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Attitudes and Practices of Corps of Engineer Economists

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This paper is a product of the Institute for Water Resources (IWR) research on uncertainty in benefit analysis. The research is intended to enable Corps of Engineer economists to make better estimates of project benefits with limited resources, and to help the Corps to better orient its research program to provide useful methods and empirical data for resolving uncertainty in project planning. To help focus the effort, IWR organized a workshop on 29 April 1988 to determine the current attitudes and practices from a survey of Corps economists. This report summarizes the questionnaire which covered the most significant topics of that workshop.

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ATTITUDES AND PRACTICES OF CORPS OF ENGINEER ECONOMISTS

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INTRODUCTION

In April 1988, immediately following the Corps of Engineers biennial conference of economists and social scientists, the Institute for Water Resources conducted a workshop on uncertainty in benefit analysis. The purpose of the workshop was to meet with district and division economists to discuss details of the IWR work unit, "Uncertainty in Benefit Analysis." Since economists only convene every two years, it was a rare occasion to meet with a large number of them. It also allowed researchers a chance to discuss the project definition document and to solicit field input on where the research effort should be focused. The workshop allowed IWR to get an extensive response to a questionnaire and have an open discussion of the most critical issues related to the work unit.

WORKSHOP AGENDA

The workshop consisted of a formal presentation, a discussion of major research issues, administration of the questionnaire, and a discussion of policy issues. The formal presentation included a review of the project definition document, which defined the purpose and scope of the research unit; a statement of the requirements for risk and uncertainty analysis in Principles and Guidelines; a description of the classifications for sources of uncertainty; and, an examination of the various methods for dealing with uncertainty.

The presentation was followed by a discussion of these major issues:

1) Study Fund Allocation: How are funds distributed between study elements: ie. economics, hydrology and hydraulics, and environmental branches? How can economic

sections allocate funds to minimize uncertainty? How can resources from various study elements be used to take advantage of interdependent needs?

2) Economists' perceptions of the major sources of uncertainty.

3) Explicit Ways We Now Handle Uncertainty: contingency factors, discount rates, sensitivity analysis, and limited claiming of "future benefits."

4) Implicit Ways We Now Handle Uncertainty: the effects uncertainty may have on plan formulation, evaluation, and plan selection.

The central focus of the workshop was the administration of a questionnaire. The questionnaire was divided into seven parts: 1) respondents' experience with evaluating flood damage reduction project; 2) the relative importance of the benefits; 3) the relative magnitude of economic analysis as compared to other project tasks; 4) the relative costs of economic analysis as compared to other study elements; 5) study fund allocation for economics work; 6) the experiences and propensity of the economists to use various techniques for display of uncertainty; and, 7) economists' attitude to several provocative policy questions.

WORKSHOP PARTICIPATION

Copies of the work unit project definition and agenda for the workshop were mailed out in advance to the chief of economics in each division and district. Participants were self-selected by making the commitment to stay on after the economists and social science conference. Twenty-five district and division economists, planners, and social scientists attended the workshop. All eleven Corps divisions were represented. Even though the workshop participants represented a broad geographic coverage, it should not be assumed that those attending represented a "scientific" sample of the population. However, some of the patterns of response to the questionnaire were consistent enough to suggest that they are fairly strong indicators of the collective experience and attitudes.

GENERAL INSTRUCTIONS FOR THE QUESTIONNAIRE

The following instructions were given in the introduction to the questionnaire:

As was mentioned in the project definition document for the "Uncertainty in Benefit Analysis" work unit, we are attempting to assist field offices in addressing uncertainty in benefit estimates. Your participation in this workshop session is greatly appreciated. We would like to ask for your continued assistance in helping us to focus our research so that the needs of the field offices are adequately addressed. The following questionnaire has been developed to help assess the manner in which uncertainty has been, or should be, addressed in estimating the benefits of flood damage alleviation projects. As a result of the emerging nature of the state-of-the-art in uncertainty analysis, and as a result of our attempt to not make the questionnaire too long, complex or detailed, some of the questions may seem vague or overly simplistic with regard to the comprehensive and elaborate nature of the activities that encompass the feasibility study process. In this regard it is useful to keep in mind that we are seeking your expert judgement and, therefore, would appreciate your making an informed guess on some of these issues. We have provided space on most questions for you to expand your answers, or to provide your own categories, comment on the questions, or describe any difficulties with providing an answer to the questions.

We realize that there is a wide variety of flood damage project components that provide alleviation benefits. To structure this questionnaire to include all those possibilities would be overly prohibitive in time and resources. We, therefore, ask that your answers should, to the extent possible, represent an amalgam of the experience you have had in performing or reviewing feasibility studies for flood damage alleviation projects.

RESULTS

The results of the survey are recorded and interpreted below. Four statistics are used in this analysis: the mean (average), the range, the standard deviation, and the coefficient of variation. The standard deviation is given to indicate the level of dispersion in the answers. The coefficient of variation gives the level of dispersion relative to the magnitude of the mean.

Note that the questions and tabulation of responses for each question are given in bold type.

QUESTIONS AND RESPONSES

QUESTION 1. RESPONDENTS' EXPERIENCE WITH FLOOD PROJECTS

Please indicate below the percent that each of the following characteristics and components are applicable to your urban flood damage reduction feasibility studies.

The mean and range for each are given below:

a. coastal flooding 15.7 (0-50) riverine flooding 38.2 (0-80) stream flooding 46.1 (0-100)

b. single purpose 70.0 (0-100) multi-purpose 30.0 (0-100)

c. levees and flood walls 34.7 (0-100) reservoirs 19.4 (0-60) channels 43.8 (0-90)

d. permanent relocation 15.9 (0-96) flood warning/response 24.5 (0-100) floodproofing 23.9 (0-100)

Respondents indicated, as we expected, a vast majority work on inland river and stream flooding rather than coastal flooding. What may not have been expected 10 or 15 years ago is a major shift in work from riverine flooding to stream flooding. There also appears to be a shift away from multi-purpose to single-purpose projects. This has occurred as the Corps has been building fewer reservoir projects and become less involved in recreation. Structural measures are still the most commonly considered in planning, although almost 25% of respondents say that they have been involved in projects where flood warning was considered and another nearly 25% say they were involved in studies where floodproofing was considered.

QUESTION 2. RELATIVE IMPORTANCE OF BENEFIT CATEGORIES

Please estimate the average, minimum and maximum percent contribution to total benefits from each of the following categories. Do not worry about average percentages adding to 100%. We are only interested in relative contributions.

Category	Average Percent	Coefficient of Variation	Average Minimum Percent	Average Maximum Percent
Existing physical inundation reduction benefits	67.1	.24	44.3	83.0
Future physical inundation reduction benefits	11.5	.61	3.1	20.5
Existing non-physical inundation reduction benefits	12.4	.80	1.8	15.1
Income losses	(1.4)		.6	8.1
Emergency costs	(2.9)		.9	11.0
Traffic rerouting and delay	(6.0)		2.8	17.5
Floodproofing	(1.7)		.4	14.8
Administrative costs of flood insurance	(1.7)		2.0	12.0
Temporary relocation and reoccupation costs	(1.0)		.6	6.3
Modified use of floodproofing property	(.6)		.4	4.0
Restoration of land market values	(1.3)		.9	10.2
Future non-physical inundation reduction benefits	1.4	2.71	0	6.5
Location benefits	2.7	1.19	.3	20.0
Intensification benefits	3.5	1.29	.4	16.4
Advanced bridge replacement	1.5	1.33	.3	6.2
Employment Benefits	1.8	1.06	0	7.5
Negative benefits (non-mitigated induced damage)	-2.0	2.6	0	-5.2
Other				

(Please note that average percents for all major categories (not including the various types of non-physical benefits) have been normalized to add to 100%. The components of non-physical benefits have been normalized to add to 12.4%, the sum of the non-physical benefit contribution to the total.)

We are not aware of any standard reporting within the Corps that gives estimated benefits by project or by district. The large cross-section of individuals represented at this meeting afforded the opportunity to start collecting this information. If we could not obtain statistically significant estimates, we could at least get an idea of the relative importance of the benefit categories. All of the major benefit categories defined in Principles and Guidelines for Water and Related Land Resources Implementation Studies were listed in this question. Respondents were asked, given all the projects that they have worked on or reviewed, to identify the average, minimum, and maximum of total project benefits that are attributed to each benefit category. The relative importance of each benefit category indicates the significance of the uncertainty associated with that benefit category.

The results of question 2 are also illustrated in Figures 1 through 5. Figure 1 gives the average proportion each of the major benefit categories contributes to the total benefits. Figure 2 shows how the average proportion of each of the non-physical benefit categories on the average contributes to total non-physical benefits. Figures 3 through 5 show the distribution of total benefits respectively contributed by existing physical and non-physical and future inundation reduction benefits.

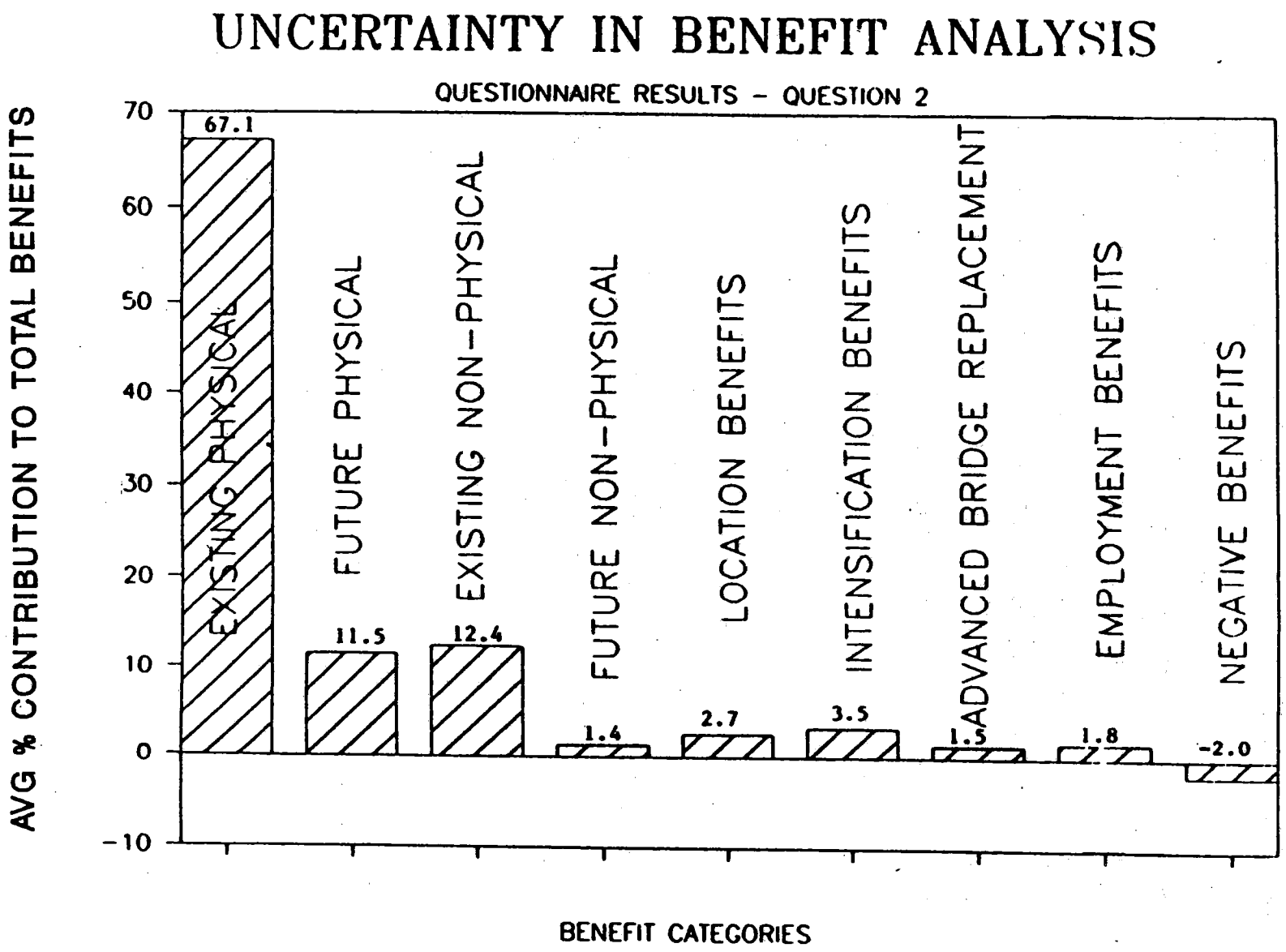

FIGURE 1 - BENEFIT CATEGORIES CONTRIBUTION TO TOTAL BENEFITS

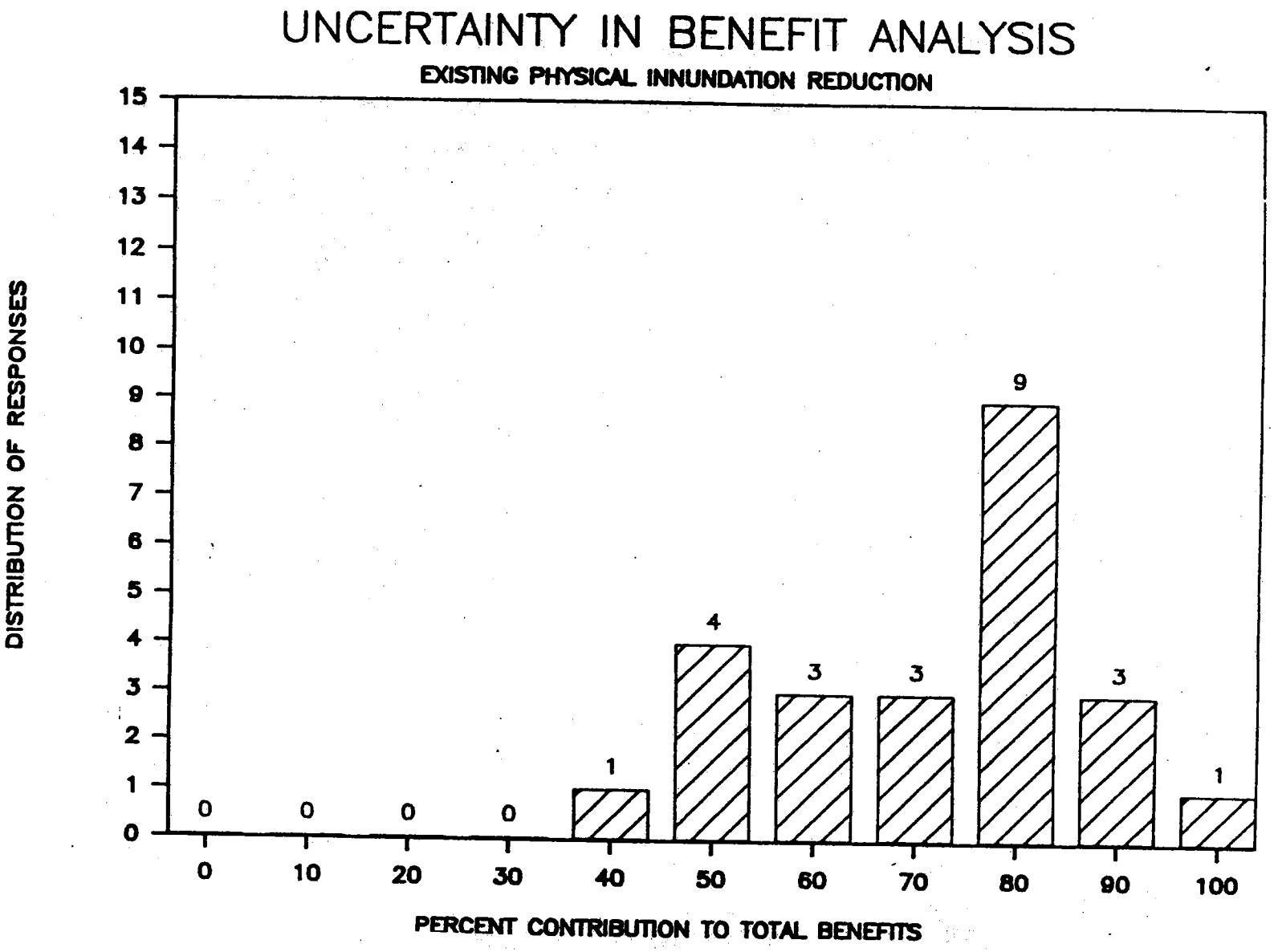

FIGURE 2 - DISTRIBUTION OF PHYSICAL CONTRIBUTION TO TOTAL BENEFITS

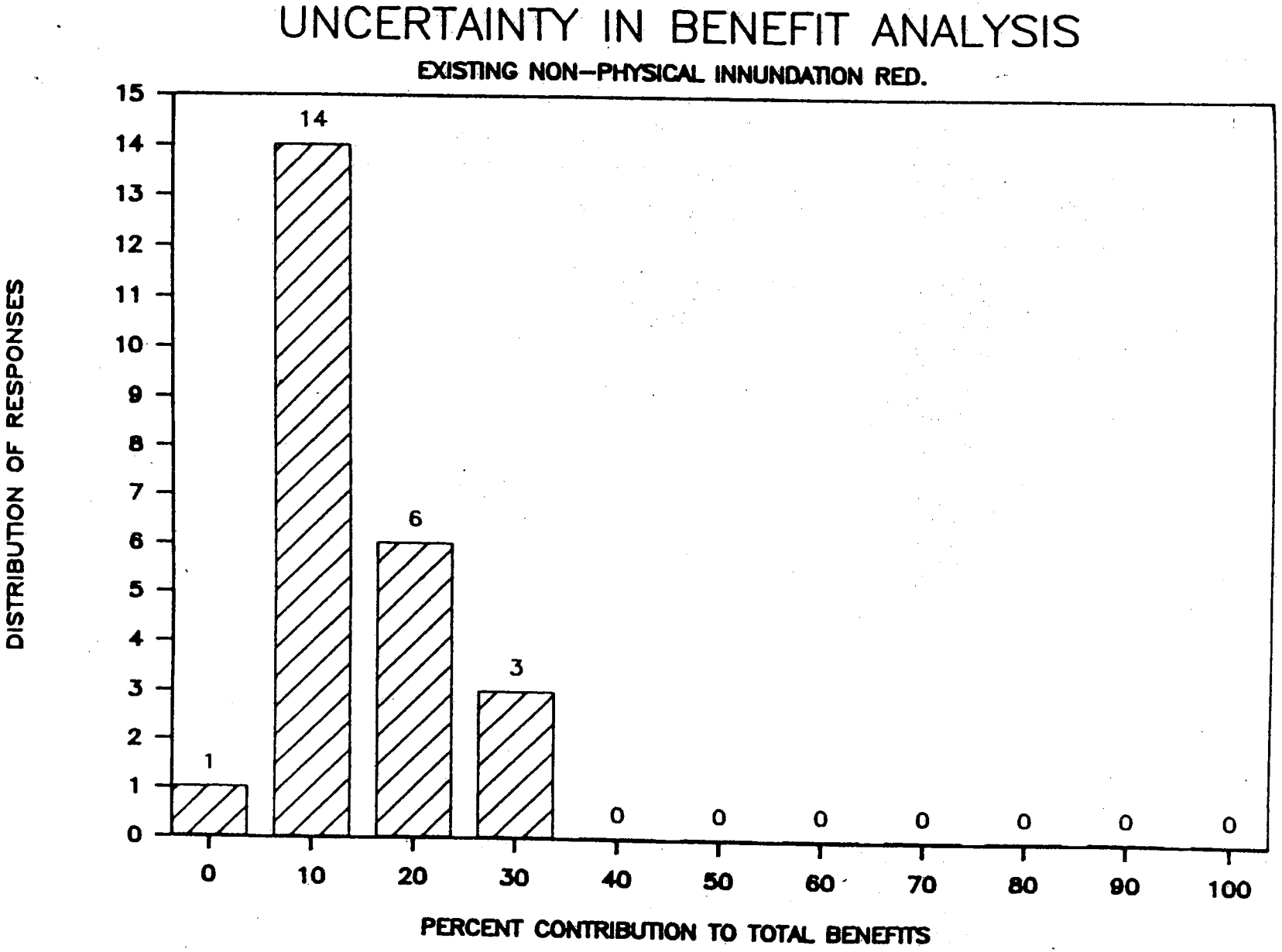

FIGURE 3 - DISTRIBUTION OF NON-PHYSICAL CONTRIBUTION TO TOTAL BENEFITS

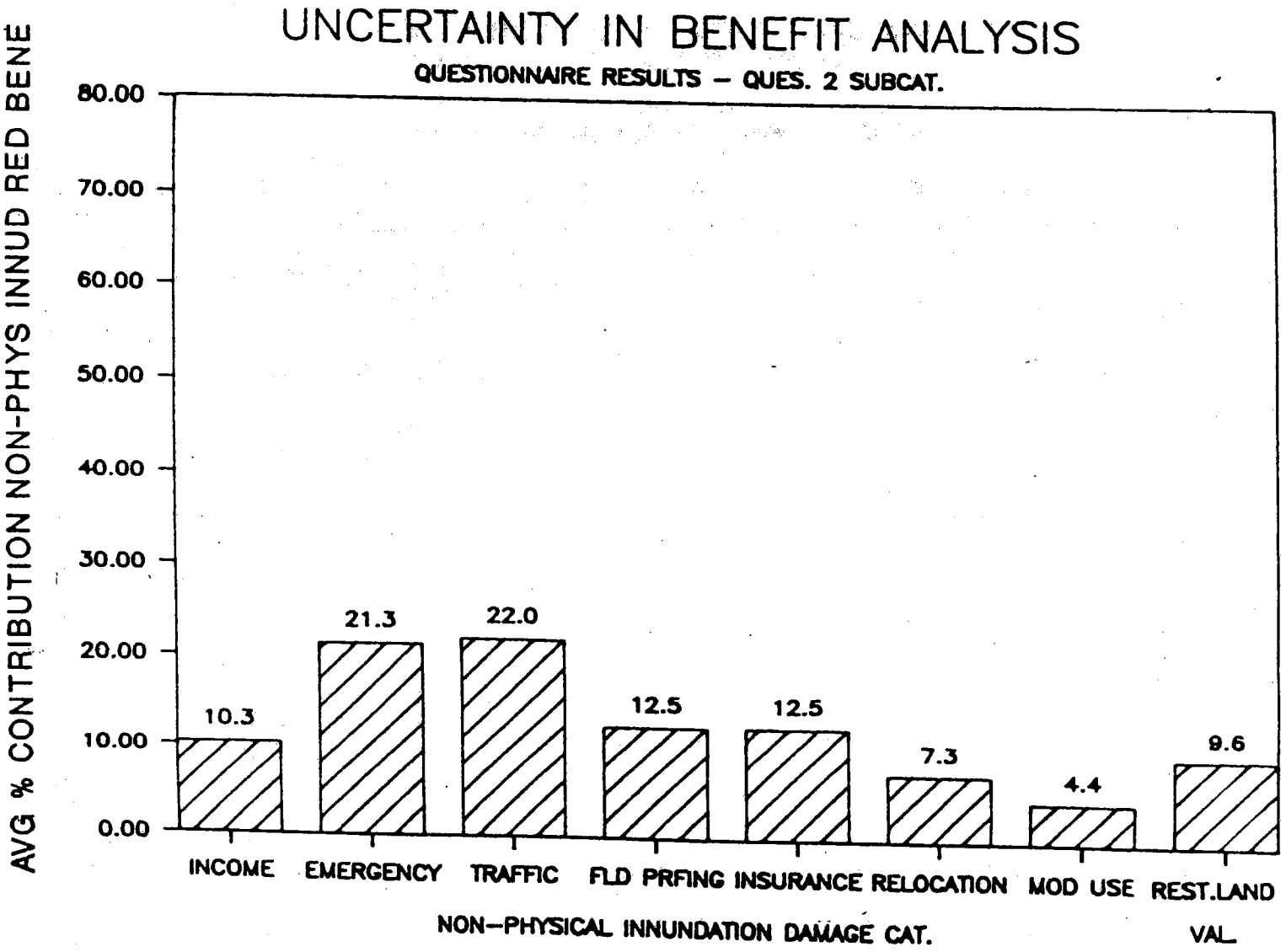

FIGURE 4 - DISTRIBUTION OF NON-PHYSICAL COMPONENTS TO TOTAL NON-PHYSICAL

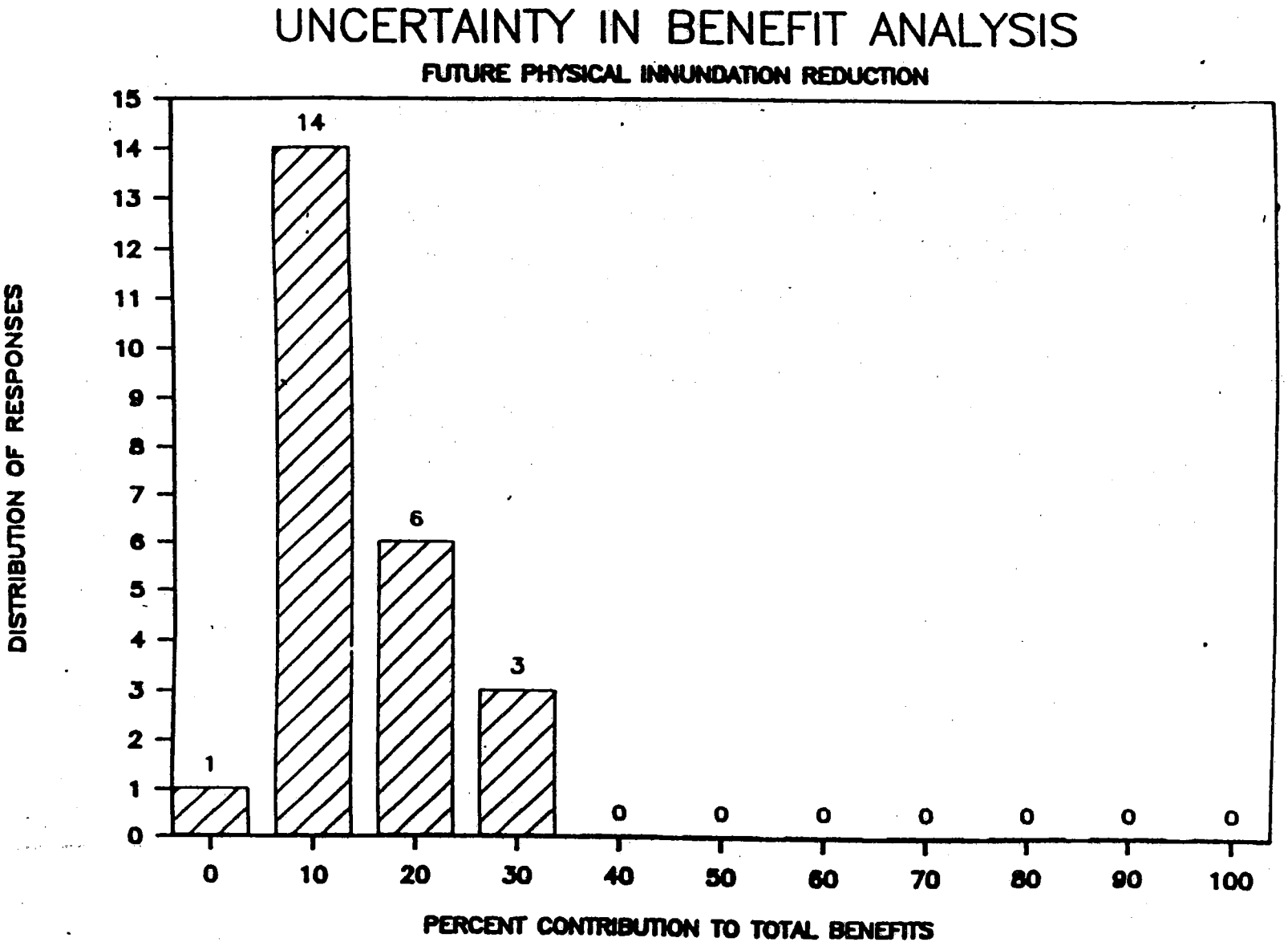

FIGURE 5 - DISTRIBUTION OF FUTURE PHYSICAL DAMAGE CONTRIBUTION TO TOTAL BENEFITS

QUESTION 3. COMPONENT CONTRIBUTION TO PHYSICAL INUNDATION REDUCTION BENEFITS

Which of the following categories generally contribute the most to total physical inundation reduction benefits? Please indicate by giving the percentage of physical damages that each of these categories typically compose.

Residential damage	45.4
Commercial damage	26.1
Industrial damage	11.9
Institutional damage (e.g. damage to government buildings, hospitals, churches, and surrounding property)	6.2
Public utility damages	3.5
Transportation facility damage	4.0
Other	2.8

Benefit evaluation of many project reports that indicated physical inundation reduction benefits have traditionally accounted for the lion's share of benefits. This category of benefits is so large, it is important to identify the components of the category to have a meaningful breakdown of the sources of benefits that are most important. Question 3 had respondents rate the types of property by the relative contributions to the overall project benefits.

The average contribution of each major type of property to total physical inundation reduction benefits is illustrated in Figure 6. Figures 7 through 9 give the respective distribution of responses for residential, commercial, and industrial property. The figures show that the bulk of inundation reduction benefits come from residential and commercial damages.

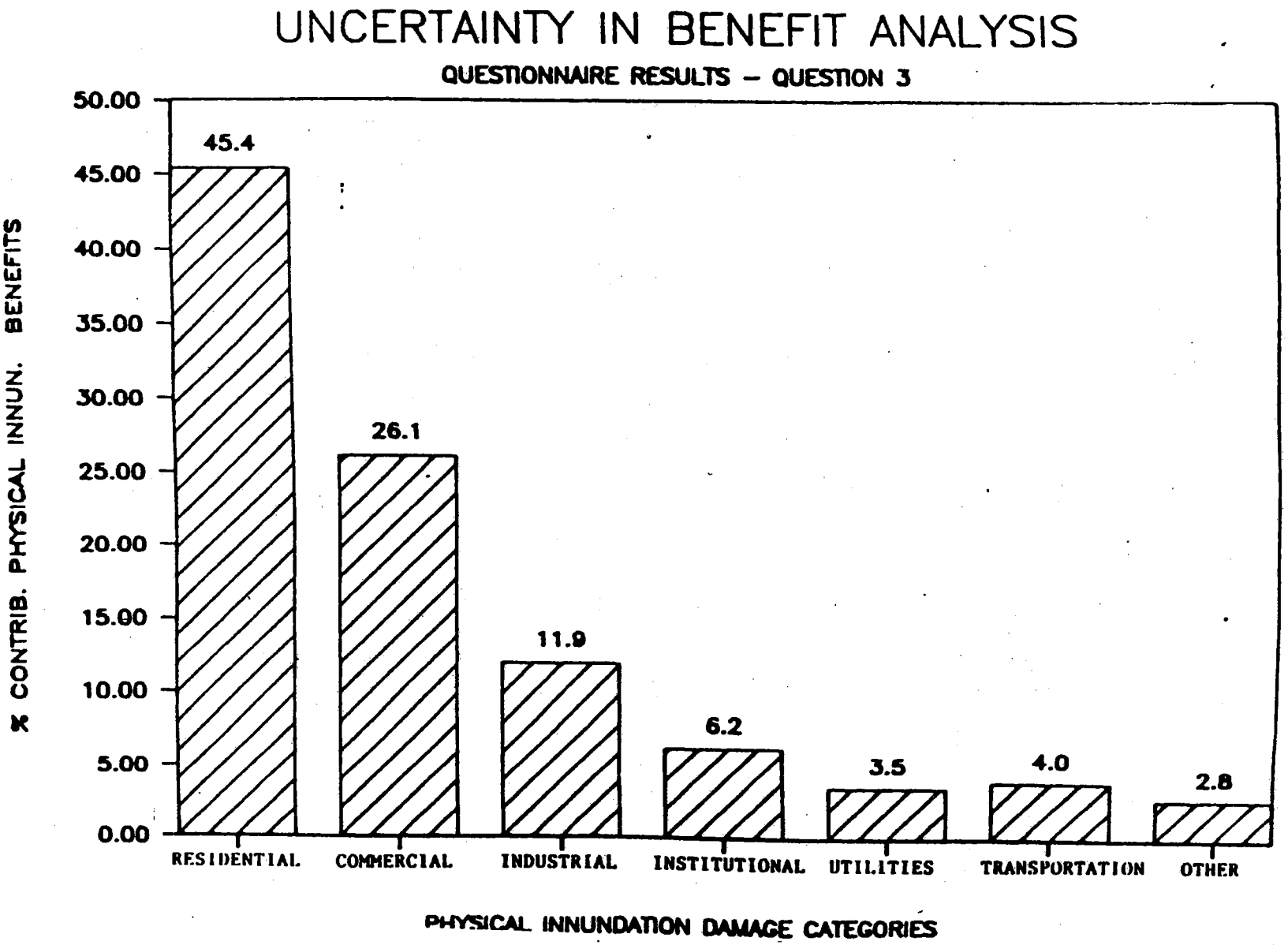

FIGURE 6 - COMPONENTS OF PHYSICAL INUNDATION REDUCTION BENEFITS

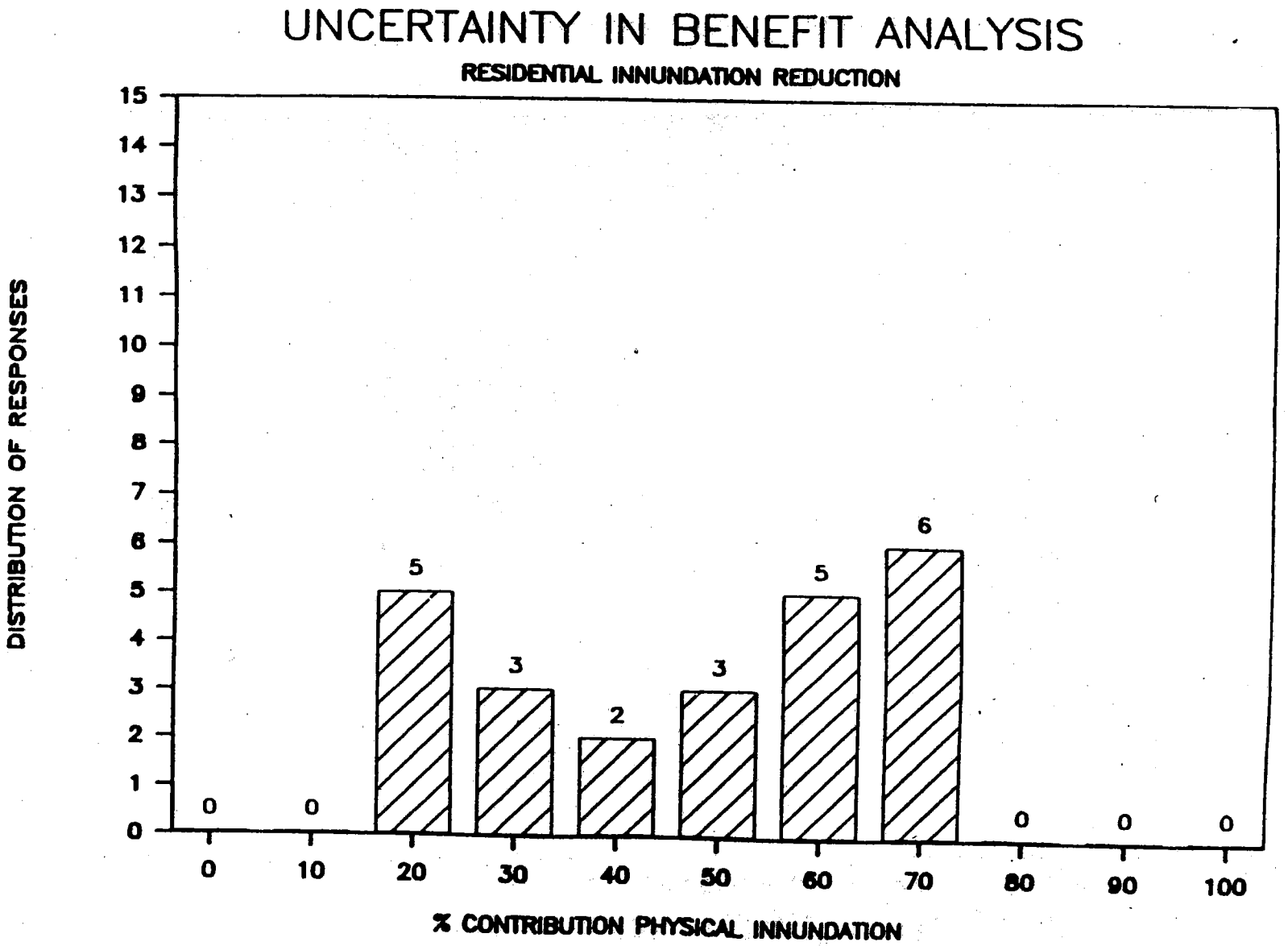

FIGURE 7 - DISTRIBUTION FOR RESIDENTIAL SHARE OF PHYSICAL COSTS

QUESTION 4. ALLOCATION OF STUDY FUNDS

The allocation of study funds will vary by district and project. This question was included to get an estimate of the average allocation to economics relative to other elements of the study, and to see just how much variation there might be between those averages. It is an indicator of whether funds are adequate for benefit calculation and what the process is to establish that funding.

The survey indicated an average of 13.5% of study funds are allocated to economics, with a range of 5 to 50%, and a median value of 12.5%. There was certainly an indication that: 1) cost estimates are made on an individual project basis; 2) standard percentages are seldom applied to allocate project planning funds; and, 3) economists generally make their own cost estimates and then negotiate.

The following answers were given as to how study funds were allocated:

Economics section estimates	14
Negotiated between project elements	5
Project manager assigns values	6
Determined by scale of the project	2
Funds are transferred in as needed	1
Appropriations are revised after division review of report	1
A normal allocation is based on past studies	1
A decision is made by higher elements within the district	1
Allocation is proportional to H+H costs	1
Don't know	3

Multiple responses are recorded.

QUESTION 5. ALLOCATION OF FUNDS BY STUDY TASK

In general, how are study funds for calculating economic benefits allocated to the following tasks in estimating flood damage reduction project economic benefits?

Category	Average Percent	Coefficient of Variation	Average Minimum Percent	Average Maximum Percent
Existing Conditions				
a. Delineate Affected Area and Select Reaches for Analysis	8.7	1.76	4.1	12.7
b. Inventory existing floodplain	35.0	.47		
- estimate elevations of structures	35.0*	.32	8.3	19.3
- determine value of structures	25.0*	.32	5.5	20.4
- determine value of contents	19.0*	.36	2.3	16.1
- determine value of outside property	11.0*	.4	1.6	7.9
- other	10.0*	.59	0	2.7
c. Determine depth-damage relationships	10.6	1.07	4.9	18.7
d. Calculate expected annual damages	9.3	.78	2.7	15.1
Future Conditions				
e. Project population and land use changes in affected area	6.1	.99	2.7	10.8
f. Develop future floodplain inventory				
without-project:	4.9	1.27	5.2	1.3
with-project:	2.8	1.14	.6	6.5
g. Determine future depth-damage relationships	1.9	1.52	.3	5.5
h. Calculate equivalent annual damages	4.4	1.09	2.8	6.7
Other Benefits				
i. Calculate non-physical benefits	7.0	.79	2.6	14.4
j. Calculate location and intensification benefits	4.9	1.27	2.4	19.4
k. Other	4.4	1.77	6.2	17.0

* indicates a percentage of total inventory costs

Sixty-three percent of resources spent in flood damage reduction studies were spent on estimating inundation reduction benefits for existing conditions. Over half that, 35.0% of the total, was spent on inventory of the existing floodplain. Aggregate mean values and the coefficient of variation on the average percent of resource for each task are given along with the aggregate mean values for minimum and maximum of economics' resources devoted to each task. The coefficients of variation indicates a very sizeable difference among field offices in the proportion of resources devoted to each task, except for the very basic floodplain inventory work.

Figure 10 gives the breakdown of the average allocation of resources to each of the major task in benefit computation. Figures 11 through 16 give the average distribution of responses for each of the major tasks.

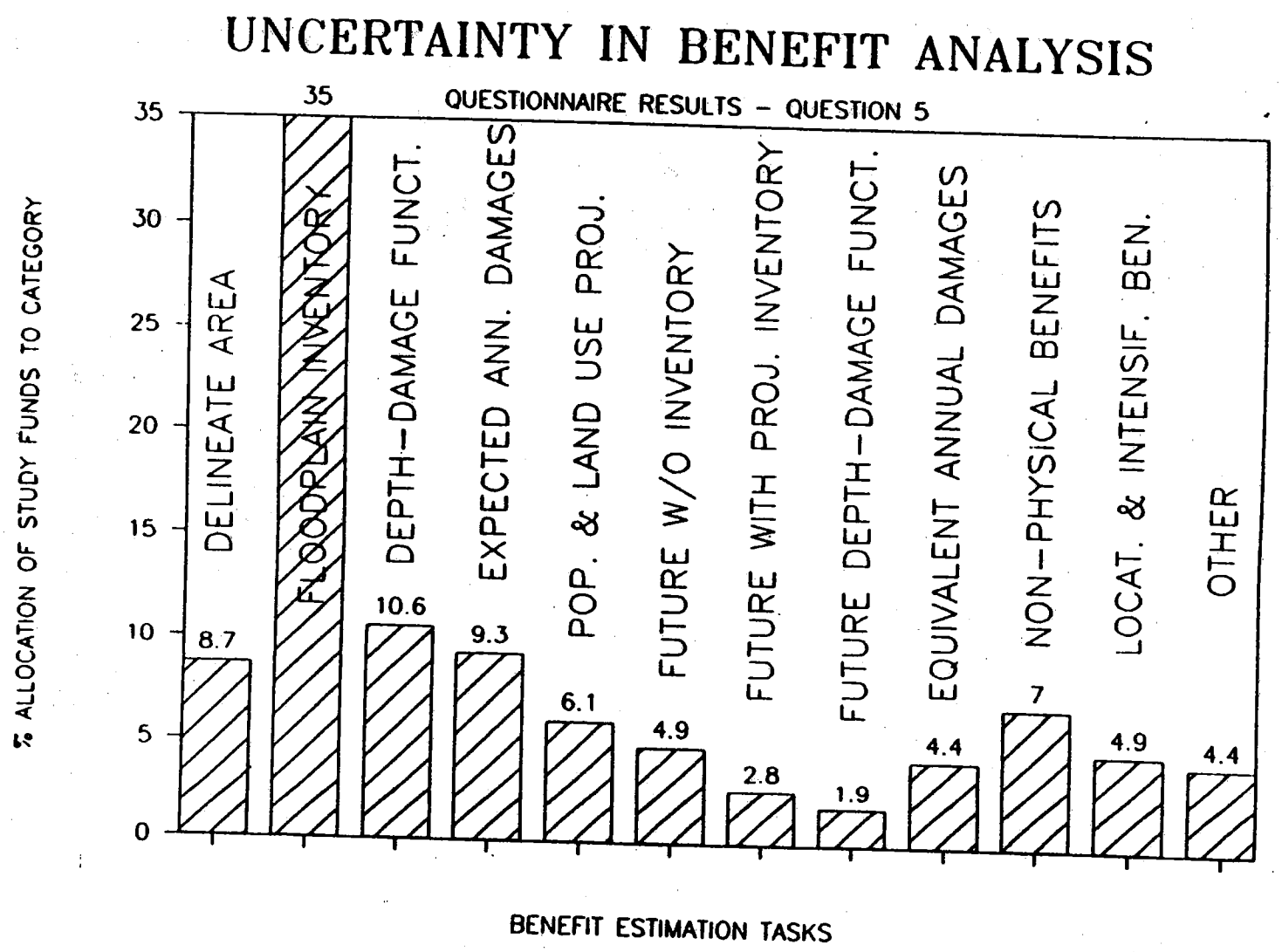

FIGURE 10 - PERCENT OF STUDY FUNDS GOING TO EACH MAJOR TASK

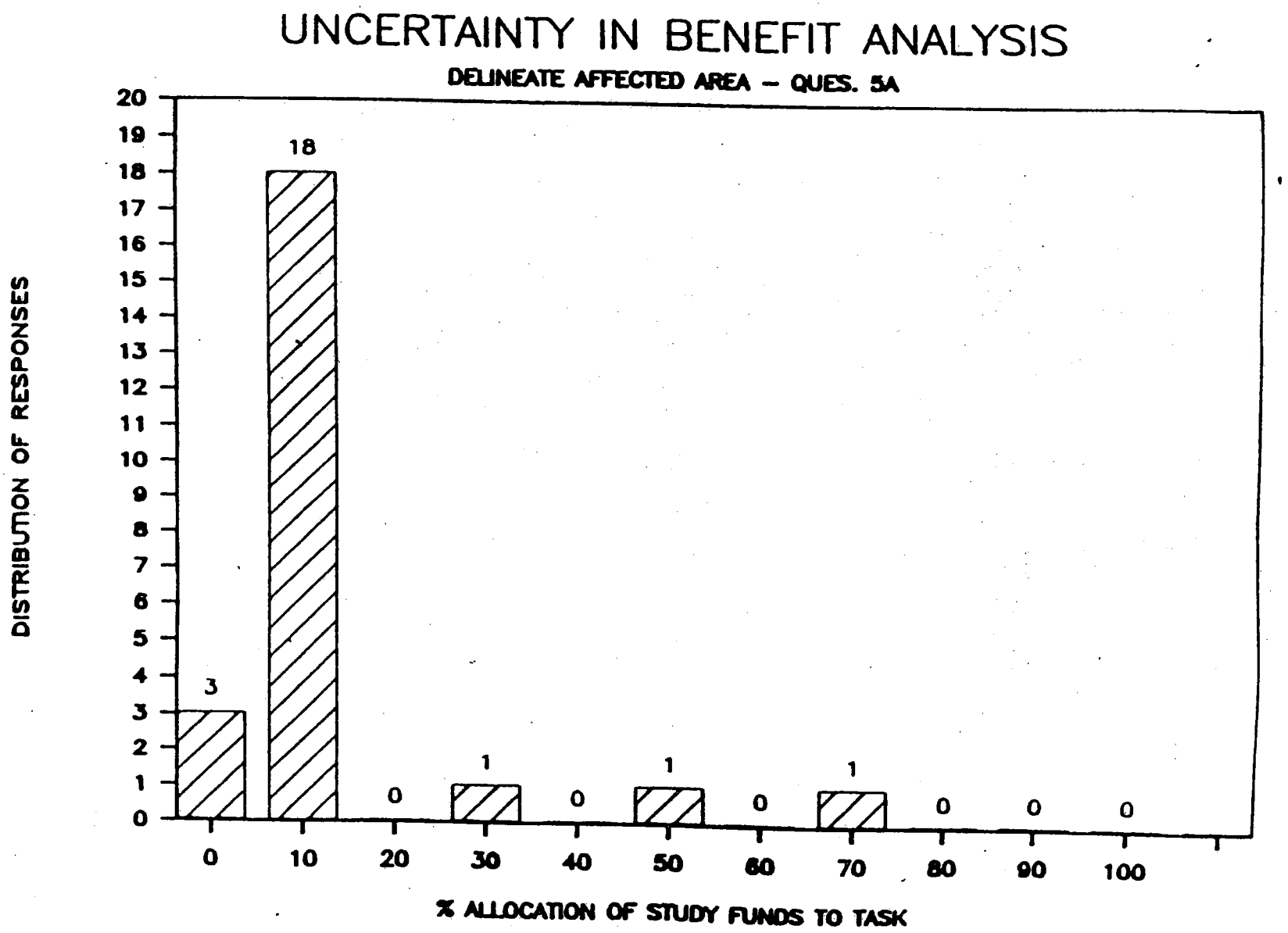

FIGURE 11 - AVERAGE ALLOCATION OF FUNDS TO DELINEATION OF STUDY AREA

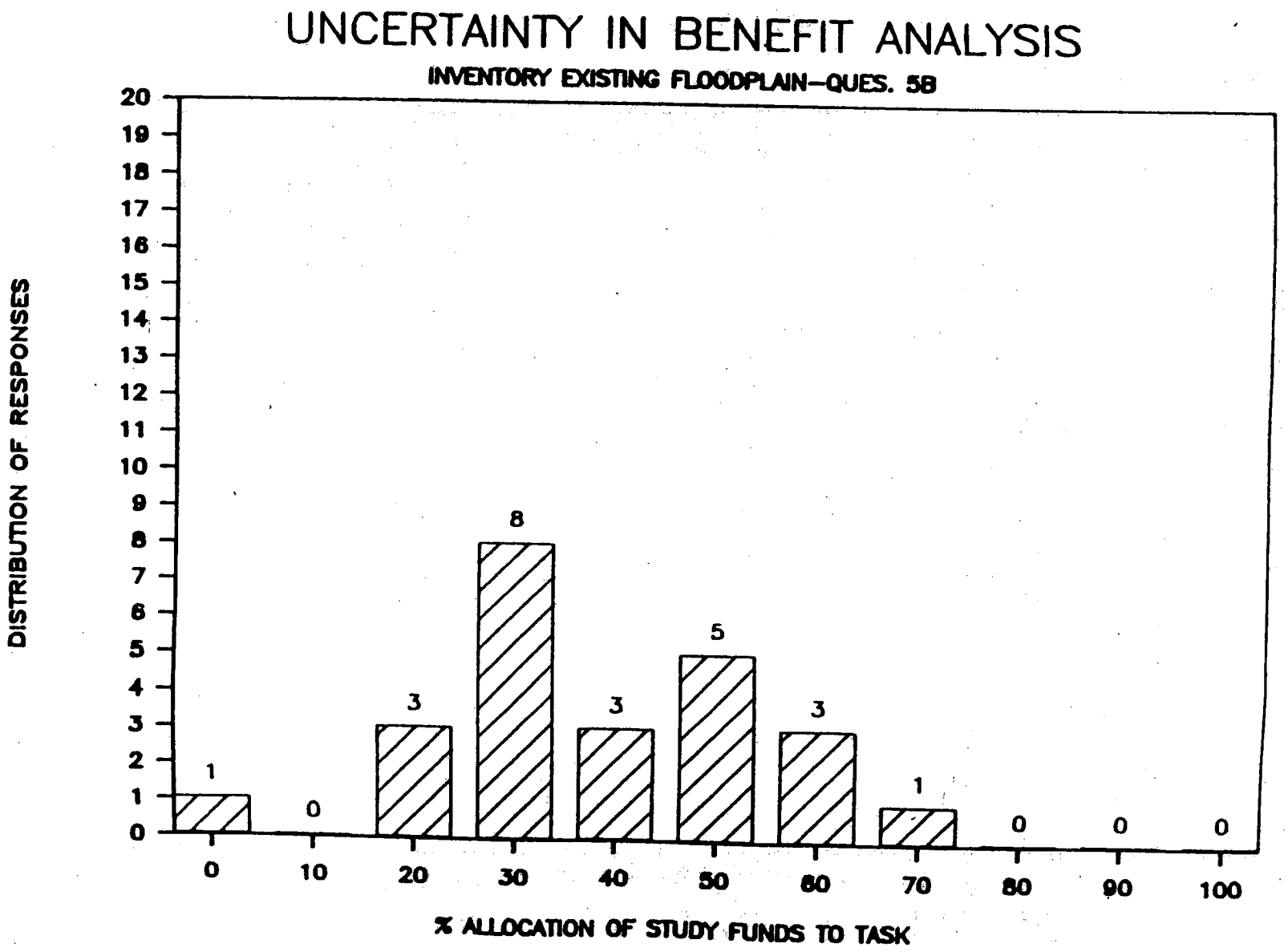

FIGURE 12 - AVERAGE ALLOCATION OF FUNDS TO FLOODPLAIN INVENTORY

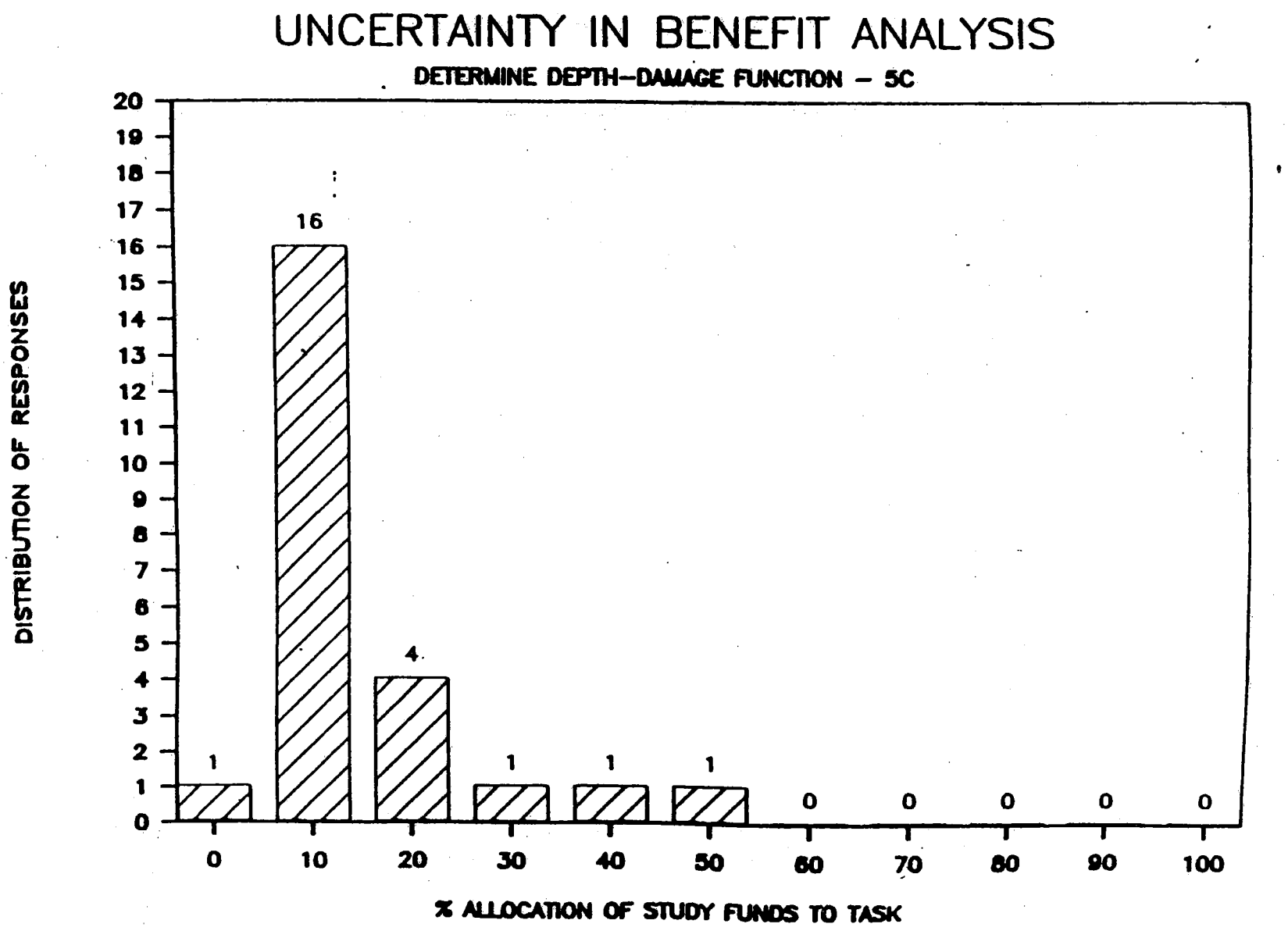

FIGURE 13 - AVERAGE ALLOCATION OF FUNDS TO COMPUTATION OF DEPTH-DAMAGE FUNCTIONS

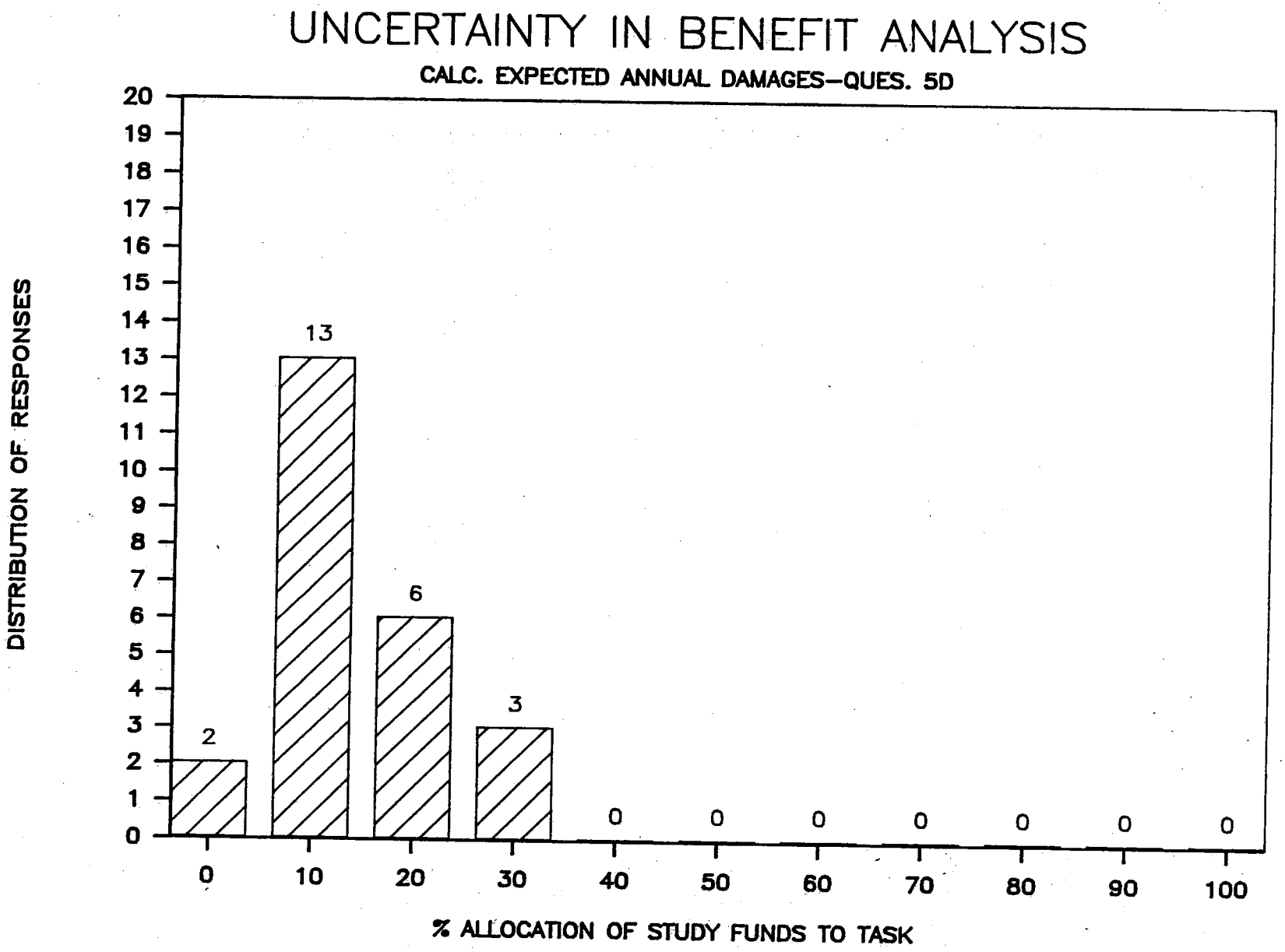

FIGURE 14 - AVERAGE ALLOCATION OF FUNDS TO COMPUTATION OF EXPECTED ANNUAL DAMAGE

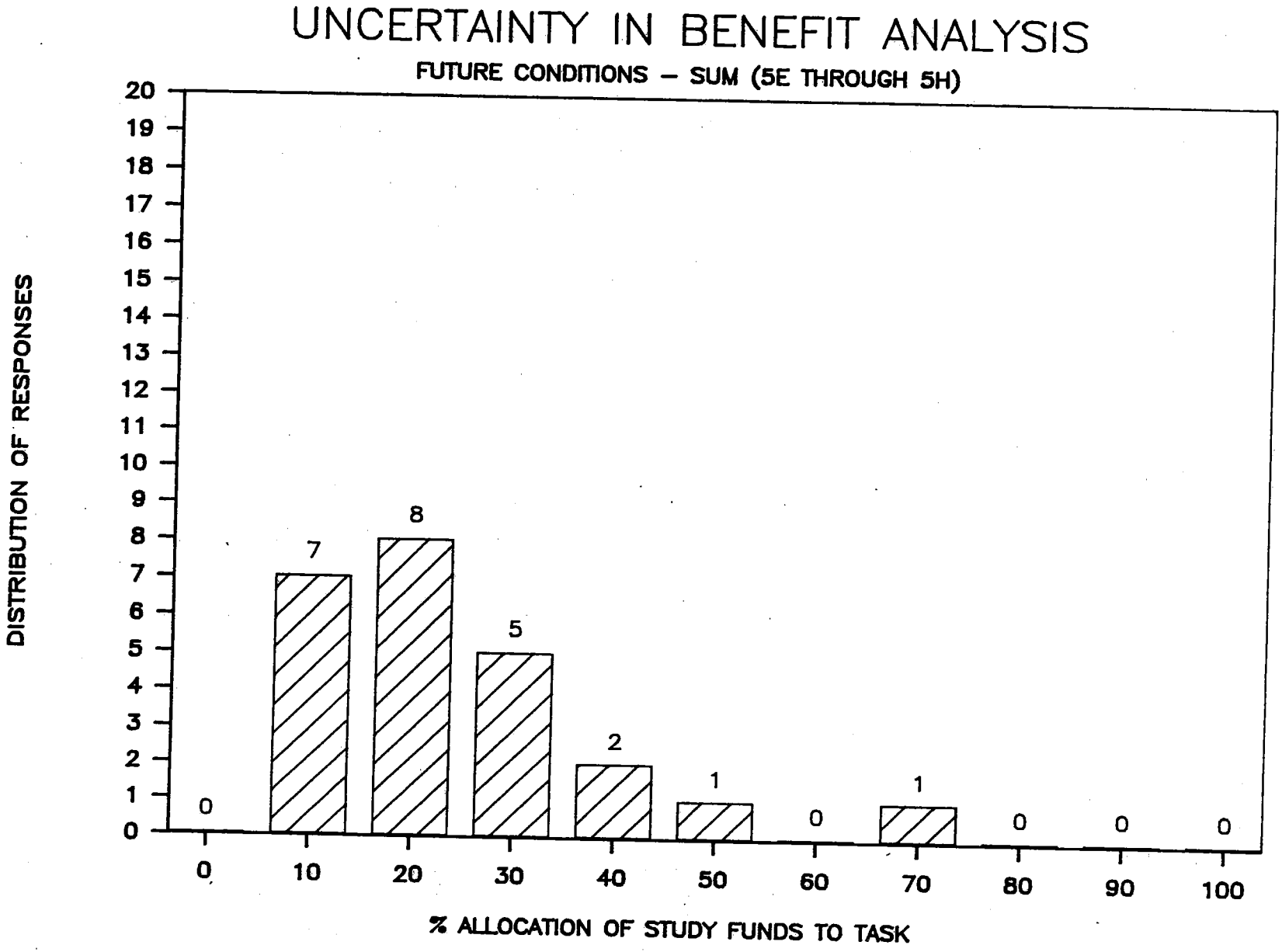

FIGURE 15 - AVERAGE ALLOCATION OF FUNDS TO TASKS 5E THRU 5H

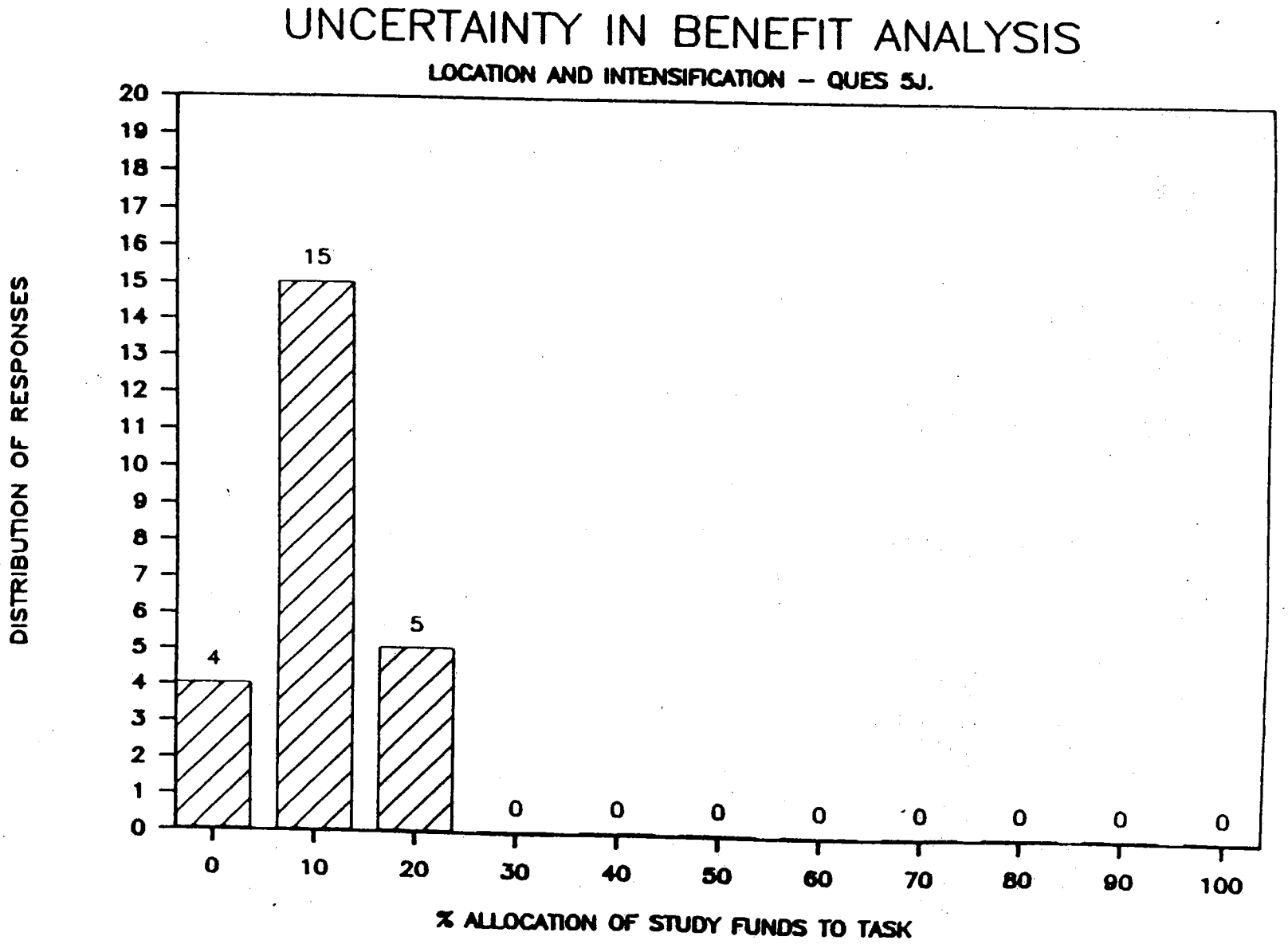

FIGURE 16 - AVERAGE ALLOCATION OF FUNDS TO LOCATION AND INTENSIFICATION BENEFITS

QUESTION 6. MAJOR SOURCES OF UNCERTAINTY

What do you feel are the major sources of uncertainty in each of the tasks outlined in question 4? Put an "X" under each column that describes a source of uncertainty for that task.

Major Sources of Uncertainty

Tasks	Insufficient Data	Faulty Data	Unavailability of Reliable Methods of Analysis	Unanticipated Changes in Conditions	Other (Describe)
	(number of responses)				
Existing Conditions					
a. Delineate Affected Area and Select Reaches for Analysis	10	6	2	7	1
b. Inventory existing floodplain					
- estimate structure elevations	13	9	2	3	0
- determine value of structures	11	11	2	6	0
- determine value of contents	17	8	5	5	0
- determine value of outside property	11	6	3	3	0
- other	1	1	0	0	0
c. Determine depth-damage relationships	17	14	6	7	0
d. Calculate expected annual damages	3	7	3	9	2
Future Conditions					
e. Project population and land use changes in affected area	13	5	8	15	0
f. Develop future floodplain inventory:					
without-project	12	3	9	17	0
with-project	10	3	8	15	0
g. Determine future depth-damage relationships	11	5	7	7	1
h. Calculate expected annual damages	4	9	3	8	1
Other Benefits					
i. Calculate non-physical benefits	14	7	9	6	0
j. Calculate location and intensification benefits	14	6	6	11	1
k. Other	0	0	0	0	0

The results of question 6 indicate insufficient and faulty data are particularly difficult problems throughout the planning process, while unanticipated conditions created obstacles to accurate estimates of future population and future floodplain inventory. Insufficient data was considered to be the greatest overall source of uncertainty. Faulty data was a particularly bad problem for estimating structure values and elevations, content values, depth-damage relationships, calculating expected annual damages, and benefits for alleviating non-physical costs.

Respondents were, for the most part, satisfied with available methods for establishing existing conditions. However, about one-third of the respondents thought that current methodology was inadequate for projecting future population and land use, and depth-damage relationships.

Responses are indicated in the table below. In addition, figure 17 gives the total number of times that insufficient data was identified as being a major source of uncertainty for each of the major tasks in benefit computation. Figures 18 through 20 do the same for faulty data, unreliable methods, and unanticipated changes in conditions.

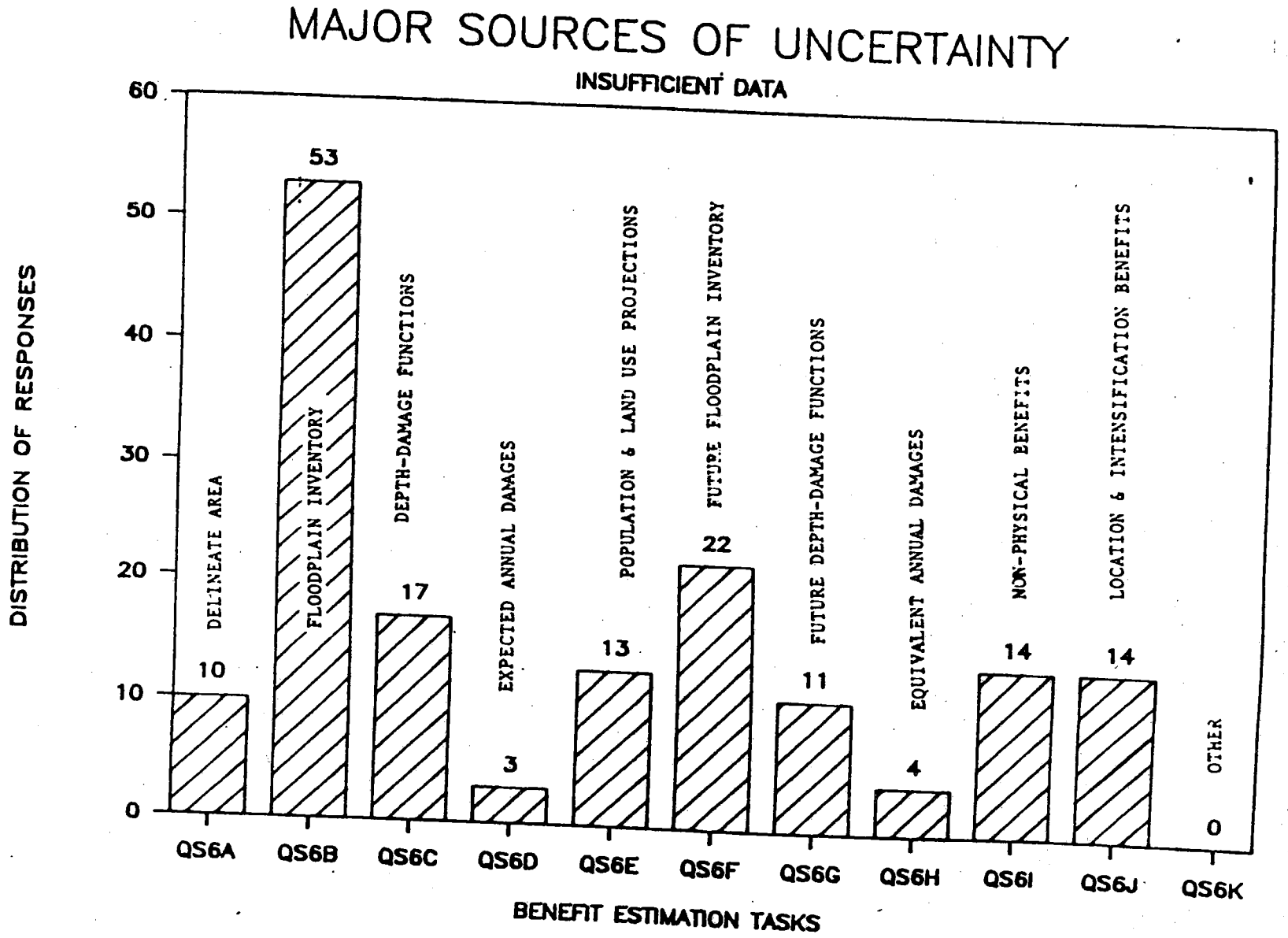

FIGURE 17 - INSUFFICIENT DATA AS A MAJOR SOURCE OF UNCERTAINTY BY STUDY TASK

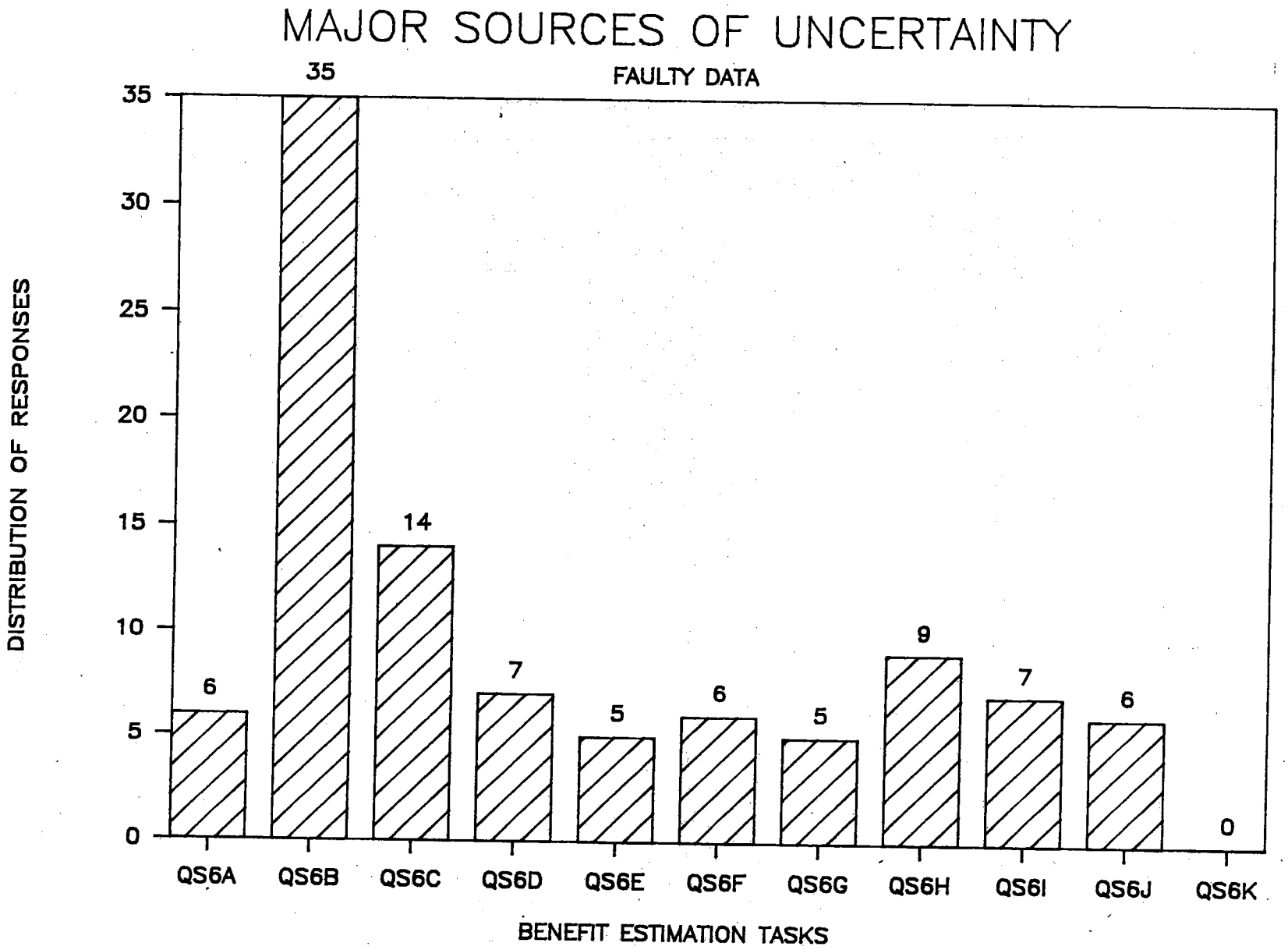

FIGURE 18 - FAULTY DATA AS A MAJOR SOURCE OF UNCERTAINTY BY STUDY TASK

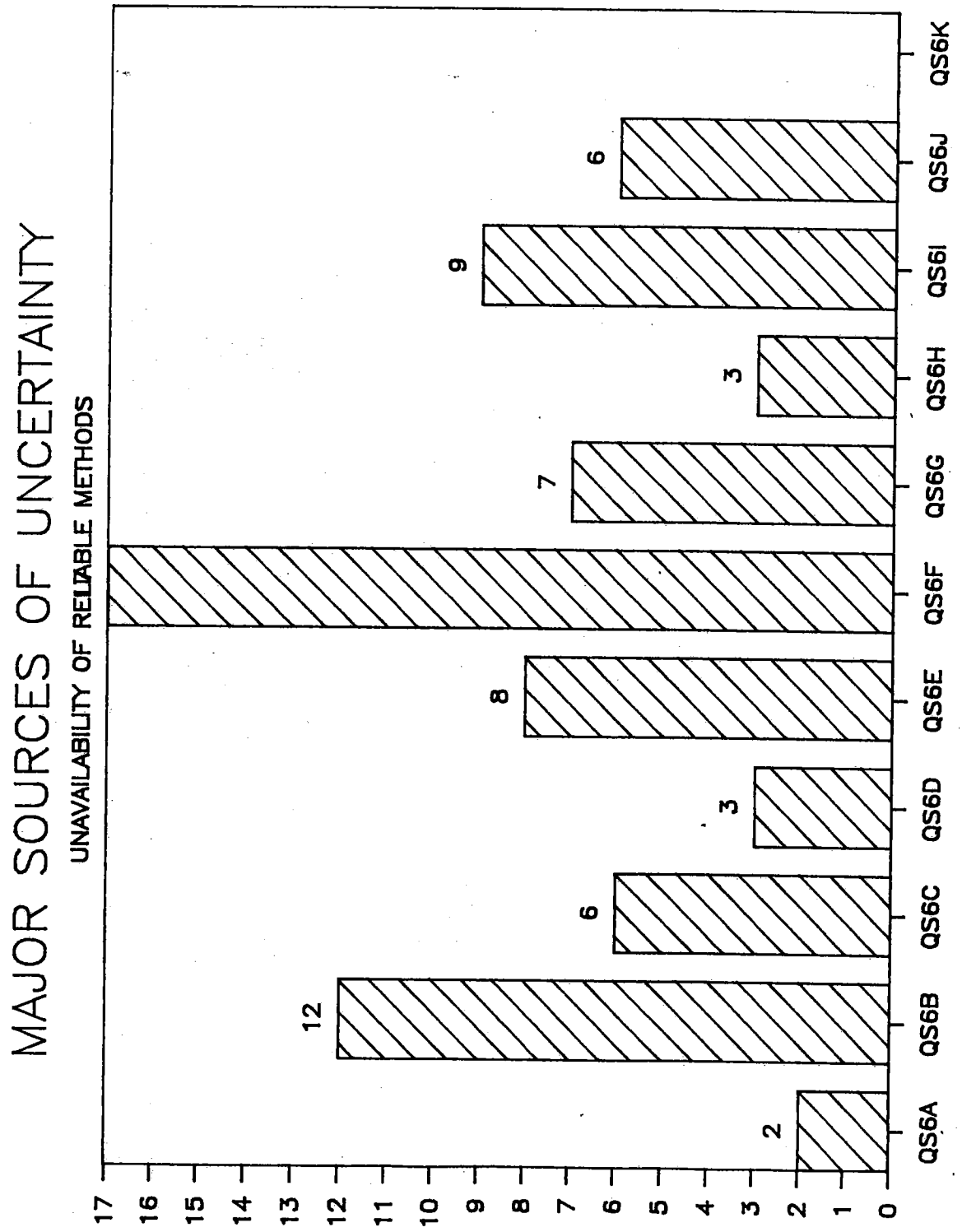

FIGURE 19 - UNAVAILABILITY OF RELIABLE METHODS AS A MAJOR SOURCE OF UNCERTAINTY

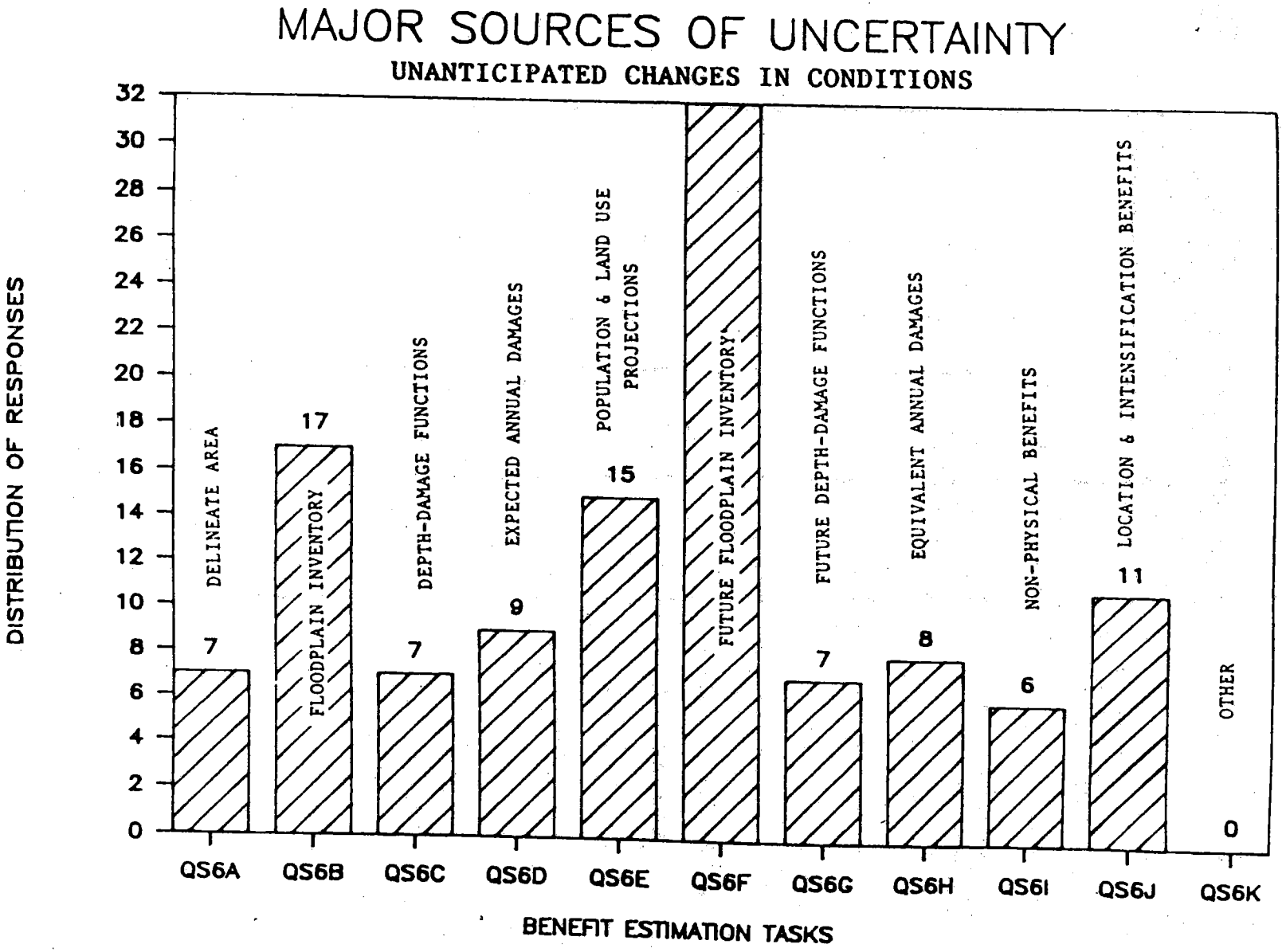

FIGURE 20 - UNANTICIPATED CHANGES AS A MAJOR SOURCE OF UNCERTAINTY BY STUDY TASK

QUESTION 7.
For the cells indicate with an "R" or a "N" as follows:
Mark with an "R" - if this source of uncertainty in benefit estimates can be significantly reduced with an adequate increase in study funds and time.
Mark with an "N" - if this source of uncertainty in benefit estimates cannot be significantly reduced even with substantial increases in study funds and time.

QUESTION 7 RESULTS

TASKS	MAJOR SOURCES OF UNCERTAINTY: INSUFFICIENT DATA		FAULTY DATA		UNAVAILABILITY OF RELIABLE METHODS		UNANTICIPATED CHANGES IN CONDITIONS		OTHER	
R=UNCERTAINTY CAN BE REDUCED	R	---	R	---	R	---	R	---	R	---
N=UNCERTAINTY CANNOT BE REDUCED	---	N	---	N	---	N	---	N	---	N
DELINEATE AREA AND SELECT REACHES	9	3	5	3	2	2	2	7	1	0
INVENTORY EXISTING FLOOD PLAIN										
ESTIMATE STRUCTURE ELEVATIONS	17	0	11	1	4	1	3	2	0	0
DETERMINE VALUE OF STRUCTURES	18	0	8	0	3	1	3	2	0	0
DETERMINE VALUE OF CONTENTS	19	0	10	1	7	1	3	3	0	0
DETERMINE VALUE OF OUTSIDE PROP.	15	0	9	1	3	1	3	1	0	0
OTHER	0	0	0	0	0	0	0	0	0	0
DETERMINE DEPTH-DAMAGE RELATIONSHIPS	14	5	10	5	5	2	4	5	0	0
CALUCULATE EXPECTED ANNUAL DAMAGES	4	2	6	2	3	2	3	7	0	0
PROJECT POP. AND LAND USE CHANGES	9	4	3	4	1	9	2	18	0	0
FUTURE INVENTORY WITHOUT-PROJECT	11	3	5	0	6	6	2	13	0	0
FUTURE INVENTORY WITH-PROJECT	10	1	5	0	6	5	2	11	0	0
FUTURE DEPTH-DAMAGE RELATIONSHIPS	9	2	4	2	3	6	2	4	0	0
CALCULATE EQUIVALENT ANNUAL DAMAGES	3	1	7	2	2	2	5	4	0	0
CALCULATE NON-PHYSICAL BENEFITS	13	2	7	1	6	4	2	5	0	0
CALC. LOCATION AND INTENS. BENEFITS	11	4	7	3	4	5	2	11	0	0
OTHER	0	0	0	0	0	0	0	0	0	0

Respondents were very confident that the uncertainty inherent in insufficient or faulty data could be significantly reduced for every task in benefit calculation. There was less confidence concerning uncertainty due to unavailability of reliable methods. Many respondents did not believe that more reliable methods could be developed to reduce uncertainty for population and land use changes, future floodplain inventory, calculation of non-physical benefits, or location and intensification benefits. Not surprisingly, there was a good deal of skepticism that uncertainty due to unanticipated changes could be reduced.

Figure 21 illustrates the results of question 7 by giving the total number of responses for all respondents and tasks on the reducibility of uncertainty due to insufficient data, faulty data, unreliable methods, and unanticipated changes in conditions. The cross-tabulation of questions 6 and 7 is illustrated in Figure 22, where the distinction between reducible and non-reducible uncertainty is made only for that uncertainty which was identified as significant in question 6.

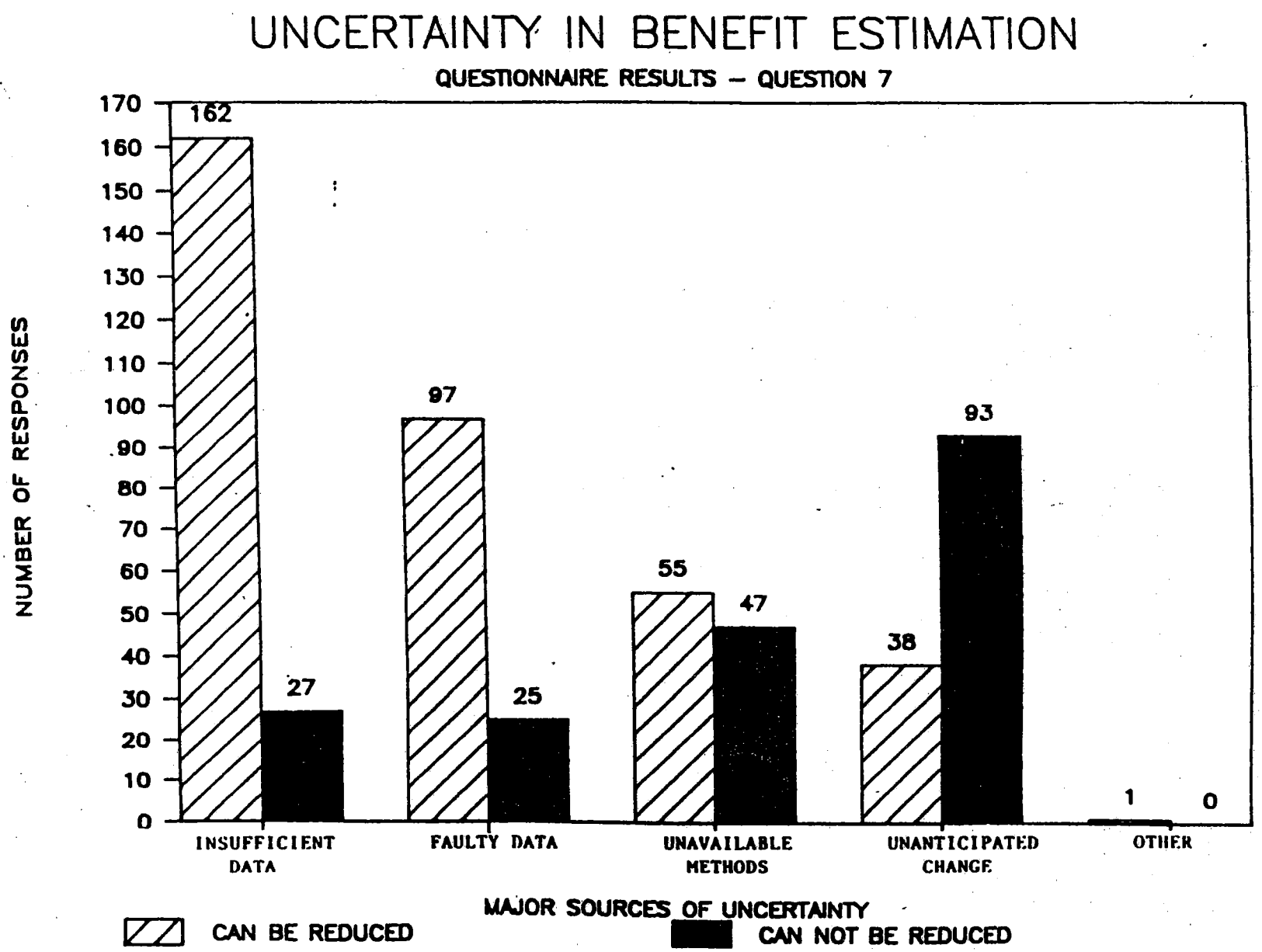

FIGURE 21 - EXTENT THAT UNCERTAINTY CAN BE REDUCED BY SOURCE OF UNCERTAINTY

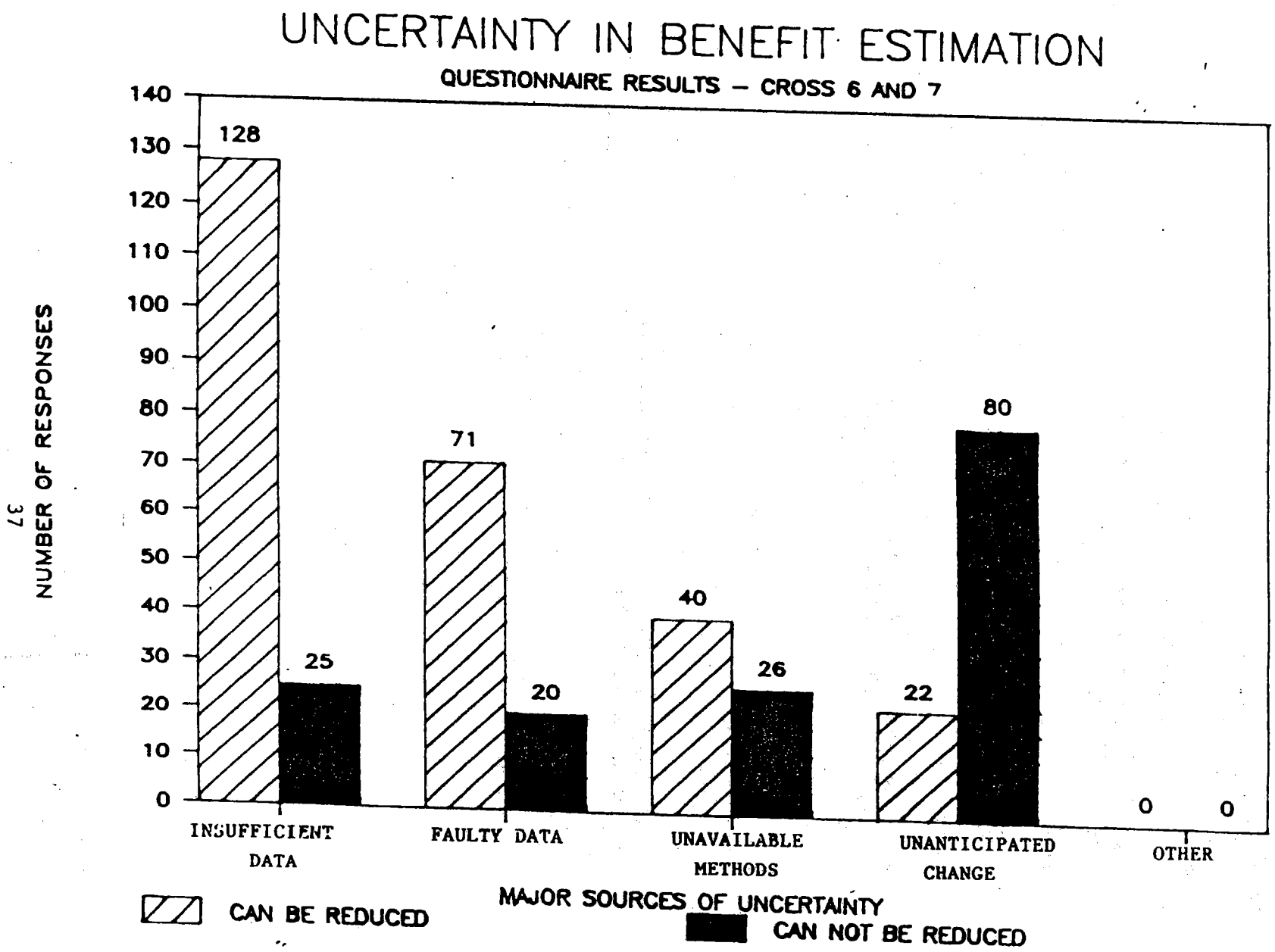

FIGURE 22 - CROSS-TABULATION BETWEEN QUESTIONS 6 AND 7

QUESTION 8. USE OF UNCERTAINTY ANALYSIS METHODS

a. How frequently have you used the following methods for describing and measuring uncertainty in benefit estimates? Please indicate by placing one letter on the line.

A - We have often used this methods in our studies
B - We have occasionally used this method in our studies.
C - We do not use this method in our studies.

_____ Use of objective statistical measures of expected values and confidence intervals.

3 A / 11 B / 10 C

_____ Use of subjective statistical measures of expected values and confidence intervals.

3 A / 12 B / 9 C

_____ Use of subjective expert opinion about the range of values for estimates (i.e., a high, medium and low estimate of economic growth)

11 A / 11 B / 2 C

_____ Use of sensitivity analysis for key parameters and variables used in the benefit estimation procedure.

10 A / 13 B / 1 C

_____ Use of qualitative text descriptions of the types and relative magnitude of uncertainty in benefit estimates.

11 A / 11 B / 2 C

_____ Use of graphic displays to convey the types and relative magnitudes of uncertainty in benefit estimates.

3 A / 11 B / 10 C

b. How frequently would you use the following methods for describing and measuring uncertainty in benefit estimates? Please indicate by placing one letter on the line.

A - We plan to use this method frequently in future feasibility studies.
B - We plan to use this method occasionally in future studies.
C - We do not have any plans to use this method in future studies.

_____ Use of objective statistical measures of expected values and confidence intervals.

4 A / 14 B / 6 C

_____ Use of subjective statistical measures of expected values and confidence intervals.

6 A / 10 B / 8 C

_____ Use of subjective expert opinion about the range of values for estimates (i.e., a high, medium and low estimate of economic growth)

11 A / 13 B / 0 C

_____ Use of sensitivity analysis for key parameters and variables used in the benefit estimation procedure.

17 A / 7 B / 0 C

_____ Use of qualitative text descriptions of the types and relative magnitude of uncertainty in benefit estimates.

13 A / 10 B / 1 C

_____ Use of graphic displays to convey the types and relative magnitudes of uncertainty in benefit estimates.

10 A / 10 B / 4 C

Question 8 gives some of the most common techniques used to identify and display uncertainty in benefit analysis. This question was included to determine the current state of practice and the intention to use these techniques in the future. The answers to this question are given above and in Figures 23 and 24. The results indicate a definite interest in the increased use of several methods for managing uncertainty. The extent of anticipated change in use for each method is illustrated in Figure 25. Only the use of statistical measures for defining confidence limits on key variables encountered much resistance. It should be noted, however, that those confidence intervals are often the primary inputs to sensitivity analysis, for which all the respondents expressed intention to use.

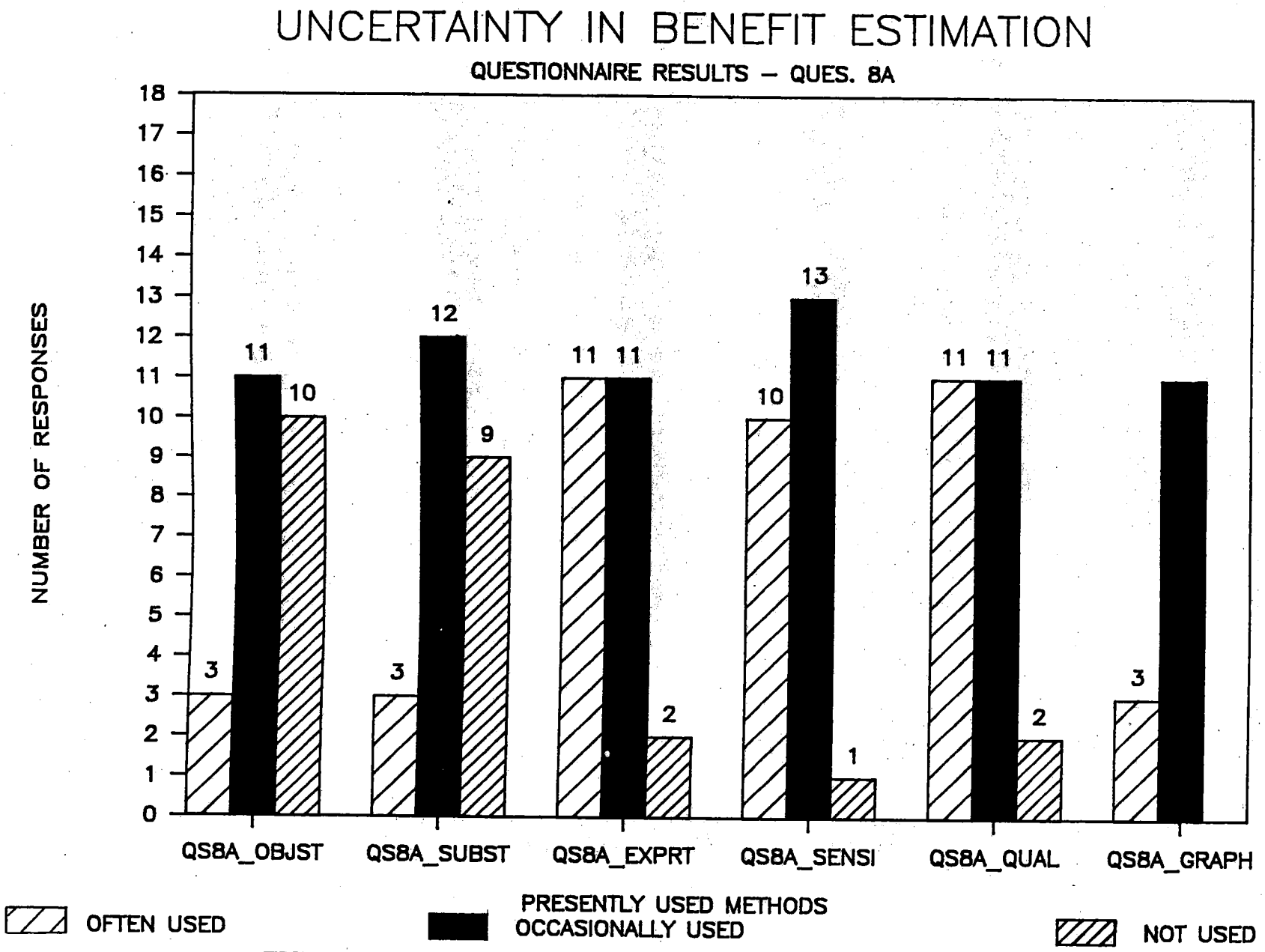

FIGURE 23 - EXTENT TO WHICH METHODS OF DEALING WITH UNCERTAINTY ARE PRESENTLY USED

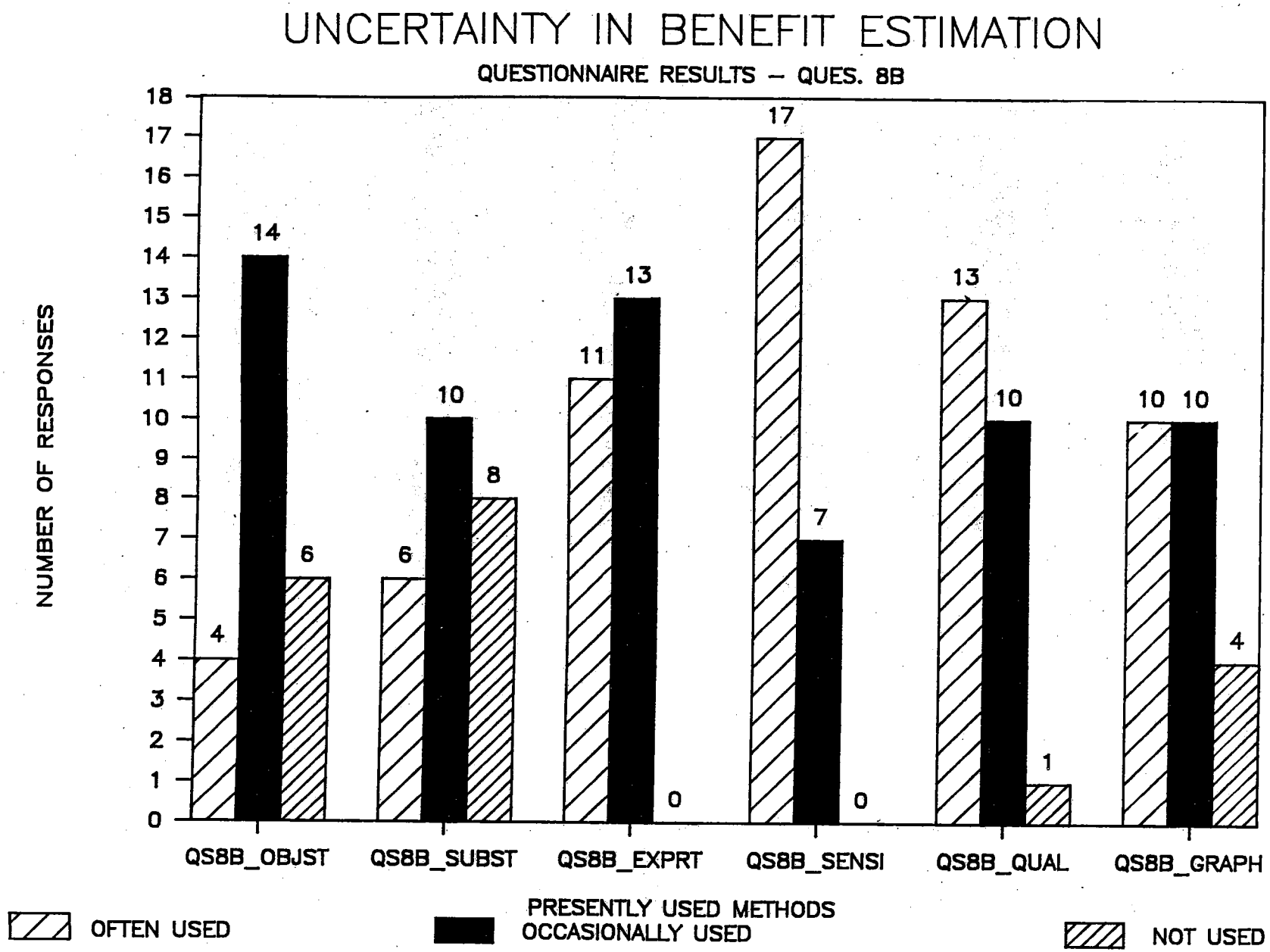

FIGURE 24 - EXTENT TO WHICH METHODS OF DEALING WITH UNCERTAINTY MAY BE USED

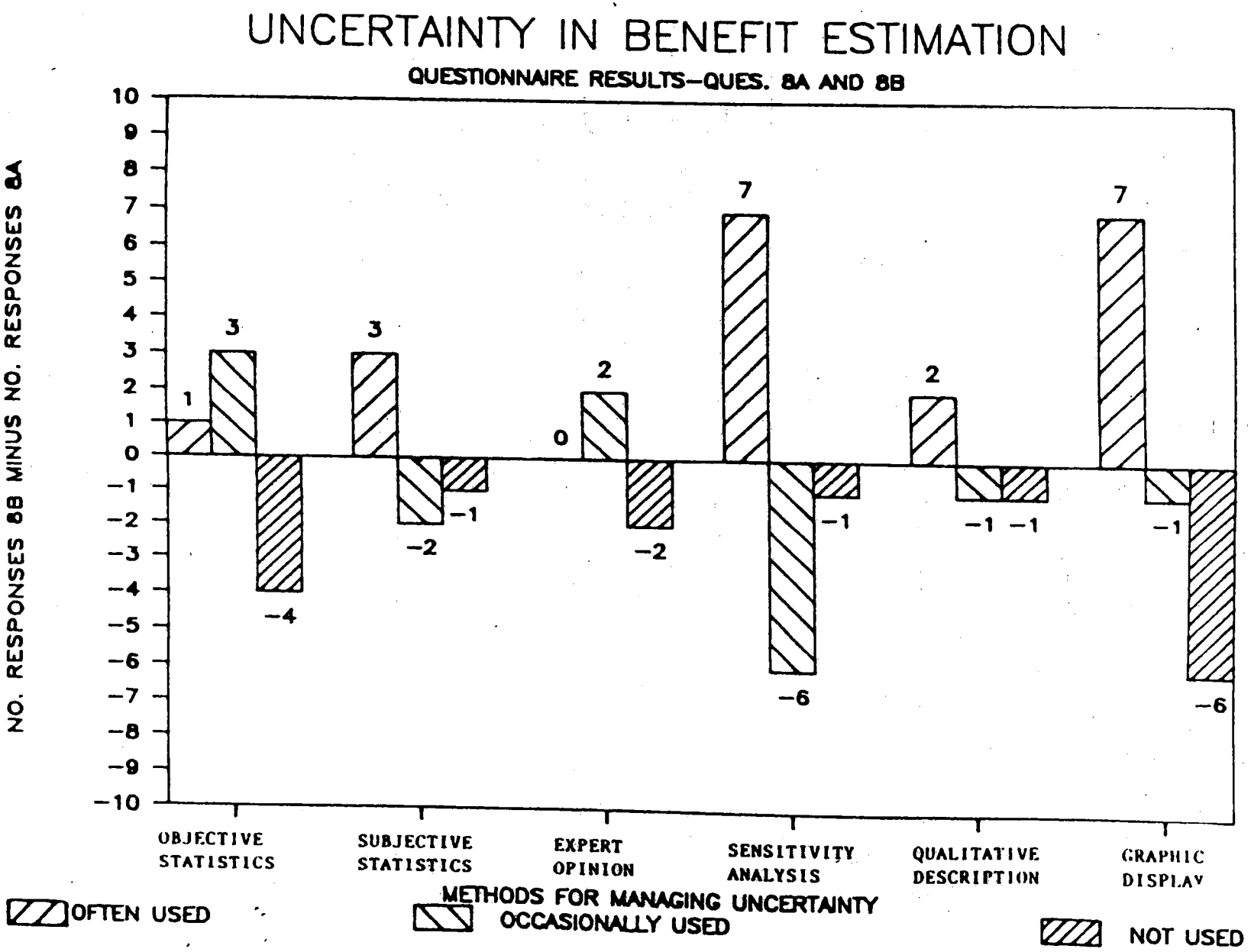

FIGURE 25 - EXPECTED CHANGE IN USE FOR METHODS OF DEALING WITH UNCERTAINTY

QUESTION 9. MOST USEFUL GUIDANCE

What type of information would be most useful to emphasize in a manual on uncertainty in benefit analysis?
Please rate on scale of 0 to 5, 0-not useful, 5-most useful.

	AVERAGE	STANDARD DEVIATION
Description of primary sources of uncertainty.	3.6	1.6
How to allocate project funds to reduce uncertainty.	2.3	1.8
Techniques for estimating uncertainty.	4.7	0.5
Techniques for display of the degree of uncertainty.	3.7	1.4
Other:	3.8	3.4

Respondents clearly and consistently indicated that the most useful guidance would be on techniques for estimating uncertainty. There was also strong support for display techniques and a description of the primary sources of uncertainty. There was greatly divided opinion on the usefulness of guidance on study fund allocation. Other types of guidance suggested for the manual included: 1) case studies of application of uncertainty in benefit analysis; 2) typical questions asked by reviewers from the Board of Engineers for Rivers and Harbors (BERH), the Office of the Chief of Engineers (OCE), the Assistant Secretary of the Army for Civil Works (ASA), and the Office of Management and Budget (OMB); 3) the sensitivity of net benefits to various types of uncertainty; and, 4) the limitations of uncertainty analysis.

QUESTION 10. APPLICATIONS OF UNCERTAINTY ANALYSIS

Please rate the degree to which uncertainty analysis can be applied to other project purposes. Please rate on a scale from 0 to 5, 0-not applicable, 5-most applicable.

	MEAN	STANDARD DEVIATION
Urban flood damage reduction	4.3	1.0
Agricultural flood damage reduction	3.9	1.3
Inland Navigation	4.8	1.3
Recreation	3.4	1.5
Water Supply	3.6	1.5
Hydropower	3.2	1.8
Deep Draft Navigation	4.6	.7
Coastal Flood Protection	4.3	

Uncertainty analysis was seen as very applicable to all types of the major project purposes in which the Corps is involved, particularly to navigation and flood control projects. Uncertainty analysis was also mentioned as being applicable to erosion control projects.

QUESTION 11. ATTITUDES ON POLICY ISSUES

For the following questions, please circle the number which indicates the extent you agree or disagree.

The mean and standard deviation are given for each question.

a. With present techniques, we carefully account for the benefits from flood damage reduction projects.

strongly disagree	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3** **strongly agree**

Mean = 1.3 Coefficient of Variation = 1

It was clear from the answer here and the discussion that followed that participants were at least moderately satisfied with the procedures available for evaluating the benefits of flood damage reduction.

b. Uncertainty in benefit analysis is an important issue.

strongly disagree	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3** **strongly agree**

Mean = 1.7 Coefficient of Variation = .65

There was strong, nearly unanimous support of the statement that uncertainty is an important issue in benefit analysis. This could be due in part to the fact that the respondents were a self-selected group, who had to stay an extra day for the workshop. Those that were in the strongest support of this statement said that the economic analysis is much more useful if it identifies the degree of uncertainty associated with any particular benefits and the degree of confidence in the estimate of net benefits for each alternative.

c. There are well developed techniques for estimating uncertainty.

strongly disagree	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3** **strongly agree**

Mean = -.9 Coefficient of Variation = 2.11

In question 8 and in the discussion that followed, respondents indicated that they used techniques for estimating uncertainty, but in this question it appeared that they did not necessarily consider the techniques they use to be adequate. They appeared to be looking for more explicit techniques.

d. The fact that hydrologic forecasting may have such a large degree of uncertainty should have no bearing on the resources devoted to benefit analysis.

strongly disagree	-3	-2	-1	0	1	2	3	strongly agree

Mean = -.3 Coefficient of Variation = 7.33

Opinion on this question was extremely mixed, with strong opinions on both sides. Overall, there was a slight edge against this proposition. It was argued that uncertainty about hydrology was no excuse to reduce the precision of economic analysis.

e. There is an over-reliance on benefits under existing conditions for project justification.

strongly disagree	-3	-2	-1	0	1	2	3	strongly agree

Mean = -.3 Coefficient of Variation = 6

There was a slightly negative and highly fractionalized vote on this issue. Reviewers routinely look more closely and less favorably on benefits claimed under future conditions. This has led many districts to spend fewer resources on estimating benefits based on future conditions and to refrain from counting future benefits as a large part of the total project benefits.

f. The degree of uncertainty in estimating project benefits should be a major parameter in project selection.

strongly disagree	-3	-2	-1	0	1	2	3	strongly agree

Mean = .2 Coefficient of Variation = 9

This issue had respondents equally divided. There was seldom a neutral opinion. While answering question 9, respondents almost unanimously advocated the value of techniques to measure uncertainty; they also had an unfavorable view of using uncertainty as a major parameter in project selection. Reasons for this large negative reaction were due in part to lack of confidence in techniques currently available for measuring uncertainty, and the belief that we can still be confident enough in our benefit-cost estimates to accept them as an adequate measure of economic efficiency.

g. A 25% contingency factor should be <u>added</u> to the total benefits estimate to cover benefits "left on the table".

strongly disagree	-3	-2	-1	0	1	2	3	strongly agree

Mean = -.9 Coefficient of Variation = 2.89

This statement brought the strongest and most consistent negative reaction. While several people said that there are probably just as many benefits unaccounted for as cost, and that it would be only fair to apply the same contingency factor to benefits as costs, the majority thought that it would be more credible and generally accepted to make a thorough job of computing benefits.

h. Ex-post studies should be used to improve the accuracy of benefit estimate methods.

Mean = .9 Coefficient of Variation = 4.11

Several people argued that ex-post studies would be extremely valuable for tracing the economic benefits of projects, especially for projecting benefits based on future development. There are reservations, however, about the ability to isolate the effects of flood protection on development from what otherwise would have occurred and the expense of conducting the ex-post studies.

The distributions for each part of question 11 are illustrated in Figures 26 through 33.

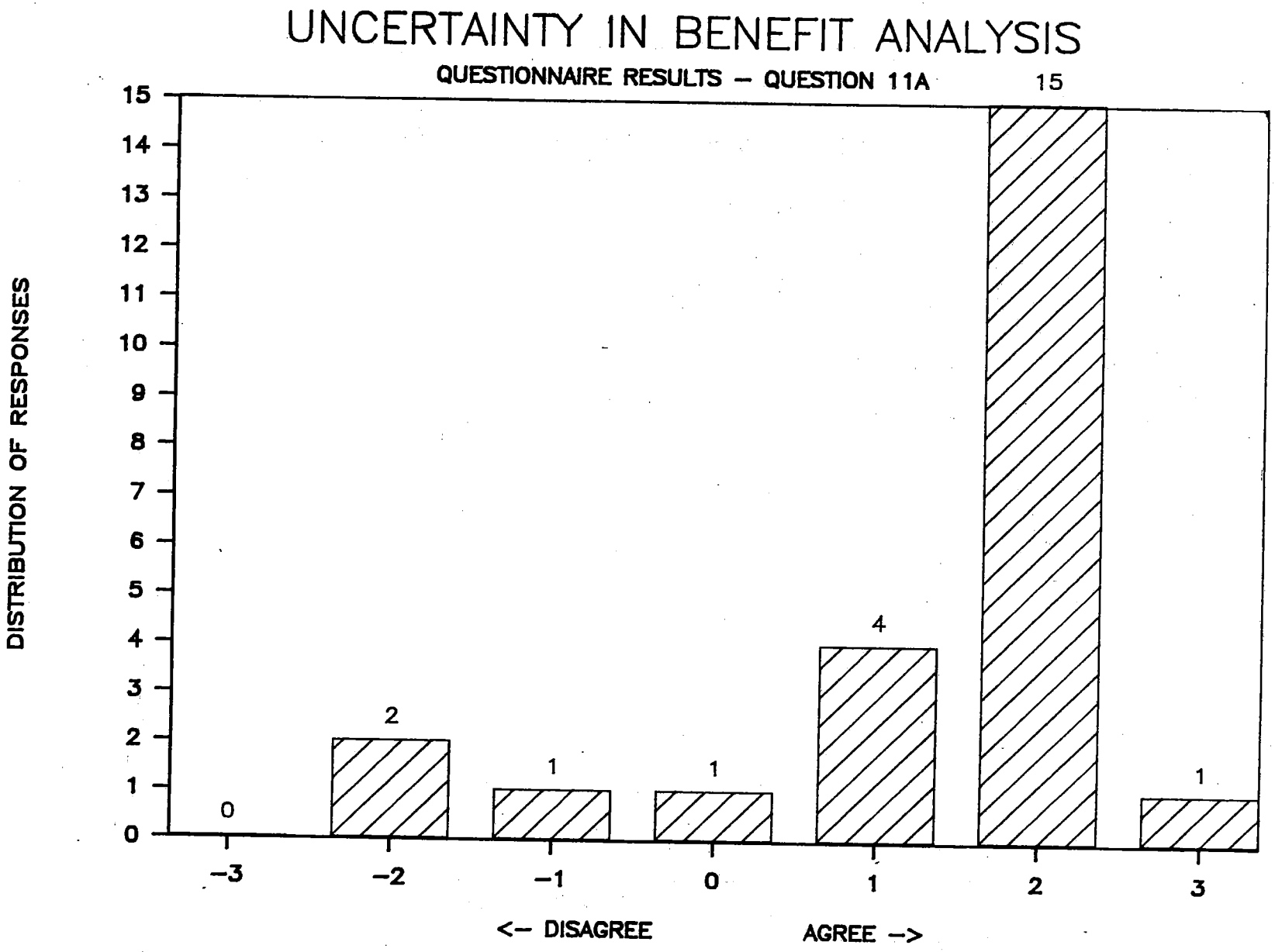

FIGURE 26 - RESPONSES TO QUESTION 11A

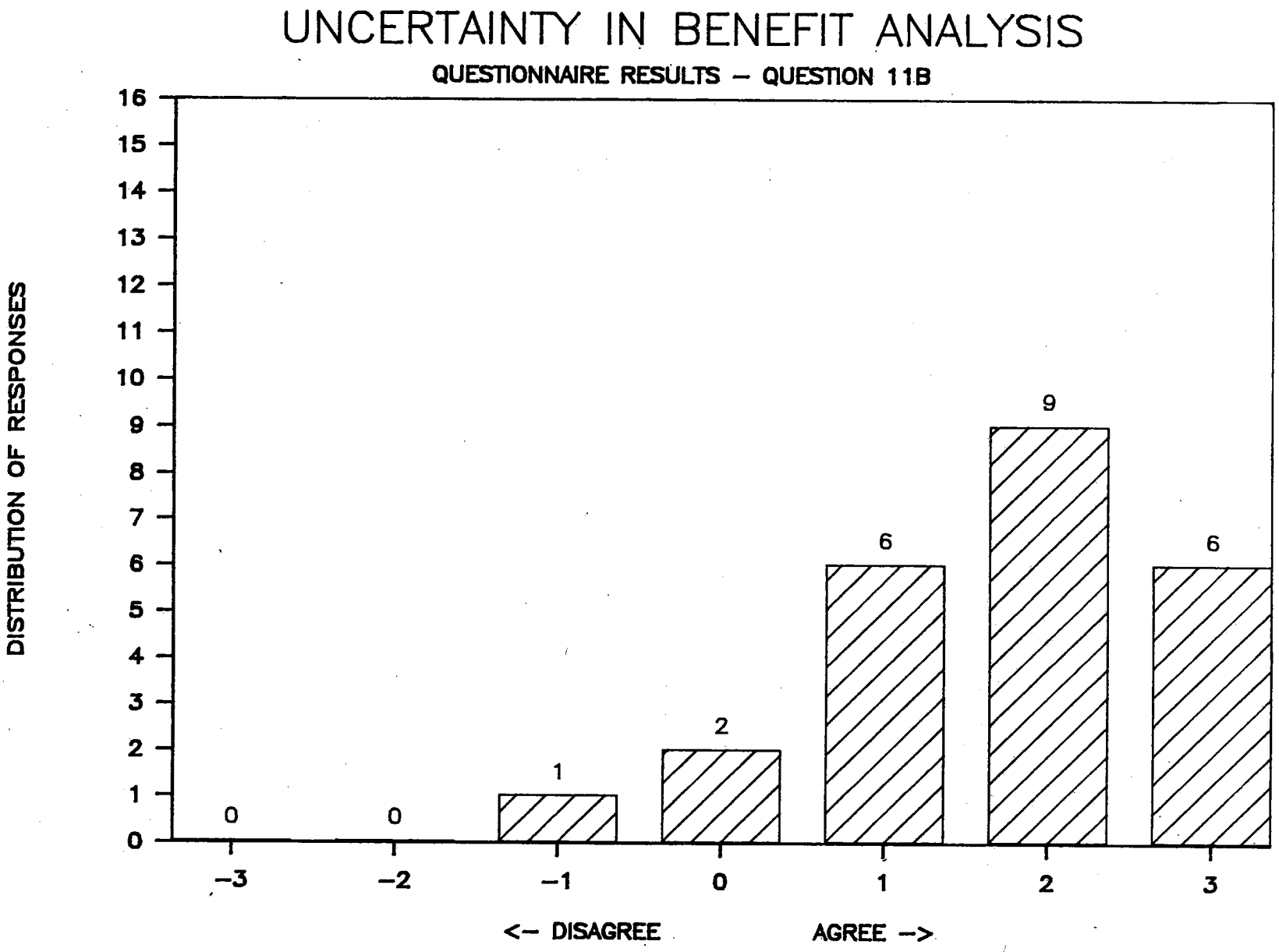

FIGURE 27 - RESPONSES TO QUESTION 11B

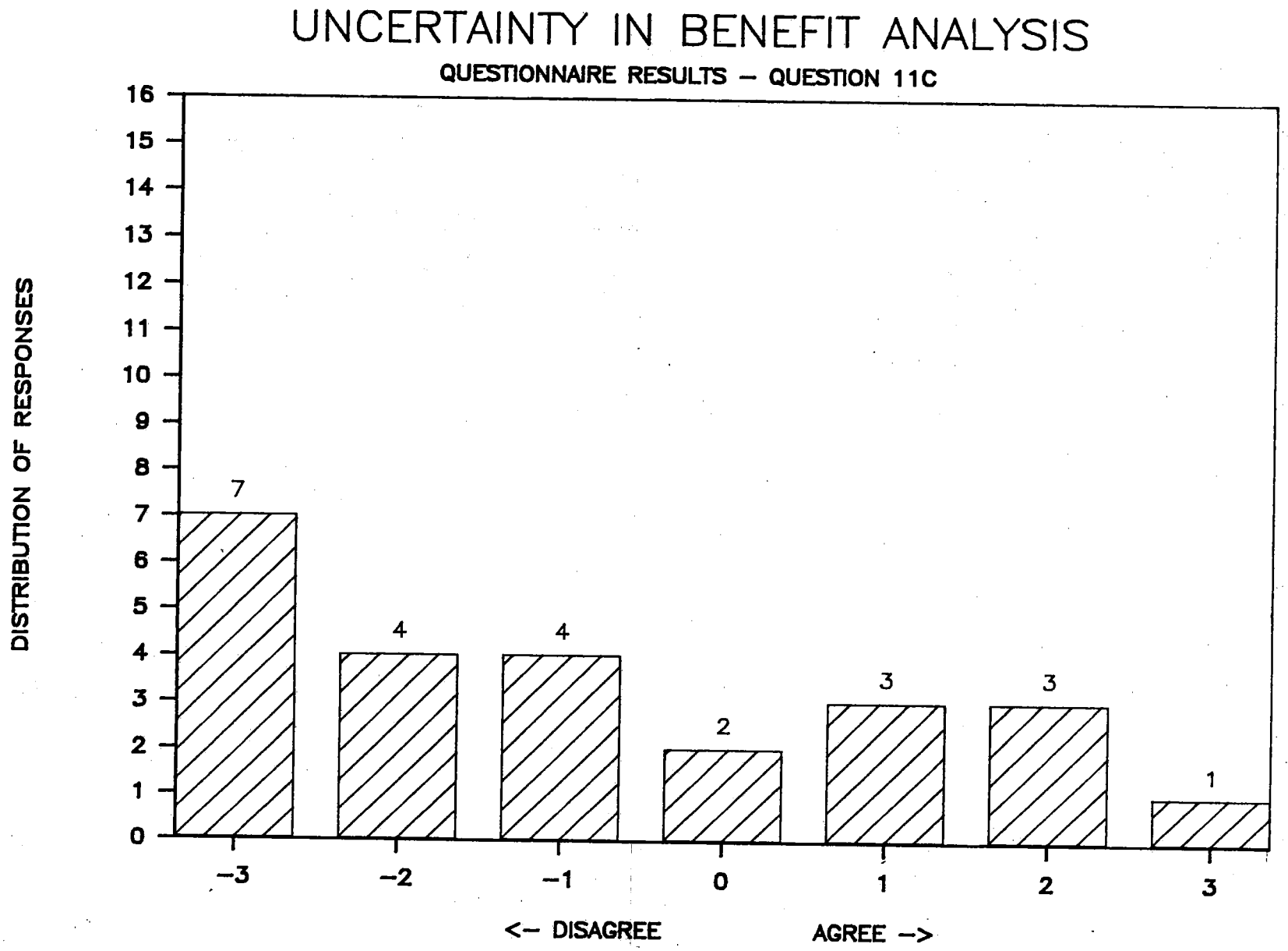

FIGURE 28 - RESPONSES TO QUESTION 11C

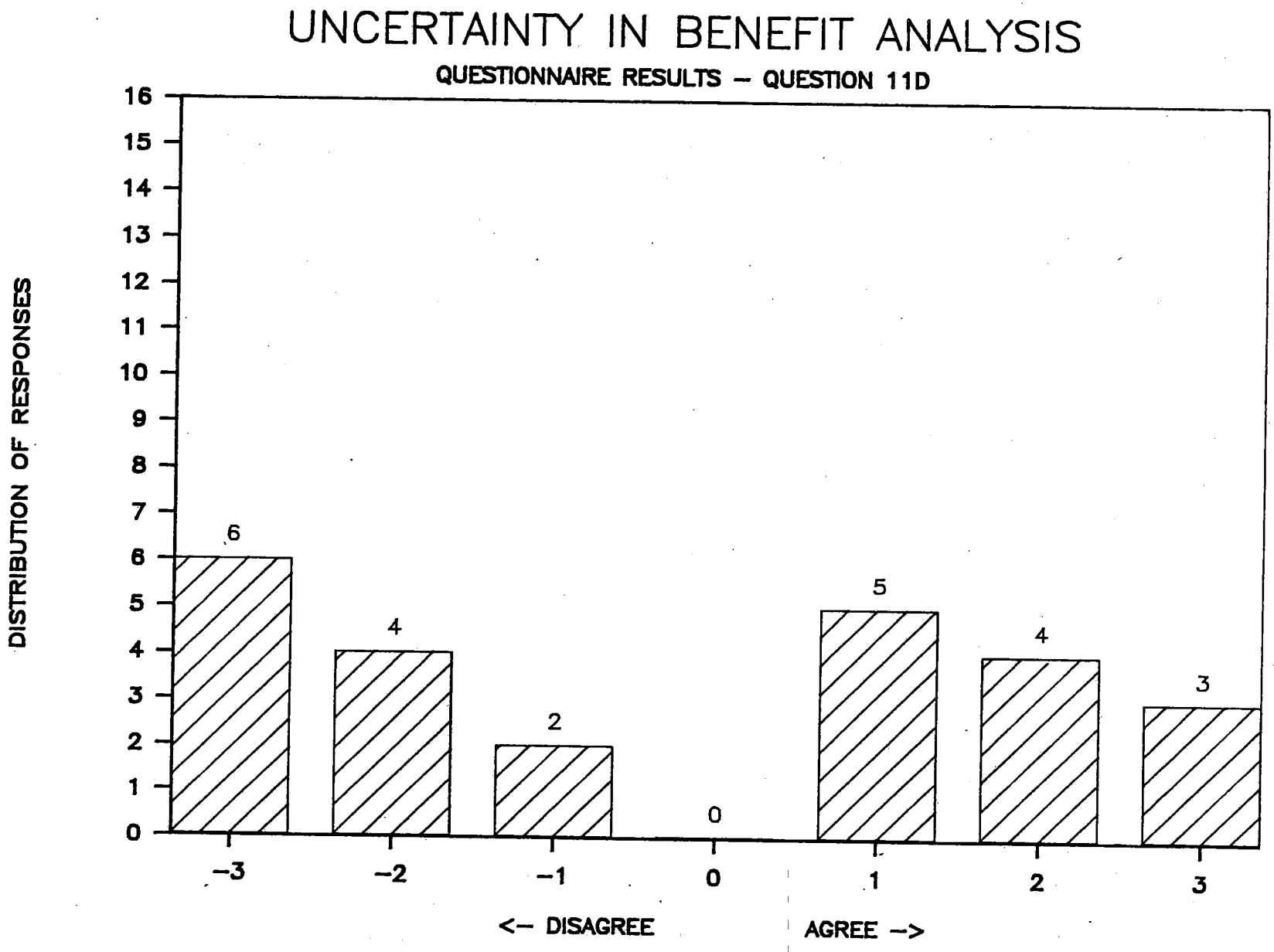

FIGURE 29 - RESPONSES TO QUESTION 11D

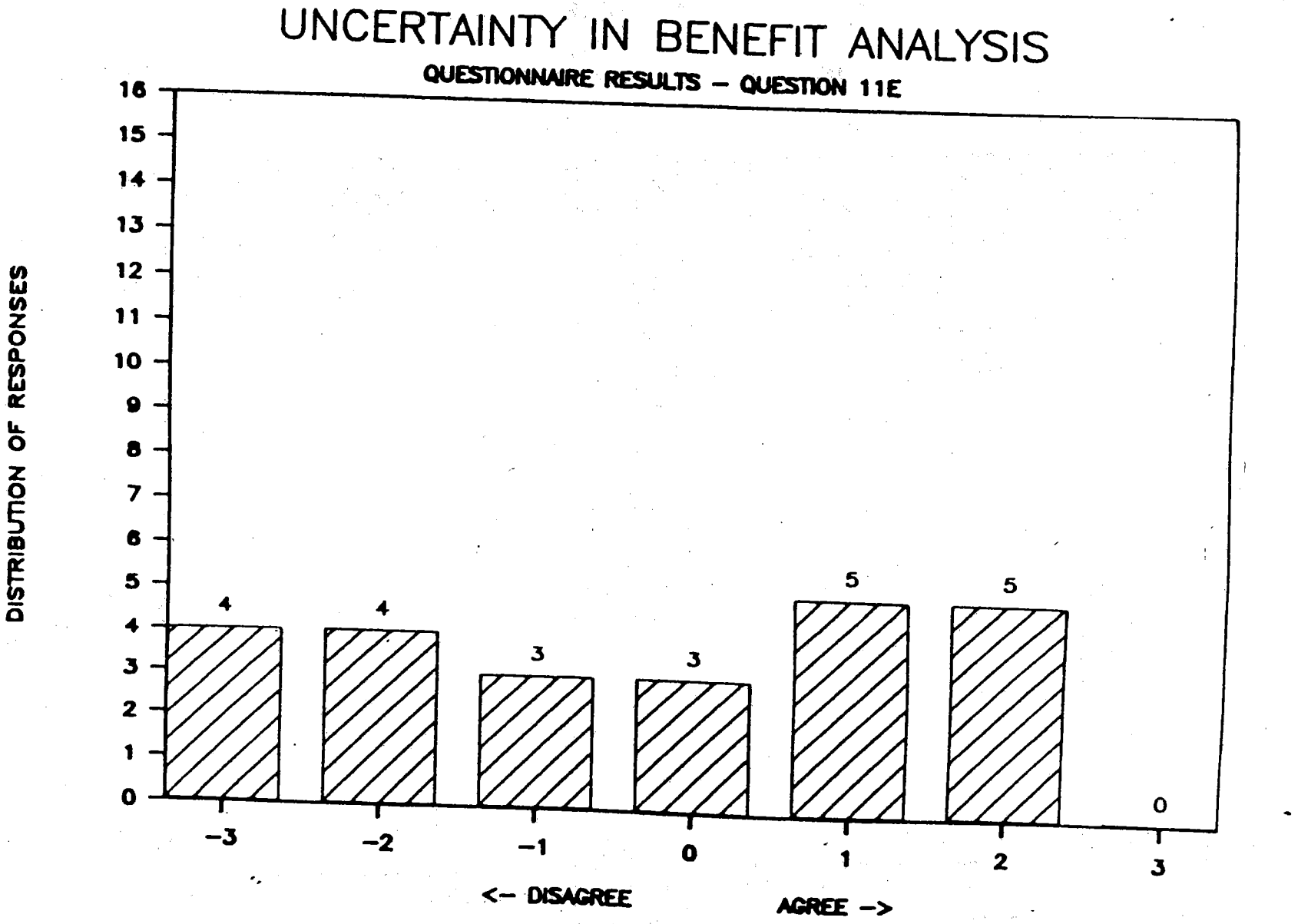

FIGURE 30 - RESPONSES TO QUESTION 11E