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# Managerial efficiency under risk for broiler producers in Saudi Arabia

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## Abstract

Managerial efficiency for broiler producers in Saudi Arabia is generally difficult to achieve. High investment costs coupled with relatively high average production costs and the consequent incompetent market prices, have resulted in projects either working at less than full capacity or being shut down completely. The aim here is to determine the most efficient production alternatives (actions) available to managers under business risk considerations. The ordinary stochastic dominance approach was used to solicit the most efficient production alternatives for broiler producing projects of all sizes in the Central Region of Saudi Arabia. For small- and medium-sized projects, the efficient production alternatives concentrated on marketing risk. For large projects, the efficient actions concentrated on both marketing and production risks. For the three sizes of projects, the two production alternatives that proved to be the most efficient, were the one that contains creating more marketing strategies and the one that adopts good veterinary care systems. On the other hand, the production alternative that deals with selecting good breeds of chicks appeared to be most efficient for small and large projects only. © 1999 Elsevier Science B.V. All rights reserved.

## 1. Introduction

In less-developed countries in general, and in the Middle East in particular, bad management is the explanation for the failure of any project when no apparent technical reasons can be identified. Despite this common belief, however, very few studies take management problems seriously. That is to say, management studies usually measure management utilizing proxies. The index number technique is considered the rule when quantitatively measuring the management input in any production process. Other studies attribute low profitability to management without even attempting to examine management techniques.

Moreover, risk considerations associated with most management decisions are almost always neglected.

In other words, in Saudi Arabia bad management is considered to be the reason that some broiler projects either shut down or are functioning below capacity. High investment and high production costs are really the characteristics of the Saudi broiler projects. This has occurred despite the ever increasing government support and subsidization over the twenty years of the broiler industry in Saudi Arabia. Interest-free loans are provided to farmers. These loans are characterized by a one-year grace period, after which the loans are to be paid back to the Saudi Arabian Agricultural Bank over a ten-year period. Subsidies that amounted to 50% of the cost of forage and 20% of the cost of equipment and machinery were also provided. Moreover, land

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was provided to broiler producers free of charge (Al-Zahrani, 1991).

As a result of government support, the private sector invested a lot in the broiler industry. Consequently, the number of specialized broiler projects in Saudi Arabia increased dramatically over a short period of time. The number of standing projects reached 369 with a production capacity of 262 million birds/year. Meanwhile, 21 new projects are under implementation, with an additional capacity of 20 million birds/year. 42% of the standing projects (154 projects) are located in the Central Region (Riyadh, Kharj, and Qassim). Their capacity is estimated at 132 million birds/year, which amounts to approximately 50% of the total production capacity for broiler projects kingdomwide (The Saudi Arabian Agricultural Bank, 1993a).

On the other hand, the total amount in loans provided by the Saudi Arabian Agricultural Bank to the specialized broiler projects is estimated at 1.4 billion Saudi riyal through 1993.<sup>1</sup> Approximately 25% of all loans are provided for specialized agricultural projects in the country (Saudi Arabian Agricultural Bank, 1993b).

As mentioned above, a few studies have pointed to poor managerial efficiency in the broiler producing industry in Saudi Arabia (Arab Company for Livestock Development, 1986; Al-Zahrani, 1986; and Al-Zahrani, 1991). However, these studies did not specifically examine or measure managerial efficiency. Instead, the three studies tried to illustrate the obstacles facing the poultry industry in Saudi Arabia.

No effort was made at studying and analyzing managers' opinions of the means of production practices that can be used to form production alternatives. Nor was an attempt made to determine which production alternatives of broiler projects are able to overcome the risk factors associated with this type of business.

## 2. Data and methodology

This study investigates the specialized broiler projects located in the Central Region of Saudi Arabia. Primary data was collected from a random sample of 43 of the 154 broiler projects in the area. Question-

naires and personal interviews were used. Both the closed farming system used in the majority of projects and the open farming system were investigated. Data gathering was performed in the summer and fall of 1993.

Post-sampling stratification for broiler projects was divided into three main categories according to production capacity. The first category was made up of projects with a production capacity of fewer than 1 million birds/year. The second category was projects with capacities of 1–2 million birds/year. The third was projects with a capacity of over 2 million birds/year. There were 27 projects in the first category, 11 projects in the second, and 5 projects in the third category.

Managers were asked about the means of productive practices by offering them different states of nature. The states of nature included production risk as a result of the variance of the mortality rates, price risk that represents price levels, and marketing risk due to lack of ability to sell the entire production, and therefore, effecting the production cycle. They were asked to provide three combinations of productive practices to counter these risks. Each combination was considered to be a production plan (alternative actions). Finally, managers were asked about the cost of each alternative action in addition to its impact on production to facilitate calculating the gross margin of each alternative.

The ordinary stochastic dominance (OSD) approach was used to determine the most efficient managerial decisions for the broiler industry. The OSD approach relies on making comparisons among the cumulative distribution functions (CDF) of the different production alternatives available to the manager. The approach basically assumes that the decision makers prefer more to less (for the first-degree stochastic dominance (FSD)) and that they are risk averse (for the second-degree stochastic dominance (SSD)). The major disadvantage of this criterion is that it does not necessarily reduce the efficient set of actions (alternatives) to a single action (although this turned out not to be the case in this study). However, the approach possesses the great advantage of not having to estimate the manager's utility function (Boehlje and Eidman, 1984; Robison, 1980).

The area under the CDF at each outcome of the CDF of a particular action could be calculated

<sup>1</sup>US\$ 1 =3.75 Saudi riyals.

as follows:

$$A_i = \sum_{j=2}^i \Delta O_j F_{j-1},$$

where  $A_i$  stands for the area under the cumulative distribution function of an action at the outcome  $i$ ,  $\Delta O_j$  stands for the change in the value of the outcome, and  $F_{j-1}$  stands for the cumulative probability at the previous outcome. Note that the outcomes that compromise the two uncertain actions has to be in ascending order before the above equation will hold.<sup>2</sup>

The gross margin of each alternative action must be calculated to implement the OSD approach. However, total production, total variable cost, and total revenue for each alternative are needed for gross margin calculation.

The total production for an alternative action (TPA) was computed by adjusting the average production capacity per class (APC) due to its average mortality rate (AMR) and number of production cycles (NPC). Hence, this production is scaled by the percentage effect of using this alternative action on production level (PEP). The effect of the state of nature on this total production of an alternative action is considered by the level of production risk (mortality rate) and marketing risk (marketing status). Accordingly, the following equation was designed to calculate total production resulting from the adoption of a certain alternative

$$\text{TPA} = \text{APC} \times (\text{NPC}/\text{GPC}) [(1 - \text{AMR}) / (1 - \text{GMR})] \\ \times [1 + \text{PEP}/100]$$

where GPC is the general number of production cycle and GNM is the general mortality rate

The total variable cost per action that includes the cost of forage, medicine, chicks, operation and maintenance, marketing, and the like is obtained by averaging the total variable costs for the appreciated projects of this alternative. Then, it is scaled to correspond to the TPA. The effect of the states of nature on this alternative action cost is affected only

by the marketing status and not by the mortality rates. The total revenue is calculated by multiplying the selling price (as the price risk level) by the total production of alternative action.

The gross margin is defined as the difference between total revenue and total variable cost. The gross margin of the alternative action is computed according to the three state of nature levels for total revenue and the marketing status for the total variable cost.

### 3. Results

The results include the managers' opinions about means of productive practices that can be used to form production alternatives. The subjective probabilities for states of nature are estimated according to the managers' opinions. The most efficient alternative actions are determined by applying the stochastic dominance model.

#### 3.1. The states of nature

The estimation of the managers' subjective probabilities was made feasible through the method of assigning conviction weights (Boehlje and Eidman, 1984). The subjective probabilities associated with mortality rates are made through this method by determining a degree of belief for each manager toward each mortality rate. Note that no single average has been considered for the three classes of projects, because each class of projects is different from the other. Because mortality rate was peculiar to each project, the manager's opinion was seriously considered. In the estimation of the subjective probabilities associated with the prevailing prices, it is assumed that the managers believe that the prices are independent of market status. Table 1 summarizes the results of the estimation procedure of the subjective probabilities associated with the state of nature.

The expected mortality rates are 12%, 12%, and 13%, respectively, for the small, medium, and large projects. This means that according to their opinion the managers of large projects expect to have a production risk (mortality rate) greater than that expected for the small and medium projects. However, large projects face high mortality rates for more than

<sup>2</sup>For more rigorous discussion of the stochastic dominance approach, refer to Boehlje and Eidman, 1984; Robison and Barry, 1986; Anderson et al., 1980; Nelson et al., 1978; Young, 1979; and Zentner et al., 1981.

Table 1  
Subjective probabilities for the state of nature of broiler projects

States of Nature <sup>a</sup>	Project size			
	Class	Small	Medium	Large
Mortality rate (%)	5	0.2639	0.2000	0.0600
	10	0.3290	0.4364	0.4000
	15	0.2379	0.1682	0.4300
	20	0.0986	0.1272	0.0700
	25	0.0706	0.0682	0.0400
Prices (SR/kg)	5.0	0.1081	0.0682	0.0694
	6.0	0.6481	0.6182	0.4554
	7.0	0.1730	0.2409	0.1980
	8.0	0.0541	0.0636	0.0396
	9.0	0.0167	0.0091	0.2376
Marketing status <sup>b</sup>	Poor	0.2740	0.2098	0.3104
	Normal	0.3596	0.3924	0.3448
	Excellent	0.3664	0.3978	0.3448

<sup>a</sup> The figures for the three states of nature were determined according to the technical staff recommendations in Saudi Arabia.

<sup>b</sup> Poor, normal, and excellent indicate producer products 1–2, 3–4, and 5–6 production periods/year, respectively.

Source: Computed and compiled from a field survey, 1993.

10% with a 0.54 probability, while medium projects have low mortality rates with a 0.36 probability.

The expected price risks are 6.59, 6.33, and 7.04 SR kg<sup>-1</sup> for the small, medium, and large projects, respectively. Implying that the large projects will face low price risk with a 0.52 probability, while there

is a high price risk for medium and small projects with probabilities of 0.68 and 0.57, respectively, for prices less than 7 SR kg<sup>-1</sup>. Accordingly, subjective probability for each class has to be computed separately for the production and price risk. Meanwhile, marketing status is assumed to have the same affect for all classes. Thus, the averages of the probabilities of marketing status are 0.2618, 0.3663, and 0.3719 for poor, normal, and excellent, respectively. As a result of the assumption of independence among the states of nature, there are 75 states of nature. The probability of each state is computed by multiplying the probability of production, by price and then by marketing risk.

### 3.2. Alternative actions

The productive practices of alternative actions are illustrated in Table 2. Alternative actions a<sub>1</sub>–a<sub>4</sub> are appreciated by the project managers from all three classes. However, alternative action a<sub>4</sub>, which contains the choice of good breeds of chicks, the choice of excellent feed rations, and the adoption of a good veterinary care system is ranked first for all project classes. It was selected by 77.8%, 72.7%, and 80% of small, medium, and large project managers, respectively. Interestingly, action a<sub>4</sub> is suitable for facing production risk.

Table 2  
The productive practice components of alternative actions for different project sizes

Alternative actions	Productive practices code <sup>a</sup>						Small	Medium	Large
	A	B	C	D	E	F			
a <sub>1</sub>	*	*	*	*	*	*	11	5	2
a <sub>2</sub>		*	*	*	*	*	10	6	2
a <sub>3</sub>	*	*	*				7	3	2
a <sub>4</sub>		*	*	*			21	8	4
a <sub>5</sub>	*	*	*	*			11	5	
a <sub>6</sub>				*	*	*	6	3	
a <sub>7</sub>	*	*	*	*	*		4		
a <sub>8</sub>		*		*	*		5		
a <sub>9</sub>		*			*	*	5		
a <sub>10</sub>		*	*		*		6		
a <sub>11</sub>		*	*	*	*			3	
a <sub>12</sub>		*	*	*		*			4

The asterisk (\*) indicates that productive practice is a component of the corresponding alternative action.

<sup>a</sup> The productive practice codes are defined as follows: (A) the duration of production period; (B) the choice of good breeds of chicks; (C) the choice of excellent feed rations; (D) the adoption of a good veterinary care system; (E) the adoption of different marketing strategies; and (F) employing well-trained labor. Source: Computed and compiled from a field survey, 1993.

### 3.3. Managerial efficiency actions (stochastic dominance model)

#### 3.3.1. Small-sized projects

Small production operations are the predominant type in the Central Region of Saudi Arabia. Twenty-seven of these projects were studied. Ten production alternatives (actions) were surveyed. They are:  $a_1$ – $a_{10}$  as defined in Table 2. The results of the stochastic dominance approach reveal that production alternative  $a_8$  is the most efficient action. This alternative dominated actions ( $a_1$ – $a_7$ ,  $a_9$ – $a_{10}$ ) with the FSD. Alternative  $a_8$  also dominated actions  $a_6$  and  $a_9$  with the SSD. Action  $a_6$  ranked second in efficiency. Action  $a_6$  dominated actions ( $a_1$ – $a_5$ ,  $a_7$ , and  $a_{10}$ ) with the FSD and dominated action  $a_9$  (which ranked third) with the SSD. Action  $a_9$  dominated actions ( $a_1$ – $a_5$ ,  $a_7$ , and  $a_{10}$ ) with the FSD. Alternative action  $a_8$  contains different marketing strategies and productive practices that make it superior over action  $a_4$ .

#### 3.3.2. Medium-sized projects

Results show that for the medium-size broiler projects, alternative action  $a_6$  is the most efficient production alternative. Action  $a_6$  dominated all other actions with the FSD, except action  $a_{11}$ , which was dominant with the SSD. This implies that action  $a_{11}$  came in second. Action  $a_{11}$  also dominated other actions with the FSD.

#### 3.3.3. Large-sized projects

Large-sized projects are the least common in the Central Region. There are only five such projects in the area. The alternative actions surveyed for this class of projects were  $a_1$ – $a_4$ , and  $a_{12}$ . The application of the previously mentioned stochastic dominance analysis showed that action  $a_2$  is the most efficient action. Action  $a_2$  dominated actions  $a_1$  and  $a_3$  with the FSD and actions  $a_{12}$  and  $a_4$  with the SSD. On the other hand, actions  $a_{12}$  and  $a_4$  followed in efficiency.

## 4. Conclusions

Alternative action  $a_4$ , which was the mode for the all three project sizes, can be used to overwhelm production risk. However, this action is not the most efficient. This indicates that the projects' managers focused

more on production risk due to their expectation of high mortality rates. The results of the stochastic dominance model showed different efficient actions for small, medium, and large projects—namely, actions  $a_8$ ,  $a_6$ , and  $a_2$ , respectively. The most efficient actions are different from the most repeated action,  $a_4$ . This can be clarified by considering the productive practices of the following actions: action  $a_8$  takes over different marketing strategies instead of excellent feed rations; action  $a_6$  replaces marketing strategies and well-trained labor with feed rations and good breeds of chicks; and action  $a_2$  is equal to action  $a_4$  plus adopting different marketing strategies and employing well-trained labor. Actions  $a_8$  and  $a_6$  involve more marketing risk, while action  $a_2$  involves both marketing and production risks. Each class has a different efficient action, this is consistent since managers of large are expect high mortality rates, while managers of small and medium projects expect high price risks. Finally, large projects are in a better position in terms of marketing competition because they compensate for low production by increasing their production capacity and are able to sell at a lower price.

The decisions regarding the adoption of good veterinary service (D) and the adoption of different marketing strategies (E) were repeated in the most efficient actions for all three classes. Meanwhile, the decision regarding employing well-trained labor (F) was efficient only for medium- and large-sized projects.

In summary, raising the managerial efficiency for broiler producers in Saudi Arabia will involve more emphasis on adopting good veterinary services and adopting different marketing strategies regardless of the size of the project. This conclusion holds true throughout, given the assumptions of the stochastic dominance model that managers prefer more gross margins to less and that they are risk averse.

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