significant number, 69.4 percent, felt that surface water should be regulated under conditions of drought and when demand exceeds supply. Surprisingly, a total of 39.7 percent of the farmers felt that groundwater should be regulated under these same conditions. This result is surprising not because the farmers have necessarily been for the overuse of a resource but because in the State of Texas groundwater is considered part of the property rights of the surface owner.

In regard to surface water, 22.2 percent of the farmers felt that it should *never* be regulated. As was expected, a large number of farmers, 54.8 percent, felt that groundwater should *never* be regulated. A cross tabulation was run on the questions of surface water regulation and groundwater regulation to see if farmers tended to respond similarly to both questions (see Table 5.2).

A statistically significant association was found.<sup>4</sup> The largest group was those who felt that both groundwater and surface water should *never* be regulated. An even 50 percent of the farmers felt that even in situations when demand exceeds supply, neither groundwater nor surface water should be regulated.

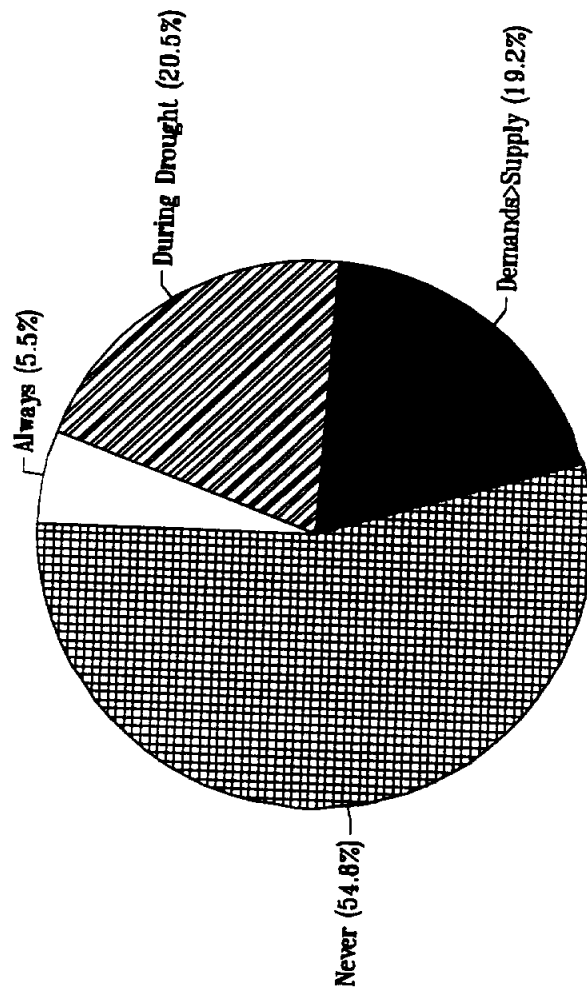
To get an impression of the overall relationship between the farmers and the LCRA, farmers were asked whether they felt that, in general, the LCRA was helpful, or not, to rice farmers. Most of the farmers, 84.4 percent, felt that the LCRA was at least *helpful* to the farmers (see Figure 5.14). Equal portions, 14.7 percent, expressed opposing opinions that the LCRA was *very helpful* or *not helpful* to rice farmers. This indicates that overall the LCRA has a good reputation with the farmers, though there is a small portion, 14.7 percent, who are unhappy with the organization. It is undetermined how much of this unhappiness is the result of the new rate structure. It is possible that some farmers are judging the LCRA's entire operations on the fact that they don't like the new rate structure. However, it is possible that this small, but significant, number of farmers have a poor opinion of the LCRA regardless of the new volumetric rate structure.

**Figure 5.11**  
**Usefulness of LCRA Farmer Meetings**



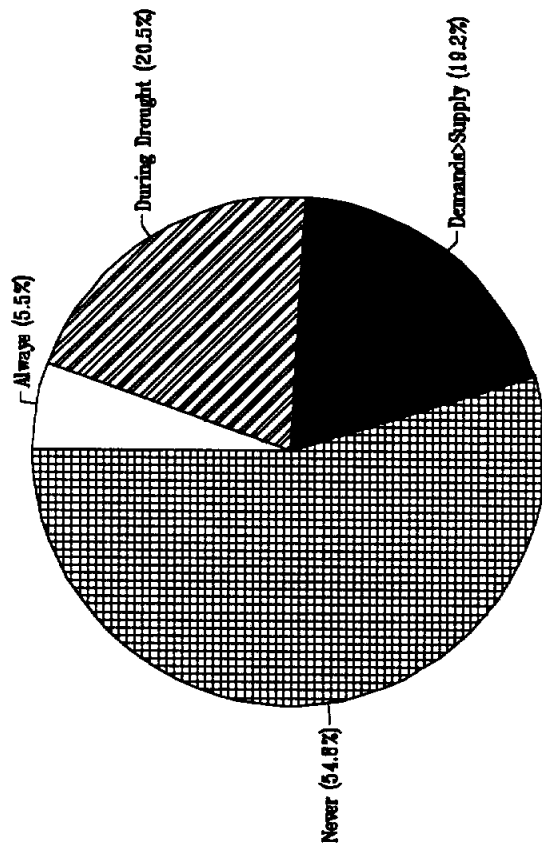
Source: Policy Research Project Survey

Figure 5.12  
Value of Conservation Demonstrations



Source: Policy Research Project Survey

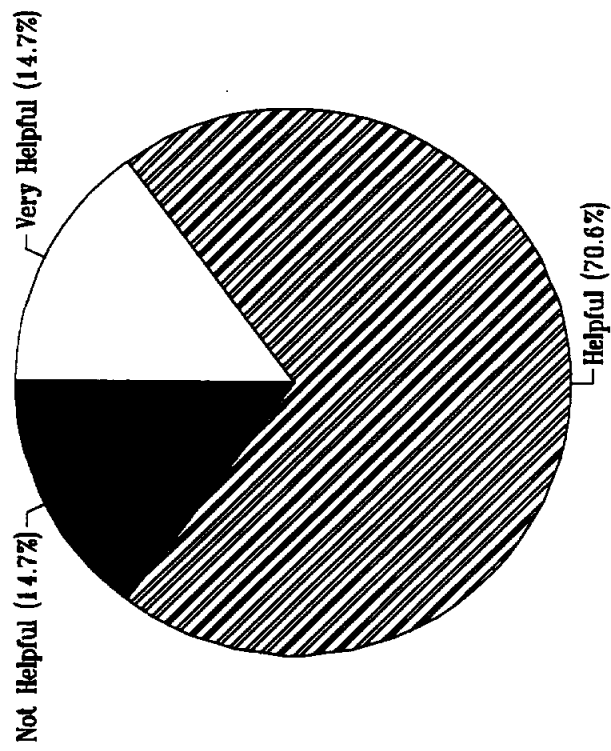
**Figure 5.13**  
**When Should Groundwater be Regulated?**



Source: Policy Research Project Survey



**Figure 5.14**  
**Is The LCRA Helpful--Overall?**



Source: Policy Research Project Survey.

**Table 5.2**  
**Cross Tabulation: Farmers' Attitudes Towards Regulation of**  
**Groundwater by Surface Water**

Surface Regulation	Groundwater Regulation				Total
	Always	During Drought	When Demands Exceed Supply	Never	
Always	2 (0)	2 (1.3)	2 (1.3)	2 (1.3)	6 (8.6)
During Drought	2 (2.9)	9 (12.9)	3 (4.3)	9 (12.9)	23 (32.9)
When Demands Exceeds Supply	2 (2.9)	2 (2.9)	9 (12.9)	12 (17.1)	25 (35.7)
Never	0 (0)	2 (2.9)	0 (0)	14 (20)	16 (22.9)
<b>Total</b>	<b>4</b> <b>(5.7)</b>	<b>15</b> <b>(21.4)</b>	<b>14</b> <b>(20)</b>	<b>37</b> <b>(52.9)</b>	<b>70</b> <b>(100)</b>

Source: Policy Research Program Survey.

Note: percentages are contained within parentheses.

### New Rate Structure

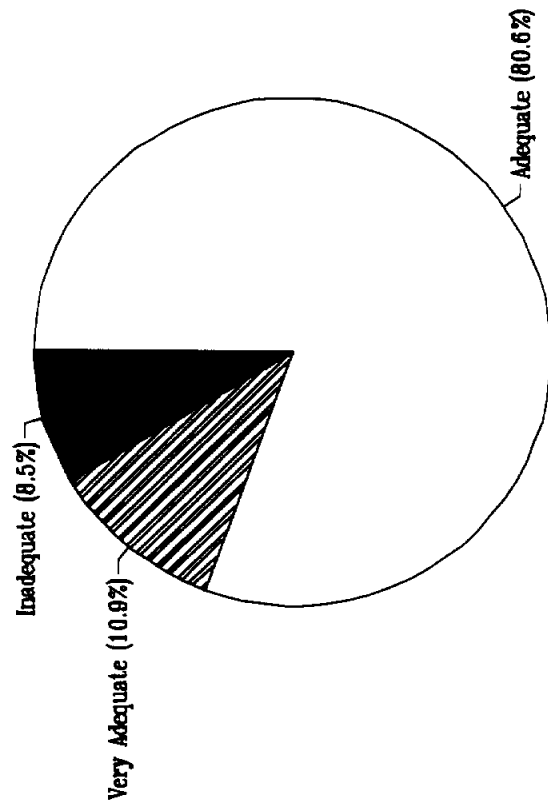
The proposed volumetric rate structure is a major departure from the past. Beginning in 1993, the farmers now have a chance to reduce water bill if they use less water. Conversely, water bills could go up if farmers use more water.

An important factor in getting farmer support for the new plan was to educate them about its design, purpose, and function. In this respect, 91.4 percent of farmers felt that LCRA had done at least an *adequate* job informing them of the new rate structure (see Figure 5.15). Some, 12.3 percent, even felt the LCRA had done a *very adequate* job of informing them of the new rate. A slightly smaller number, 9.6 percent, felt that the LCRA had done an *inadequate* job in this area.

It is interesting that given the many reservations the farmers have about the new rate structure, that over 90 percent would report the LCRA had done an adequate job informing them. This would seem to indicate that although most farmers understand the structure well, they still disagree with it.

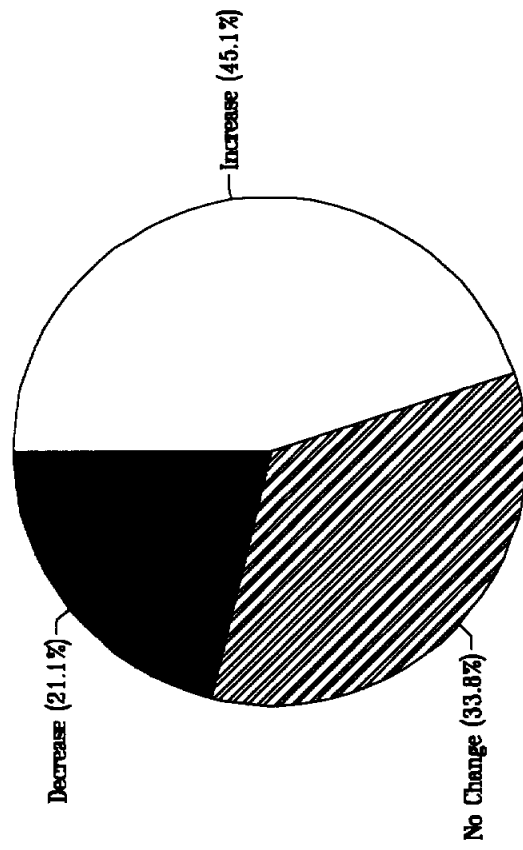
Much of the opposition comes from the belief on the part of 45.1 percent of the farmers that their water bills will increase as a result of the new structure (see Figure 5.16). One third of the farmers, 33.8 percent, predict that there will be no change in their water bill while 21.1 percent predicted that their bills would decrease.

**Figure 5.15**  
**LCRA's Explanation of Rate Structure**



Source: Policy Research Project Survey

**Figure 5.16**  
**Effect on Water Bill of New Rate**



Source: Policy Research Project Survey

A major concern with the new rate structure is that the method used to determine water use is not accurate. This is essentially reflected in the belief by 45.8 percent of the farmers that the water deliveries by the LCRA were inaccurate. A cross tabulation was run on the questions of water delivery accuracy and the effect of the new rate on water bills (see Table 5.3).

Table 5.3  
Cross Tabulation: Accuracy of Water Deliveries and Effect on  
Water Bill of New Rate Structure

Accuracy of Deliveries	Effect on Water Bill			
	Increase	No Change	Decrease	Total
Very Accurate	1 (1.4)	1 (1.4)	2 (2.8)	4 (5.6)
Accurate	7 (9.9)	19 (26.8)	8 (11.3)	34 (47.9)
Inaccurate	24 (33.8)	4 (5.6)	5 (7.0)	33 (46.5)
<b>Total</b>	<b>32</b> <b>(45.1)</b>	<b>24</b> <b>(33.8)</b>	<b>15</b> <b>(21.1)</b>	<b>71</b> <b>(100)</b>

Source: Policy Research Program Survey.

Note: percentages are contained within parentheses.

The results showed a very strong association.<sup>5</sup> Farmers that believe the water deliveries to be inaccurate also believe the new rate structure will increase their bill. It is not clear if they just fear it will increase their bill or actually believe that the bill will increase. Many farmers apparently feel that the water will not be delivered at as high a rate as the measurement will indicate.

They feel that fluctuations in the canal levels results in times when the pressure is insufficient to deliver the calculated amount in the required time.

The strongest association, 33.8 percent, was between farmers who felt the deliveries were inaccurate and that the new rate structure would increase their water bills. The next largest group, 26.8 percent, were those who believed the water deliveries to be accurate and that there would be no change in their water bill.

The farmers were asked if they felt the new rate structure was fair. Most, 63.7 percent, felt that the new rate structure was at least *fair* and 7.2 percent felt it was *very fair* (see Figure 5.17). Many, 36.2 percent, felt that the new rate structure was *unfair*.

A cross tabulation was run on the questions of fairness and the predicted effect on water bills (see Table 5.4). The two were strongly associated.<sup>6</sup> Those who believed that the new rate structure would increase their bill felt that the rate structure was *unfair*. This represented the single largest group of responses at 30.9 percent of the total. The second largest group believed their bill would not change and considered the rate structure *fair*. A

significant number, 13.2 percent, believed their bills would increase and yet still considered the new structure to be fair.

**Table 5.4**  
**Cross Tabulation: Effect on Water Bill of New Structure and**  
**Fairness of New Structure**

Fairness of New Structure	Effect on Water Bill			
	Increase	No Change	Decrease	Total
Very Fair	1 (1.5)	1 (1.5)	3 (4.4)	5 (7.4)
Fair	9 (13.2)	19 (27.9)	11 (16.2)	39 (57.4)
Unfair	21 (30.9)	2 (2.9)	1 (1.5)	24 (35.3)
<b>Total</b>	<b>31</b> <b>(45.6)</b>	<b>22</b> <b>(32.4)</b>	<b>15</b> <b>(22.1)</b>	<b>68</b> <b>(100)</b>

Source: Policy Research Program Survey.

Note: percentages are contained within parentheses.

A cross tabulation was also run on the questions of fairness and the accuracy of the water deliveries (see Table 5.5). The results showed a strong statistically significant association.<sup>7</sup>

The largest group, 35.3 percent, thought the water deliveries were accurate and considered the new structure fair. The second largest group, 26.5 percent, felt that water deliveries were inaccurate and consequently that the new structure was unfair.

Finally, the farmers were asked whether the new rate structure provided incentive to save water (see figure 5.18). A majority, 58.3 percent, thought that the new structure did provide incentive while 20.8 percent felt it did not. A large number, 20.8 percent, had no opinion.

A cross tabulation was computed on the accuracy of water deliveries and whether the new structure provided incentive to save water but there was not found to be any statistically significant association. The largest group, 30 percent, felt that the deliveries were accurate and that the new structure did provide an incentive to save water. The second largest group, 22.9 percent, felt that water deliveries were inaccurate but that the new structure was fair nonetheless. These results are surprising, as one might expect that if the water measurements are inaccurate, then a rate structure which depends on these measurements for its billing would not provide incentive to save water.

A separate cross tabulation was run on the questions whether the new structure provided incentive to save water and the predicted effect on water bills (see Table 5.6).

**Table 5.5**  
**Cross Tabulation: Accuracy of Water Deliveries and Fairness of New Structure**

Accuracy of Deliveries	Fairness of Structure			
	Very Fair	Fair	Unfair	Total
Very Accurate	2 (2.9)	2 (2.9)	0 (0)	4 (5.9)
Accurate	2 (1.5)	24 (35.3)	6 (8.8)	32 (47.1)
Inaccurate	1 (1.5)	13 (19.1)	18 (26.5)	32 (47.1)
<b>Total</b>	<b>5</b> (7.4)	<b>39</b> (57.4)	<b>24</b> (35.3)	<b>68</b> (100)

Source: Policy Research Program Survey.

Note: percentages are contained within parentheses.

The results from this test showed a statistically significant association.<sup>8</sup> One-fifth of the farmers believed that the new structure did provide incentive to save water but that it would also increase their water bills. An equal number also felt that the new structure provided a water saving incentive but that it would not change their bills. The third largest group, 18.6 percent, also felt that the new structure provided water saving incentive but that it would allow their bills to decrease.

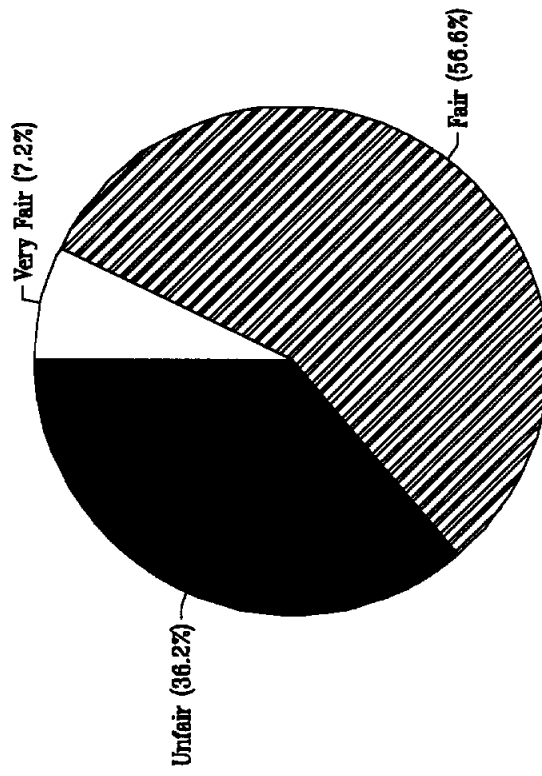
**Table 5.6**  
**Cross Tabulation: Effect on Water Bill of New Structure and, "Does New Structure Provide Incentive to Save Water?"**

Effect on Bill	Agree With Statement			
	Yes	No Opinion	No	Total
Increase	14 (20)	8 (11.4)	10 (14.3)	32 (45.7)
No Change	14 (20)	6 (8.6)	3 (4.3)	23 (32.9)
Decrease	13 (18.6)	0 (0)	2 (2.9)	15 (21.4)
<b>Total</b>	<b>41</b> (58.6)	<b>14</b> (20)	<b>15</b> (21.4)	<b>70</b> (100)

Source: Policy Research Program Survey.

Note: percentages are contained within parentheses.

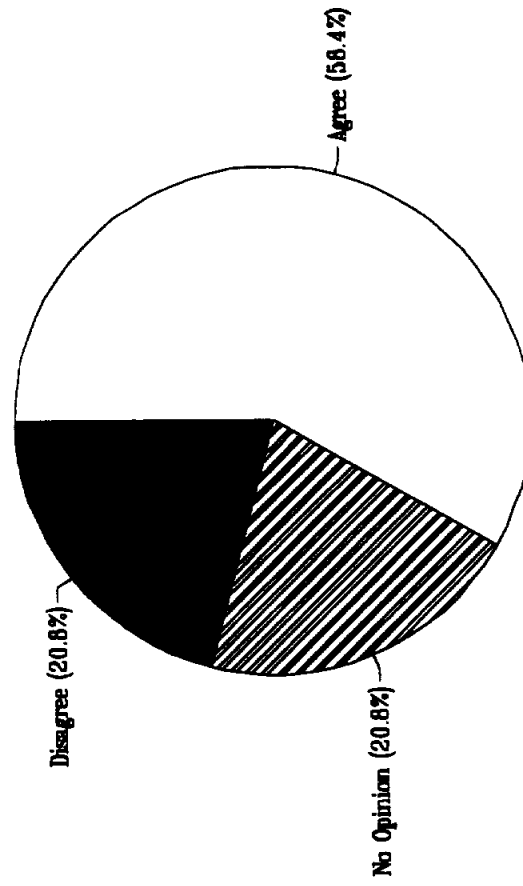
**Figure 5.17**  
**Fairness of New Rate Structure**



Source: Policy Research Project Survey



**Figure 5.18**  
**New Rate Structure Gives Incentive to Save Water?**



Source: Policy Research Project Survey

## Essay Responses

Response to the essay section of the survey was widespread as 53 percent of the respondents wrote comments.

Two issues were mentioned with much greater frequency than any others: (a) inaccuracy of the water delivery measurements by the LCRA and (b) the opinion that the LCRA is an inefficient bureaucracy.

The item most often mentioned was the inaccuracy of the water delivery measurements (see also Figure 5.8). Many farmers remain unconvinced of the LCRA's ability to charge them on a volumetric basis fairly when the method of measurement is so prone to error. While some farmers exhibited what amounts to indignant outrage over this issue, others were more moderate and voiced a reasonable concern. The main concern is that fluctuating canal depths prevent the assumed amount of water from being delivered to the fields. As one farmer states:

Without an actual gear driven counter, the volumetric rate structure will be inaccurate. This is because the canal level fluctuates up and down, and at times (up to 36-48 hours) no water is flowing through the water box, but the clock is still ticking indicating how much water should be flowing through the opening in the water box (quoted from a respondent to the PRP Survey).

Of the farmers responding in this section of the survey, 30 percent remarked about this issue, thereby showing its importance to them. Several of these respondents noted that they agreed with the theory of volumetric pricing but felt that in practice it would not be fair since the accuracy of the water deliveries was so poor.

The second most common remark by the respondents in the essay section was the feeling that the LCRA was itself inefficient in its use and management of water. Many also felt that the LCRA was simply an inefficient bureaucracy that had become self-serving and did not respond to the farmers' needs.

Farmers suggested that a major water savings could be obtained if the LCRA would improve its own canal system. This would include better maintenance of levees, as well as removal of vegetation from the canals.

Several farmers voiced frustration over the point that while farmer water use had decreased greatly in the previous several years, the LCRA had raised water prices. The result is that much of the inefficiencies of water use have already been removed but the farmers did not benefit financially from this savings. In fact, they have paid more. Now, when increased efficiency is harder to come by, the LCRA is instituting a volumetric price structure.

Several farmers remarked in the essay section that the idea of volumetric pricing was indeed good and should constitute a larger portion of the total water bill. While they welcome the chance to save money through the conservation of water, they contend the savings will not be enough to merit the investment in capital intensive items such as underground pipelines and precision leveled fields. The volumetric portion of the bill was considered too small and the flat *per* acre fee too large. This limits the amount of money a farmer can save no matter how small the amount of water used. The farmers indicated that if the flat fee was reduced and the volumetric fee increased, this would provide more incentive to save water.

Some farmers also expressed frustration over their perceived lack of input about issues which effect them. Although in the survey the farmer meetings received an overall good rating by farmers (see Figure 5.10), several farmers remarked that they had been "taken out of the decision making loop." Generally, these types of opinions were associated with the notion that LCRA had become a self-serving bureaucracy that was not concerned about working *with* the farmers.

Numerous farmers did make positive comments. The most frequent was the sentiment that the LCRA and the farmers need to work together more. The farmers noted that they are not the only ones who benefit from their rice farming. The farmers claim to represent a large portion of the economy in their areas and to support many local businesses. The LCRA also derives income from the farmers. In light of these factors, the respondents felt it is important that the two groups cooperate to develop an arrangement which is fair to all parties.

### Notes

1. In the following discussion, the term *combined* means the combination of two response groups. For example, if 10 percent of the respondents chose the options *good* and 15 percent chose the options *very good* the combined number would be 25 percent of the respondents indicating at least *good*.
2. Pearson chi-square statistic is 0.04.
3. The term *technical* was not defined in the survey and may have been misunderstood.
4. Pearson chi-square statistic is 0.01.
5. Pearson chi-square statistic is 0.0001.
6. Pearson chi-square statistic is 0.0001.
7. Pearson chi-square statistic is 0.0002.
8. Pearson chi-square statistic is 0.004.

## Chapter 6. Summary and Recommendations

The report begins with a brief introduction about the irrigation districts operated by the LCRA. Following this introduction, an extensive review of existing work in the adoption of conservation practices is presented to provide a theoretical background from which to judge the practices of the farmers in this survey. The consensus of existing research is shown to be that a combination of economic and personal factors have an impact on adoption of conservation practices. This conclusion is supported by the present study.

Existing research deals almost exclusively with the factors affecting the adoption of conservation tillage among farmers. This study is important because of its examination of the factors affecting the adoption of water conservation techniques among farmers. The author knows of no other similar study performed on this topic.

The report presents a thorough discussion of survey theory and methodology. The resulting survey was a product of this extensive review. The PRP determined that a mail survey of all farmers in the two districts represented the best strategy. A short review of the steps required to accomplish this task are presented in Chapter 4.

The farmer survey attempted to gain as unbiased an assessment as possible of information in several areas. One area is the farming techniques used by the farmers. Knowledge of the techniques employed by the farmers is needed for the LCRA to understand where possible improvements could be made. The LCRA can also gain information on its performance as perceived by the farmers from the section which asks the farmer to evaluate the LCRA. The section on attitudes about the new rate structure will inform the LCRA about the factors which need to be addressed in regard to this issue.

Most of the farms are not large operations run by outside corporations but small to moderate size ones run by area natives. Three-quarters of the farmers employ one or no farm hands and the average size of farms is 636 acres if all crops are included. Farmer income was moderate with more farmers falling into the \$40,000 to \$60,000 annual income range than any other. A calculation was performed that showed a farmer average annual income of \$46,301. This amount was 30 percent higher than the comparable figure for a U.S. family of four.

Every farmer in the survey grows rice as their main crop, though a number of other crops were also reported. Other crops raised included: corn, sorghum, cotton, and soybeans. Rice, corn, and cotton demand large amounts of water while sorghum requires less. Ten percent of the farmers reported raising a sorghum crop in 1992. The author believes that in the future, as water is charged volumetrically, sorghum may represent a larger portion of the farmers' acreage.

The farmers used a number of water conservation techniques but did not invest great effort in this area. The lack of strong commitment to water conservation techniques is not surprising given the culture and tradition of rice farming, the history of water supply in the area, and current land tenure situations. Historically, water has been provided for a flat fee which did not charge for water by the amount used. Considering that most water conservation techniques require capital investment, farmers may have had a financial disincentive to invest in water conserving methods. With the additional factor that most farmers lease or rent the land they farm on a short term basis, the farmers may not benefit financially from any investment in the land.

The most popular water conservation techniques to be used by the farmers were improved levees, multiple delivery points, shallow flood, and canal maintenance. The less popular techniques included precision leveling, underground pipes, permanent levees, and field records. The lack of popularity of this second group may reflect the high cost. The survey indicates that only 42 percent of farmers are currently using any type of field record.

Field records should be promoted as a way to improve water savings that do not require large financial inputs from the farmers. The use of field records may also assist in the changing of farmer attitudes. Keeping records of field conditions and problems aids in the solution of problems and promotes a more systematic approach to the practice of farming. A more studied and systematic approach may help many farmers improve their efficiency and become more receptive to new techniques and behaviors.

It is likely that with water being charged for on a volumetric basis, farmers will move to employ more water conservation techniques as they now have a financial incentive to save water. The LCRA can aid this change by providing technical assistance to the farmers. In addition, the LCRA should consider a program which would allow farmers to deduct the cost of certain improvements from their water bill. For example, the precision leveling of land is expensive but the returns last for many years. It may be in the public's best interest to assist in the development of such strategies.

The farmers generally had a positive impression of the LCRA, but improvements could be made. The farmers indicated that for the most part they were happy with the manner in which the LCRA responded to their questions.

Of course the major issue at hand is the new volumetric rate structure. The manner in which the implementation of this new program is handled will likely set the tone for relations between farmers and the LCRA for many years to come.

The farmers indicate a major concern over the accuracy of the water delivery measurements. Some farmers even liked the idea of volumetric pricing but refrained from endorsing the program because of perceived measurement inaccuracies. If the LCRA can prove that delivery measurements are accurate, this would make substantial progress towards an overall positive impression of the new rate structure. Demonstrations should be held to show measurement accuracy. The best type of example would be an in-field demonstration over an extended time. The extended time period is important to convince the farmers that canal fluctuations do not effect the water deliveries. Another approach is to try in-field audits of measuring equipment to confirm continuing accuracy.

The concerns expressed by many of the farmers indicate that communication between the two parties could be improved. To meet this end it is recommended that every effort be made to improve communication between the farmers and the LCRA. Improved communication could help in two areas. The first is in the effectiveness of the water measurement techniques. The farmers need to be convinced of this effectiveness. The second is in regards to the feeling by farmers that their interests do not matter to the LCRA.

While most farmers expressed a general positive attitude toward the LCRA, others felt that their concerns were not being considered with proper weight. The farmers want to feel that they are part of the decision making process. In light of the fact that a majority of farmers indicated that farmer meetings were of value, these meetings should be continued. The meetings should also be continually reevaluated to determine if they could be improved in the future.

The response rate to this survey indicates that the farmers appreciate the opportunity to express their views. To continue to monitor the farmers' practices and opinions in as unbiased a fashion as possible, future surveys should be conducted. The response achieved by this survey appears, in some part, due to the fact that it was conducted by a third party and not the LCRA. This fact apparently convinced the farmers that their opinions would be considered fairly. Future surveys could also be conducted by a third party but it would be helpful if farmers could be made aware that their participation in this survey made a difference. The precedent set by this survey should be continued to maintain and promote any positive feelings on the part of the farmers.

In general, knowledge of the farmers' attitudes on this multitude of subjects will aid policy development. The LCRA will be able to use this information to determine how the farmers may react to potential policy changes. The LCRA should take this information into account in order to choose the appropriate policy and method through which the policy may be presented and implemented. The information gained from the survey will thus help the LCRA to be a more effective agency by helping it to better understand its customers.

## **Appendix A. Survey Forms**

This appendix includes the documents that were sent to all persons on the LCRA mailing lists for both the Gulf Coast and Lakeside districts. The first four pages represent the survey form itself. The succeeding three pages are postcards which were sent before, along with, and after the survey form.

We want to start by thanking you for your valuable participation in this survey. Section I focuses on your field(s) and farming practices.

	Please do not write in this column
1. Which crops did you farm last year? (Please check all that apply) <input type="checkbox"/> rice <input type="checkbox"/> maize <input type="checkbox"/> sorghum <input type="checkbox"/> cotton <input type="checkbox"/> Other (please specify) _____	_____ _____
2. How many acres of each crop did you farm last year? (Please write in the appropriate number) <input type="checkbox"/> rice <input type="checkbox"/> maize <input type="checkbox"/> sorghum <input type="checkbox"/> cotton <input type="checkbox"/> Other (please specify) _____	_____ _____ _____
3. Do you rotate crops? <input type="checkbox"/> yes (within same year) <input type="checkbox"/> yes (year to year) <input type="checkbox"/> no	_____ _____
4. Please estimate the percentage of irrigation water you use from surface and groundwater sources. <input type="checkbox"/> % surface water <input type="checkbox"/> % groundwater	_____ _____
5. How many separate fields did you farm last year? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 or more	_____ _____
6. How would you describe the soil types of your field(s)? (Please check all that apply) <input type="checkbox"/> silty sand <input type="checkbox"/> sandy clay <input type="checkbox"/> sandy clay loam <input type="checkbox"/> loam <input type="checkbox"/> silt loam <input type="checkbox"/> sandy loam <input type="checkbox"/> clay <input type="checkbox"/> sand	_____ _____ _____
7. Of the land you farmed last year, what percentage do you own? <input type="checkbox"/> 0-20% <input type="checkbox"/> 21-40% <input type="checkbox"/> 41-60% <input type="checkbox"/> 61-80% <input type="checkbox"/> 81-100%	_____ _____
8. On the land you farmed that you do not own, were you <input type="checkbox"/> leasing? <input type="checkbox"/> employed? <input type="checkbox"/> co-oping?	_____ _____
9. Do you employ any field hands? <input type="checkbox"/> yes (give number) <input type="checkbox"/> no	_____ _____
10. Do you live next to the land you farm? <input type="checkbox"/> yes <input type="checkbox"/> no	_____ _____
11. How many miles do you travel each day during the growing season to tend your fields (average)? <input type="checkbox"/> 0-10 <input type="checkbox"/> 11-30 <input type="checkbox"/> 31-50 <input type="checkbox"/> more than 50	_____ _____
12. Which of the following water conservation methods are you currently using? (Please check all that apply) <input type="checkbox"/> precision leveling <input type="checkbox"/> multiple delivery points <input type="checkbox"/> improved levees <input type="checkbox"/> shallow flood <input type="checkbox"/> underground pipelines <input type="checkbox"/> canal maintenance <input type="checkbox"/> field records <input type="checkbox"/> permanent levees <input type="checkbox"/> Other (please specify) _____	_____ _____ _____ _____
13. How many acres of your farm land has been precision leveled? <input type="checkbox"/> 0-50 <input type="checkbox"/> 50-100 <input type="checkbox"/> 100-200 <input type="checkbox"/> 200-300 <input type="checkbox"/> more than 300	_____ _____
14. How many flushings did you use last year? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> more than 3 (please write in the number) _____	_____ _____
15. If you use a feeder stream to maintain the water level on your field(s), please check the reasons as they apply to your situation. <input type="checkbox"/> lead time on orders is too long <input type="checkbox"/> water may not be delivered when ordered <input type="checkbox"/> too little time to check every field <input type="checkbox"/> used only during extreme heat waves <input type="checkbox"/> Other (please specify) _____	_____ _____ _____



**II. Section II covers personal characteristics. We would like to know this information to help us with our analysis. If you do not wish to answer a question in section II, please feel free to skip it.**

<p>16. What is your age?  <input type="checkbox"/> less than 30    <input type="checkbox"/> 31-40    <input type="checkbox"/> 41-50    <input type="checkbox"/> 51-60    <input type="checkbox"/> more than 60</p>	<p>Please do not write in this column</p> <p>____/____/____/____</p> <p>____/____</p> <p>____/____</p> <p>____/____/____/____</p> <p>____/____/____</p> <p>____/____/____</p> <p>____/____/____</p> <p>____/____/____/____</p> <p>____/____/____</p>
<p>17. In which irrigation district do you farm?  <input type="checkbox"/> Gulfcoast    <input type="checkbox"/> Lakeside</p>	
<p>18. Are you a native of this area?  <input type="checkbox"/> yes    <input type="checkbox"/> no</p>	
<p>19. How many years have you been farming in this district?  <input type="checkbox"/> 0-5    <input type="checkbox"/> 6-10    <input type="checkbox"/> 11-15    <input type="checkbox"/> 16-20    <input type="checkbox"/> more than 20</p>	
<p>20. What is the highest level of education that you have completed?  <input type="checkbox"/> 8th grade    <input type="checkbox"/> high school    <input type="checkbox"/> college    <input type="checkbox"/> graduate school</p>	
<p>21. Is your formal education related to your success in farming?  <input type="checkbox"/> very important    <input type="checkbox"/> related    <input type="checkbox"/> not related</p>	
<p>22. How many persons are there in your household?  <input type="checkbox"/> 1    <input type="checkbox"/> 2    <input type="checkbox"/> 3    <input type="checkbox"/> 4    <input type="checkbox"/> 5    <input type="checkbox"/> 6    <input type="checkbox"/> more than 6</p>	
<p>23. Which of the following comes closest to your total family income?  <input type="checkbox"/> 0-\$10,000    <input type="checkbox"/> \$10,000-\$20,000    <input type="checkbox"/> \$20,000-\$30,000  <input type="checkbox"/> \$30,000-\$40,000    <input type="checkbox"/> \$40,000-\$60,000    <input type="checkbox"/> over \$60,000</p>	

**III. Section III is the last section. It deals with your interaction with the LCRA, your opinions on water conservation, and the proposed rate structure. We really appreciate your time and effort.**

<p>24. Who do you most often contact at LCRA?  <input type="checkbox"/> water boss    <input type="checkbox"/> district manger    <input type="checkbox"/> secretary    <input type="checkbox"/> supervisor  <input type="checkbox"/> Other (please specify) _____</p>	<p>Please do not write in this column</p> <p>____/____/____/____</p> <p>____/____/____/____</p> <p>____/____</p> <p>____/____/____/____</p> <p>____/____/____/____</p> <p>____/____</p> <p>____/____/____/____</p> <p>____/____</p> <p>____/____</p> <p>____/____</p> <p>____/____</p>
<p>25. How do you most often communicate with this person?  <input type="checkbox"/> by telephone during the working day    <input type="checkbox"/> by telephone in the evening  <input type="checkbox"/> by coincidental meeting in the field    <input type="checkbox"/> by planned meeting  <input type="checkbox"/> Other (please specify) _____</p>	
<p>26. How frequently do you communicate with LCRA?  <input type="checkbox"/> more than once per month    <input type="checkbox"/> about once per month    <input type="checkbox"/> less than once per month</p>	
<p>27. Approximately how many times did you order water from LCRA during last year's growing season?  1st crop:    <input type="checkbox"/> 1    <input type="checkbox"/> 2    <input type="checkbox"/> 3    <input type="checkbox"/> 4    <input type="checkbox"/> more than 5  2nd crop:    <input type="checkbox"/> 1    <input type="checkbox"/> 2    <input type="checkbox"/> 3    <input type="checkbox"/> 4    <input type="checkbox"/> more than 5</p>	
<p>28. Has LCRA invited you to any farmer meetings during the last two years?  <input type="checkbox"/> yes    <input type="checkbox"/> no</p>	
<p>29. Have you attended any of these LCRA farmer meetings?  <input type="checkbox"/> yes    <input type="checkbox"/> no</p>	
<p>30. If you attended any farmer meetings, how useful was the information you received from them?  <input type="checkbox"/> very useful    <input type="checkbox"/> useful    <input type="checkbox"/> not useful</p>	
<p>31. Has LCRA informed you about its water conservation demonstration projects?  <input type="checkbox"/> yes    <input type="checkbox"/> no</p>	
<p>32. If you have observed these demonstration projects, how would you assess their value to you?  <input type="checkbox"/> very helpful    <input type="checkbox"/> helpful    <input type="checkbox"/> not helpful</p>	

<p>33. Did LCRA offer you any technical information last year?  <input type="checkbox"/> yes                      <input type="checkbox"/> no</p>	<p>__/_</p>
<p>34. Do you ever experiment with new or different farming techniques?  <input type="checkbox"/> yes                      <input type="checkbox"/> no</p>	<p>__/_</p>
<p>35. How helpful are LCRA staff when you have questions about water deliveries?  <input type="checkbox"/> very helpful      <input type="checkbox"/> helpful      <input type="checkbox"/> not helpful</p>	<p>__/_/_</p>
<p>36. How helpful are LCRA staff when you have questions about water conservation techniques?  <input type="checkbox"/> very helpful      <input type="checkbox"/> helpful      <input type="checkbox"/> not helpful</p>	<p>__/_/_</p>
<p>37. How helpful are LCRA staff when you have questions about your irrigation water bill?  <input type="checkbox"/> very helpful      <input type="checkbox"/> helpful      <input type="checkbox"/> not helpful</p>	<p>__/_/_</p>
<p>38. How would you rate the accuracy of LCRA's water deliveries?  <input type="checkbox"/> very accurate      <input type="checkbox"/> accurate      <input type="checkbox"/> inaccurate</p>	<p>__/_/_</p>
<p>39. How would you rate LCRA's attempts to inform you of its proposed volumetric rate structure?  <input type="checkbox"/> very adequate      <input type="checkbox"/> adequate      <input type="checkbox"/> inadequate</p>	<p>__/_/_</p>
<p>40. In your opinion, the proposed volumetric rate structure is:  <input type="checkbox"/> very fair      <input type="checkbox"/> fair      <input type="checkbox"/> unfair</p>	<p>__/_/_</p>
<p>41. In your opinion, how will the proposed volumetric rate structure affect your bill?  <input type="checkbox"/> increase in water costs      <input type="checkbox"/> no change in water costs      <input type="checkbox"/> decrease in water costs</p>	<p>__/_/_</p>
<p>42. What is your position on this statement, "LCRA's proposed rate structure will provide incentives to save water"?  <input type="checkbox"/> agree      <input type="checkbox"/> no opinion      <input type="checkbox"/> disagree</p>	<p>__/_/_</p>
<p>43. From which of these sources have you gotten most of your farming knowledge?  (Please check all that apply)  <input type="checkbox"/> parents/relatives                      <input type="checkbox"/> school  <input type="checkbox"/> other farmers                              <input type="checkbox"/> trade magazines  <input type="checkbox"/> practice/experience                      <input type="checkbox"/> LCRA  <input type="checkbox"/> agricultural extension service  <input type="checkbox"/> Other (please specify) _____</p>	<p>__/_/_/_/_</p> <p>__/_/_/_/_</p>
<p>44. Of the sources you checked above in # 43, which one is most related to your farming success?  (Please check only one)  <input type="checkbox"/> parents/relatives                      <input type="checkbox"/> school  <input type="checkbox"/> other farmers                              <input type="checkbox"/> trade magazines  <input type="checkbox"/> practice/experience                      <input type="checkbox"/> LCRA  <input type="checkbox"/> agricultural extension service  <input type="checkbox"/> Other (please specify) _____</p>	<p>__/_/_/_/_</p> <p>__/_/_/_/_</p>
<p>45. When LCRA develops its water conservation policies, whose interests do they have in mind?  (Please check all that apply)  <input type="checkbox"/> farmers' interests                      <input type="checkbox"/> LCRA's own interest  <input type="checkbox"/> state government                      <input type="checkbox"/> municipalities  <input type="checkbox"/> other (please specify) _____</p>	<p>__/_/_/_/_</p> <p>__/_/_</p>
<p>46. In your opinion, which of these options should be most important in the development of water conservation programs for rice farming? (Please check only one)  <input type="checkbox"/> farmers' interests                      <input type="checkbox"/> LCRA's own interest  <input type="checkbox"/> state government                      <input type="checkbox"/> municipalities  <input type="checkbox"/> other (please specify) _____</p>	<p>__/_/_/_/_</p> <p>__/_/_</p>
<p>47. When should public authorities have the right to regulate surface water use?  <input type="checkbox"/> all the time                      <input type="checkbox"/> only when there are more demands than supply  <input type="checkbox"/> in periods of extreme drought      <input type="checkbox"/> never</p>	<p>__/_/_/_/_</p>



**Dear LCRA Customer,**

**If you would like to receive a copy of the survey results, please check the box below and return this card with your name and address.**

**Yes, I would like to be sent a copy of the survey results.**

**Return address:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Dear LCRA Customer,**

**You should have received a survey form in the mail recently. If you have not completed the survey and returned it in the prepaid envelope, please take a few minutes to do this as soon as it is convenient.**

**If you did not receive a survey form, please phone Ms. Gail Bunce collect at (512) 471-4962, ext. 318. We will then forward one to you promptly.**

**Thank you for your participation.**

**David J. Eaton  
Beth Harris Jones Centennial  
Professor in Natural  
Resource Policy Studies**

**Dear LCRA Customer,**

**As part of a graduate course at the LBJ School of Public Affairs at The University of Texas, my students are conducting an evaluation of the LCRA's water conservation program. An important part of this evaluation will be a survey. We will be asking farmers who use LCRA water for irrigation about their opinions on the LCRA and its water policies.**

**The survey should be arriving shortly. Please watch for it.**

**Thank you.**

**David J. Eaton  
Beth Harris Jones Centennial  
Professor in Natural  
Resource Policy Studies**

## Appendix B. Survey Data

This appendix contains the raw data response for each question on the survey administered to the rice farmers. Following each response is the number of farmers who marked that particular response. To the right of this number is the percentage of total responses represented by this number. The total of all percentages for each question may not add up to 100. This may be due to any combination of two reasons. One reason is the rounding of percentages. The second reason is that several questions contain multiple responses. As an example of the latter, a question may ask a farmer to "check all answers that apply." In this case, the recorded data will indicate the percentage of farmers who "checked" a particular response, not a particular response's percentage out of all possible responses.

	No.	(Percent)
Surveys mailed	230	
Surveys returned	79	(35)
Surveys not returned	151	(65)

---

Question 1--"Which crops did you farm last year? (Please check all that apply)"

No response . . . . .	0	
Rice . . . . .	79	(100.0)
Maize . . . . .	8	(10.1)
Sorghum . . . . .	9	(11.4)
Cotton . . . . .	9	(11.4)
Other . . . . .	13	(16.5)

---

Question 2--"How many acres of each crop did you farm last year?"

(Average acreage for those who farm each respective crop)

No response . . . . .	1
Rice . . . . .	554.3
Maize . . . . .	190.3
Sorghum . . . . .	557.8
Cotton . . . . .	327.3
Other . . . . .	244.1

(Average total acreage cultivated by each farmer for 1992)

Total . . . . .	636.2
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Question 3--"Do you rotate crops?"

No response . . . . .	0	(20.3)
No . . . . .	16	(6.3)
Yes (within same year) . . . . .	5	(73.4)
Yes (year to year) . . . . .	58	

Question 4--"Please estimate the percentage of irrigation water you use from surface and groundwater sources.

(Average responses)

No response . . . . .	7
Surface Water . . . . .	86.8%
Groundwater . . . . .	41.6%

Question 5--"How many separate fields did you farm last year?"

No response . . . . .	2	(9.1)
1 . . . . .	7	(14.3)
2 . . . . .	11	(9.1)
3 . . . . .	7	(14.3)
4 . . . . .	11	(53.2)
5 or more . . . . .	41	
Average . . . . .	3.9	

Question 6--"How would you describe the soil types of your field(s)? (Please check all that apply)"

No response . . . . .	0	(3.8)
Silty Sand . . . . .	3	(29.1)
Sandy Clay . . . . .	23	(38.0)
Sandy Clay Loam . . . . .	30	(1.3)
Loam . . . . .	1	(7.6)
Silt Loam . . . . .	6	(48.1)
Sandy Loam . . . . .	38	(21.5)
Clay . . . . .	17	(5.1)
Sand . . . . .	4	

Question 7--"Of the land you farmed last year, what percentage do you own?"

No response . . . . .	1	(56.4)
0-20% . . . . .	44	(10.3)
21-40% . . . . .	8	(1.3)
41-60% . . . . .	1	(3.8)
61-80% . . . . .	3	(28.2)
81-100% . . . . .	22	



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Question 8--"On the land you farmed that you do not own, were you . . ."

No response . . . . .	19	
Leasing . . . . .	51	(85)
Employed . . . . .	1	(1.7)
Co-oping . . . . .	8	(13.3)

---

Question 9--"Do you employ any field hands?"

No response . . . . .	0	
No (0) . . . . .	36	(45.6)
1 . . . . .	23	(29.1)
2 . . . . .	8	(10.1)
3 . . . . .	5	(6.3)
4 . . . . .	3	(3.8)
5 . . . . .	1	(1.3)
6 . . . . .	2	(2.5)
7 . . . . .	0	(0.0)
8 . . . . .	1	(1.3)

---

Question 10--"Do you live next to the land you farm?"

No response . . . . .	1	
No . . . . .	60	(76.9)
Yes . . . . .	18	(23.1)

---

Question 11--"How many miles do you travel each day during the growing season to tend you fields? (Average)"

No response . . . . .	3	
0-10 . . . . .	12	(15.8)
11-30 . . . . .	24	(31.6)
31-50 . . . . .	20	(26.3)
More than 50 . . . . .	20	(26.3)

---

Question 12--"Which of the following water conservation methods are you currently using? (Please check all that apply)"

No response . . . . .	3	
Precision leveling . . . . .	33	(41.8)
Improved levees . . . . .	57	(72.2)
Underground pipelines . . . . .	17	(21.5)
Field records . . . . .	33	(41.8)
Multiple delivery points . . . . .	56	(70.9)
Shallow flood . . . . .	51	(64.6)
Canal Maintenance . . . . .	57	(72.2)
Permanent levees . . . . .	14	(17.7)
Other . . . . .	4	(5.1)

---

Question 13--"How many acres of your farm land has been precision leveled?"

No response	5	
0-50	40	(54.1)
51-100	5	(6.8)
101-200	5	(6.8)
201-300	7	(9.5)
More than 300	17	(23.0)

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Question 14--"How many flushings did you use last year?"

No response	7	
0	24	(33.3)
1	32	(44.4)
2	11	(15.3)
3	5	(6.9)
More than 3	0	(0.0)

---

Question 15--"If you use a feeder stream to maintain the water level on your field(s), please check all reasons as they apply to your situation."

No response	35	(44.3)
Lead time on orders is too long	15	(19.0)
Too little time to check every field	3	(3.8)
Water may not be delivered when ordered	24	(30.4)
Only during periods of extreme heat waves	14	(17.7)
Other	13	(16.5)

---

Question 16--"What is your age?"

No response	1	
Less than 30	6	(7.7)
30-40	18	(23.1)
41-50	22	(28.2)
51-60	18	(23.1)
More than 60	14	(17.9)

---

Question 17--"In which irrigation district do you farm?"

No response	1	
Gulf Coast	38	(48.7)
Lakeside	40	(51.3)

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Question 18--"Are you a native of this area?"

No response	1	
No	9	(11.5)
Yes	69	(88.5)

---

Question 19--"How many years have you been farming in this district?"

No response	2	
0-5	7	(9.1)
6-10	15	(19.5)
11-15	9	(11.7)
16-20	13	(16.9)
More than 20	33	(42.9)

---

Question 20--"What is the highest level of education that you have completed?"

No response	1	
8th grade	0	(0.0)
High school	29	(37.2)
College	41	(52.6)
Graduate school	8	(10.3)

---

Question 21--"Is your formal education related to your success in farming?"

No response	2	
Very important	14	(18.2)
Related	42	(54.5)
Not related	21	(27.3)

---

Question 22--"How many persons are there in your household?"

No response	2	
1	3	(3.9)
2	23	(29.9)
3	18	(23.4)
4	20	(26.0)
5	10	(13.0)
6	3	(3.9)
More than 6	0	(0.0)
Average	3.2	

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Question 23--"Which of the following comes closest to your total family income?"

No response . . . . .	6	
\$0-\$10,000 . . . . .	2	(2.7)
\$10,000-\$20,000 . . . . .	6	(8.2)
\$20,000-\$30,000 . . . . .	6	(8.2)
\$30,000-\$40,000 . . . . .	14	(19.2)
\$40,000-\$60,000 . . . . .	26	(35.6)
Over \$60,000 . . . . .	19	(26.0)

---

Question 24--"Whom do you most often contact at the LCRA?"

No response . . . . .	2	
Water boss . . . . .	69	(89.6)
District manager . . . . .	2	(2.6)
Secretary . . . . .	4	(5.2)
Supervisor . . . . .	0	(0.0)
Other . . . . .	2	(2.6)

---

Question 25--"How do you most often communicate with this person?"

No response . . . . .	1	
By telephone during the working day . . . . .	62	(79.5)
By coincidental meeting in the field . . . . .	8	(10.3)
By telephone in the evening . . . . .	1	(1.3)
By planned meeting . . . . .	3	(3.8)
Other . . . . .	4	(5.1)

---

Question 26--"How frequently do you communicate with this person?"

No response . . . . .	3	
More than once per month . . . . .	60	(78.9)
About once per month . . . . .	4	(5.3)
Less than once per month . . . . .	12	(15.8)

---

Question 27--"Approximately how many times did you order water from the LCRA?"

1st Crop:

No response . . . . .	9	
1 . . . . .	1	(1.4)
2 . . . . .	9	(12.9)
3 . . . . .	6	(8.6)
4 . . . . .	11	(15.7)
5 or more . . . . .	43	(61.4)
Average . . . . .	4.2	

2nd Crop:

No response	25	
1	5	(9.3)
2	15	(27.8)
3	12	(22.2)
4	7	(13.0)
5 or more	15	(27.8)
Average	3.3	

Question 28--"Has the LCRA invited you to any farmer meetings?"

No response	2	
No	2	(2.6)
Yes	55	(97.4)

Question 29--"Have you attended any of these meetings?"

No response	3	
No	15	(19.7)
Yes	61	(80.3)

Question 30--"If you attended any farmer meetings, how useful was the information you received from them?"

No response	13	
Very useful	10	(15.2)
Useful	44	(66.7)
Not useful	12	(18.2)

Question 31--"Has the LCRA informed you about its water conservation demonstration projects?"

No response	3	
No	9	(11.8)
Yes	67	(88.2)

Question 32--"If you observed these demonstration projects, how would you assess their value to you?"

No response	26	
Very Helpfu	5	(9.4)
Helpful	35	(66.0)
Not Helpful	13	(24.5)

Question 33--"Did the LCRA offer you any technical information last year?"

No response	8	
No	35	(49.3)
Yes	36	(50.7)

---

Question 34--"Do you ever experiment with new or different farming techniques?"

No response	6	(21.9)
No	16	(78.1)
Yes	57	(78.1)

---

Question 35--"How helpful are the LCRA staff when you have questions about water deliveries?"

No response	7	(26.4)
Very helpful	19	(68.1)
Helpful	49	(5.6)
Not helpful	4	(5.6)

---

Question 36--"How helpful are the LCRA staff when you have questions about water conservation techniques?"

No response	12	(17.9)
Very helpful	12	(71.6)
Helpful	48	(10.4)
Not helpful	7	(10.4)

---

Question 37--"How helpful are the LCRA staff when you have questions about your irrigation bill?"

No response	8	(31.6)
Very helpful	25	(55.7)
Helpful	44	(2.5)
Not helpful	2	(2.5)

---

Question 38--"How would you rate the accuracy of the LCRA's water deliveries?"

No response	7	(5.6)
Very accurate	4	(48.6)
Accurate	35	(45.8)
Inaccurate	33	(45.8)

---

Question 39--"How would you rate the LCRA's attempts to inform you of its proposed volumetric rate structure?"

No response	6	(12.3)
Very adequate	9	(78.1)
Adequate	57	(9.6)
Inadequate	7	(9.6)

---

Question 40--"In your opinion, the proposed volumetric rate structure is:

No response	10	
Very fair	5	
Fair	39	(7.2)
Unfair	25	(56.5)
		(36.2)

Question 41--"In your opinion, how will the proposed volumetric rate structure affect your bill?"

No response	8	
Increase in water costs	32	(45.1)
No change in water costs	24	(33.8)
Decrease in water costs	15	(21.1)

Question 42--"What is your position on the statement, 'the LCRA's proposed rate structure will provide incentives to save water?'"

No response	7	
Agree	42	(58.3)
No opinion	15	(20.8)
Disagree	15	(20.8)

Question 43--"From which of these sources have you gotten most of your farming knowledge? (Please check all that apply)"

No response	4	
Parents/relatives	51	(64.6)
Other farmers	62	(78.5)
Practice/experience	63	(79.7)
Agricultural extension service	41	(51.9)
School	11	(13.9)
Trade magazines	15	(19.0)
LCRA	5	(6.3)
Other	2	(2.5)

Question 44--"Of the sources checked above in #43, which one is most related to your farming success? (Please check only one)"

No response	7	
Parents/relatives	25	(34.7)
Other farmers	13	(18.1)
Practice/experience	27	(37.5)
Agricultural extension service	6	(8.3)
School	0	(0.0)
Trade magazines	0	(0.0)
LCRA	0	(0.0)

Other . . . . . 1 . . . . . (1.3)

Question 45--"When the LCRA develops its water conservation policies, whose interests do they have in mind? (Please check all that apply)"

No response . . . . .	4	
Farmer's interest . . . . .	29	
State Government . . . . .	19	(36.7)
LCRA's own interest . . . . .	49	(24.1)
Municipalities . . . . .	36	(62.0)
Other . . . . .	9	(45.6)
		(11.4)

Question 46--"In your opinion, which of these options should be most important in the development of water conservation programs for rice farming? (Please check only one)"

No response . . . . .	6	
Farmer's interest . . . . .	67	(91.8)
State Government . . . . .	1	(1.4)
LCRA's own interest . . . . .	1	(1.4)
Municipalities . . . . .	0	(0.0)
Other . . . . .	4	(5.5)

Question 47--"When should public authorities have the right to regulate surface water use?"

No response . . . . .	7	
Always . . . . .	6	(8.3)
In periods of extreme drought . . . . .	24	(33.3)
Only when more demands than supply . . . . .	26	(36.1)
Never . . . . .	16	(22.2)

Question 48--"When should public authorities have the right to regulate groundwater use?"

No response . . . . .	6	
Always . . . . .	4	(5.5)
In periods of extreme drought . . . . .	15	(20.5)
Only when there are more demands than supply . . . . .	14	(19.2)
Never . . . . .	40	(54.8)

Question 49--"Do you believe that the LCRA helps rice farmers?"

No response . . . . .	4	
Very helpful . . . . .	11	(14.7)
Helpful . . . . .	53	(70.7)
Not helpful . . . . .	11	(14.7)



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Question 50—"Please add your comments about any issues not addressed in the questionnaire."

(Essay style responses)

See Appendix C for text responses of question #50.

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## APPENDIX C: RESPONSES TO SURVEY QUESTION #50

This appendix contains the complete text of all written responses given to question #50: "Please add your comments about any issues not addressed in the questionnaire." Written responses were given by 42 of the 79 respondents. Note that the symbols "----" indicate writing on the survey form that could not be read.

**Respondent 1:**

LCRA wastes more water than any farmer ever thought about. They never patrol their canals to look for leaks. They often leave canals leaking all season, resulting in pastures being flooded and roads washed out. The volumetric billing is simply LCRA figuring a way to make the farmers pay for their incompetence. The extra charge for purchase of stored water is unfair. The farmer cannot pass extra and unexpected costs through to his customer and LCRA should not either. There should be one price for water no matter where it comes from.

**Respondent 2:**

(questions) # 40, 41, 42: Cannot express an opinion at this time because it has not been in practice long enough or on enough fields to determine its efficiency.

**Respondent 3:**

How about the price of LCRA water compared to others in the state and other states? One, in my opinion, to be higher than any other.

**Respondent 4:**

We have farmed rice for only one year, therefore, our answers are limited in value to you. At a recent Rice Growers' Seminar in Bay City, it was shown that we are the high cost producers of rice in the nation. Water is a big part of that cost. This puts a premium on LCRA to provide lower cost water to rice farmers or lose the customers.

**Respondent 5:**

I can pump groundwater cheaper than I can buy from LCRA.

**Respondent 6:**

I think the LCRA needs to pay more attention to the quality of water being dumped into the river by cities and towns up the river.

**Respondent 7:**

The metering system of measuring water flowing into fields is not accurate when pushing water to high points. Canals are not checked for trash or ---- in them. Canals are not held at regular levels.

**Respondent 8:**

I believe LCRA, like most other public utility companies, spends too much money on new equipment. If farmers had new trucks, backhoes, tractors, etc., we wouldn't be able to afford them. I believe the average tractor in the U.S. is 19 years old. I wonder what the average price of equipment of LCRA is. Also I believe we should have a lower flat rate for water and a higher charge for the amount of water that we really use. This would make farmers conserve more water.

**Respondent 9:**

Any regulations placed on water that is used by the agricultural community or farmers would only lead to further regulations, to which my tax dollars, as well as other farmers, would be used to fight these usually very unfair regulations.

**Respondent 10:**

I believe the metering of our water is needed and has been needed in the past. There are a lot of people in Texas today and water will become a very important and costly commodity. Hopefully we will be able to answer the challenge. The only way we will be able to compete with cities for water is by using up to date methods of conserving water. This will come with the implementation of volumetric metering of our usage of water. Farmers must curtail the way they use in every way and every phase of the crop during the year. But LCRA needs to make these efforts worthwhile to the farmer. Incentive is going to have to play a big part in this project. This will have to come from LCRA. Hopefully the process of metering will also improve in 1993 over 1992. Too much difference from field to field in '92. Hope you can get something out of this. Thank you for your efforts.

**Respondent 11:**

LCRA has done a very good job through the years. My biggest concern is on the new measuring system that we are going to be charged by in 1993. I think there has not been enough studies done on the system for enough years to start charging us by this method, although it has been said there will be adjustments made if there is a large amount of difference in the normal amount of water used. I just think this program needs a few more years and different weather conditions in these years, such as a drought or two, to come up with fair rates to both LCRA and the farmer.

**Respondent 12:**

Surface water belongs to everyone, but the people in the Colorado River Water Shed should have priority. Here we share the concerns of floods, droughts, or any environmental or industrial disaster that may occur on the River or Highland lakes. The rice farmer pays for water used in the irrigation of their crops that support their families, cities, counties, and businesses along the Colorado River. Without our water so goes the rice farmer and everyone connected, including LCRA. I also feel that ground water should be regarded as a mineral and should be handled in this manner. The land owner should have some consideration in this, an important issue as well. I support a volumetric metering concept for conservation and billing purposes, but I feel that inconsistencies in canal levels, high rainfall amounts, debris in delivery points add to the problem with the method and type of metering equipment available for an accurate delivery measurement, plus or minus 10%, at this time. This is the only opposition I have, as well as many of my cohorts. Higher irrigation cost is a fear shared by all farmers. The incentive for better water conservation needs to be addressed further, the proposed Rate Tariff does not make it feasible or profitable to invest in the enormous expense involved in precision land leveling and or underground pipelines. Perhaps, lower per acre charges and higher diversion charges, and/or discounts for precision leveled land, along with higher rice prices could help enhance these incentives. We all need each other, to work together, to achieve our goals, and make this program profitable for all of us.

**Respondent 13:**

Thank you for this opportunity to share my thoughts and feelings regarding LCRA and the proposed water conservation program. As rice farmers dependent on water from the Colorado River we realize that we are forced to deal with, yea - at the mercy of a bureaucracy. A bureaucratic organization with little interest in irrigation. In my small farming operation, water costs have increased 21.12% in three years. In a dry year this could increase another 10% as projected by the LCRA stored water charge (\$5.27 per acre foot). At each meeting for farmers and the LCRA which I have attended some farmer has asked "Are you attempting to shut down irrigation and put farmers out of business?" Volumetric billing is sound, however three boards and a yardstick in a silted lateral do not a meter make. Our water costs go up - then there is an announcement that "LCRA has frozen electric rates until the turn of the Century." AND another - "LCRA announces with pride the winning of \$1.5 million in grants for Environmental Purposes" including \$414,000 in fact gathering and report

preparation for the Colorado River under Clean Rivers Act. Also \$200,000 for solid waste management planning. Folks, what are we dealing with here? Oh yes, BUREAUCRACY. A far better question - Would not LCRA employees and customers all be far better served should these assets become part of a well managed and for profit business? Again, thank you.

**Respondent 14:**

LCRA is a state agency - it pays no taxes - generates 0 jobs in the private sector, but can greatly effect jobs in the private sector by its decisions and policy making.

**Respondent 15:**

#48 - Water usage policy must be developed in a rational and objective atmosphere and environment and not as a "knee jerk reaction". The establishment of policy for water is critical and should be openly debated.

**Respondent 16:**

The LCRA makes no attempt to listen to, or implement any of our ideas. Sure, they have meetings down here but they are only to pacify us. It's obvious because of their attitude and we see nothing coming back our way at all. We used to have local farmers on some committee that went to Austin from time to time to voice our concerns and give suggestions to help us and LCRA see things eye to eye but this committee has not met in 2 years. We as farmers have been taken out of the decision making loop. We just do and pay as we are told with no input. Six or eight years ago we in Matagorda County were using approximately 8 to 9 acre feet per acre (AFPA). This past year I think we used an average of approximately 4.5 to 5 AFPA. We as farmers in the field are the ones for this decrease in usage by our hard work and our willingness to be conservative for environmental reasons. LCRA is getting and gladly taking all of the credit and in return we farmers are getting to pay approx. 45% more in rates. Times as they are in the rice farming business, it has become apparent that something has got to change for the better or we will be out of business soon, real soon. We have got to all work together because without us we take down lots of other businesses with us. This includes a lot of jobs employed by LCRA.

**Respondent 17:**

Person in charge of water, water boss: isn't working with the farmer like he should, in the last 3 year this is a little better than year ago. LCRA needs the rice farmer and rice farmer need LCRA. Some of your personnel is hard to get along with.

**Respondent 18:**

No one with LCRA has ever actually watered rice. They do not understand a lot of the many problems the farmer faces in his day to day watering process. This in turn costs the farmer alot of time, money, and stress. There needs to be more understanding and cooperation between the farmers' everyday needs and LCRA's employees handling the water distribution.

**Respondent 19:**

LCRA is becoming a self-servicing organization.

**Respondent 20:**

The only revenue that I can remember to pay for the dams was from the rice farmer for many years. I know it is going to cost more to meter and keep back then the small amount of water saved. It will create new jobs and cost.

**Respondent 21:**

Without an actual gear driven counter, the volumetric rate structure will be inaccurate. This is because the canal level fluctuates up and down, and at times (up to 36-48 hours) no water is flowing through the water box, but the clock is still ticking indicating how much water should be flowing through the opening in the water box. In

other words - we are being charged for the hole in the water box and nothing is passing through it but air. Unfluctuating canal depths to maintain constant pressure is extremely important.

**Respondent 22:**

This is an estate (family) operation. We have a tenant farmer, therefore cannot answer all the questions.

**Respondent 23:**

Thank you for giving us the opportunity to make comments on the LCRA. It is our opinion that the LCRA is working for the good of all in their attempt at volumetric metering, but there are many problems that must be worked out if it will be successful and have the approval of farmers. Two problems that have already surfaced at Gulfcoast are:

- A. inaccuracies in measurement
- B. lack of incentive in curtailment of usage

The LCRA staff has attempted over the last several years to obtain a better working relationship with its customers. They have organized two different "Farmer Advisory Groups", the first met only once or twice. The second group was formed only shortly before the first of the year. For the most part, members of the group feel that their opinions and suggestions fall on deaf ears with the staff at Austin. The staff uses the "Farmer Advisory Groups" to add to their recommendations to the LCRA board. At a recent board meeting in Austin the staff stated that over 50% of their irrigation customers were in support of a rate change. This could not be farther from the truth. Nearly all Texas rice farmers are feeling the effects of higher inputs and lower prices from the mills.

**Respondent 24:**

I believe that the volumetric rate system will not be an accurate way to charge for water use.

**Respondent 25:**

Re: Volumetric Rate Structure. The method of measurement is unfair. The system used is accurate when the water level in the canal is constant. Unfortunately, the water level fluctuates and therefore true water use is not fairly determined.

**Respondent 26:**

Out of the 650 ac. of rice, only 250 ac. on LCRA. The remainder of the rice and soybeans are irrigated by a private irrigation well.

**Respondent 27:**

Questions #47 and #48 need one more choice - that being a water commission of equal representation from each water user in the river basin. This is a nice questionnaire, but what is its purpose? LCRA has a monopoly and our only choice is to pay their proposed rate or do without the water, in other words, don't grow a crop that depends upon the use of irrigation water. LCRA could provide the same or better service to our area by cutting overhead, staff, \_\_\_\_\_, etc.

**Respondent 28:**

The G&A cost factored into the water division of the LCRA continued to grow as the LCRA Bureaucracy grows. This monster has grown exponentially since 1980 to date. This growth has been by Management, Board of Directors, Legislated Mandates, etc. The farmers and Water division of LCRA have taken a lot of flack from the Board and Lake People because we are not a profit center with the huge G&A expense in our budget. Which by the way continues to grow annually.

**Respondent 29:**

Your survey is not applicable in several ways to us as we are landowners who lease their land for a share of crop and for cash. For crop share leases for rice, we provide land, water and seed plus a portion of the other crop inputs, however the lessees provide the labor and equipment. Also the land is owned and operated by partnerships of six people so the personal questions are answered only by one partner, the managing partner. W.R.T. LCRA meetings -- they are generally on short notice and in conflict with other important meeting and at a distance. (In fact it seems that LCRA schedules meetings in conflict with some obvious events.)

**Respondent 30:**

Some rice farmers have abused their water rights. They were inattentive to their watering practices and did not care about using water conservatively - I appreciate the method that if a farmer conserves and manages his water he will be billed accordingly.

**Respondent 31:**

LCRA is overstaffed and overpaid. Too much emphasis put on recreation. Environmental input is great. Farmers will soon be priced out of business per acre ft. costs will soon outgrow our income.

**Respondent 32:**

The volumetric measurement was inaccurate. I had two fields side by side. One read 1.5 feet difference. It will be very good to help conserve water when it is perfected. If the water Boss would spend a little more time on the canal he could do a better job. They don't have the experience the older water bosses had.

**Respondent 33:**

Water is becoming a bigger farming issue every year. A farmer's conservation practice is becoming more important and mandatory. We cannot afford to experiment with too radical a farming techniques so the information LCRA and extension services provide can be very helpful.

**Respondent 34:**

In my opinion LCRA needs a more accurate way to measure water discharged into fields. The way water is measured to date is not accurate enough to allow them to fairly charge farmers for usage.

**Respondent 35:**

I have been farming rice since 1976. Water is absolutely necessary in growing rice. Since '76 LCRA has more than doubled, in fact almost tripled, the rate they charge me for water. Yet with practically no change in services - except for now a metering system which in "theory" is great but in "practice" is terribly inaccurate! Personally, I feel LCRA is selling water to the highest bid which would be municipalities and leaving the farmers hung out to dry because of the prohibitive cost of LCRA water. I think it's terrible and I can't stop it and will merely become a victim of the system.

**Respondent 36:**

Four years ago rates were increased by 28% spread over a four year period at 7%/year actually compounded to a 35% increase. At the same time water use by LCRA's own numbers have decreased in Gulf Coast from over 9 acre feet/acre to under 6 acre feet/acre. Actually 5.25 acre feet/acre. Over 30% savings in water usage. We were also promised there would be no more rate increases for 4-5 years after this. Now to get around a rate increase they come up with a new system of billing - volumetric rates - which in most of the farmer's opinion a very poor method of measurement. Wildly fluctuates between fields. So you tell me - do you believe that LCRA helps rice farmers? Sadly most of us feel that we will be paying 10-25% more within 2-3 years and the low prices of rice will not sustain this increase.

**Respondent 37:**

As a rice producer I feel like the municipalities and recreational interests have tried to take away water rights from the farmers. As a whole the farmers have cut way back on the amount of water used in the last 10 years.

But every year we pay more and more for water. While the price we receive for our crop decreases every year. I sometimes feel people are more concerned about the water level of the lake, that was built for irrigation purposes, than the crops that produce food to feed them. I also feel that after studies have been completed they will show water coming out of our rice fields are cleaner than the water we are putting in the top of our fields.

**Respondent 38:**

LCRA does not spend enough time or energy conserving water within their system, i.e., main canals.

**Respondent 39:**

Best relations between water boss and farmer in my 50 years of farming. Note I own \$100,000.00 LCRA bonds.

**Respondent 40:**

The accuracy of LCRA measurements of water concerns me greatly. They need an independent measuring service consisting of farmers and LCRA employees that are educated in the practice of measuring water so that this will be fair for everybody. Hand held meters should be thrown away. This is not in my opinion an accurate way to measure water, especially when you are farming on the end of the canal because of canal level fluctuations. Accuracy above all is my main concern. Send me this survey a year from now and I will be able to answer your questions more accurately.

**Respondent 41:**

Water rate is too high in comparison to the prices we receive on our rice.

**Respondent 42:**

LCRA is a bureaucracy with too many folks trying to run other people's business to impress the folks above them. The water districts and their local management should be left alone to do their jobs without Austin breathing down their necks. This survey just seems to me to be another attempt by bureaucrats to look impressive. There is a point at which information becomes futile. LCRA is not and will not every be one of the rice farmers' main sources of information. That is not and should not be LCRA's responsibility except where it pertains to water conservation.

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## VITA

William Eugene Roberts, Jr. was born in Beaumont, Texas on October 31, 1961, the son of Barbara Ann Roberts and William Eugene Roberts. After completing his work at Clear Lake High School, Clear Lake City, Texas, in 1980, he entered Texas A&M University in College Station, Texas in 1984. He received the degree of Bachelor of Arts from Texas A&M University in December, 1988. In August, 1991 he entered The Graduate School at the University of Texas. He is currently employed by the Texas Water Development Board.

**Permanent Address:**

**4010 Ave. B  
Austin, Texas 78751**

**This report was typed by the author.**