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REGIONAL FOOD DISTRIBUTION CHARACTERISTICS AND A METHODOLOGY FO--ETC(U)  
JUL 80 W T OLSEN, R G RUBINO DCPA01-78-C-0237

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REGIONAL FOOD DISTRIBUTION CHARACTERISTICS  
AND A  
METHODOLOGY FOR REDISTRIBUTION IN  
ACCORDANCE WITH CRISIS RELOCATION

Federal Emergency Management Agency

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A research report prepared by  
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Final Report

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Washington, D. C., 20472

by

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RESEARCH ABSTRACT

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The rationale for this research effort emerged from observed difficulties experienced by state Nuclear Civil Protection (NCP) planning staffs in obtaining the data and employing the methodologies advocated by existing Federal Emergency Management Agency (FEMA) guidance materials pertaining to the food support component of crisis relocation planning. The need for this research was amplified by the realization that plans which addressed only in-state considerations possessed great potential for creating conflicts between states or regions unless regional considerations were accounted for by the planning process. Thus, the ambitious goals set for the research involved the acquisition of data about the characteristics of the existing food supply system and the development of a methodology for undertaking regional scale food support planning. Also, it was hoped that this methodology would be transferable to the other FEMA regions. The following components established special elements of the scope of the research:

1. Analyze the existing food distribution system which currently supports the population of the FEMA Region IV states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee.
2. Develop a regionwide redistribution pattern which conforms to the population redistribution pattern of persons that have evacuated in accordance with the state crisis relocation plans (CRP).
3. Investigate the transportation stresses which result as consequences of the redistribution of the regional food shipment pattern.
4. In coordination with NCP planners currently developing CRP's for the FEMA Region IV states, apply the research results to develop state level food annex supplements for each of the eight states, and provide assistance in incorporating these supplements into the individual state plans.

In order to accomplish the first component of the research, a variety of available data sources and collection techniques were examined. A major finding was that no existing data source provided sufficient detail to support regional or statewide food distribution planning needs. Consequently the research effort focused on ways to obtain these details without arduous original surveys. A major product was the specification and acquisition of a unique data set which provided an unprecedented level of quality information sufficient to permit the type of regional analyses which had previously been impossible. Thus, the existing regional food distribution pattern, revealed for the first time by these data, established the basis for achieving the remaining components of the research. More importantly, since the data set was found to be capable of being established for any number of counties in the United States, both the data and the analysis methodologies developed

to operate on these data are readily transferable to other states and regions. Because of its broad applicability, the research has provided the basis for future food support planning at the state, regional, and national levels.

Since the major obstacle for regional food support planning had been the difficulty in obtaining sufficient food distribution data, the elimination of that obstacle made the task of reconfiguration of the existing distribution pattern to support the crisis relocated population relatively simple. A food allocation procedure based upon population allocations established for each of the states' crisis relocation plans was developed and executed. Besides providing a methodology transferable to other states and FEMA regions, this report provides the information required to develop state level food annex supplements. As a result, each of the states in Region IV can now have food support plans which incorporate the before and after food shipment pattern details of which food distribution warehouses are serving (or will serve) which retail outlets in each county within a state. Thus, a major concern regarding the credibility and completeness of these plans has been eliminated.

Given the existing and crisis relocation food distribution details produced as research products, the assessment of transportation stress at a meaningful scale was also made possible for the first time. Previous research efforts and planning applications had been forced to deal with crude surrogates of areawide transportation stress or partial representations of transportation stress pertaining only to single risk area conglomerates. The research has provided an assessment of regional transportation stress corresponding to the regional distribution patterns of major food chains and warehouse locations. A research finding revealed by the analysis was that transportation stresses resulting from crisis relocation were apparently well within the existing capability of at least the top ten food chains serving the Southeast, provided that existing transportation resources could be redistributed to even out localized stress factors.

Finally, since the ability to plan at the regional level has been feasible, the research identified some of the regional organization and management issues suggested by this expanded scale of food distribution planning in support of crisis relocation. These issues need to be addressed and resolved to ensure effective food support planning for crisis relation.

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## INTRODUCTION AND SCOPE OF RESEARCH

A. Introduction

The purpose of this research effort is to provide civil preparedness planners with a regional perspective and supportive methodology for the development of feasible food distribution plans required as a part of the Crisis Relocation Planning (CRP) component of the Nuclear Civil Protection (NCP) program. Since its inception, the CRP component has been extensively supported by a series of in-house publications providing basic planning guidance, resource data, and model plans for nuclear civil protection planners.

The basic contingency planning information relating to food support was derived from research conducted by SYSTAN, Inc., of Los Altos, California, in 1974-75.<sup>1</sup> Four basic alternatives were examined by the SYSTAN research as ways of providing the logistical support needed to assemble food supplies in sufficient quantity to satisfy the increased demand in designated areas due to crisis relocation population redistribution:

1. Maintenance of the existing food distribution system during the crisis period - essentially requiring the continuance of risk area wholesale operations.
2. Establishment of emergency warehousing facilities in the host areas.
3. By-passing the wholesaler entirely with direct shipments from manufacturers (food processors) to the host areas.

4. Stockpiling of emergency food supplies in strategic locations outside of designated high risk areas.

The alternative recommended by SYSTAN as being the most feasible and effective was to make maximum use of the resources and expertise of the existing food distribution system by maintaining existing wholesale food distribution operations (including those within risk areas) throughout the crisis period. In essence, this strategy would require each food wholesale warehouse to curtail food shipments normally destined to serve risk areas and to redirect these shipments to specific locations designated as hosts for the relocated risk area populations. The adoption of this alternative as a preferred food support strategy, however, was not without problems requiring resolution in the planning process.

The SYSTAN research documents, referred to above, were not necessarily regarded as presenting mandated planning requirements, but as the only research documentation available to NCP planners, they tended to be regarded in such fashion in the initial attempts to develop state food support plans during the period 1976-1978. The problems which arose in this context were a combination of those foreseen by the SYSTAN research and those encountered by NCP planning staffs in implementing the food planning approach. Basically these problems fell into three major categories:

1. System management problems.
  - a. Who is responsible for the management of pre-attack food distribution system redirections?

- b. Who has the responsibility to plan for such events?
- c. How would rationing, method of payment, etc., be accomplished?
- 2. Food system data problems.
  - a. What level of detail is required of data to describe the existing and crisis relocation food distribution systems?
  - b. How can these data be best obtained (i.e., from what sources and through what techniques)?
- 3. Analysis of food system stress.
  - a. What is the outlet stress imposed by additional shipments to host areas?
  - b. How much transportation stress is imposed by modification of shipment patterns?

B. Previous Food Planning Effort in Region IV

During the 1976-77 program year, the Department of Urban and Regional Planning of the Florida State University engaged in contract planning with the Federal Emergency Management Agency (FEMA) Region IV which at that time was known as the Defense Civil Preparedness Agency (DCPA), Region III) office in Thomasville, Georgia, to develop the following CRP components for the State of Florida:

- 1. The state food support plan.
- 2. The state transportation support plan.
- 3. A risk area operations plan for the Tampa/St. Petersburg risk area.

Specifically with respect to food support, the above work program was intended to satisfy the following objectives:

- 1. To test the applicability of available CRP program guidance (i.e., research) dealing with the food support strategy.<sup>2</sup>

2. To investigate and test alternative data sources and planning approaches for food support planning.
3. To demonstrate food planning concepts and procedures to NCP planners in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee.

An apparent reason for the concern over food support planning concepts and procedures stemmed from the inability of states to produce state food plans incorporating the degree of detail suggested by the available CRP guidance materials,<sup>3</sup> which were based upon prototype planning studies conducted in the state of Colorado. Basically, the food planning difficulty experienced by the states was due to a number of factors:

1. A skepticism regarding the relevance of the guidance for "their state".
2. A belief that the responsibility for food planning rested with the USDA and state departments of agriculture.
3. A conflict due to the CRP planning process being organized in a "top down" fashion in which state level plan development preceded detailed risk and host area planning, while the food support guidance assumed a "bottom up" flow of food data in which local inventories of outlets, warehouses, transport vehicles, labor force, etc., would be available for aggregation to support the statewide food planning effort.

The Florida State University (FSU) approach to the NCP/CRP food support planning issue at the statewide level has been presented in two planning documents.<sup>4</sup> The salient features of the FSU approach are as follows:

1. The basic assumption is that all persons in each state are presently being fed by the existing food distribution system. If there are variations in food consumption due to tourism, for example, the existing food industry is well accustomed to these variations and is able to accommodate corresponding demand shifts.
2. Since the crisis relocation process does not change the number of persons residing in each risk area conglomerate, the food industry merely has to alter the distribution of food shipments so that they correspond to the crisis relocation population distribution.
3. This food shipment redistribution can be closely approximated by planning to allocate food normally destined for the risk area according to the percentage of risk area population assigned to specific host areas. For example, if 15% of a risk area population were assigned to a specific host area, then 15% of the risk area food would also go to that host area, in addition to the food normally supplied for that host area.
4. The planning approach at the state level was to document the sources of supply (i.e., food distributors) for each risk area, and to provide these distributors with food reallocation instructions which were coordinated with the initial statewide population allocation for each risk area conglomerate in the state.

The philosophy behind the simplified food redistribution approach just described is based upon the concept of a top-down planning process wherein initial statewide allocations of population and support logistics (i.e., food supply) are subsequently reexamined in greater detail during following planning studies which focus on specific risk area conglomerates.

In other words, the FSU approach represented a first cut statewide food allocation comparable in detail to the statewide risk area population allocation. The approach had the obvious merit of not requiring extensive inventories of retail outlet locations, truck transport fleets, and warehouse capacities in the initial stage of food planning. Thus, it was felt that this approach could be used by state NCP planning staffs to augment their state food plans with first cut food redistribution details.

A relative disadvantage of the approach, as compared to the Food Support Guidance, was that it was incapable of estimating retail outlet stress and revised shipment patterns. The plan also provided logistical guidance which was in reverse of normal food distribution procedures in that the retail outlets are the initiators of shipment orders rather than food wholesalers. Finally, since a detailed inventory of retail outlets by county was not available at the initial state plan level, it could not be guaranteed that wholesalers responding to food redirection instructions would actually have any retail outlets to ship to in certain counties. In such cases, the plan had to assume that the wholesaler could be directed to ship to outlets of other food chains or to other designated locations (e.g., congregate feeding facilities in schools).

As an example of the subsequent modifications to the food support plans which would be included in more detailed planning stages of the CRP process, FSU was contracted to develop host area food plans for the counties in Florida which were designated as the host counties for the Hillsborough County portion of the Tampa-St. Petersburg risk area.<sup>5</sup> This planning effort was designed to resolve the major difficulties of

the statewide "first cut" food redistribution plan by focusing on four major components:

1. A detailed inventory of local food retail outlets (i.e., supermarkets) in each county.
2. Identification of the source of food supply (i.e., locations of wholesale warehouses) for each of these outlets.
3. Assessment of outlet stresses.
4. Assessment of transportation stresses.

This planning effort served to demonstrate the feasibility of the two-tiered approach to food support planning. Since the locations of food distribution sources had already been established in the statewide plan, the additional information needs of identifying retail outlet locations and distances between these outlets and their supply source were easily accomplished. Three major simplifications were incorporated in assembling the food distribution data employed at the risk area conglomerate level of detail.

1. The capacities of existing retail outlets were not inventoried on the assumption that an outlet stress of three to four times the normal food volumes could be accommodated at each outlet by adding additional personnel, longer hours of operation, etc. Also resulting from this simplification is the treatment of all supermarkets as being "essentially" equal in terms of food capacity.
2. The existing food transport capacity of each chain was not inventoried. It was assumed that each chain presently has sufficient transport capacity to service its wholesale-retail food distribution operations.

3. The concept of supermarket equivalents was introduced as a surrogate measure of the actual food quantity shipped from the wholesaler to supermarket retail outlets. A supermarket equivalent was defined as the quantity and composition of food supply normally shipped to a typical supermarket per unit of time. Thus, the doubling of food shipped to a host area retail outlet is represented by two supermarket equivalents, a tripling of food shipment by three supermarket equivalents, etc. and details corresponding to the quantity and composition (e.g., how many pounds of potatoes) are not considered.
4. Transportation stresses were analyzed by means of a before-after comparison of equivalent store-miles of food shipment, rather than by ton-miles.

C. Rationale for the Present Research

During the course of data collection, analysis, and planning associated with the two food distribution planning levels (i.e., state-wide and risk area conglomerate) described above, three major research issues arose. These issues, which became the focus for the present research, were as follows:

1. It was noticed in the Florida planning effort that many of the food distribution sources for supermarket outlets were located outside of the state. Further examination of the food distribution system revealed the fact that the system is organized to serve market areas which are frequently multi-state in nature, and food distribution patterns for most areas involve regional (i.e., interstate) shipment patterns. Thus, NCP planning which operated solely upon in-state considerations, was inadequate for food distribution planning purposes.

2. The best source of food distribution data to support state-wide or regional food planning efforts remained uncertain. In order to be effectively utilized in the CRP process, it was determined that food distribution data were needed for every county in the region in suitable detail to permit consideration of outlet and transportation stresses associated with CRP relocation modifications. A major constraint regarding the collection of these data was that it should not require extensive original inventories at the local level, since such inventories were viewed as being impractical due to the large number of retail outlets in the eight state region.
3. While the details presented in the FSU planning efforts for the host counties of the Hillsborough County portion of the Tampa-St. Petersburg risk area permitted the computation of transportation stress factors, these stress factors were acknowledged to be only partial in that they related to modified distribution patterns for only five counties. Since all of the food distribution sources identified served more locations than those contained in the area studied, the overall stress effect could not be ascertained without a more extensive (e.g., regional) level of analysis.

D. Scope of research

Based on the preceding rationale for an expanded level of analysis (i.e., regional scale) for the development of food distribution plans in support of crisis relocation, the present research effort was directed to investigate alternative strategies for the distribution of

food in the FEMA Region IV states. The research was also intended to provide sufficient food distribution details (for the normal and crises relocation situations) to supplement existing state food plans for the region. To achieve these general expectations, the FSU research team was directed to undertake five major tasks:

1. Analyze the existing food distribution system in the eight southeastern states.
2. Develop a regionwide redistribtuion pattern to assure flow of food to relocated persons.
3. Investigate transportation needs to accommodate crisis relocation planning, including procedures to overcome transportation stress.
4. Provide supplements to state food annexes outlining the organization, deployment, and procedures needed to implement a revised pattern of food distribtuion.
5. Provide information and assistance to state nuclear civil protection planning.

The remaining sections of this report describe the approach taken in accomplishing the research, the characteristics of the existing food distribution system, the modified crisis relocation food distribution pattern that was developed, an assessment of the consequences of redistribution, and applications to regional and state planning.

## II

### DESCRIPTION OF EXISTING FOOD DISTRIBUTION IN REGION IV

#### A. Research Approach

The key ingredient necessary for the description of existing food distribution patterns at the regional (or any other) scale is the identification and acquisition of a suitable data set. A major portion of the research effort was expended on this critical element, without which all subsequent tasks identified in the research scope would have been impossible to achieve.

Previous experience with the CRP food support problem and review of the food support research materials<sup>6</sup> indicated that three issues needed to be resolved before developing food support data:

1. Identification of relevant food data elements within the production to consumption chain.
2. Top-down versus bottom-up data acquisition philosophy.
3. Level of detail in the data set (i.e., choice of variables).

The choice of relevant food data elements is an important delimiting device in determining data acquisition needs. In the most extreme version of defining relevant food data, a researcher is faced with the prospect of attempting to inventory and describe the production and flow of food products from agricultural sources, to market centers, to food processors, to wholesale distributors, and finally to retail outlets. However, since the crisis relocation period is usually described in terms of a one week minimum up to an uncertain maximum, which for planning purposes has been constrained to three weeks, the primary

element of the food distribution chain which needs to be considered in order to ensure adequate food supplies during crisis relocation is the linkage between wholesale distributors (i.e., warehouses) and retail outlets.

Top-down data collection efforts lead to identification of aggregate data sources at national or regional scales. Generally, the top-down approach relies upon the published statistics of such sources, and is benefited by not requiring an extensive collection of original data. While the efficiencies of the top-down approach cannot be denied, the obvious problem of working with published statistics from other sources is that they may not be suitable for the task at hand. Bottom-up data collection, on the other hand, can be tailored to provide for very specific research and planning needs at the cost of often laborious original data collection efforts. As a research approach, it was determined that both extremes should be examined as sources of food distribution data, but an approach which more efficiently utilized existing data resources would be favored.

The level of detail selected for the data set was determined by considering the minimum requirements for regional and state-level crisis relocation planning. In order to describe the existing food distribution pattern and provide the basis for the reconfiguration of this pattern to support a crisis relocated population, the most essential notion is that of food supply linkages between wholesale distributors and the retail outlets that these wholesalers serve. Thus, the minimum data set was defined as consisting of the locations of all wholesale food distribution warehouses which serve retail food outlets in the

southeast states, the locations of the retail food outlets, and the transportation linkages connecting the warehouses with the retail outlets. In order to minimize the data collection burden but still account for the majority of food shipment, it was decided that only supermarket types of retail food outlets would be considered. In 1976, these supermarkets accounted for 75% of all grocery sales but only about 18% of the total number of stores.<sup>7</sup> Thus, the elimination of convenience and specialty food stores constituted a significant reduction in data collection requirements without unduly compromising the descriptive power of the data set.

As a further simplification to size requirements of the data set, the areal unit for describing the location of supermarket outlets was taken to be the county.

FEMA's revised planning guidelines for food support indicate requirements for considerably more detailed information than discussed above.<sup>8</sup> For food wholesale distributors, for example, the recommended data set includes such detail as square feet of warehouse storage, number of loading docks, number of warehouse personnel, number of drivers, number of tractors, trailers, capacities, etc. Since the source of such detailed data is logically constrained to an in-depth survey of each location (a "bottom-up" approach), and previous experience with warehouse visitation revealed some lack of willingness of the food industry to divulge their operational details, this level of data acquisition was determined to be unfeasible at the regional or state level. Thus, the most important element of the research was a search for an efficient data source to provide information in sufficient detail to

support regional, state, and risk area conglomerate CRP information needs in FEMA Region IV. It was also intended that any data source selected should be transferable to other FEMA regions.

#### B. Alternative Data Sources

Given the basic orientation toward CRP applicability embodied in the research approach to data collection, the research problem became one of identifying promising sources of food distribution data, and evaluating these sources. During the course of the FSU research team's involvement with CRP food support for Florida, a number of data sources had been identified and utilized in plan development. However, it was not known whether such sources were readily available in the other southeastern states. Basically, the most promising sources of food distribution data fell into three groups.

##### 1. Federal Agency Sources--

The set of data sources encompasses the published statistics, data records, planning, and research documentation of federal agencies related to food distribution and crisis planning. The U. S. Department of Agriculture was reported to possess data listings of food support capacity at the local level under the heading of Food and Feed Facility Listings. Prior to the issue of USDA Emergency Memorandum No. 60, dated March 23, 1977, and Supplement 1 of that memorandum, dated May 23, 1978, the information contained in these listings could only be released to state NCP planning staffs under condition of national emergency (e.g., an attack on the United States or declaration of war). Under the policy set forth in the memorandum, however, the content

and utility of USDA's food data for CRP purposes could now be assessed.

The U. S. Department of Commerce, Bureau of the Census publications were also of interest for their compilations of agricultural and business statistics, although all of those encountered appeared to be eight or more years old and, hence, not suitable for current CRP applications.

Finally, the FEMA research publications which pertain to food support and redistribution of food supplies were included primarily as sources of data requirements, although they also present some information on the basic food distribution pattern in the United States.

## 2. State Agency Sources--

Within this set of data sources, the chief interest was in state departments of agriculture. One of the resources found most useful in the Florida experience was a listing of all retail food outlets by county which was compiled to support the role of the Florida Department of Agriculture in the inspection of such facilities. While the Department of Agriculture could furnish information pertaining to the locations of wholesale distributors serving various portions of the state, no official data listings were maintained by the agency on the wholesale to retail food distribution linkages. An objective of the research effort, therefore, was to determine the data resource capabilities of departments of agriculture in the other southeastern states which could be used in support of the CRP food support data needs.

Similarly, the possibility of other state agencies, such as departments of health, revenue, transportation, etc., having information pertaining to food facilities or food shipments needed to be examined. Finally, the food system inventories and food plan details organized to date by each of the Region IV state NCP planning staffs were identified as sources of data.

### 3. Food Industry Sources--

In terms of the ability to satisfy NCP food support data requirements, the resources of the food industry itself provided the greatest probability of usefulness. Elements of both the top-down and bottom-up planning approaches can be identified within this group. It was discovered in the Florida experience, for example, that retail food outlets would often readily provide information on their source of food shipments, the number of shipments per week, etc.

Thus, a bottom-up data acquisition approach could virtually guarantee the establishment of the distribution pattern of food shipments serving supermarkets in the southeastern states. However, an obvious difficulty with this approach is the large number of supermarkets which must be surveyed. Preliminary indication of the number of supermarkets in the southeastern states was obtained from the Progressive Grocer Company for the twenty-four major market areas contained wholly or in part within the eight state region.<sup>9</sup> This source (which understates the true number of supermarkets by not accounting for those outside major market area boundaries) indicated that there are well over 4,700 such outlets in the region. Since some risk area

conglomerates are not necessarily within food distribution market areas, a prerequisite information need was identified to be a listing of supermarket locations for each county in each southeastern state.

The set of wholesale distributors serving the major food retailers in the eight states was identified as a second major source of food industry data. Although less numerous than the retail outlets themselves and, therefore, much easier to inventory, this data source was not viewed as an especially promising one due to the FSU research team's previous experience in Florida when they encountered great reluctance on the part of some wholesale distributors to divulge their operational details. As before, the prerequisite for such an inventory was identified as acquiring a complete listing of all food distribution warehouse locations serving retail food outlets in the eight southeastern states. The possible sources of such listings were considered to include the USDA, state departments of agriculture, and food industry marketing associations (e.g., Progressive Grocer Company). It was further anticipated that the complete set of wholesale food distributors would contain numerous entities located outside of the FEMA Region IV area, and, therefore, substantial data collection efforts beyond regional boundaries would be necessary.

Finally, the various food industry organizations were considered as possible data sources. These organizations fall into two major groups. The first group represents specific food products (e. g., citrus growers, egg and poultry, cattle, etc.).

This group was rejected as a data source because of the emphasis on food production rather than retailing activity, and because it would necessitate the tracing of each food component making up the total market basket of consumer food products. The second type of organization represents the wholesaling, retailing, and marketing aspects of the food distribution chain. Since FSU research team's previous food support activities in Florida had utilized the Progressive Grocer Company's published statistics, this data source was considered most promising for expansion to represent the entire southeastern region. Beyond the utilization of readily available published statistics, a further possibility was identified as creating a special purpose data summary specifically tailored for crisis relocation food support planning needs. This option would depend upon the existence of a computerized food industry distribution data file to which access could be gained, and which contained a suitable level of detail for special purpose summarization.

C. Data Source Evaluation and Refinement

In order to test the application of each of the food data resource categories described above, a series of meetings were conducted in each of the eight southeastern states in the Fall of 1978. At each of these meetings the following agency groups were represented:

1. The Florida State University research team.
2. State nuclear civil protection planning personnel.
3. Federal representatives on the state emergency board.
4. State department of agriculture personnel.

As a focal point for these meetings, market area data for the

southeastern states were assembled. After presenting this summary, which represented one of the data sources: namely food industry associations involved in wholesaling, retailing, and marketing), the agency representatives were asked about the feasibility of obtaining food distribution data from each of the data resource categories (i.e., federal agency sources, state agency sources, food industry sources). Results of these meetings revealed the following data conclusions:

1. The state emergency board representatives interviewed in each state could not identify any data source that described the distribution pattern linking wholesale food warehouses with the individual retail food outlets served by those warehouses.
2. The USDA Food and Feed Facility Listings were found to not contain any food distribution data.
3. Few departments of agriculture in the southeastern states kept any data pertaining to either wholesale food distribution warehouse locations serving their state or food distribution patterns.
4. Florida was one of the few southeastern states which maintained a listing of retail food outlets, but even its listing did not identify the sources of supply and food shipment patterns.
5. The market area data which had been assembled to introduce the topic and focus discussions in the state meetings was already as good or better than any alternative secondary data source utilizing readily available published statistics.

While the published market area data, referred to above, emerged as the best source of data identified to date, the various meetings in the eight southeastern states revealed several glaring weaknesses of this

data source. One of the most obvious deficiencies observed was the lack of information in some portions of the region. The extent of this deficiency is depicted in Figure 1.

Examination of Figure 1 indicates that although some 24 market areas have been identified, a substantial portion of the Southeast does not fall within major food market areas. A major band of missing coverage extends from eastern North Carolina down to the Florida Panhandle. Another band of missing information is located along the Alabama-Mississippi state line and extends through the states of Tennessee and Kentucky. Despite the fact that the population within the 24 market areas represented approximately 83 percent of the total population (1977 estimate) of the region, the geographic limitation is such that 35 of the 71 risk area conglomerates in Region IV lie wholly or partially outside of the market areas covered (see Figure 2 for locations of risk areas). In terms of the ability of the market area data to provide for detailed crisis relocation planning within risk area conglomerates, a total of 101 risk/host counties were observed to be located outside of the market area boundaries.

Another weakness of the market area data was its incomplete description of the food distribution pattern. While the major distributors serving each market area were identified in the Marketing Guidebook, no information was provided to indicate which food stores in which counties were served by each of these major wholesale distributors. Thus, it was concluded that the published market area data was also an inadequate source of information for food support planning.

The next data source option investigated was the development of special purpose summaries from existing food industry resources. In this attempt, the research effort was rewarded with an unexpected degree of

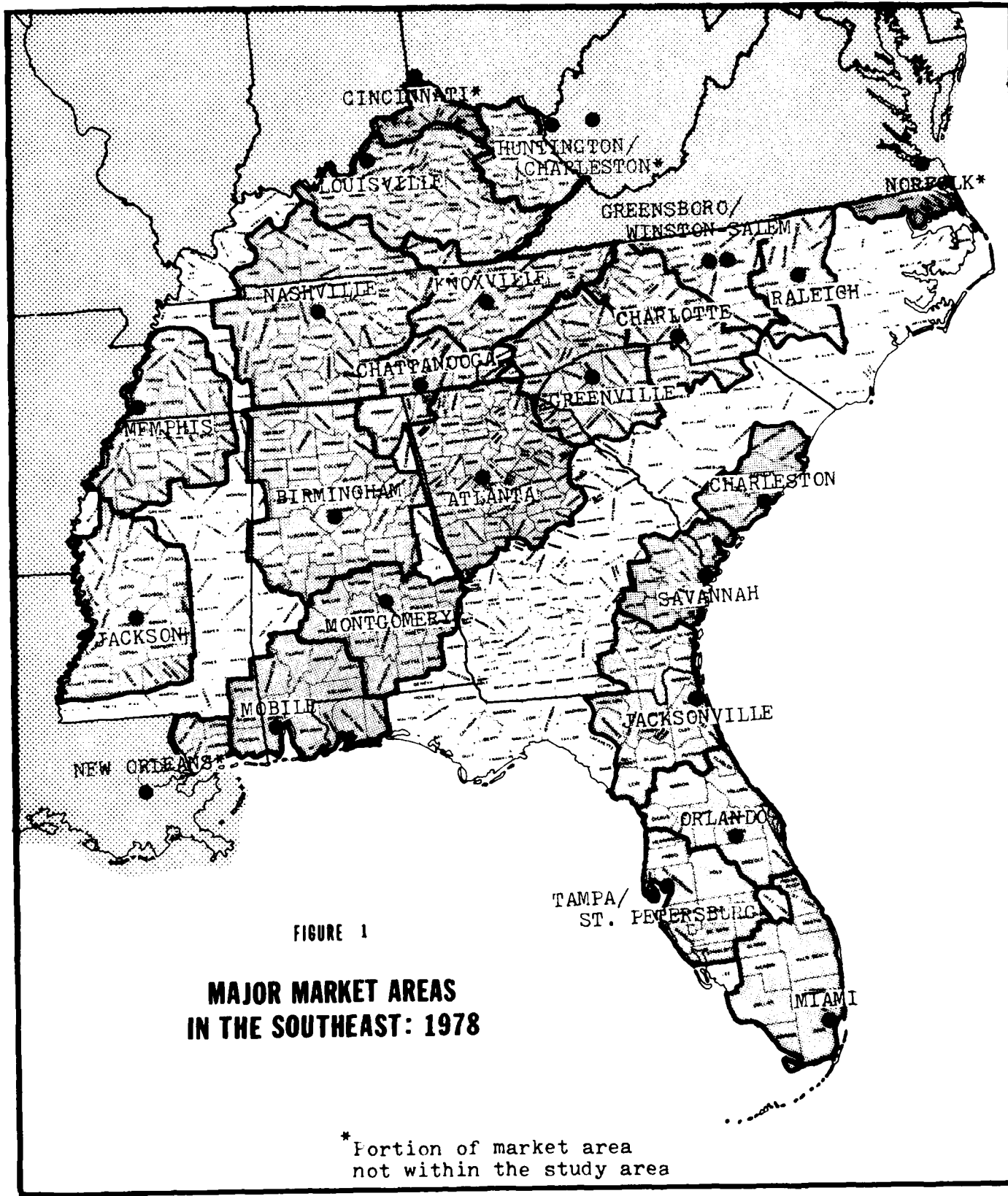


FIGURE 1

**MAJOR MARKET AREAS  
IN THE SOUTHEAST: 1978**

\* Portion of market area  
not within the study area

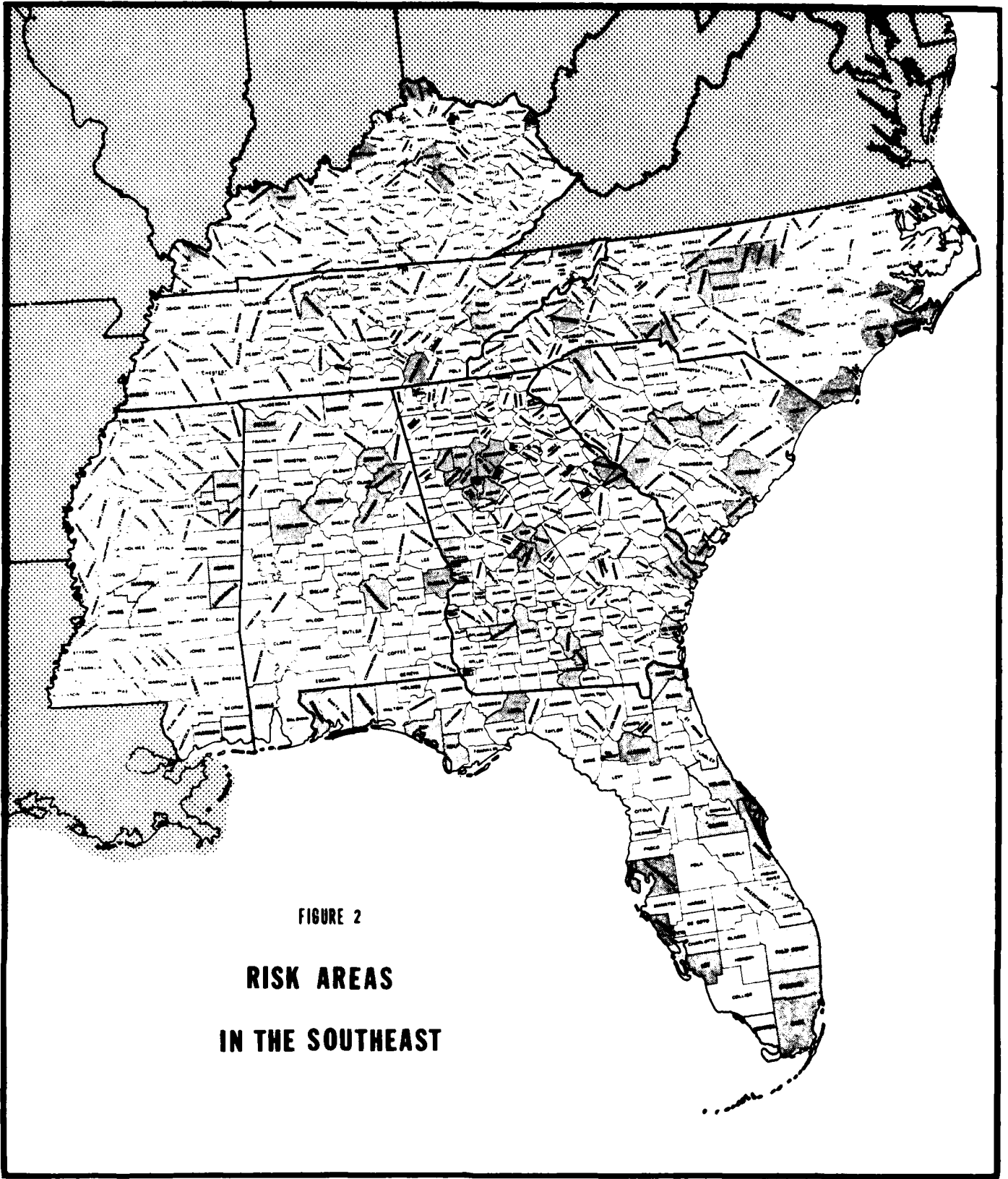


FIGURE 2

**RISK AREAS  
IN THE SOUTHEAST**

success. During the FSU research team's earlier food support planning efforts in 1976, it was learned that the Progressive Grocer Company maintained a computerized data center on the retail food industry in the United States. Subsequent reinvestigation of the data source revealed the existence of a marketing information services unit which was geared toward providing special purpose marketing information to the food industry. The data base maintained by the Progressive Grocer Company for this purpose consisted of a comprehensive store by store analysis of the retail grocery industry in the United States.

Negotiations with the Progressive Grocer's Marketing Information Services section finally provided the FSU research team with the quantity and quality of CRP food support data previously thought to be unobtainable short of mounting a massive, bottom-up, original data collection effort. The CRP food support data requirements were established in matrix format by the FSU research team, and submitted to the Progressive Grocer Company to create a specialized data summary unduplicated by any other known data source.

The data summary consists of two components. The first component is the identification of every major food distributor serving supermarkets in the eight states in FEMA Region IV. For each of these distributors, a table is provided which contains the following information:

1. The counties in each state served by that distributor.
2. The number of supermarkets in each county that are supplied by that distributor.
3. The annual sales volume range for each supermarket.
4. The total annual retail sales of all supermarkets served by that distributor in each county.

The set of information which resulted from this component is contained in Appendix A.

The second component consists of a listing of all of the counties in the eight states, organized alphabetically by state. For each county the following information is provided:

1. The total number of supermarkets.
2. The distribution of annual sales volumes among these stores.
3. The total supermarket retail sales.

The county data generated under this component is contained in Appendix B.

Examination of the data set described above indicated a wealth of food distribution detail previously thought to be unobtainable without an arduous survey. The previous attempts to obtain such information through existing sources served to clearly demonstrate that no other alternative was capable of providing the quality and quantity of food support data that was available through this source. With these data assembled, the remainder of the regional food support research tasks could be confidently pursued.

#### D. Results

As of April, 1979, the eight states in FEMA Region IV were served by a total of over 7,500 supermarkets. The average supermarket had a volume of retail sales of over three million dollars, and the total retail sales within the region in 1978 was approximately 23 billion dollars. The supermarkets were supplied with food shipments from 218 separate warehouses, 50 of which were located in states outside of FEMA Region IV. Thus, the magnitude of the wholesale food distribution system serving the southeast is documentably large in scale; much larger than had originally been anticipated. A summary of the existing food distribution system is given in Table 1.

Table 1

Food Distribution Summary: Southeastern States  
(1978)

State	Number of Food Distribution Warehouses	Number of Supermarkets	Annual Sale (in 1000's)	Average Sales Per Supermarket (in 1000's)
Alabama	16	845	\$2,264,000	\$2,679
Florida	24	1449	5,937,500	4,098
Georgia	25	1063	3,367,500	3,168
Kentucky	18	773	1,978,500	2,560
Mississippi	9	534	1,332,750	2,496
N. Carolina	32	1264	3,588,000	2,839
S. Carolina	16	630	2,060,750	3,271
Tennessee	28	1013	2,461,250	2,430
Outside Region	50	--	--	--
Totals	218	7571	\$22,990,250	\$3,037

The location of the major food distribution warehouses are graphically displayed in Figure 3. The sizes of the circles in the figure are proportional to the summation of supermarket annual sales volumes accounted for by all wholesale food distributors within or in close proximity to the various cities. Based on the sum of annual sales volumes for all local food distributors, the fifty most important food distribution centers which are sources of supply for supermarkets located in the southeast are listed in Table 2. The annual sales volumes are for retail sales within the eight state region only. Thus, if a city serves as a distribution center for supermarkets outside the southeast region states, its sales importance is understated by the amount of out-of-region sales.

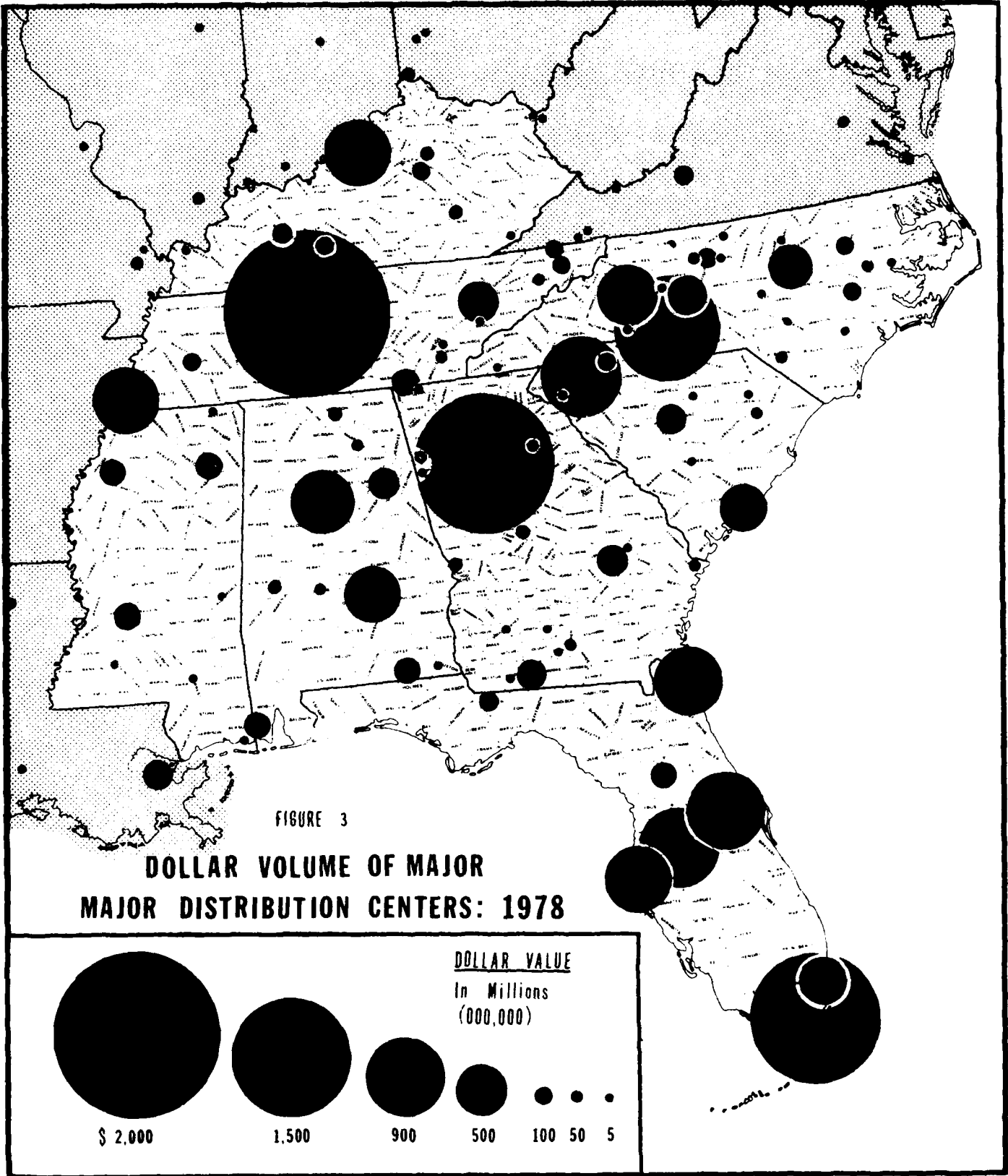


Table 2

Sales Importance of the Top Twenty-Five Food Distribution Centers  
Serving Supermarkets in the Southeastern States  
 (1978)

<u>Distribution Center</u>	<u>Annual Sales (ACV)</u> <u>(in 1000's)</u>
1. Nashville, TN	\$2,002,500
2. Atlanta, GA	1,655,500
3. Miami, FL	1,558,250
4. Charlotte, NC	1,256,750
5. Greenville, NC	917,250
6. Lakeland, FL	903,000
7. Orlando, FL	845,000
8. Jacksonville, FL	799,500
9. Memphis, TN	786,250
10. Tampa, FL	759,000
11. Louisville, KY	750,000
12. Birmingham, AL	692,000
13. Hickory, NC	648,750
14. Montgomery, AL	638,250
15. Charleston, SC	495,500
16. Ft. Lauderdale, FL	493,500
17. Raleigh, NC	448,750
18. Knoxville, TN	386,750
19. Salisbury, NC	365,500
20. Columbia, SC	316,750
21. Anniston, AL	296,750
22. Vadalia, GA	276,000
23. New Orleans, LA	266,000
24. Thomasville, GA	249,750
25. Indianola, MS	244,000

ACV = Sum of all commodity volumes (annual retail sales) accounted for by supermarkets located within the southeastern region which were supplied from warehouses located within or in close proximity to each city.

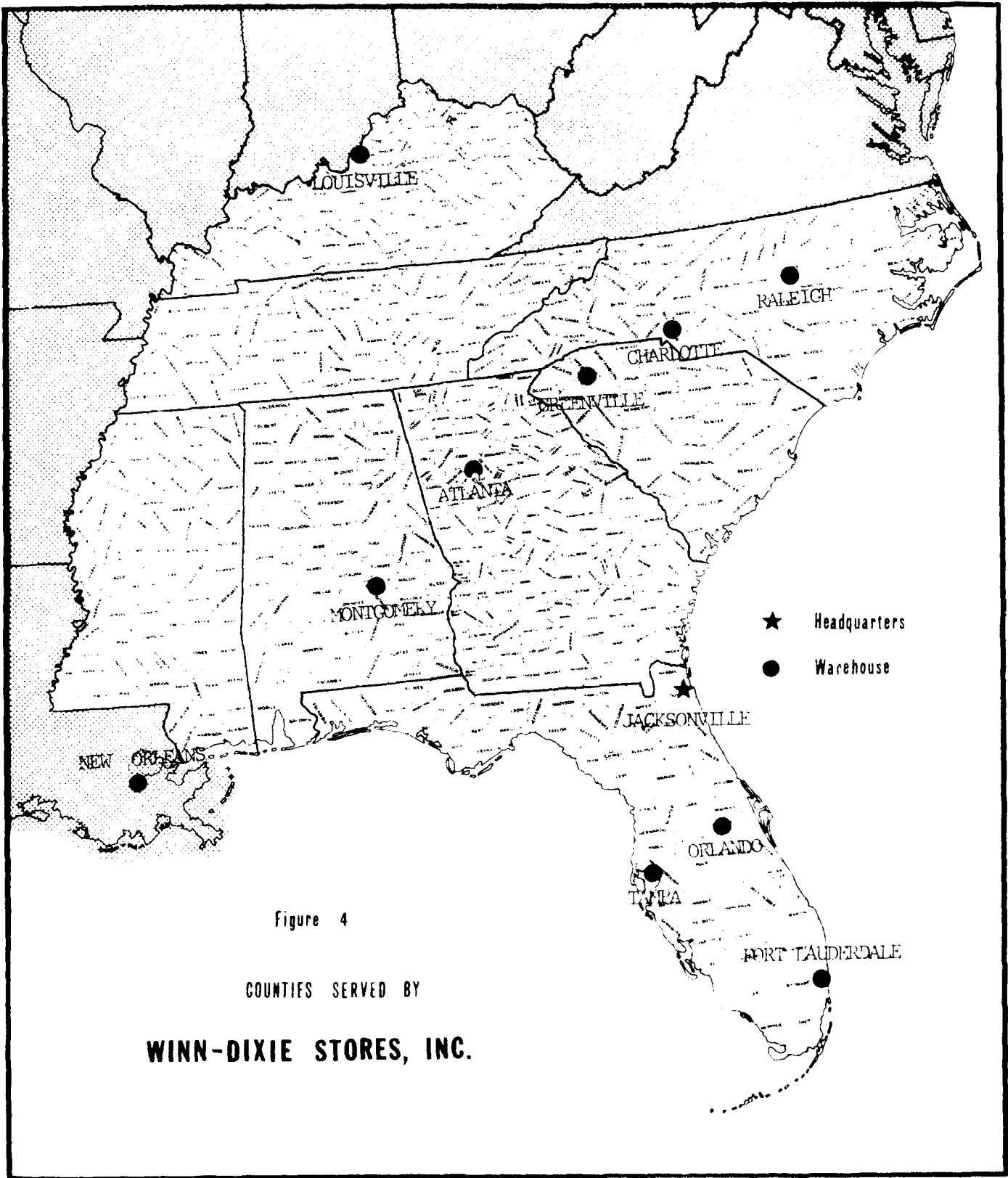
The top ten food distributors serving supermarkets within the eight state region are summarized in Table 3. These ten distributors taken as a group account for 48 percent of the total number of supermarkets and 55 percent of the total supermarket retail sales within the eight state region. The counties in the region that are served by these ten distributors are shown in Figures 4 through 13; the figures also show locations of warehouses and headquarters of the distributors. Note that eight of these distributors serve five or more southeastern states, a fact which emphasizes interstate dependencies in food distribution.

Table 3

Top Ten Food Distributors Serving Supermarkets in the  
Southeastern States  
(1978)

Distributor	Annual Retail Sales of all Stores Supplied (in 1000's)	Number of Supply Points (Warehouses)	Number of Stores Supplied	Average Annual Sales Per Store Supplied (in 1000's)
1. Winn Dixie Stores, Inc.	\$ 3,720,500	11	943	\$3,945
2. Kroger Co.	1,377,250	5	255	5,401
3. Publix Super- markets	1,320,500	2	224	2,051
4. Malone and Hyde, Inc.	1,228,250	11	599	3,531
5. A & P Tea Co.	1,070,000	4	303	3,531
6. Colonial Stores	1,061,500	5	302	3,515
7. Piggly Wiggly	989,250	7	340	2,910
8. Merchants Distributors	659,250	4	228	2,891
9. Bi-Lo, Inc.	511,000	1	91	5,615
10. Food Fair Stores	409,750	2	81	5,059
Totals	12,347,250	52	3,366	3,668

Note: Each distributor is ranked in terms of the total retail sales volume of all supermarkets in the eight southeastern states that its warehouses supply with food shipments.



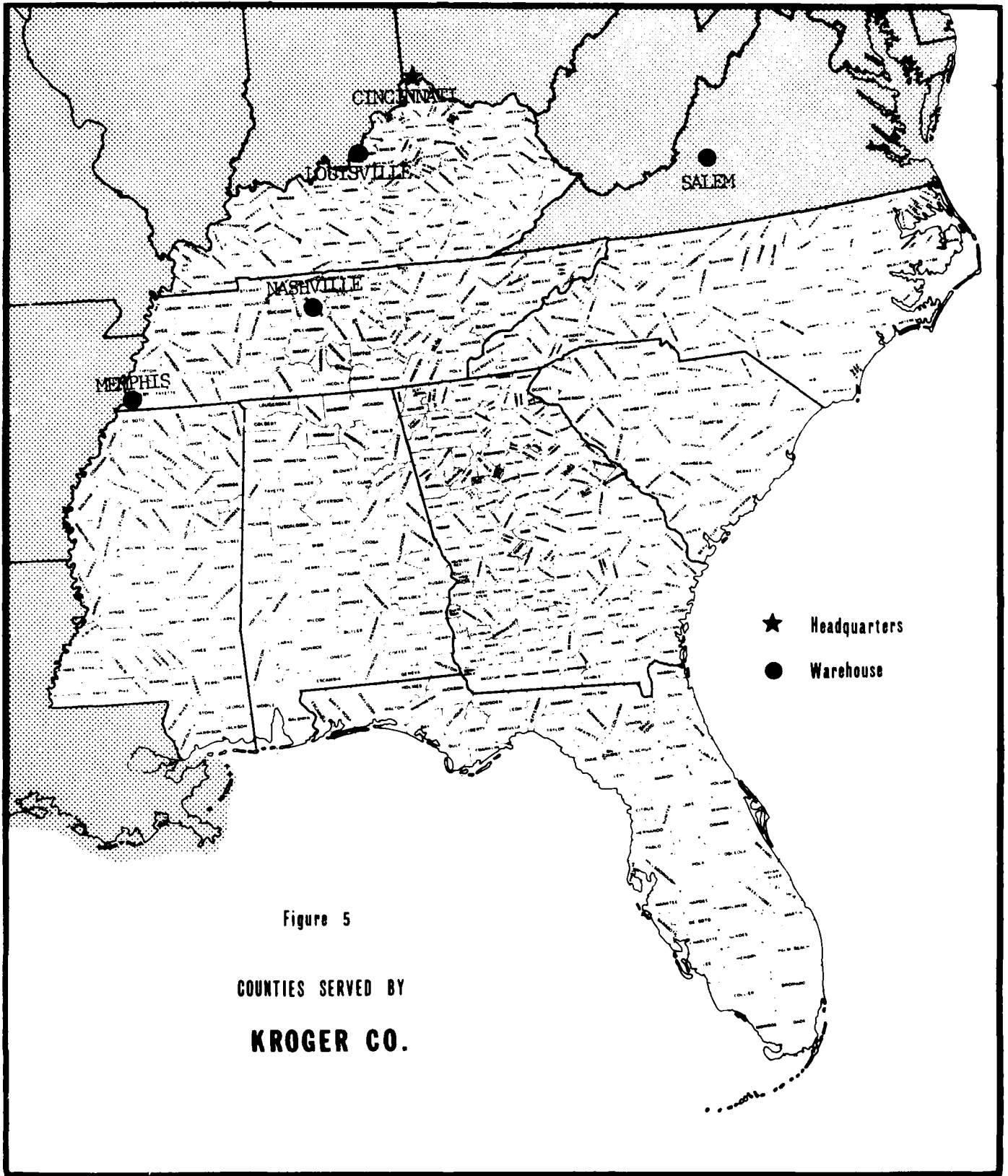


Figure 5

COUNTIES SERVED BY  
**KROGER CO.**

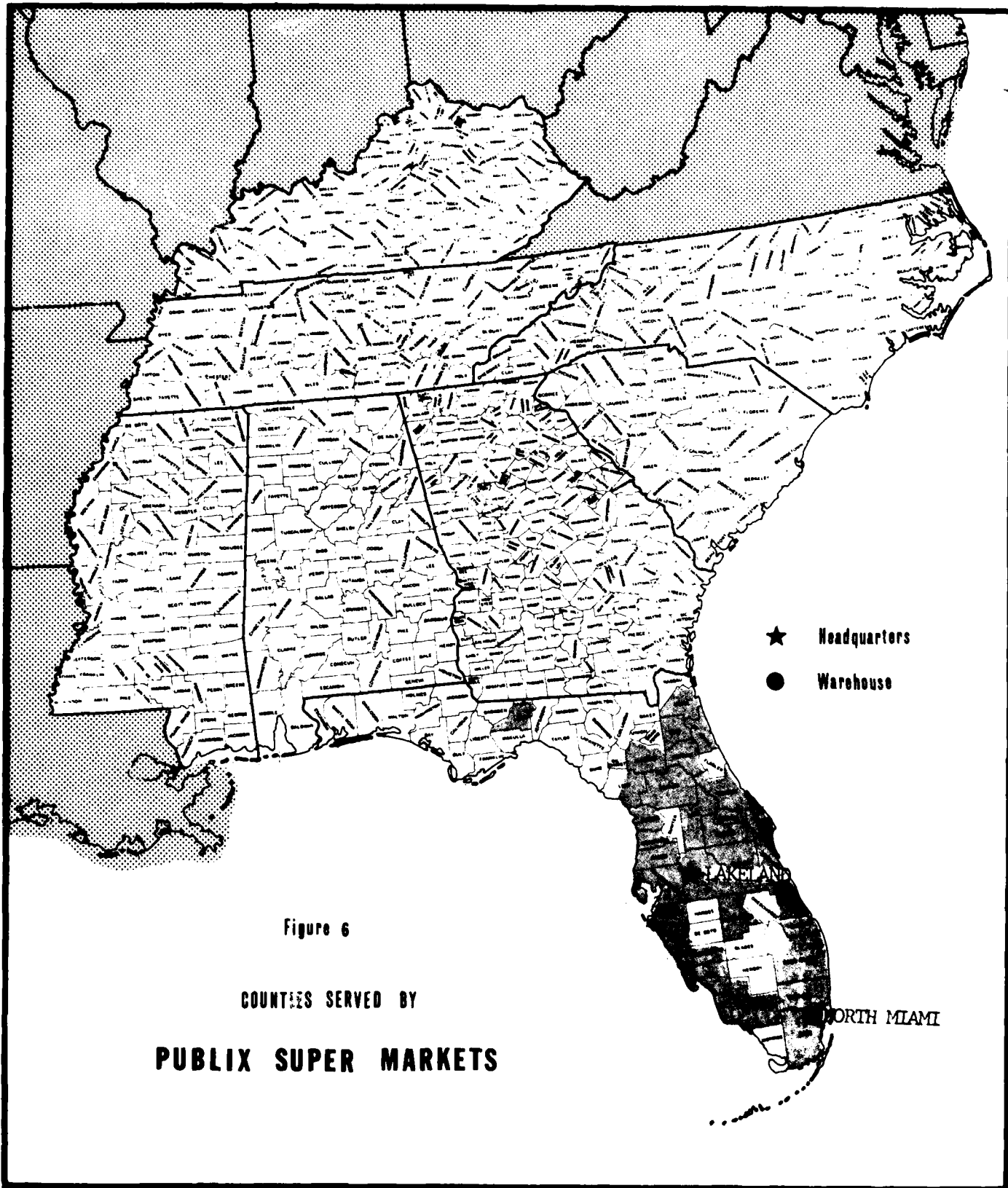


Figure 6

COUNTIES SERVED BY

**PUBLIX SUPER MARKETS**

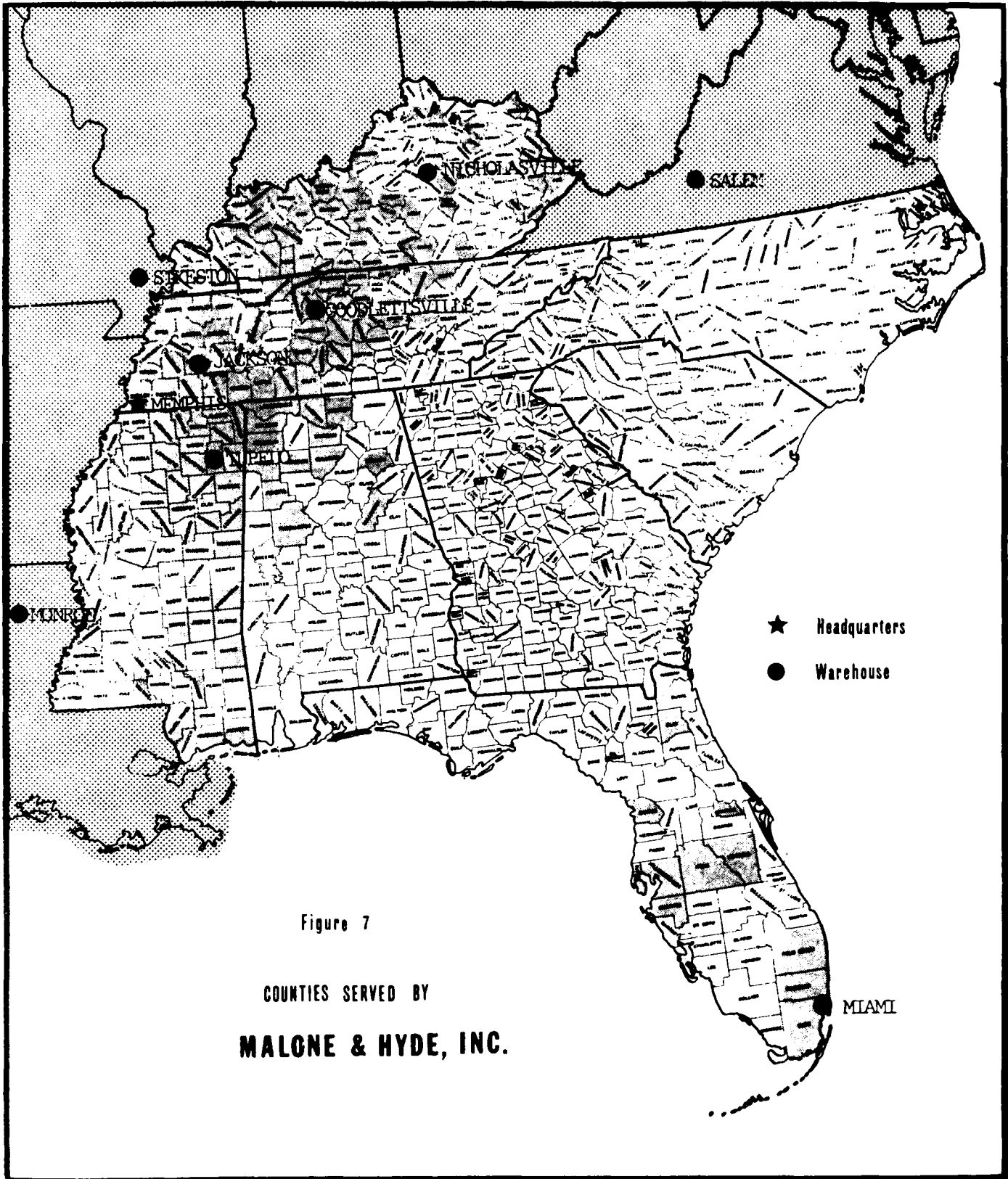


Figure 7  
 COUNTIES SERVED BY  
**MALGNE & HYDE, INC.**

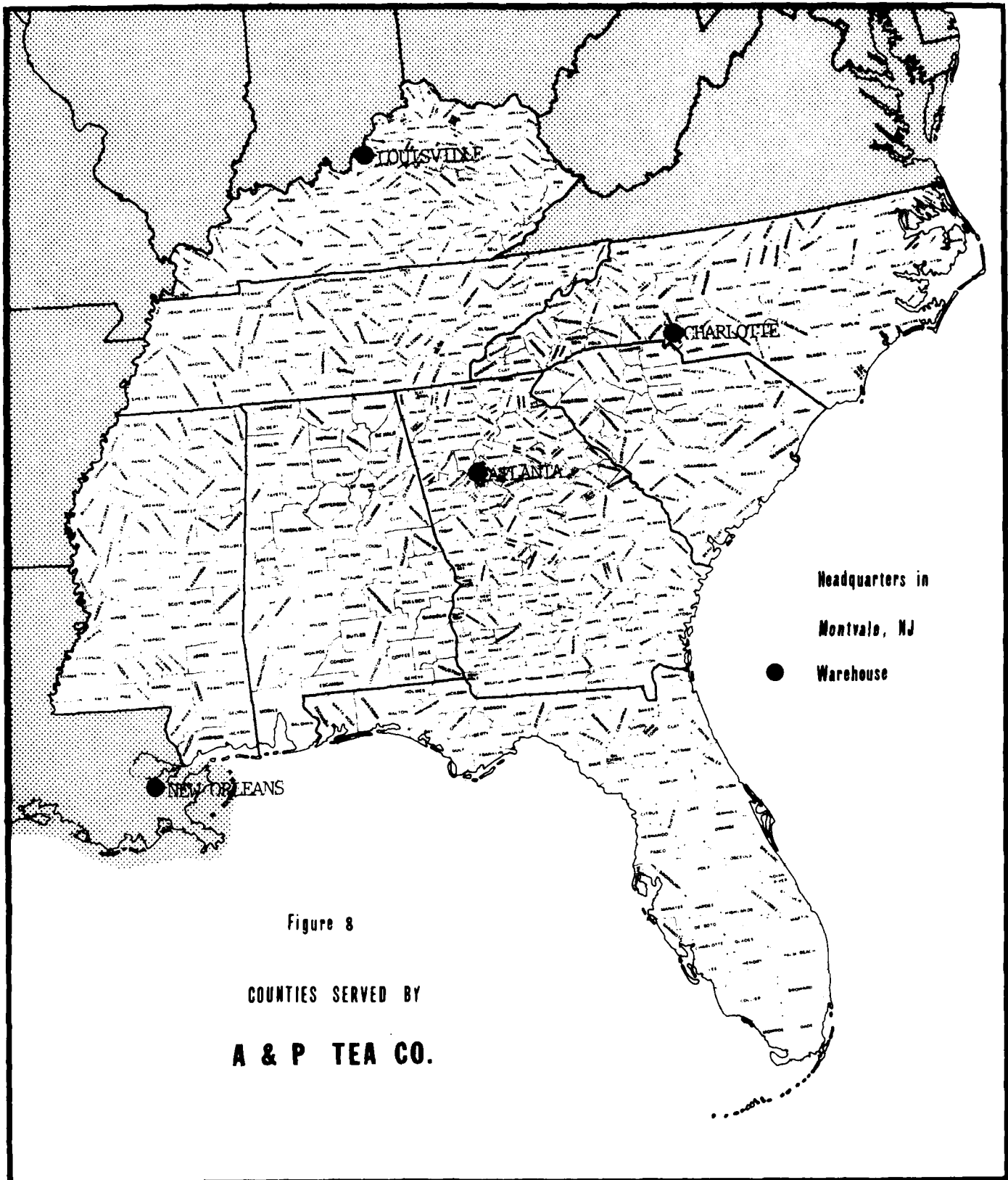


Figure 8

COUNTIES SERVED BY  
**A & P TEA CO.**

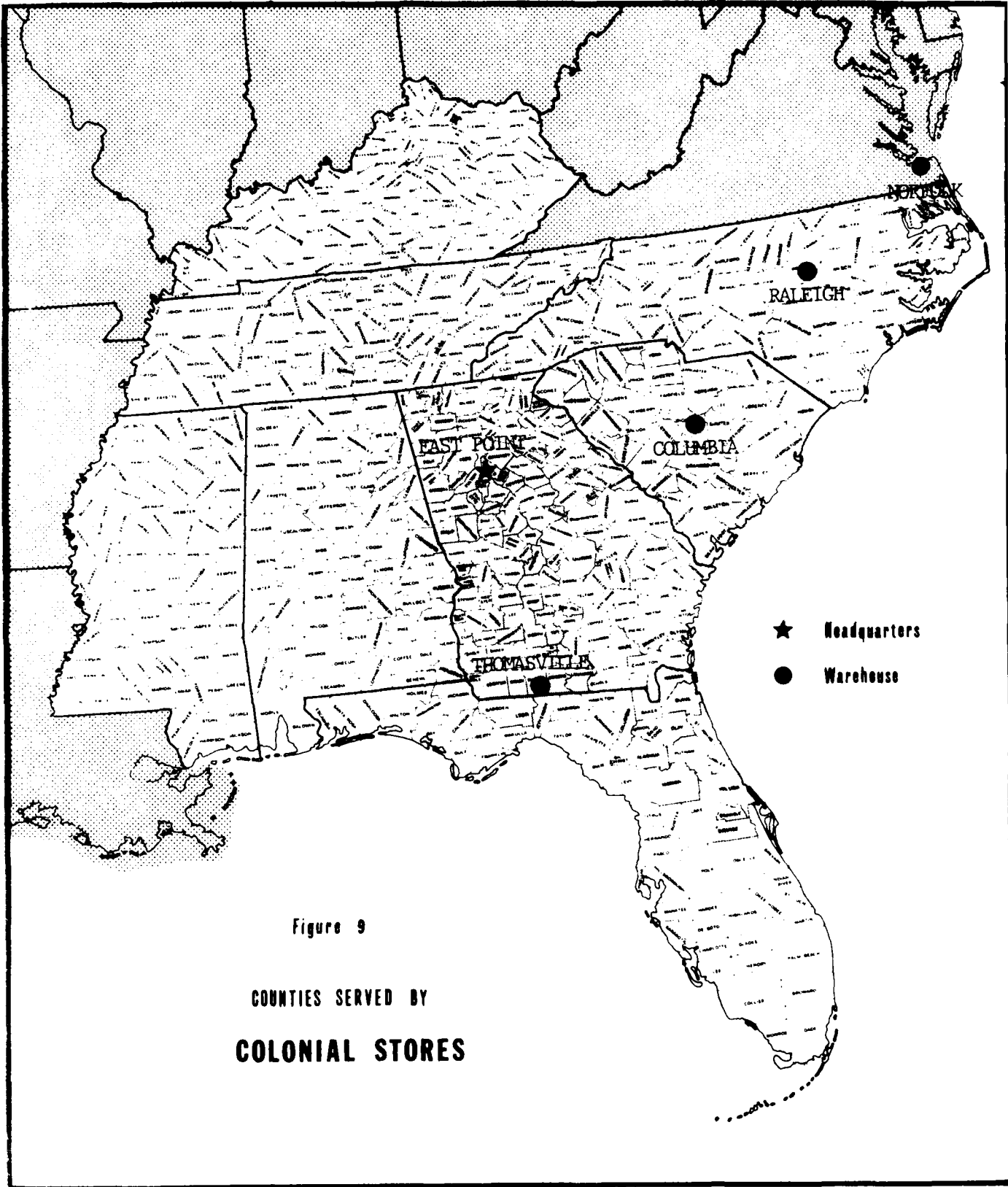
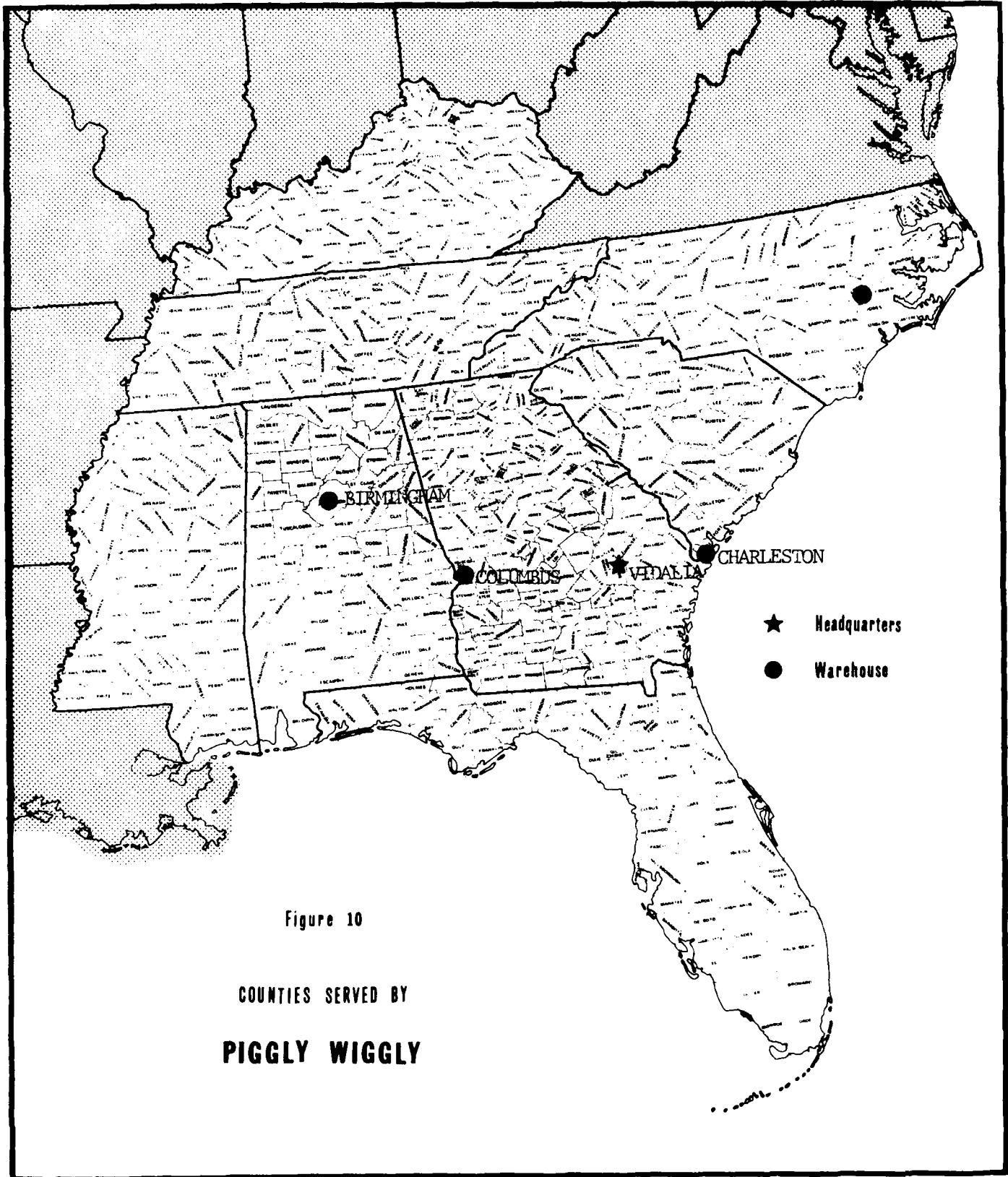


Figure 9  
COUNTIES SERVED BY  
COLONIAL STORES





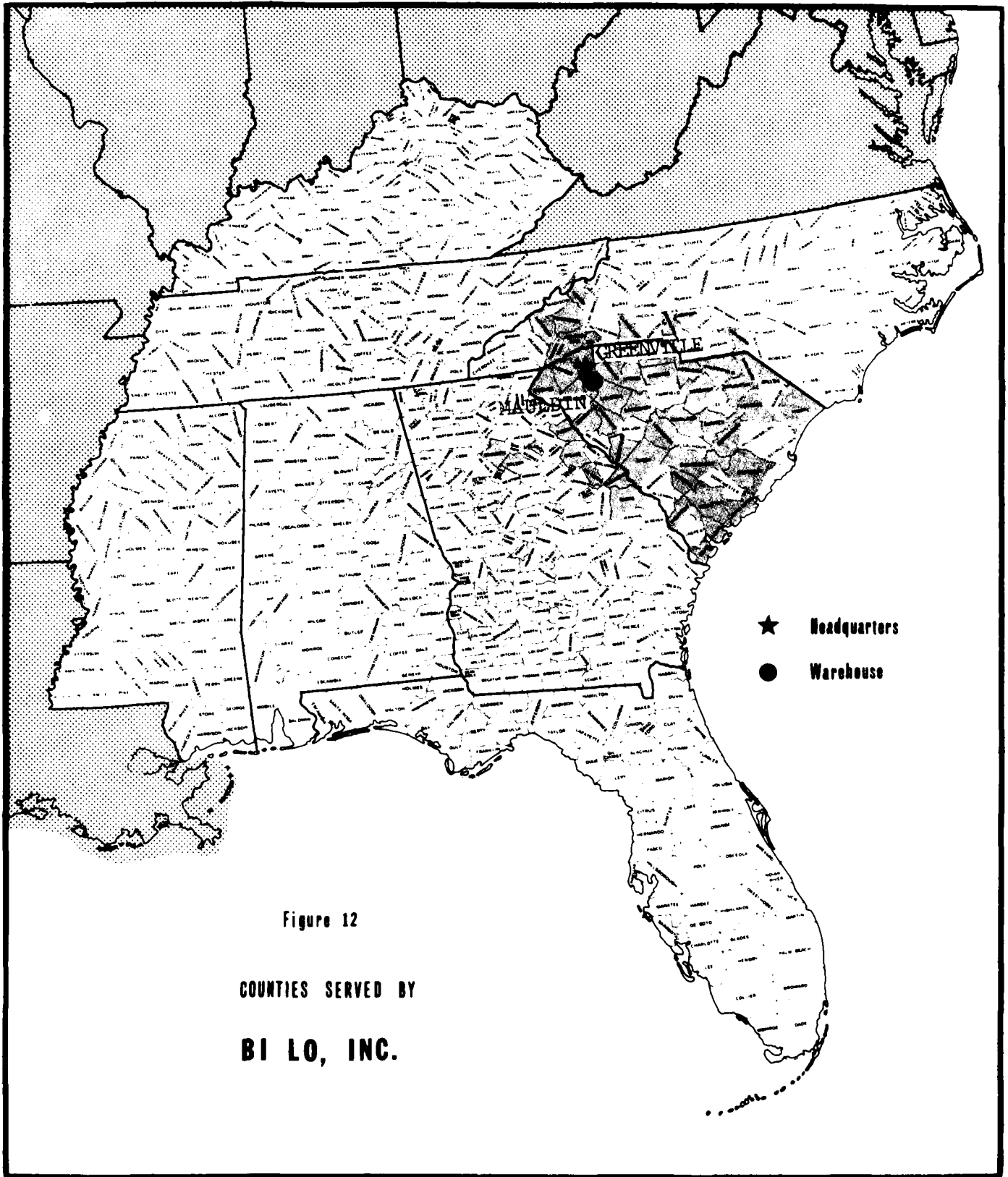


Figure 12

COUNTIES SERVED BY

**BI LO, INC.**

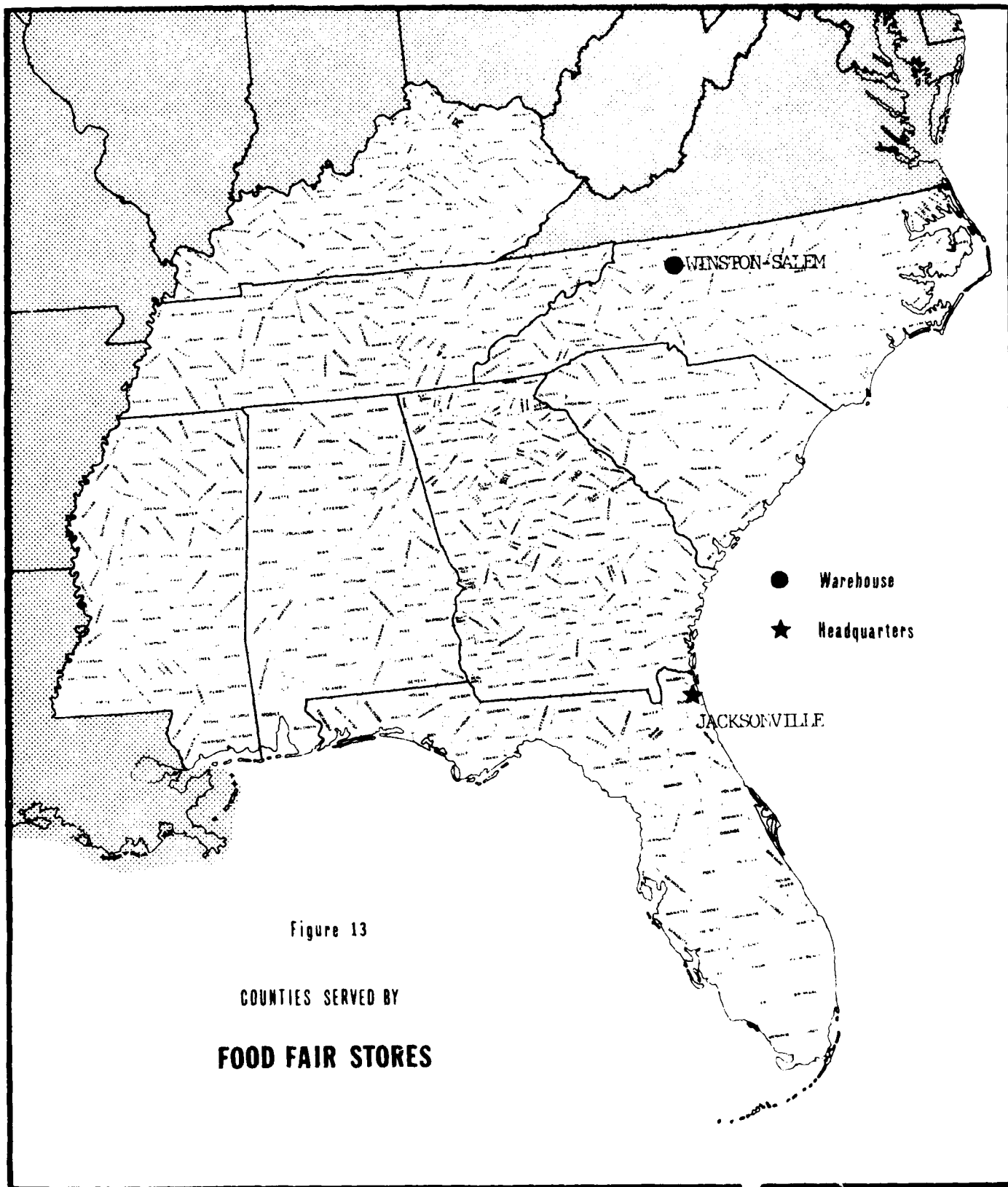


Figure 13

COUNTIES SERVED BY  
**FOOD FAIR STORES**

### III

#### DEVELOPMENT OF THE MODIFIED CRISIS RELOCATION FOOD DISTRIBUTION PATTERN

##### A. Assumptions

Since the focal point of the crisis relocation planning (CRP) process is the geographic entity comprising a designated risk area and its association host areas, the basic premise of this research component is that the risk area conglomerate should also serve as the focus for wholesale/retail food distribution modifications to support the relocated population. Briefly, the research approach rests on the following assumptions:

1. The populations of each of the 71 risk area conglomerates contained within the eight state region will not change under the provisions of CRP but will simply be redistributed.
2. The existing food distribution pattern is sufficient to feed the risk area conglomerates in their normal status.
3. If properly reconfigured and protected, the existing food distribution system will also be sufficient to feed risk area conglomerate populations relocated under the provisions of their CRP's.
4. No inventory of food distribution warehouse supplies is required since the food industry is well accustomed to meeting and anticipating seasonal fluctuations in demand.
5. Since a three-week relocation period has been assumed for planning purposes and conservative estimates of food availability within the wholesale to retail food distribution component have indicated a four-week supply is on hand at any time,<sup>10</sup> no significant

food shortages are anticipated, provided that all distribution warehouses and host area retail food outlets are kept in operation throughout the crisis period.

6. Food distribution modification instructions during the crisis period will be initiated at either the retail food outlet or wholesale distribution levels.
7. Supermarkets and designated congregate feeding or food storage facilities in the host areas will be the primary delivery points for wholesale food shipments. These delivery points will serve as local food distribution sources to supply the needs of congregate feeding establishments as identified and coordinated by the local host county plan.
8. Any discrepancies noticed in the adequacy of food redistribution due to unanticipated variations in the population redistribution (e.g., if a risk area population does not relocate exactly as indicated by its CRP) will be adjusted during the relocation period under the coordination of county, regional, and state emergency operations centers.
9. Counties which contain designated risk areas will have their food shipments eliminated or reduced during the crisis period according to the percentage of population relocated.
10. Counties which are designated as hosts for relocated populations will have their food shipments increased during the crisis period according to the percentage of population relocated.
11. Counties which are neither risk nor host will, in general, experience an unusual volume of food shipment.

### B. Data Requirements

The data requirements for development of the modified (i.e., crisis relocation) food distribution pattern are minimal. Basically, only two data sources were used.

First, the population allocations for the 71 risk area conglomerates in the eight state region were assembled. The identification of specific counties to be used as hosts for the relocated risk area population and the resulting crisis relocation population in each county is essential for determination of the food distribution modification. As changes are made in these allocations, (particularly when new host counties are added) the food support plans must also be changed. Data collection for this information was coordinated through the FEMA Region IV headquarters in Thomasville, Georgia.

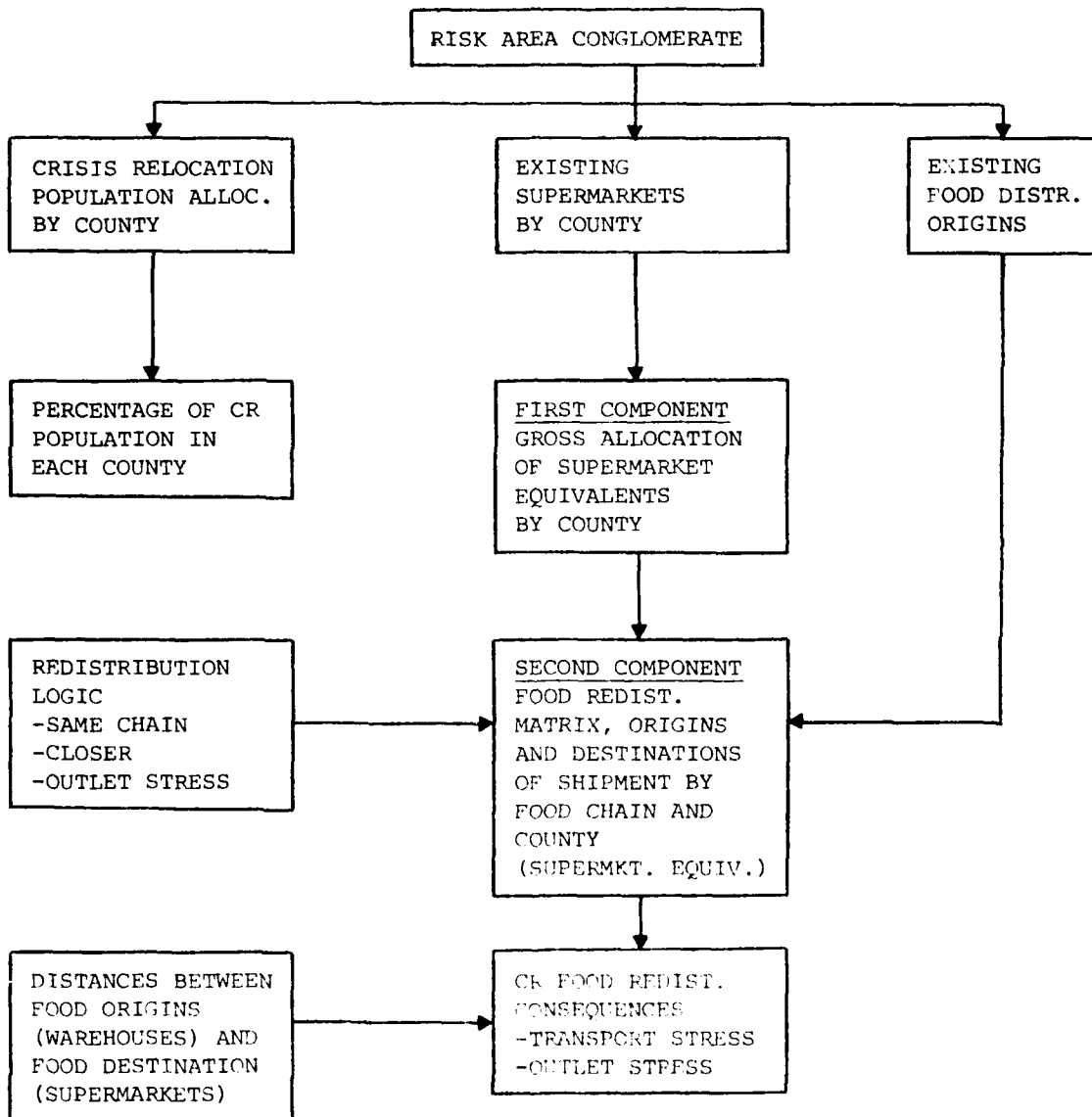
The second data component required for developing the modified food distribution plan is the existing food distribution pattern described in Chapter II and contained in Appendices A and B. These appendices list by county the number of supermarkets supplied by each of the various food distribution warehouses and total number of supermarkets for each county.

### C. Research Approach

The food redistribution procedure which was employed is shown in Figure 14. This procedure employs two allocation components in achieving the modified crisis relocation food distribution pattern. The first component is a gross allocation of the distribution of supermarket food supplies to each of the risk conglomerate counties, based on the crisis relocation population. The allocation is in terms of supermarket equivalents, an analysis unit which portrays the quantity and composition of food supply normally directed to a typical supermarket over a given period of time. The quantity of food shipment so described is "correct" in that the normal and crisis relocation

Figure 14

CRISIS RELOCATION PLANNING FOOD REDISTRIBUTION PROCEDURE



total food shipments are designed to be unchanged (i.e., except for the exclusion of non-essential goods) for each risk area conglomerate. Although the exact volume or weight of food shipment is unstated by this simplification, it is understood that this information is well known by the wholesale distributors and supermarket outlets themselves. The gross allocation component which was employed is summarized by the following procedural steps:

1. Determine the crisis relocation population totals for each county within a risk area conglomerate.
2. Compute the percentage of total conglomerate population in each of the counties during the crisis relocation period.
3. Determine the total number of supermarkets in the risk area conglomerate prior to crisis relocation (from Appendix B).
4. Assuming that the volume of food shipment will remain unchanged, allocate the number of crisis relocation supermarket equivalents to each county by applying the various county population percentages (step 2) to the total number of supermarkets (step 3).

Gross allocations of crisis relocation supermarket equivalents were produced using the above procedure on each of the 71 risk area conglomerates. The resulting allocations of supermarket equivalents are presented in Appendix C. For each county, the gross number of supermarket equivalents provides control totals for the second food distribution allocation component.

The purpose of the second food allocation component is to provide details on how the modified number of supermarket equivalents is achieved for each county. This is accomplished by identifying the sources of supply (i.e., wholesale distributors) for each county, the number of stores they normally serve in each county, and the modified shipments (i.e., in terms of supermarket

equivalents) that the distribution sources would be instructed to provide during the crisis relocation period. The allocation procedure which was employed for this component is summarized as follows:

1. Identify the distribution warehouse sources for supermarkets in each of the risk area conglomerate counties (from Appendix A).
2. Reallocate the food shipments from the set of distributors (generally from risk area outlets to host area outlets) so that the crisis relocation control totals of supermarket equivalents (developed in the initial allocation component) can be achieved for each county.
3. Develop allocation details by inspection of the existing shipment patterns, location of warehouse supply sources, and location of the outlets served by each supply source. Although the allocation procedure employed was largely subjective, the following principles were adopted to organize the effort.
  - a. Total volume of food shipment from each distribution source remained constant.
  - b. Distributors with outlets within risk area boundaries would be instructed to shift food shipments to their other outlets in host area counties (if such existed), otherwise it is assumed that these distributors could be instructed to ship directly to congregate feeding or food storage facilities which would be designated during detailed host area planning efforts.
  - c. In order to avoid unmanageable outlet stress, the maximum increase in volume of shipment to host area supermarkets was constrained to not exceed a ratio of three or four to one.<sup>11</sup>

Where increases of greater than four to one might be necessary due to scarcity of food outlets in the host area, it was assumed that the excess would be directed to congregate feeding facilities or other storage points.

- d. Distribution modifications were constrained so that each distributor would continue shipping only to its own supermarkets (except as noted above, where other storage facilities might be designated for direct shipment).
- e. Distribution modifications were made so as to shorten shipment distances and simplify crisis relocation routing (i.e., reduce transportation stress) wherever possible.

The intermediate and final outputs of the allocation procedure can be summarized by the following illustrations:

1. Food Distribution Matrix Depicting the Existing Food Distribution System:

	County 1 Existing No. of Supermarkets	County 2 Existing No. of Supermarkets	County 3 Existing No. of Supermarkets	Totals Existing No. of Supermarkets
Distributor 1	" "	" "	" "	" "
Distributor 2	" "	" "	" "	" "
Distributor 3	" "	" "	" "	" "
Distributor 4	" "	" "	" "	" "
Totals	Total	Total	Total	Grand Total Existing Super- markets in Risk Area Conglomerate

## 2. Gross Allocation of Supermarket Equivalents:

	County 1	County 2	County 3	Totals
Post CR Population	population (1)	population (2)	population (3)	Risk Area Conglomerate Total
Population Percentage	percent (1)	percent (2)	percent (3)	100%
Allocated Existing Supermarket Equivalents	percent (1) x total stores	percent (2) x total stores	percent (3) x total stores	Total Existing Supermarkets (from Matrix 1)

## 3. Food Distribution Matrix Depicting Control Totals for Reallocation Modification:

	County 1	County 2	County 3	Totals
Distributor 1	SE*(1,1)	SE (1,2)	SE (1,3)	Existing Supermarkets (from Matrix 1)
Distributor 2	SE (2,1)	SE (2,2)	SE (2,3)	"
Distributor 3	SE (3,1)	SE (3,2)	SE (3,3)	"
Distributor 4	SE (4,1)	SE (4,2)	SE (4,3)	"
Totals	Supermarket Equivalents (from Matrix 2)	Supermarket Equivalents (from Matrix 2)	Supermarket Equivalents (from Matrix 2)	Total Existing Supermarkets (from Matrix 1)

Where: SE (1,1) = Supermarket equivalents of modified food shipment from distributor 1 to county 1.

SE (2,1) = Supermarket equivalents of modified food shipment from distributor 2 to county 1, etc.

\*SE means supermarket equivalents.

D. Results

Utilizing the allocation procedures described above, modified food distribution patterns were readily obtained for the risk area conglomerates.

As noted before, the complete set of gross allocations of supermarket equivalents by risk area conglomerates and counties as determined by crisis relocation population are contained in Appendix C. A sample of the outputs produced under this gross allocation component is presented in Table 4.

Table 4

Allocation of Supermarkets by Crisis Relocation Population

County	Risk Area Conglomerate No. 3501 - Biloxi/Gulfport, Mississippi		Supermarkets	
	Crisis Relocation Population Number	Percent	Existing	Crisis Relocation
Harrison (risk)	0	0	27	0
Forrest	144,652	58.9	14	31
Hancock	33,786	13.7	4	7
Pearl River	48,702	19.8	6	11
Stone	18,581	7.6	2	4
Total	245,721	100.0	53	53

The complete set of detailed allocations of supermarket equivalent food shipments by individual distributor is presented for each of the FEMA Region IV risk area conglomerates in Appendix D. A sample of these outputs is shown in Table 5A & 5B.

The example illustrated in Tables 4, 5A, and 5B pertains to the Biloxi/Gulfport, Mississippi risk area conglomerate which consists of one risk and four host counties. During the crisis relocation period, the entire population of Harrison County has been assigned to host area congregate care facilities in Forrest, Hancock, Pearl River, and Stone Counties.

Table 5A

Existing Distribution of Supermarkets

Distributor & Location	Risk Area Conglomerate No. 3501 - Biloxi/Gulfport, Mississippi					Totals
	Harrison	Forrest	Hancock	Pearl River	Stone	
A & P Tea Co.: New Orleans, LA	5	1	1	0	0	7
Delchamps: Mobile, AL	4	2	0	1	0	7
Fleming Co., Inc.: Geneva, AL	1	0	0	0	1	2
Jitney Jungle Stores, Inc.: Jackson, MS	3	2	1	0	0	6
Lewis Bear Co., Inc.: Pensacola, FL	1	0	0	0	0	1
Lewis Grocer: Indianola, MS	3	2	0	2	1	8
Malone & Hyde: Monroe, LA	0	0	0	1	0	1
Malone & Hyde: Tupelo, MS	3	2	0	0	0	5
Merchants Cash Groc.: Pascagoula, MS	1	0	0	0	0	1
National Tea Co: New Orleans, LA	1	0	1	0	0	2
Russell Co.: Jackson, MS	0	3	0	1	0	4
Winn Dixie Stores, Inc.: New Orleans, LA	5	2	1	1	0	9
<b>Totals</b>	<b>27</b>	<b>14</b>	<b>4</b>	<b>6</b>	<b>2</b>	<b>53</b>

Table 5B

Crisis Relocation Allocation of Supermarkets

Distributor and Location	Risk Area Conglomerate No. 3501 - Biloxi/Gulfport, Mississippi					Totals
	Harrison	Forrest	Hancock	Pearl River	Stone	
A & P Tea Co.: New Orleans, LA	0	4	3	0	0	7
Delchamps: Mobile, AL	0	4	0	3	0	7
Fleming Co., Inc.: Geneva, AL	0	0	0	0	2	2
Jitney Jungle Stores, Inc.: Jackson, MS	0	5	1	0	0	6
Lewis Bear Co., Inc.: Pensacola, FL	0	0	0	1	0	1
Lewis Grocer: Indianola, MS	0	4	0	2	2	8
Malone & Hyde: Monroe, LA	0	0	0	1	0	1
Malone & Hyde: Tupelo, MS	0	5	0	0	0	5
Merchants Cash Groc.: Pascagoula, MS	0	1	0	0	0	1
National Tea Co.: New Orleans, LA	0	0	2	0	0	2
Russell Co.: Jackson, MS	0	3	0	1	0	4
Winn Dixie Stores, Inc.: New Orleans, LA	0	5	1	3	0	9
<b>Totals</b>	<b>0</b>	<b>31</b>	<b>7</b>	<b>11</b>	<b>4</b>	<b>53</b>

Under normal conditions, the population of these risk area conglomerate counties are served by a total of 53 supermarkets, distributed as follows: Harrison (27), Forrest (14), Hancock (4), Pearl River (6), and Stone (2). The gross allocation depicted in Table 4 distributes food shipment resources (measured in terms of supermarket equivalents) among the host counties in the conglomerate according to the percentage of total population planned to reside in each county during the crisis period. Thus, it can be seen that the 27 supermarkets inside Harrison County will not receive food shipment and that shipments to host county outlets will be increased by the equivalent volume of food normally destined for those 27 stores. The total shipment of food to the risk area conglomerate as a whole will remain unchanged.

Given the gross allocation of food shipment to support the crisis relocated population, Tables 5A and 5B identify a specific way that this redistribution can be achieved. Table 5A shows the existing sources of supply (wholesale distribution warehouses) and the number of supermarkets normally supplied by each of these sources in each county. Table 5B, constructed by applying the food allocation logic described earlier, identifies the modified food shipment details to be initiated during crisis relocation.

For example, the Atlantic and Pacific Tea Company (A&P) normally supplies five supermarkets inside the risk area from its New Orleans, Louisiana, warehouse. During the crisis relocation period, this warehouse would be instructed to redistribute the food normally sent to its five Harrison County stores to Forrest and Hancock Counties. The A&P outlet in Forrest County would receive the equivalent shipment volume of three of these risk area stores in addition to its normal food supply, for an overall increase in volume of approximately four to one. Similarly, the A&P outlet in Hancock County would receive an

additional two supermarket equivalents for an overall food shipment increase of approximately three to one.

Prior to the crisis relocation period, it is anticipated that both the distribution warehouse and the retail outlets would be informed as to the desired modification. During the crisis relocation period, any deficiencies or surpluses created by the approximate nature of the reallocation based on supermarket equivalents or created by people relocating in variance to their CRP allocation details would be adjusted by the designated crisis relocation management entity.

Upon completion of the normal and crisis relocation description of the food distribution pattern serving the eight FEMA Region IV states, the next phase of the research dealt with how to assess the consequences of the redistribution.

## ASSESSMENT OF FOOD REDISTRIBUTION CONSEQUENCES

A. Research Approach

Redistribution of the normal food distribution pattern to support the needs of a population relocated under the provisions of crisis relocation has the potential of creating at least two major adverse consequences. These consequences manifest themselves in stresses imposed upon host area retail food outlets due to increased volume of food shipment (i.e., outlet stress) and stresses imposed due to changes in shipment volume-distance relationships (i.e., transportation stress).

By using the research approach described, outlet stress has been reduced as a cause of major concern. According to previous FEMA research<sup>12</sup>, as long as volume increases at supermarket locations are less than three or four fold, they can be satisfactorily dealt with. By constraining food shipments to host area outlets to be no greater than four to one, with any excess shipments to be delivered directly to congregate feeding facilities or other designated host area storage points, the host area supermarkets are expected to function without unmanageable stress during the crisis relocation period.

Transportation stress, on the other hand, represents a more difficult consequence to analyze than retail outlet stress. Consequently, a great deal of effort has been expended in previous FEMA research to develop alternative models for transportation stress computation.<sup>13</sup> These various approaches to transportation stress have suffered from the following problems:

1. The most straightforward and conceptually simple method of transportation stress computation (called the Network Model in CPG2-8-2) required generally unavailable data inputs on the existing and reconfigured food distribution systems.

2. Surrogate methods of stress computation (based on population distribution and abstract area characteristics) operated with available data but provided only gross areawide approximations to transportation stress.
3. An inappropriate level of analysis.

Of the problems listed above, the first two effectively precluded the application of transportation stress factor analysis by any of the state NCP planning staffs in the southeastern region. The inappropriateness of the level of analysis employed in the previous research is due to its focus upon individual risk area conglomerates rather than regional food distribution patterns. If a food distributor serves retail outlets in many different cities (as is commonly the case) then any stress factor computed for that distributor on the basis of the relocation of the population of only one city is, at best, a partial representation of relocation consequences. While relocations away from a distributor's location increase transportation effort, it is also true that relocations which move populations closer to their food distribution sources reduce transportation effort. Thus, the net effect of the relocation strategy on a specific food distributor is unclear unless the entire distribution pattern of the distributor has been examined.

The above reasoning dictated the analysis unit for transportation stress factor modeling to be the entire distribution shed for each wholesale distribution warehouse. In order to illustrate the technique employed, the top ten food chains (in terms of annual sales volume in 1978) serving supermarket retail outlets in the eight southeastern states were selected. These ten distributors, previously identified in Table 3, account for 48% of the total supermarkets and 55% of the supermarket sales within the region.

Because of the quality of data produced in this research effort, a detailed assessment of transportation stress was made possible. The only supplementary data required were the travel distances between each wholesale distribution warehouse location and the counties containing retail outlets which were supplied by that warehouse (either under normal or crisis relocation conditions). These distances reflect actual highway network routings, and were determined from official state highway maps and atlases.<sup>14</sup>

Transportation stress factors were computed for each distribution warehouse location. In each case, the transportation stress factor was taken to be the ratio of crisis relocation transportation effort (i.e., equivalent store-miles) to normal transportation effort (store-miles). The formula which was used to determine the transportation stress factor (TSF) is as follows:

$$\text{TSF (i)} = \frac{\sum_{j=1}^n \text{Rij}' \text{dij}}{\sum_{j=1}^n \text{Rij} \text{dij}}$$

- Where: i = Specific wholesale distribution warehouse.  
 j = Counties supplied by i either prior to or after relocation.  
 Rij = The number of supermarkets served by i in county j prior to relocation.  
 Rij' = The number of supermarket equivalents allocated to county j and supplied by i after relocation.  
 dij = The road distance in miles between i and j.

When TSF(i) is less than 1, the food shipment transportation effort is actually made easier by relocation. When TSF(i) is equal to 1, the the food shipment transportation effort is unchanged. When TSF(i) is greater than 1, possible adverse transportation stress is present.

## B. Results

The complete set of transportation stress factors developed using the computational procedure described above are included in Appendix E.

These stress factors represent the impact of the food shipment redistribution shown in Appendix D on each of the wholesale distribution warehouses operated by the top ten food chains in the southeastern states.

The least stressed warehouse was Winn Dixie's Charlotte, North Carolina, facility, which had a stress factor of 0.893. The most highly stressed warehouse, also located in North Carolina, was Food Fair's Winston-Salem facility with a stress factor of 9.00.

In assessing the impact of modified food shipment patterns on each of the food distributors, it seemed reasonable to assume that the distributors might attempt to even out the stresses imposed on individual warehouses by redistributing their resources. At a minimum, this type of effort could consist of redeployment of trucks and drivers from least stressed to most stressed warehouses. For example, considering all of the Winn Dixie warehouses as a group produces an overall stress factor of 1.333. The set of overall stress factors for each of the top ten major food distributors in the southeastern states is given in Table 6.

More extensive efforts by the food distributors in response to the demands of a modified food shipment pattern might include changing the volume of food shipped from each of its warehouses so as to always serve host county retail outlets from the closest distribution point. Thus, the overall transportation stress factors given in Table 6 most likely represent conservative worst-case situations.

Table 6

Overall Transportation Stress:  
Top Ten (Southeastern States Only) Food Distributors

<u>Food Distributor</u>	<u>Transportation Stress Factors</u>
1. Winn-Dixie Stores, Inc.	1.333
2. Kroger Company	1.151
3. Publix Super Markets	1.048
4. Malone and Hyde, Inc.	1.234
5. A and P Tea Company	1.117
6. Colonial Stores	1.142
7. Piggly Wiggly	1.023
8. Merchants Distributors, Inc.	0.972
9. Bi Lo, Inc.	1.025
10. Food Fair Stores	1.036

FEMA planning guidelines concerning transportation system impacts provide the basis for estimating the need for additional drivers and equipment due to the imposition of transportation stress.<sup>15</sup> These guidelines indicate that additional drivers are not generally necessary for transportation stress factors less than 1.5, and additional equipment is not required for stress factors less than 2.2. Thus, an examination of the overall stress factors given in Table 6 would indicate that the food distribution modifications in the eight state region are readily obtainable with present food industry resources. None of the top ten food distributors would require any additional vehicles or drivers; i.e., if the distributors attempted to even out the stresses imposed on individual warehouses.

## APPLICATIONS TO REGIONAL AND STATE PLANNING

A. Regional Planning Issues

One of the most significant features of this research study is that it clearly demonstrates that food distribution patterns transcend state and regional boundaries and thus there is a need for food planning at a greater than state-level scale. There must be some degree of regional planning and even national planning to ensure an uninterrupted flow of priority foods between states during crisis relocation.

This research effort offers nuclear civil protection planners a feasible method for redistributing food during crisis relocation. It provides the basis for modifying state food annexes to include food distribution details which are consistent with regional food distribution patterns. In effect, the product of this research project is a generalized food redistribution plan applicable to all eight states in FEMA Region IV.

Yet the research product is not sufficiently comprehensive in scope to be a complete regional food plan. It addresses only food distribution from major warehouses to major retail outlets; there are other regional supply issues which transcend state boundaries and need to be addressed. For instance, despite estimates which have indicated that a four-week supply of food is on hand at any time and that this is sufficient for the anticipated duration of crisis relocation (i.e., three weeks), there is still a need for identifying and undertaking planning for the interstate food distribution system from food processors to major warehouses. There is no certainty that a crisis relocation situation will be limited to a three to four-week period. If crisis relocation should extend beyond this period, it is essential that the food processing industry

be kept operating and that shipments are continued to major warehouses. In many instances, food processors have a broader interstate food distribution pattern than do the major food warehouses discussed in this research report. This issue cannot be adequately addressed through state-level food planning. The question of whether shipments, either from food processors or warehouses, will continue to cross state lines during crisis relocation can be resolved only through regional and national perspectives, and through direct federal participation in planning for food support.

Other prominent regional issues relative to planning food supply relate to details of organization and management. There needs to be a regional food management plan and a regional organization plan in order to facilitate interstate food shipments during crisis relocation. No state can afford to run the risk, no matter how small or how accidental, that a neighboring state might close out a food source critical to its own relocated population. This could occur through such a simple matter as one state failing to list as a critical industry a food warehouse which might be a minor source of in-state supply yet be a major source of supply to another state. Then again, the matter of adding or readjusting risk area conglomerates in one state could have a significant effect on the transportation stress imposed on a food supplier located in another state, causing a ripple effect on transportation stress factors within the other state.

Issues such as these intensify the need for national policies to facilitate coordination between the various organizations involved in the food management system. The organizations most involved are the Federal Emergency Management Agency (FEMA) and the U. S. Department of Agriculture (USDA). These two federal organizations have the leadership roles in food planning

and management for crisis relocation; the interface between their respective sub-agencies becomes particularly critical in regard to food distribution. FEMA provides the direction and financial support for the planning and overall coordination of food support for crisis relocation, at least to the level of distribution from warehouses. The USDA is charged with the national leadership and direction of emergency programs pertaining to food sources and other matters; this includes providing direction to the production, processing, and wholesale distribution components of the food industry. There is some overlap.

At the national level, the Office of Intergovernmental Affairs (OIA) directs and coordinates USDA crisis preparedness and response activities. The OIA is the contact point for FEMA, and it works closely with other agencies having crisis relocation responsibilities. However, in regard to food distribution during crisis relocation it is at the regional level that USDA and FEMA need to coordinate the most. The USDA has a regional emergency staff in each of the federal regions to assist in carrying out departmental responsibilities. This is the USDA agency that has liaison responsibilities with the Region IV office of the FEMA. Here is where the coordination of interstate food supply is most crucial. One of these agencies must assume the primary role in developing regional management plans and guidelines for interstate distribution of food. There must be no question on the part of state agencies or the food distribution industry as to which agency is in charge of interstate planning and/or management for food supply.

At the state level of government it is the state emergency board (SEB) that is responsible for USDA crisis preparedness, including that of directing food shipments. This board generally coordinates its activities through state departments of agriculture, and acts as liaison between the USDA and other state agencies, such as the disaster preparedness agencies which have

primary responsibility for the preparation of state crisis relocation plans. If interstate food planning is adequately undertaken at the regional level then inter-agency coordination at the state level should be facilitated.

B. Implications to State Planning

Regional planning, such as that necessary for ensuring food distribution, is not easily accommodated within any of the components of the existing CRP process. Yet, it is an essential aspect of crisis relocation. Planning on a regionwide basis is necessary in order to provide the type of data and information which is critical to state planning (especially to a food support annex), host area planning, and most certainly organizational planning. Hence, it stands to reason that some type of regionwide planning (e.g., for food distribution) be initiated as early in the crisis relocation planning process as possible, and that this planning be incorporated into state food support appendixes.

In anticipation of this need, one element of this research study was to develop state-level food supplements for the eight states in FEMA Region IV. These supplements have been published separately from this research report. The supplements are intended to provide regionwide food distribution information and data which can be incorporated into existing state food annexes. In some states, this material should be readily assimilated, but in other states, because of the scope and content of the current food annex, it may be difficult to incorporate the supplements without making considerable change in the annexes themselves.

In addition to the state-specific data and information provided in this research report and its appendices, the supplements specifically address the major food distributors which are located in the state, the

dependencies of other states on these distributors, the total number of major distributors serving the state and their warehouse locations, and the major distributors serving each risk area in the state. The data and information on distributors serving risk area conglomerates includes maps depicting the location of major warehouses, tables which provide the number of supermarkets served by each distributor by risk area conglomerate, and tables showing the number of supermarkets served in both risk and host counties. The data and information provided in the supplements will allow the states to include before and after food shipment details into their food support annexes.

The state supplements also provide suggestions on how to incorporate the data and information developed by this research project into each individual and current state food support annex.

#### C. Organizational Planning

One of the most positive features of the food distribution approach developed in this research study is that it creates little stress on the existing management systems of the food distributors themselves. The approach leaves basically undisturbed the chain of command (i.e., the management system) for the food industry. Some degree of transportation and outlet stress is inevitable, however, this stress can be most effectively and efficiently absorbed if the management system of the food industry remains relatively unbroken. This should be a precept of good organizational planning for all critical industries, particularly those involved in food distribution. The food industry needs to be brought into the food distribution planning process early, because it is they who must execute a state food support plan for crisis relocation. Most of the major food industry warehouses supply outlets in two or more states. Some of the states (e.g.,

Kentucky, Mississippi) in FEMA Region IV are quite dependent on food shipments from out-of-state sources. In some states, risk area conglomerates are also highly dependent on sources located outside of Region IV. If effective and efficient distribution of food is expected, then considerable involvement of the food industry is needed during the preparatory phase of crisis relocation planning. In turn, the participation (and to some degree commitment) in the development of plans for distribution of food during crisis relocation by the food industry will depend on the direction provided by the public agencies most responsible for crisis relocation planning. This direction must be clear, and not diffused. Under the current approach to food distribution for crisis relocation (i.e., state by state), the food industry will be caught between intervening state demands. There must be national policies and regionwide plans and management systems to ensure food distribution during crisis relocation.

VI

EPILOGUE

The outputs of this research effort have presented a regional food planning methodology for data acquisition, reallocation of distribution patterns, and assessment of consequences at a scale considered to be appropriate for statewide crisis relocation planning. Within the regional focus provided by this research, individualized state food plan supplements have been prepared which recognize, identify, and incorporate the web of interstate food distribution interdependencies (see Appendix F for a discussion of each supplement). Since one of the desired outcomes of this research was to assist the various Federal Emergency Management Agency (FEMA) Region IV states in the implementation of these food distribution details within their existing crisis relocation plans, the principal investigators visited each of the states during the months of July and August 1980 to present the research findings, suggest implementation strategies, and solicit review comments. Each state meeting was generally attended by the following types of persons:

1. A member of the FSU research team.
2. A representative of FEMA Region IV.
3. The State NCP/CRP director and staff.
4. A regional representative of the USDA/ASCS.
5. A state department of agriculture representative.

In one state (Mississippi) the list of attendees was bolstered by the presence of a major food distribution representative (Jitney Jungle Stores, Inc. of Jackson, Mississippi). Reaction to the food plan supplements presented were extremely positive in every state visited. Further, the meetings served to confirm previously stated conclusions that prior to this research

effort, state agencies knew very little about the food distribution pattern and its interstate character. As the regional patterns of food distribution and interstate dependencies were revealed, however, this new knowledge prompted discussion of several recurring policy and planning issues.

Essentially, the recurring issues with respect to the food distribution system (i.e., which were identified by persons attending the state meetings) focused on three content areas:

1. Planning procedure, especially relating to acquisition, communication, and updating of food data.
2. System management and control.
3. Coordination.

Another salient feature of the discussion of issues at the state meetings involved the expression of concern for these issues at four levels of analysis.

1. Individual risk area conglomerate or food distribution entity.
2. State.
3. Regional grouping of states (e.g., FEMA Region IV) or multi-state food chain distribution sheds.
4. National or inter-regional considerations.

Within the planning/food data related issues discussed at the state meetings, the following questions seemed most prominent:

1. How should plan details be presented to the food industry?
2. How often should the data be updated?
3. Should the planning data be acquired on a regional basis for other FEMA regions as was done in this research, or should a national data set be obtained?
4. How could planning information be standardized and shared with other states in other regions?

System management and control issues tended to produce the following questions:

1. Who will ensure that food warehouses will continue to be supplied?
2. Who will ensure that all food warehouses and local outlets will continue to operate?
3. How can the continuation of interstate food shipments be maintained?
4. What are the respective roles of FEMA, the USDA, and the states in an emergency food management system?
5. How can guaranteed payment for food, rationing, security, etc., be achieved, and who should be responsible for these activities?

Issues of coordination which were identified tended to expand upon the basic research theme that because the food distribution system is multi-state in nature, these same states need to better coordinate their planning and food system management activities. Three of the more frequently expressed concerns were:

1. What interstate agreements are necessary to ensure effective coordination?
2. How will the various federal regions interact? Should there be a national plan for inter-regional coordination?
3. Should national policies be developed to guide inter-regional and interstate planning?

As a result of the research effort and subsequent discussions concerning its findings and implications, it is apparent that a number of answers have been provided--but a number of questions have been raised, as well. Clearly, the ability to effectively utilize the research findings is now dependent on subsequent attention to the issues listed above. Therefore, as a final recommendation, it is suggested that analysis of regional and national food

planning, management, coordination, and control policies appropriate to crisis relocation planning be given high priority for forthcoming FEMA/USDA research support decisions.

## FOOTNOTES

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