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Structural Analysis of Animal Husbandry and Fishery in Turkey: An Input-output Analysis

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Abstract: This study investigates the structural interdependency of the animal husbandry and fishery sector and other sectors in Turkish economy. It reports the relationship between animal husbandry and fishery sector and other sectors. The analysis done in this study used the input-output technique. The data of this study was compiled from the State Institute of Statistics of Turkey (SIS). Direct and secondary impacts of animal husbandry and fishery sector were estimated using input output (I-O) model. The final demand multipliers by sectors are 1.7644 for animal husbandry and fishery sector, 1.4755 for crop growing sector, 2.1088 for manufacture of food products and 2.2984 for manufacture of prepared feeds. The largest total effect can be traced to manufacture of prepared feeds.

Key words: Animal husbandry and fishery, input-output analysis, structural analysis

INTRODUCTION

Animal husbandry has been historically a major component of Turkish economy. Despite the historical importance of animal husbandry, it is no longer the single largest sector in Turkey. The development in Turkish agriculture is less than the one in industry and service sectors (Karkacier *et al*., 2006). The relationship between animal husbandry and fishery sectors and other sectors was not calculated on previous studies in Turkey. This model (I-Q) was applied for the first time to animal husbandry and fishery sector in Turkey. I-O models have been found to be useful in analyzing the economic relationship or linkages among major sectors of an economy, either national or regional. In agricultural economics, we are frequently interested in using I-O models to examine the economic interrelationship between agricultural sector, such as, crops, animal husbandry and fishery and other sections of the economy (Jones, 1997). I-O analysis is a mathematical tool that traces linkages among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Bangsund and Leistritz, 2004).

The I-O model has been steadily applied to various areas over the last 40 years (Miller and Blair, 1985). In the last year input-output model was used by many researchers. Franke and Kalmbach (2005) employed an input-output framework to identify the contribution of economy-wide changes in technology and international trade to sectoral output growth in the German economy over the 1990s. Karkacier and Goktolga (2005) input-output model was used for analyzed structural interdependency of the agricultural sector and energy sectors in Turkey. Sengul and Erkan (1998) used the input-output model to analyse structure and structural interdependency of the cotton and textile industries in the Southeastern Anatolia Project (GAP) Region of Turkey. (Han *et al*., 2004) used input-output analysis to investigate the role of the four electric power sectors in the Korean national economy for the period 1985-1998.

In the study, Turkish economy was aggregated seven groups as a follows;

1) Animal husbandry and fishery, 2) Crop growing, 3) Manufacture of food products, beverages and tobacco products, 4) Manufacture of prepared animal feeds 5) Manufacture of pharmaceuticals, medicinal and botanical products, 6) Services, 7) Other sectors.

Turkey's animal and animal product productions since 1980 can be characterized by its steady and rapid growth. Table 1 shows change of major animal and animal product output levels since 1980. The main objective of the animal husbandry sector in Turkey is to increase animal and animal product in order to provide adequate and balanced nutrition for the population (SPO, 2003).

The purpose of this study was to estimate the economic contribution (direct and secondary effects) of the animal husbandry and fishery sector to the economy of Turkey. Assessment of the animal husbandry and fishery sector's economic importance would be helpful to demonstrate the economic implications of the future

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Table 1: The amounts of animal and animal products output in Turkey (metric ton)

Years	Total meat output	Red meat	Poultry meat	Eggs	Cow milk
1980	687683	433040	250000	206736	7710600
1985	1002549	712892	284886	291880	7994269
1990	1160869	742149	415000	384930	7960640
1995	1180800	670545	506165	550000	9275310
2000	1396726	732683	660916	810000	8732041
2003	1494135	604165	887041	791674	9514318
2005	1647035	685900	958010	830000	9500000

Source: FAO, 2006, www. fao.org/

policy change affecting domestic animal husbandry and fishery industries and document the economic effect of recent industry expansions.

MATERIALS AND METHODS

In this study, the data were received from the State Institute of Statistics (SIS) databases for the input output structure of the Turkish economy (SIS, 2004). The SIS publication contains summary information about data sources, sectoral computations and results tables obtained from during the compilation process of the 1998 supply use and input-output tables. The 1998 input-output tables are the latest and seventy of tables compiled by the SIS. The tables prepared at 210 products and industries and aggregated 97 products and industry groups. The International Standard Industrial Classification of all economic activities (ISIC Rev.3) was used in 1998 supply use and input-output tables.

The input-output tables may be constructed from primary or secondary data or a combination of primary or secondary data. This analysis will use secondary data from SIS.

Economic activity from a project, program, or policy can be categorized into direct and secondary impacts. Direct impacts are those changes in output, employment, or income that represent the initial or first-round effects of a project, program, or event. Secondary impacts result from subsequent rounds of spending and re-spending within an economy. This process of spending and re-spending is sometimes termed the multiplier process and the resultant secondary effects are sometimes referred to as multiplier effects (Bangsund and Leistritz, 2004).

Specific limitations to the input-output model's accuracy include: (Davis, 1990).

Constant coefficients, linearity, sector homogeneity and no capacity constraints.

Constant coefficients imply that advances in production technology, new inventions, import substitution, changes in consumer patterns of demand and the increase or decrease of relative prices do not alter a_{ij} (Holland and Cooke, 1992).

The I-O model is a linear, inter-sectoral model which shows the relationships among the productive sectors of a given economic system. The basic balance equations of the I-O model consisting of n industry sectors can be expressed as

$$X_i = \Sigma_j X_{ij} d_i \ (i, j, \ldots\ldots\ldots\ldots, n) \quad (1)$$

Where, X_{ij} represent sales from sector i (rows) to sector j (column), d_i represent sales from sector i to final demand, X_i represent total output of sector i.

Formula (1) may be rewritten as form matrix

$$X = AX+D \quad (2)$$

Where final demand (D) was treated as exogenous and the equation (2) was rewritten as follows;

$$X-AX = D \quad (3)$$

Where, X the output matrix, A the coefficient matrix and D final demand matrix. Equation 3 was rewritten as follows;

$$IX-AX = (I-A)X = D \quad (4)$$

Where, (I) matrix is called identity matrix and the matrix (I-A) is called the Leontief matrix (Haeussler and Paul, 1987). Now, Eq. 4 may be rearranged as follow:

$$X = (I-A)^{-1} D \quad (5)$$

Equation 5 is the solution equation to the input-output analysis. The matrix $(I-A)^{-1}$ is called the Leontief inverse matrix (key matrix). The elements of key matrix measure the direct and indirect output levels from each sector of the economy required to satisfy given the levels of final demand (Jones, 1997).

RESULTS

Economic contribution of the animal husbandry and fishery industry was estimated from production and processing expenditures. Both production and processing expenditures represent the direct economic impacts from the animal husbandry and fishery industry. Subsequently, the direct impacts were used with an I-O model to estimate the secondary impacts. Secondary impacts result from the turnover or responding of direct impacts within the area economy. From an economic perspective, direct impacts are those changes in output, employment, or income that represent the initial or first-round effects of a project, program, or event.

Table 2: Transaction table of Turkey economy (Million Turkish Liras)

Sectors	1	2	3	4	5	6	7
Animal husbandry and fishery	116831318	65698500	330883981	10244891	80871117	136	2935460
Crop growing	693933457	678244656	1567367650	61606188	145629240	5449239	321055751
Manufacture of food products, beverages and tobacco products	58934206	445320	967164497	50204416	682467637	1857776	79928784
Manufacture of prepared animal feeds	139075903	1022255	58267595	3892036	894741	481	332783
Services	154826721	620167728	712712594	34163291	6517846068	72326678	4190233228
Manufacture of pharmaceuticals, medicinal and botanical products	28221560	706270516	635966664	13981167	3679574687	57575883	13774793174
Other sectors	10208413	18	6067955	3155824	25397903	138958704	3414046
Total	1202031579	2071848993	4278430937	177247814	11132681393	276168898	18372693226

Table 3: Technical coefficients for seven grouped sectors (A matrix)

Sectors	1	2	3	4	5	6	7
Animal husbandry and fishery	0.0451	0.0090	0.0493	0.0431	0.0020	0.0000	0.0001
Crop growing	0.2680	0.0926	0.2337	0.2590	0.0036	0.0099	0.0096
Manufacture of food products, beverages and tobacco prod.	0.0228	0.0001	0.1442	0.2111	0.0170	0.0034	0.0024
Manufacture of prepared animal feeds	0.0537	0.0001	0.0087	0.0164	0.0000	0.0000	0.0000
Services	0.0598	0.0847	0.1063	0.1436	0.1623	0.1317	0.1256
Manufacture of pharm, medic. and botanical products	0.0039	0.0000	0.0009	0.0133	0.0006	0.2531	0.0001
Other sectors	0.0109	0.0964	0.0948	0.0588	0.0916	0.1049	0.4129

Table 4: Leontief inverse matrix for seven grouped sectors $(I-A)^{-1}$

Sectors	1	2	3	4	5	6	7
Animal husbandry and fishery	1.0557	0.0110	0.0652	0.0638	0.0041	0.0015	0.0014
Crop growing	0.3419	1.1093	0.3309	0.3819	0.0149	0.0228	0.0221
Manufacture of food products, beverages and tobacco prod.	0.0456	0.0040	1.1792	0.2605	0.0252	0.0103	0.0113
Manufacture of prepared animal feeds	0.0581	0.0008	0.0140	1.0225	0.0005	0.0002	0.0002
Services	0.1436	0.1444	0.2331	0.2931	1.2288	0.2663	0.2571
Manufacture of pharm, medic. And botanical products	0.0068	0.0002	0.0023	0.0191	0.0011	0.0005	1.3392
Other sectors	0.1126	0.2057	0.2842	0.2575	0.1986	1.7504	0.2848

Table 2 shows a transaction table for the Turkish economy that has been subdivided into seven sectors. The transaction table summarizes the annual TL value. Table 2 records the flow of goods and services among industries. The columns in this table show the value of the inputs absorbed by the industries and the payment for the primary inputs. Along the rows, the distribution of products into various industries and final demand categories are shown.

The matrix of technical coefficient (A matrix) is shown in Table 3. This matrix is obtained by dividing each entry in the transaction table by its column total i.e., the total output of the respective industry. Thus, an element in this matrix, expressed as a percentage, shows the direct requirement from the supply to the industry. That is, for each million TL of output produced by the animal husbandry and fishery sector, the animal husbandry and fishery sector must purchase from the crop growing 0.2680 million TL, from manufacture of food products 0.0228 million TL, manufacture of prepared feeds 0.0537 million TL, from services 0.0598 million TL, from manufacture of pharmaceuticals, medicinal and botanical products 0.0039 million TL and from other sectors 0.0109 million TL. Similarly, for each TL of manufacture of prepared feeds 0.0431 million TL must be purchased from animal husbandry and fishery sector and 0.2590 million TL from crop growing. These coefficients show the direct impacts in all sectors due to a one TL change in output in a particular sector.

Each coefficient in the $(I-A)^{-1}$ matrix (Table 4), reveals the linkage among industries in the economy (Davis, 1990; Coffey, 1996). Input-output analysis is a mathematical tool that trace linkages among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon *et al*., 1985).

The secondary impacts of animal husbandry and fishery industry were estimated using I-O model. As was shown in Table 3, the direct input requirements of animal husbandry and fishery from crop growing are 0.2680 million TL per 1 Million TL of output. However, the total output requirements from crop growing is 0.3419 million TL for each 1 million TL sales by animal husbandry and fishery to final demand as shown Table 4.

Table 5: Direct, secondary, and total economic impacts of animal husbandry and fishery

Sectors	Direct	Secondary	Total
Animal husbandry and fishery	0.0451	1.0106	1.0557
Crop growing	0.2680	0.0739	0.3419
Manufacture of food products, beverages and tobacco prod.	0.0228	0.0228	0.0456
Manufacture of prepared animal feeds	0.0537	0.0044	0.0581
Services	0.0598	0.0838	0.1436
Manufacture of pharm, medic. and botanical products	0.0039	0.0029	0.0068
Other sectors	0.0109	0.1017	0.1126

Table 6: The final demand multipliers

Sectors	Sum of column
Animal husbandry and fishery	1.7644
Crop growing	1.4755
Manufacture of food products, beverages and tobacco prod.	2.1088
Manufacture of prepared animal feeds	2.2984
Services	1.4732
Manufacture of pharm, medic. and botanical products	2.0519
Other sectors	1.9160

The difference between the total effect and direct effect (TL 0.3419- TL 0.2680 = TL 0.0739) is the secondary (indirect) output required from crop growing (Table 5).

Jones (1997) emphasized that importance of multiplier as follow sentence; "One of the most widely used concepts in economics is that of the multiplier. A frequent question asked by agricultural associations, industrial groups and other is, "what overall impact does my industry have on the economy". Stated differently, the question of interest is what total effect of the change in the sales of a given sector of the economy on the total output of that economy will be. The answer to this question can be obtained from input-output analysis using an estimate called the final demand multiplier".

The final demand multiplier measures the amount of output generated by a TL change in final demand for products of a particular sector. Table 6 shows the multipliers for each sector. Each sector's individual demand multiplier is the sum of seven columns of coefficient in the $(I-A)^{-1}$ matrix.

Animal husbandry and fishery products increase its sales to final demand by one TL and the total output of the seven sectors will increase by 1.7644 TL (Table 6). Manufacture of prepared feeds sector exhibits a relatively large multiplier in all sectors. If demand for products in this sector change by one TL, output will increase by 2.2984 TL. So, these multipliers may be used to estimate the economic impact of the changes in specific sectors on the general economy.

CONCLUSIONS

Turkish animal husbandry and fishery sector were analysed in this study. The purpose of this study was to estimate the economic contribution of the animal husbandry and fishery sector to Turkish economy. The analysis done in this paper used the input-output technique. An I-O model is an accounting system showing economic transactions.

As the indicators of direct impacts, coefficients were calculated as follows, the animal husbandry and fishery sector must purchase from the crop growing 0.2680 million TL, from manufacture of food products 0.0228 million TL, manufacture of prepared feeds 0.0537 million TL, from services 0.0598 million TL, from manufacture of pharmaceuticals, medicinal and botanical products 0.0039 million TL and from other sectors 0.0109 million TL. Similarly, for each TL of manufacture of prepared feeds 0.0431 million TL must be purchased from animal husbandry and fishery sector and 0.2590 million TL from crop growing.

The secondary impacts of animal husbandry and fishery industry were estimated using I-O model. The final demand multipliers by sectors are 1.7644 for animal husbandry and fishery. This coefficient was calculated by another study, too. Livesock and livestock products multiplier were calculated as 1.80, 2.28 and 1.88 for three districts which have different development level in Oklahama by Doeksen and Little (1969). These coefficients match with the ones of our study.

The results can provide useful information for policy makers and planners. 1- Animal husbandry and fishery sector has the most interdependency with crop growing sector. 2- Animal husbandry and fishery sector has lower interdependency than other five grouped sectors. These results show that the animal husbandry and fishery sector is a backward sector in Turkey. For better development in the sector, the interrelationship must be increased with crop growing sector.

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