

ADOPTION OF IMPROVED IRRIGATION AND DRAINAGE REDUCTION TECHNOLOGIES IN THE WESTSIDE OF THE SAN JOAQUIN VALLEY

**Part III Report:
A Model of Farm Organization:
Levels of Complexity and Input Use**

prepared
under contract for the
Federal-State
**San Joaquin Valley
Drainage Program**

August 1990

This report presents the results of a study conducted for the Federal-State Interagency San Joaquin Valley Drainage Program. The purpose of the report is to provide the Drainage Program agencies with information for consideration in developing alternatives for agricultural drainage-water management. Publication of any findings or recommendations in this report should not be construed as representing the concurrence of the Program agencies. Also, mention of trade names or commercial products does not constitute agency endorsement or recommendation.

The San Joaquin Valley Drainage Program was established in mid-1984 as a cooperative effort of the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, and California Department of Water Resources. The purposes of the Program are to investigate the problems associated with the drainage of irrigated agricultural lands in the San Joaquin Valley and to formulate, evaluate, and recommend alternatives for the immediate and long-term management of those problems. Consistent with these purposes, Program objectives address the following key areas: (1) Public health, (2) surface- and ground-water resources, (3) agricultural productivity, and (4) fish and wildlife resources.

Inquiries concerning the San Joaquin Valley Drainage Program may be directed to:

San Joaquin Valley Drainage Program
2800 Cottage Way, Room W-2143
Sacramento, California 95825-1898

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2800 Cottage Way Room w-2143
Sacramento, CA 95825

by

Mark B. Campbell
Management Systems Research, Davis, CA 95616
Under U.S. Bureau of Reclamation
Contract 9-PG-20-03380

and

Ariel Dinar
University of California, Riverside, CA 92521
Under U.S. Bureau of Reclamation
Contract 9-PG-20-03010

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A MODEL OF FARM ORGANIZATION: LEVELS OF COMPLEXITY AND INPUT USE

Executive Summary

In a study investigating the adoption of irrigation and drainage reduction technologies, farms were grouped by organizational characteristics in order to account for differences with regard to input use. Empirical evidence suggests that larger farms are more likely to be early adopters. The common practice of classifying farms according to economic class was found to be inadequate for interpreting the effect of size on adoption behavior. Economic classifications are structured according to the firm's total output, while organizational classifications account for levels of management, labor, and land use as a function of output. Such a classification is thought to be more appropriate for the study of social and environmental problems.

A classification of farms predicated on the organizational characteristics of the firm was used as an alternative to output models which fail to account for differences between production systems and crops. Classes of farms based on organizational characteristics compose operational units using and producing similar quantities of inputs and outputs, respectively. In the study of adoption of technology, reference to both factors is crucial to interpreting the performance of farm classes.

The results of analyses of variance for discrete and continuous variables verify the presence of five farm classes identified by reference to organizational characteristics in the west side of the San Joaquin Valley of California. Variance within classes is less than the variance between classes for specific organizational features of the farm firm. In addition, income and acres farmed proved to be significant measures of difference with regard to organizational type.

Farm classes based on organizational characteristics can be used to

interpret differences between farming practices and adoption patterns in the Western San Joaquin Valley. Different practices can be understood in the context of an organizational dynamic. That is, we know more about farms which differ in terms of their adoption patterns of irrigation or drainage practices because organizational classification tells us more about the farms in each class than do classes based on input or output alone.

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A MODEL OF FARM ORGANIZATION: LEVELS OF COMPLEXITY AND INPUT USE

INTRODUCTION

In 1950 the U.S. Bureau of the Census used economic classifications "to segregate groups of farms that are somewhat alike in their characteristics and problems, to show the relative scale of operations and relative significance of different producing groups, and to make more meaningful the statistics regarding the characteristics and organization of agricultural production" (Census of Agriculture, 1950). For researchers in the post-war era concerned with the problems of poverty, underemployment, mechanization, the specialization of agricultural production, and the concentration of agricultural production on fewer farms. They found economic classes useful for comparing the effects of these conditions on different sizes of farms. The practice of organizing farms by the gross value of farm products sold benefited from the fact that income was readily assessable and represented "a common denominator for measuring the size of all regions and types of farms (Nikolitch & McKee, 1965, p 1548). Economic classifications, however, were susceptible to various threats to reliability and Validity. First, classes of farms based on the gross value of products sold were dependent upon transitory price and yield fluctuations weakening comparisons between years. Second, classes did not account for changes in input costs or the value of such inputs. Farms whose output was dependent upon purchased inputs were grouped with farms operating with low overhead. Most importantly, economic classifications could not identify specific groups of farms within classes (Welsch & Moore, 1965). Economic classes were composed through the aggregation of the data which ignored characteristic difference between farms within a class. Despite these limitations, economic classifications remain the touchstone for agricultural structural analysis today.

When using economic classes as a mean to compare farm performances,

Feder, Just and Zilberman (1985) argue that ,for example, the intensity of fertilizer and pesticide use shows a more confusing pattern of behavior between farms of different size. Schutjer and Van der Been (1977) reach a similar conclusion with regard to access to information.

Researcher seeking more robust descriptions of farms for the study of social and economic problems have sought alternative classifications which could illuminate differences between farms with regard to the use of resources (Kraft, Roth and Thielen, 1990). Farm classes based on input criteria, however, retained similar weaknesses as economic classes. In particular, they were devised by various quantitative methods (e.g. cluster analysis) which discounted the "day to day" operation of farms. Furthermore, there was nothing to assure homogeneity between groups of parameters or the ability to trace movements of groups between classes (Welsch & Moore, 1965). Intending to provide access to the conditions of farm production, input classifications failed to account for the most important input related to the size of the farm business -- management. Variations between the classes with regard to use of resource and ultimately the productive capacities of farms are inherently tied to management (Hurley, 1965). Economic classifications do not adequately distinguish different levels and systems of resource use within a group while input models do not address differences in on-farm efficiency and performance. Both types of classifications do not address the processes through which the organization produces its output.

In this report a classification of farms employing organizational characteristics of the farm firm is developed¹. The behavior of organizations indicates that such a classification can account for the farm's use of both input and output resources. An organizational classification provides an alternative to either output models which fail to account for differences between production systems and crops and input models which fail to account for differences in productivity. Classes of farms based on their organizational characteristics

¹We are indebted to comments provided to a previous version of this report by Kristi Branch, Norm Coontz, Stephen Kraft, Ted Napier, and Craig Stroh. The responsibility to its content is of course ours.

compose operational units using and producing similar quantities of inputs and outputs, respectively. In addition, an organizational classification intends to reflect the many processes within the organization including competition, control, centralization and cooperation. In the analysis of social, environmental, and economic problems, reference to these factors is crucial to interpreting the performance of farm classes.

In the following, a review of the relevant literature on organizational modeling is provided. Then farm organizational structure is discussed, followed by the model of organizational farm type suggested in this report. The organizational types are modified to the conditions in the San Joaquin Valley, and then statistically verified. The report is concluded and the potential use of the farm organization model is demonstrated.

MODELING ORGANIZATIONS

Early research in organizations, stimulated by Weber's analysis of bureaucracies, was undertaken in the fields of sociology and administrative science (Burns and Stalker, Whyte, Hage, Crozier, Thompson), management science (Taylor, Fayol, Urwick), and social psychology (Likert, McGregor, Argyris). The common thread unifying this was the search for generalities through which all organizations could be compared.

Organizations, defined externally as persons or groups having specific responsibilities and united for a particular purpose, are driven by economic, production, and social forces which are unaddressed by the work of these researchers. Contemporary models of organizational structure intend to address the deficiencies of functional representations. The organization's structure is described by these models to be composed of the very processes the organization undertakes in the formal allocation of work roles and the administrative mechanisms used to control and integrate the work activities of the organization's members (Child, 1972, p.4). In this sense, structure balances the various and at times opposing forces which stem from the organization's production activities (Chandler, 1962).

Pugh et al (1963) used Weber's formulations as a point of departure in isolating conceptually distinct elements of the bureaucratic structure. These variables formed clusters which he identified as organizational profiles. Mintzberg (1979) and others (Khandwalla, 1973; Ranson, et al, 1980) proposed that the variables of organizational structure² were locked together in an integrated system which formed a pattern of associations characteristic of different types of organizations. Through reference to the organization's profile the presence of one structural variable implied the presence of others. The organizational typologies of Burns and Stalker (1961), Mintzberg (1973, 1979),

² The nature of job roles, task and person specialization, work-group size, span of control, and the centralization of decision making are dimensions of organizational structure (Mintzberg, 1979).

Haas, Hall, and Johnson (1966), and Miller and Friesen (1977, 1978) demonstrate the tight conceptual and or empirical interdependency among structural variables. Today researchers rely on specific dimensions of the organization's structure to provide the link between the organization's productive system and the distribution of members to work roles within the organization. Attention to the size of the work unit, centralization of decision making, and other features of the organization serves to differentiate organizations with different roles and processes (Mintzberg, 1979).

THE STRUCTURAL DIMENSIONS OF FARM ORGANIZATIONS

Today's farms have responded to the changing circumstances of agricultural production and marketing through transformations in labor (Villarejo, 1988) and management (Havlicek, 1986; Hurley, 1965). These adjustments have supplanted those made through advanced technologies or crop types followed the green revolution of the 50's. Reference to the dimensions of organizations provided by labor and management now reveal greater variability between farms than reference to other factors. As a result, the study of farm organizations is directed to these two elements of the farm firm. In operational terms, labor shall refer to horizontal task specialization and management to vertical task specialization³. Task specialization is the degree of segmentation between work units or between individual jobs or positions. Work units are defined here as the components of the production process including the decision making unit, the managerial unit, the technical assistance unit, the production unit, and the support unit (Mintzberg, 1979).

Task specialization is measured in a hierarchical organization as the horizontal or vertical differentiation of units or positions. Horizontal task specialization, or the differentiation of work units or positions at the same level in the organization, may appear as "inter-unit task specialization" or "intra-unit task specialization". Inter-unit task specialization refers to the division of labor between operating units, each composed of operators who perform the basic work of the organization related to the production of products and services (Figure 1).

Intra-units task specialization refers to the differentiation of tasks between workers (Figure 2).

Vertical task specialization refers to the hierarchical segmentation of work units or positions and addresses the separation between the work of the

³ Other dimensional measures of labor and management could have been used including centralization of decision making, person specialization, and unit size. But ready access to information concerning distribution of work roles and job titles during data collection made task specialization and configuration practicable even with the limitations of these methods.

production unit and the administration of that work. Hierarchies, created by the vertical differentiation of the organization, are designed as a means to coordinate different units so that each progressive layer serves as a point of (process and input) merger for those beneath it.

In addition to horizontal and vertical task specialization, farm organizations may be distinguished by the different physical and processional arrangements between work units, job positions, and departments within the organization. These different arrangements establish the organization's configuration. While horizontal and vertical task specialization address the division of labor within the organization, configuration is concerned with the alignment of work units within the organization's production system. It is expressed in terms of job roles, task specialization, and the distribution of decision making responsibilities in the organization.

An organization's configuration may be described as either functional or market. Functional configurations combine work units or positions which perform similar tasks in order to accommodate interdependencies in their production activities. Such configurations enhance process or scale relationships between work units or positions (Mintzberg, 1979). Market configurations reflect an emphasis on work flow interdependencies so that work units or positions committed to a specific product, client, or location form a single production unit (Mintzberg, 1979). Market configurations fragment the organization into discrete production units each exhibiting intra-unit task specialization. Market configurations may then contain multiple production units containing duplicate functional units.

A MODEL OF ORGANIZATIONAL TYPES

The dimensions of organizational structure, task specialization and configuration, can be used to obtain six organization types. Table 1 provides the characteristics of these six types.

The Unified Organization

The Unified Organization (Figure 3) demonstrates the absence of either vertical or horizontal task specialization resulting in a market organization which lacks both functional specialization and the differentiation of labor and management. The organization is directed by the products it produces or the clients and locations it serves. Workers in the production unit share the tasks of production as well as decision making equally. Since its members lack task specialization the organization cannot be arranged according to work functions.

The Differentiated Organization

The Differentiated organization (Figure 4) results from the combination of task specialization and market specialization. The organization's production activity is divided between different production units or job roles. Individuals within the production unit now specialize in a single task as a means to increase performance (Griener, 1972). Horizontal task specialization acknowledges differences in personnel resources by matching individuals to the task.

The differentiated organization exhibits no vertical task specialization nor does it maintain a separation between a production unit and a managerial unit. This organization depends on the capacities of a professional work force to simultaneously direct the organization's decision making processes. In the absence of functionally distinct units, the differentiated organization is market oriented.

The Simple Hierarchical Organization

The Simple Hierarchical organization (Figure 5) is marked by the

specialization of work along the vertical dimension between the administration of the production unit and the unit's work. Simple Hierarchies adhere to a market configuration. The production unit is composed of members who may share the work equally. Because of the lack of complexity within the production unit the managerial unit is correspondingly less complex. The size to which the undifferentiated work force may grow while remaining under the control of one manager is a function of the manager's ability to oversee the unit's work.

In the simple hierarchy with horizontal task specialization managers do not coordinate the activities of functionally disparate units. Should differentiation of the production unit occur as a result of scale interdependencies, multiple production units, each performing the same work, would remain independently oriented to the same or different markets. These units would operate as independent firms lacking a common managerial interest.

The Simple Differentiated Hierarchical Organization

The Simple Differentiated Hierarchical Organization (Figure 6) differs from the simple hierarchical organization by the presence of a horizontal division of labor between members of the production unit. A management hierarchy is now committed to integrating the different tasks performed by members of the production unit. The span of control given to managers of task specialists in the simple differentiated hierarchy is determined by the breadth of these specialties and the skills of the workers. The more professional the members of the production unit, the less oversight required of the manager and, consequently, the wider the span of control (Mintzberg, 1979).

The simple differentiated hierarchical organization is market oriented for the same reasons as simple hierarchical organizations. A single level of management does not integrate multiple production units. Integration, whether provided by single or multiple levels of managers, is a characteristic of complex and market hierarchies.

The Complex Hierarchical Organization

In the Complex Hierarchical organization (Figure 7) the work of the production unit is divided by intra-unit task specialization, that is, between different production units performing different tasks. The managerial unit undergoes diversification in the form of inter-unit task specialization. Managerial responsibilities for the different production units are distributed between two or more managers, each overseeing the work of a different production unit.

Complex hierarchical organizations are functional and production units are constructed on the basis of work processes or scale. Workers who share the same tasks or employ the same processes form a common production unit. All irrigators or shop mechanics are supervised by the same manager. Similarly, workers whose tasks are interdependent and determined by scale will compose a single unit. For example, farms may assign one mechanic to every three tractors.

The presence of two or more managers creates the need for integration at a higher level of management. Managers who have assumed the expertise of the production units under their supervision are linked by another manager whose responsibility is *managing* managers. Above the management hierarchy is the decision making unit. Support and technical services may be connected to the management hierarchy or the decision making unit depending on their roles and the discretion of the organization.

The Market Hierarchical Organization

The Market Hierarchical organization (Figure 8) is composed of horizontal and vertical task specialization in both the production and managerial units and two or more production units organized according to market interests. Additional levels of management serve to direct the activities of separate simple hierarchies, each operating as a complete and independent firm. These separate units are oriented to different products, clients, or locations.

FARM TYPES IN THE SAN JOAQUIN VALLEY

In this paper the identification of farm types in the San Joaquin Valley is predicated on an organizational model which links economic, production, and social variables together. These farm types can be demonstrated by an analysis of variance which indicates that the variance for selected variables between classes is greater than the variance within these classes.

Farms in the San Joaquin Valley of California were assigned to one of the six farm types according to the structural characteristics they exhibited. Data on farm organizations were obtained from a sample of 285 farms on the west side of the valley (Dinar and Campbell, 1990). Twenty-two questions provided information on labor use, position titles, organizational charts, types of employee reimbursement, type of labor agreement such as contract versus direct hire, educational levels of managers, relationship between managers and owners, and residence of managers and owners.

Organizational charts or organigrams, while being indicative of flow of authority, provided information on the specialization of labor, the size and complexity of the managerial unit, and the organization's configuration. The titles of jobs appearing in the organigram were corroborated through wage and salary data.

Task specialization was measured horizontally as inter-unit and intra-unit task specialization. Vertical specialization was measured as the separation between a production unit and a managerial unit. The organization's configuration was determined to be market oriented or functional by examining the organigram. Those organizations which exhibited a division within the production unit which conformed to the principles of work process or scale economics were identified as functional configurations. Those organizations which structured their production units by reference to products, market locations, or clients were labelled as market configurations.

In the analysis of farm organizations only the decision making, managerial, and production units were considered. Support and technical services were too

cumbersome to measure using the methods available to us. The relationship between these organizational features and the organization's shape must represent an area for future analysis. With regard to labor, only part-time and full-time labor obtained through direct hire practices were considered. Direct hire labor was assumed to be associated with the organization's shape since it required the farm operator's involvement in task supervision and employee support. Contract labor was discounted under the assumption that this arrangement provided its own supervisory and administrative structures independent of that present in the farm organization. Selecting only directly hired labor as opposed to contract labor served to control the variability between farms by which the roles and organization of contract labor differed from farm to farm.

The distribution of farms⁴ according to the six farm types (Table 2) indicated that the majority of farms in the study area exhibited either a simple or a simple differentiated hierarchy. Forty-five percent (45%) of all farms were of this first type while twenty percent (20%) were of the second type. Seventeen percent (17%) of all farms were found to be complex hierarchies and seven percent (7%) were market-based hierarchies. Ten percent (10%) of all farms were found to be unified structures exhibiting the characteristics of the subsistence family farm. There were only three observations of the differentiated farm in the study area representing approximately one percent (1%) of all farms studied.

Identifying farms according to task specialization and configuration from the data set revealed variations in organizational structure within farm types. All six farm organizations except the differentiated organization existed in the study area. However, only the unified farm organization fit the model precisely.

⁴ Ten observations were omitted due to the difficulty in assigning them to a farm type. Reference to income and acreage totals as well as farm characteristics gave no indications that these observations were grouped uniformly.

EMPIRICAL SPECIFICATIONS OF FARM TYPES IN THE SAN JOAQUIN VALLEY

Farms which contained one or more individuals sharing the work of the farm matched the description of the **unified organization** (Figure 3). Members of the unified organization provided the work of all five of the organization's operational units. That is, members shared equally in the production, the management, the decision making, the technical assistance, and the support activities. Technical assistance corresponded to the expertise required to operate machinery or determine pest control strategies while support services included clerical work, bookkeeping, communications, marketing services, etc. Farms classified as unified organizations were commonly family owned and operated so that the different elements of the production process were provided cooperatively and with a shared commitment to the outputs of the farm.

Individuals who operated farms alone were classified as unified organizations if they performed the work of all these units. This was made possible by the limited scale of the operation or by the use of contract labor. As we have mentioned, this type of labor provided its own administration and did not require the owner/operator to diversify his duties.

The role of women in performing the tasks of decision making or management made it difficult to classify certain farms. Farms in the study area did not formally acknowledge the duties of women in the organigram. Such farms were determined to be unified organizations. Those which did account for the different task assignments of family members by different job titles were classified as **differentiated organizations**.

Differentiated farm organizations exhibited inter-unit task specialization between members of the production unit. These farms differentiated the work of the production unit according to the task assignments identified by their job titles. Differentiated farm organizations depend on the coincidence of the equal distribution of decision making responsibilities and separation of task duties. Farms which accomplish this feat must determine a method of rotating the

decision making responsibilities or coordinating individual tasks. The Differentiated farm organization was not found in the San Joaquin Valley for the simple fact that such a structure was either incompatible with the production demands of farming in that area or the basic model was itself inappropriate. An organization which includes several individuals each performing different, unsupervised tasks implies the members of the organization are professionals whose work is organized by task training or socialization (Mintzberg, 1979). Among farm employees, only the technical and support staff approach this model. Since neither were considered in assigning farms to types, no differentiated farms were found.

The **simple hierarchical organization** marked the emergence of a decision making/managerial function distinct from the production function. Task assignments were unspecified in the production unit. The shape of the simple hierarchy reflected the vertical specialization of work between the decision making/ managerial unit and the production unit. Support and technical services were separated from the production and decision making/managerial units in the simple hierarchy and provided by farm personnel or purchased through a fee-for-service arrangements (Figure 7). Among simple hierarchical farms in the San Joaquin Valley, the responsibilities of decision making and management roles were often distributed between two or more persons while labor was provided on a part-time or full-time basis or by family members.

Many simple hierarchical farms introduced two or more levels of management. Owners who maintained decision making responsibilities often appointed a manager to supervise the labor of the production unit. This unit contained part-time workers, full-time workers, or the combination of both. Family ownership often enabled family members, usually sons, to assume the role of managers. In the case of absentee ownership, the management hierarchy was embellished to serve this purpose. Management companies which operated farms for absentee owners utilized this basic structure. As the number of farms under their management grew, however, these firms evolved into complex hierarchies.

The **simple differentiated hierarchy** differed from the simple hierarchy

only in the fact that work of the production unit was differentiated according to task specialization. Workers assumed discrete task assignments. The precursory simple differentiated hierarchy found in the San Joaquin Valley involved a decision making/ managerial unit overseeing the work of a single specialized role. For reasons of scale the first specialized task assignment to evolve on the farm was that of the irrigator. Irrigators were often hired during the growing season on a part-time basis and paid piece rate or an hourly wage. The remainder of the farm's work was accomplished by contract laborers.

As the volume and complexity of production increased, more task specialties appeared. Employees began to work full-time in their areas of specialization and the decision making/ management unit divided into two distinct units. Families assigned the managerial function to younger family members.

The use of non-family managers did not deprive the decision makers of contact with the production unit. However, this link varied from farm to farm as a function of the farm's production activities or the experience of the owner. The responsibilities of the managerial unit were ameliorated by various arrangements which placed unspecialized labor under the control of a specialized worker. These structural alignments differed with regard to the number of unspecialized persons supervised in this manner.

The **complex hierarchical organization** exhibited horizontal task specialization in both the production and the managerial units. Individuals were specialized with relation to their work roles. Task specialization in the production unit required a corresponding specialization among managers who were responsible to oversee portions of the entire production process. Organizations structured by work processes were functional and required multiple managerial levels to coordinate the different functional assignments of the specialized production units or positions.

Farms operated by families assigned managerial responsibilities to younger family members while ownership and decision making remained in the hands of senior family members. Large complex hierarchical farms used a manager to coordinate the specialized assignments of two or more managers. The number

of management positions along the vertical and horizontal axis determined the complexity of the managerial hierarchy. The greater the number of production units the greater the number of first line managers and those above them managing their work. Limits to either the number of workers or managers that were supervised by any one person was a function of the type of work being done and the expertise required to perform it.

The **market hierarchical organization** possessed the same fundamental qualities as the complex hierarchy. The production unit, however, was characterized by intra-unit task specialization. Workers were divided between two or more production units each directed to a different market orientation. Production units contained the same functional roles which were themselves separated from other similar roles. Above the different production units was a hierarchy of managers who supervised the activities of one or more production units.

Market hierarchical farms with two or more production units were committed to different crops, clients, or locations. Different market units contained managers and laborers whose expertise was associated with the unit's market orientation. In several cases the market hierarchy had adopted a functional production unit while maintaining a market managerial structure. Such firms duplicated not only task assignments but the resources needed for both production units. Due to scale inefficiencies, only the largest organizations or those dispersed geographically were able to adopt this structure.

Support and technical services were assigned to each individual production unit or shared by the organization as a common resource according to the importance and specialization of each of these services. However, technical services committed to a single market were not usefully employed by production units operating in other markets.

Although dairy farms defied many of the proposed traits of the market hierarchy they were classified as such because of the different market structures present in the farm operation. While the distribution of labor between production units, the dedication of resources, and the responsibilities of managers was determined by the farms commitment to both dairy and field

products, the managerial hierarchies were limited and unsophisticated unlike many other market hierarchies. As a function of the family ownership, dairy farms distributed the different responsibilities of the dairy and field production to different family members. Therefore, a single manager was also both the decision maker and supervisor of his production unit.

VERIFICATION OF FARM TYPES

A number of discrete and continuous variables were chosen to test the ability of organizational structure to distinguish and identify farm types in the San Joaquin Valley. The variables selected were consistent with existing farm classifications found in the U.S. Agricultural Census or with organizational descriptions of farm production systems. An analysis of variance (ANOVA) was used to assess the distribution of these variables across the six types of farm organizations identified. Table 3 presents the results of an analysis of variance for the mean values of the discrete variables and Table 4 provides the results for continuous variables. Means with the same letter suffix for a given variable are not significantly different. A correlation analysis showed that the variables chosen for this analysis were not correlated among themselves.

Type of ownership of the farm organization often differed from ownership of the farm as in the case of leased or rented lands or those farms operated under a management agreement. For that reason, type of ownership referred to the control of labor and not land or capital. Ten categories of ownership were recorded as -- Individual; Joint with Spouse; Family Multiple; Non-Family Corporation (10 or less members); Non-Family Corporation (11 or more members); Trust; Federal, State, or local government; Non-Profit; Partnership; and Family Corporation. Responses were scored from 1 to 10 according to ownership category⁵. Gross Income was taken to be the annual income derived from agricultural production for the farm. It was recorded by the following income categories derived from the US Agricultural Census -- 2,500 - 10,000; 10,000 - 20,000; 20,000 - 40,000; 40,000 - 100,000; 100,000 - 250,000; 250,000 - 500,000; and, 500,000-plus. Responses were scored from one to seven with respect to income category.

Relationship of managers to the land owner was taken to mean any familial relationship, including marital, between the owner of the farm and the manager.

⁵ There was no intent to equate numerical scores assigned for analytic purposes to the variables Types of Ownership or Type of Production Financing with different practices.

It was recorded as a binary score (yes=1; no=0) for all managers. Residence of the owner was recorded as a binary score, yes=1 for on-farm residency and no=0 for off-farm residency. Production Cost Financing related to the type of production financing used by the farm. Respondents were able to select from five categories -- Cash Only; Bank; PCA/FLB/FmHA; Private; and, Production Coops. A sixth category for other responses was provided. A score of 0 to 5 was assigned according to the category of financing.

In the analysis of continuous variables Acres Farmed was defined as all land farmed by the respondent during the 1988 crop year. Years of computer use recorded the number of years the subject farm had used a computer for any farm-related purpose. Years of Agricultural Experience reported on the number of years managers had worked in agriculture in any capacity. Full-time Employees was the number of persons working full-time in agricultural production during the agricultural season of 1988. It did not include managers and owners or the support and technical staffs of the farm. Part-time Employees included all persons employed in agricultural activities but not on a full-time basis for the 1988 agricultural season.

We have determined that the number of observations and the behavior of the differentiated farm organization were insignificant when compared to the other five farm types. Differences in the performance of this farm type across the discrete and continuous variables chosen for analysis did not allow us to collapse this type into one of the remaining five types. As a result we have eliminated this type of farm organization from our discussion.

In the analysis of discrete variables, the use of farm ownership indicates no significant difference between the Simple organization, the Simple Differentiated organization and the Complex Hierarchical organization (Table 3). Accordingly, reference to type of ownership produces three viable classes of farm organization loosely corresponding to levels of organizational complexity. Organizations with different degrees of complexity exhibit different types of ownership. Reference to the data indicated that the unified organization is associated with family or sole proprietorship and that the market hierarchy is not. The simple, simple differentiated, and complex hierarchical

organizations fall somewhere in between these values with regard to type of ownership.

Gross income significantly distinguished four of the five farm types. Earnings for the unified farm were different from those of the simple hierarchy, the simple differentiated hierarchy, and the complex/market hierarchies -- these latter two being nearly similar in their earnings. The simple differentiated hierarchy stands between the simple hierarchy and the complex/market hierarchies. Organizational complexity appears to be strongly associated with the gross income of the farm.

The relationship of managers to owners was unsuccessful in differentiating any of the five farm organizations. The residency of the owner, however, successfully distinguished the unified farm organization from the simple, simple differentiated, and market hierarchies. Each of these was differentiated from the complex hierarchy according to the owner's residence. Data for the unified farm organization indicated that owners lived on the farm while owners of the complex organization were less likely to live on the farm. Market hierarchies may be artificially grouped with simple and simple differentiated hierarchies here because of the inclusion of dairy farms in this farm type. Dairy farms in the study area were predominately family owned. Type of production financing selected by the farm organization proved to be insignificant in identifying any farm types.

In the analysis of continuous variables, acres farmed indicated that farm size was significant in discriminating all farms except the complex and market hierarchies. These two farm organizations were roughly equivalent in terms of farmed land. Years of computer use successfully distinguished all farms types. The years of agricultural experience was not significant in distinguishing any of the five farm types. The number of full-time and part-time employees significantly identified all five types of farms. Organizational complexity is associated with all the continuous variables selected except years of agricultural experience. In another analysis, not reported here, the years of education for manager proved insignificant in distinguishing any of the five farm types.

The values for the F-test reported for both discrete and continuous variables indicate that these variables were statistically valid indicators of difference between the five farm types found in the west side of the San Joaquin Valley.

DISCUSSION

According to the theory of organizations presented here, we expect that the variance within classes for specific organizational variables will be less than the the variance between them. The organizational variables included in our analysis of farm types were the Relationship of Manager to Owner, Years of Computer Use, Years of Agricultural Experience for Managers, and Number of Full and Part-Time Employees. The relationship of managers to owners is related to the distribution of decision making and managerial responsibilities on the farm when family ties serve as criteria for these roles. Likewise it may affect the horizontal division of labor if family members express preferences for selected task assignments. The years of computer use is taken as a proxy for the farm's technological level. Farms with a higher level of task specialization are able to incorporate more sophisticated production systems. Years of agricultural experience is similarly related to complexity. The more complex the organization, the more task specialization it requires to accomplish its goals. Greater task specialization is a corollary of skills and experience, so that the more differentiated organization exhibits a higher level of experience among managers. Finally, the number of full and part-time employees is related to the organization's need for managers. Intra-group task specialization is a function of the span of control exercised by managers upon employees.

Reference to Table 3 and 4 indicates the performance of these organizational variables in identifying farm types. Family relations proved to be insignificant among farms in the study area. Elements of the organization which were predicted to be associated with family involvement, including horizontal and vertical complexity, were not influenced by the relationship of the manager to the owner. Years of computer use clearly distinguished farms with regard to their use of technologies. Organizational complexity is strongly associated with the use of technology as predicted by the organizational model. The years of agricultural experience claimed by decision makers was important for the most complex organizations only. The managerial demands (or preferences) of these

organizations required managers and owners with similar backgrounds in agriculture. Finally, farm labor was associated with organizational complexity as expected. The larger the work force the more the organization reflected task specialization and line management.

Other organizational variables included the type of ownership and residency of owners. Neither of these variables was able to differentiate all of the six proposed farm types. Instead the simple, simple differentiated, and complex hierarchies were grouped together by type of ownership and the simple, simple differentiated, and market hierarchies grouped when residency was considered.

With regard to input values, the five farm types were successfully distinguished by their use of land, technology, and labor. The use of capital and experience, however, was not significantly different between the five farm types. Gross income as an indicator of production capacity successfully distinguished four of the five farm types.

The mixed success of input, output, and organizational values in distinguishing farms is a function of the complex interaction of these variables. We have suggested that the use of any one of these variables alone would only partially reflect the distribution of farm types in the study setting. In place of income levels or acreage, we have offered farm organization structure as an alternative method of grouping farms. Organization types, constructed by reference to two organizational variables, labor and management, successfully identified variations in input and output use for which uni-dimensional classifications failed to account.

Typologies based on organizational theory will evince correlations with other variables because theories intend to link variables. An organizational typology allows us to anticipate lower rates of technology use among unified farms than among complex hierarchies because the unified farm is less sophisticated. With the use of uni-dimensional descriptions of farms we can make these assessments.

Farm classes based on organizational characteristics can be used to interpret differences between farming practices and adoption patterns in the Western San Joaquin Valley. Different practices can be understood in the context of an

organizational dynamic. That is, we know more about farms which differ in terms of their adoption patterns of irrigation or drainage practices because organizational classification tells us more about the farms in each class than do classes based on input or output alone. Part II of this report (to be completed later) shall apply the classification scheme presented here in explaining different rates and strategies used in the adoption process.

REFERENCES

- Burns, Tom and G. Stalker. *The Management of Innovation*. London: Tavistock. 1961.
- Chandler, A.D. *Strategy and Structure*. MIT Press. 1962.
- Child, John. "Predicting and Understanding Organizational Structure". *Admin. Sci. Quart.* 18 (1973) pp. 168-185.
- Dinar, A. and Mark B. Campbell. "Adoption of Improved Irrigation and Drainage Technologies in the Westside of the San Joaquin Valley, Report 1. San Joaquin Valley Drainage Program. 1990.
- Feder, Gershon, Richard Just and David Zilberman, "Adoption of Agricultural Innovations in Developing Countries: A Survey". *Econ. Development and Cultural Change*. No. 33,1985. pp. 255-298.
- Haas, J.E., R.E. Hall, and N.J. Johnson. "Toward an Empirically Derived Taxonomy of Organizations". In R.V. Bowers (ed) *Studies on Behavior in Organizations*. pp. 157-180. Athens: University of Georgia. 1966.
- Havlicek, Joseph Jr.. "Megatrends Affecting Agriculture: Implications for Agricultural Economics". *Amer. Journal of Ag. Econ.* 68:4-5. Nov.-Dec. 1986. pp. 1054-1064.
- Hurley, Ray. "Problems Relating to Criteria for Classifications of Farms". *Journal of Farm Economics*. Vol. 47, No. 4. Nov. 1965 pp. 1565-1571.
- Khandwalla, P.N. "Viable and Effective Organizational Design of Firms". *Academy of Management Journal*. Vol.16, No. 3. Sept. 1973. pp. 481-495.
- Kraft, Steven, E., Paul L. Roth and Angela C. Thielen, *Soil Conservation as a Goal among Farmers, Results of a Survey and a Cluster Analysis*. *Journal of Soil and Water Conservation*, (in Press), 1990.
- Miller, Danny and Peter Friesen. "Strategy making in Context: Ten Empirical Archetype". *J. of Management Studies* 14, 1977. pp. 251-280.
- "Archetype of Strategy Formulation". *Management Science* 24, 1978. pp. 921-933.

- Mintzberg, H. *The Structuring of Organizations: A Synthesis of the Research*. Prentice-Hall, Inc. Englewood Cliffs, N.J. 1979.
- "Strategy Making in Three Modes". *California Management Rev.* Winter, 1973. pp. 44-53.
- Nikolitch, Radjole and Dean E. McKee. "The Contribution of Classification of Farms". *Journal of Farm Economics*. Vol. 47, No. 4, Nov. 1965. pp. 1545-1554.
- Pugh, D.S., D.J. Hickson, C.R. Hinings, K.M. McDonald, C. Turner, and T. Lupton. "A Conceptual Scheme for Organizational Analysis". *Adm. Sci. Quart.* 8, 1963. pp. 289-315.
- Pugh, D.S., D.J. Hickson, C.R. Hinings, and C. Turner. "Dimensions of Organization Structure". *Adm. Sci. Quart.* 13, 1963. pp. 65-105.
- Pugh, D.S., D.J. Hickson, and C.R. Hinings. "An Empirical Taxonomy of Structures of Work Organizations". *Adm. Sci. Quart.* 14, 1969. pp. 115-126.
- Ranson, Stewart, Bob Hinings, and Royston Greenwood. "The Structuring of Organizational Structure". *Adm. Sci. Quart.* 25, 1980. pp. 1-17.
- SAS, SAS/STAT™ User's Guide Release 6.03 Edition. SAS Institute Inc. SAS Circle Box 8000, Cary, NC.
- Schutjer, W. and M. Vander Been. "Economic Constraints on Agricultural Technology Adoption in Developing Countries". U.S. Agency for International Development, Occasional Paper No. 5 Washington, D.C. USAID. 1977.
- U.S. Census of Agriculture. Volume II, Chapter XII, p. 1109. 1950.
- Villarejo, Don. "Farm Restructuring and Employment in California Agriculture". *Farm Labor and Rural Poverty*, Working Paper #1. California Institute for Rural Studies. February, 1989.
- Welsch, Delane E. and Donald S. Moore. "Problems and Limitations Due to Criteria Used for Economic Classifications of Farms". *Journal of Farm Economics*, Vol. 47, No. 4, 1965. pp. 1555-1564.

Table 1: Farm organization structures characteristics

		Organizational type					
		Unified	Differentiated	Simple Hierarchy	Simple Differentiated Hierarchy	Complex Hierarchy	Market Heirarchy
		None	In production unit	None	In production unit	In management unit	In management & production units
		Horizontal					
		Intra-unit	None	None	None	Between managers & production units	Between managers & production units
		Vertical	None	None	Between decision making, management & production units	Between decision making, management & production units	Between decision making, management & production units
Configuration		Market	Market	Market	Market	Functional	Market
Market Vs. Functional							

Table 2: distribution of farm organization structures by subarea

	Subarea					Total
	Northern	Grasslands	Westlands	Tulare	Kern	
Number ¹ (%) of farms by organization structure						
Unified	9 (17)	3 (6)	0 (0)	10 (17)	5 (6)	27 (10)
Differentiated	0 (0)	1 (1)	0 (0)	1 (2)	1 (2)	3 (1)
Simple	25 (48)	16 (31)	7 (22)	40 (68)	37 (46)	125 (45)
Simple						
Differentiated	11 (21)	16 (31)	7 (22)	5 (8)	17 (21)	56 (20)
Complex	2 (4)	11 (21)	16 (50)	2 (3)	15 (19)	46 (17)
Market	5 (10)	5 (10)	2 (6)	1 (2)	5 (6)	18 (7)
Total	52 (100)	52 (100)	32 (100)	59 (100)	80 (100)	275 (100)

¹ Ten observations were omitted due to the difficulty in assessing them to a farm type

Table 3: Analysis of Variance of mean values for the discrete variables using Harmonized Duncan-Waller grouping procedure (p=.05)

	Type of Farm organization Structure					F-test
	Unified	Simple	Simple Differentiated	Complex	Market	
	Mean values					
Type of Ownership	2.25b	3.40ab	3.89ab	4.22ab	5.66a	3.32
Gross Income	3.87c	5.45b	6.29ab	6.81a	6.61a	21.02
Relationship to Owner	.83a	.87a	.83a	.79a	.77a	-
Residence	.95a	.86ab	.83ab	.63b	.83ab	5.98
Production Cost Financing	.95a	.97a	.94a	.95a	.94a	-

Means with the same letters on the same line indicate a nonsignificant difference between farm types.

Table 4: Analysis of Variance of mean values of the continuous variables using Harmonized Duncan-Waller grouping procedure (p=.05)

	Type of Farm organization Structure					F-test
	Unified	Simple	Simple Differentiated	Complex	Market	
	Mean values					
Acres Farmed	172d	612c	1407b	3478a	3736a	8.48
Years of Computer use	.53d	1.52cd	2.98bc	3.72b	6.16a	9.58
Years of Agr. Experience	29.7a	27.7a	27.6a	26.7a	30.3a	-
Full-time Employees (per 100 acres)	.011d	.572c	.622bc	.969ab	1.203a	7.78
Part-time Employees (per 100 acres)	20.72a	11.77ab	4.90bc	7.55b	3.43c	2.38

Means with the same letters on the same line indicate a nonsignificant difference between farm types.

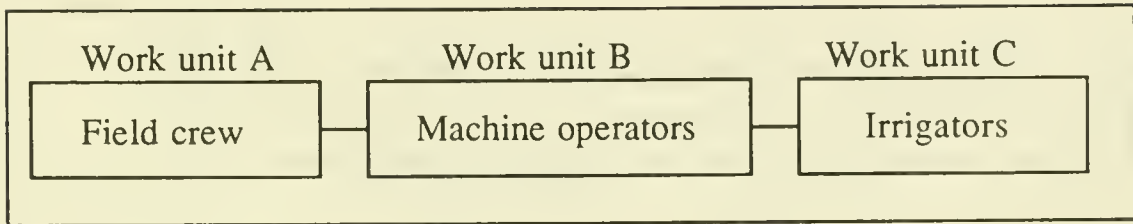


Figure 1: Inter-unit task specialization

Work unit A

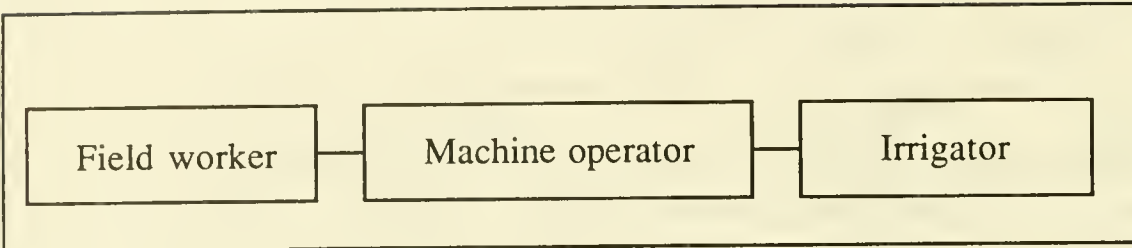


Figure 2: Intra-unit task specialization

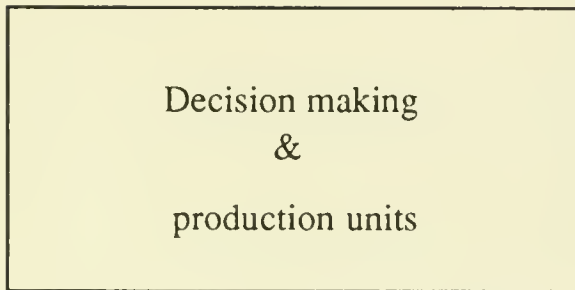


Figure 3: Unified Structure

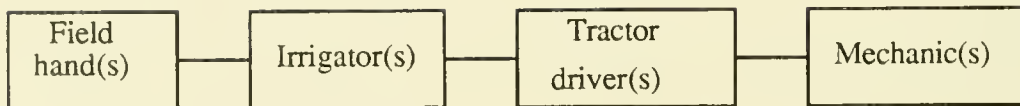


Figure 4: Differentiated Organization

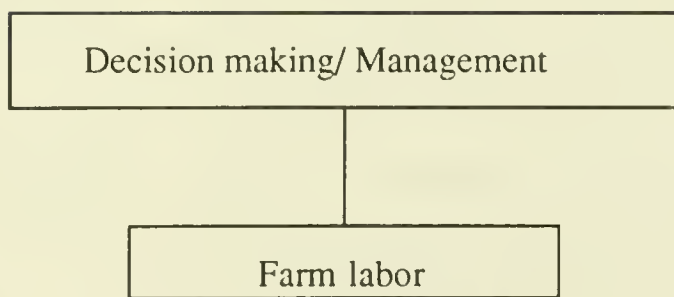


Figure 5: Simple Hierarchical Organization

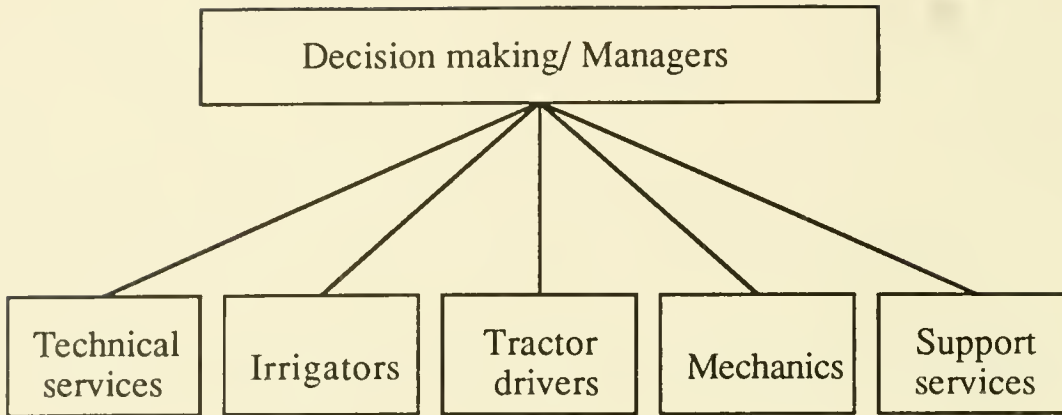


Figure 6: Simple Differentiated Hierarchical Organization

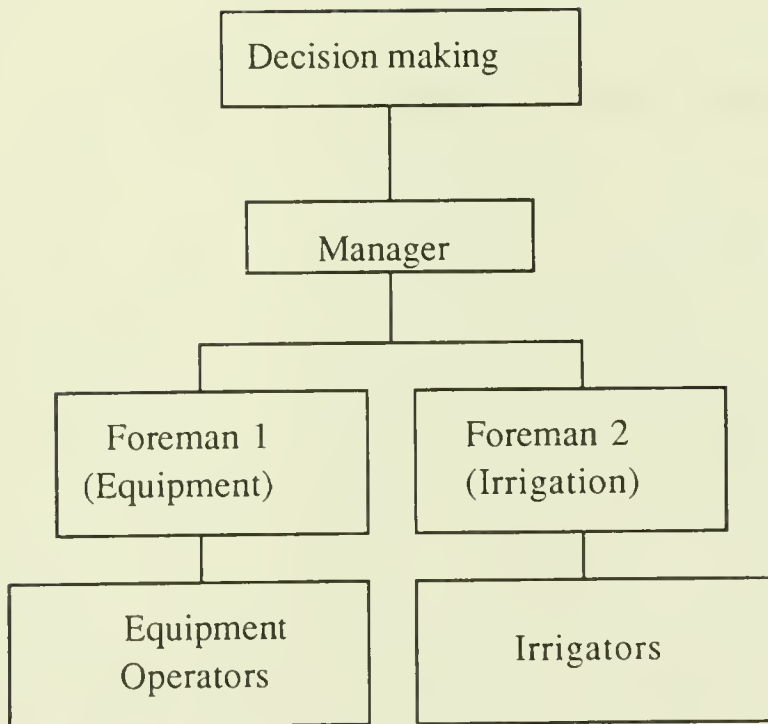


Figure 7: Complex Hierarchical Organization

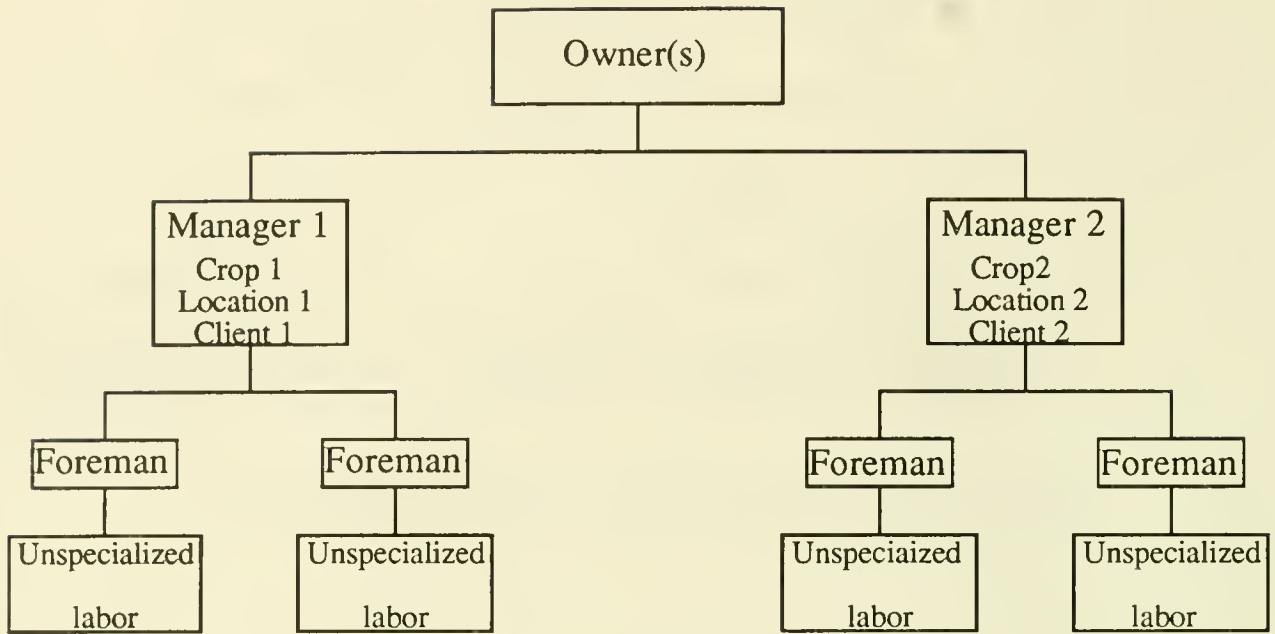


Figure 8: Market Hierarchical Organization



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