Impacts of Climate Change and the EU Accession on Turkish Rural Industries by the Input-Output model and Markov-Transition Matrix

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1. Introduction

The purpose of this paper is to discuss about impacts of climate change and the EU accession on Turkish rural industries For this purpose, the following analyses are carried out in each section.

(1) Generation of Agriculture based IO table in 2 time points (1985 and 1996)
(2) Prediction of Input coefficient and Production amount share by RAS method and the Markov Transition Probability Matrix.
(3) Simulation on the effects of Climate Change on productivities.
(4) Simulation on the effects of the EU accession on production amounts
(5) Finding and some implications

2. Generation of Agriculture based IO table in 2 time points (1985 and 1996)

Original Input-Output tables have been published for the year 1985, 1990 and 1996 by Turkish Government. Those are tables of the competing import type and the commodity based type. The 1985 and 1990 tables contain 64 industry sectors, 7 final demand sectors and 7 value added sectors and 1996 table contains 98 industry sectors, 7 final demand sectors and 7 value added sectors. The unit of all tables is million Turkish Lira.

In this paper, actually there are 3 IO tables in 1985, 1990 and 1996. and so, 3 kinds of transition process can be estimated. However, our prediction period is so long time as 70 years to year 2070. To save the estimation loss in repeated multiplication process, here the relation between the two IO tables in 1980 and 1996 is used.

By aggregating non-rural sectors as much as possible, these tables were reduced to the smaller size of 24 industry sectors, 6 final demand sectors and 4 value added sectors and they were converted to the Agriculture based IO tables. These tables are shown in Table 1, Table2 and Table3. In the following, due to the space limitations, only the rural sectors (i.e. 6 sectors from grain to fisheries) are indicated explicitly and non-rural sectors (i.e. 18 sectors from coal/oil to administration) are indicated implicitly by the notation **** in the corresponding rows and columns.

3. Prediction of Input coefficient by RAS method

1). Industry Structure Analysis

The following orthodox manipulations of the Input-Output Analysis are applied to these Agriculture-based IO tables.

$$A X + F = X \quad \text{............} \quad (1)$$

$$X = (I - A)^{-1} F \quad \text{.........} \quad (2)$$

Here, A: input coefficient matrix
F: final demand column vector
X: output column vector
I: unit matrix

And matrix $(I - A)^{-1}$ is known as the Leontief's Inverse matrix B, which shows the production inducement multiplier matrix. i.e. the matrix of the induced increase in the production derived from the unit increase of the final demand sector.

Table 1 Agriculture Based Input Output Tabl;e (1985) (unit: billion Turkish Lira, 1985)

		Intermediate Demand Sector								Final Demand Sector							Total Production
		Grain	Vegetable	Fruits	Livestock	Forestry	Fisheries	****	Intermediate Demand Total	Private Consumption	Public Consumption	Private Investment	****	Export	Final Demand Total	(-)Import	
Intermediate Input Sector	Grain	1465	0	0	7122	0	0	****	20556	4834	96	0	****	689	4799	-948	24407
	Vegetable	0	33	0	0	0	0	****	565	6658	25	0	****	76	7126	-24	7667
	Fruits	0	0	379	0	0	0	****	2154	11608	49	0	****	686	12784	-71	14867
	Livestock	12	399	130	0	0	0	****	5993	16055	62	11	****	670	16817	-475	22335
	Forestry	0	0	0	0	0	0	****	2699	601	164	0	****	97	869	-440	3128
	Fisheries	0	0	0	0	0	0	****	112	1560	0	0	****	117	1672	-8	1777
	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****
	Intermediate Input Total	9225	2284	1726	10699	489	286	****	242327	221979	29808	23169	####	59180	368546	-78935	531938
Value Added	Tax	-1800	-104	257	105	28	4	****	14080								
	Depreciation	369	129	317	108	15	16	****	15961								
	Wage	2740	844	592	539	820	179	****	59881								
	Profits	13873	4514	11974	10883	1777	1291	****	199688								
	Value added Total	15181	5383	13140	11636	2639	1491	****	289611								
Total Products		24407	7667	14867	22335	3128	1777	****	531938								

("****" shows the sectors omitted to list)

Table 2 Agriculture Based Input Output Table (1996) (unit: billion Turkish Lira, 1996)

		Intermediate Demand Sector								Final Demand Sector							Total Production
		Grain	Vegetable	Fruits	Livestock	Forestry	Fisheries	****	Intermediate Demand Total	Private Consumption	Public Consumption	Private Investment	****	Export	Final Demand Total	(-)Import	
Intermediate Input Sector	Grain	97251	0	0	289980	472	0	****	886723	231000	25410	0	****	73441	418655	-128576	1176803
	Vegetable	0	2171	0	0	0	143	****	34256	318000	6590	0	****	8141	334304	-3245	365314
	Fruits	0	0	25127	0	0	46	****	93278	554000	12883	0	****	73118	673231	-9661	756848
	Livestock	470	15609	5071	41118	22	0	****	235783	478000	504	5569	****	8455	640598	-17866	858515
	Forestry	0	1300	0	0	1481	22	****	85686	18845	1306	0	****	350	20503	-11819	94370
	Fisheries	0	265	0	0	0	672	****	9418	89888	22	0	****	1972	92494	-135	101777
	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****	**** ****
	Intermediate Input Total	444000	102000	93655	448245	12956	23924	****	11752352	9840000	1711286	3130000	****	3650000	19966954	-4133894	27585412
Value Added	Tax	-97000	-5615	13866	8583	2477	900	****	586262								
	Depreciation	25767	9034	22136	13764	401	690	****	837440								
	Wage	104000	32059	22514	41927	24943	8018	****	3234567								
	Profits	701000	228000	604674	345994	53590	68242	****	11174788								
	Value added Total	733000	263000	663192	410269	81413	77852	****	15833059								
Total Products		1176803	365314	756848	858515	94370	101777	****	27585412								

("****" shows the sectors omitted to list)

$$\begin{bmatrix} r_1 & 0 & 0 & 0 \\ 0 & r_2 & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & r_n \end{bmatrix}^m \bullet \begin{bmatrix} a_{11} & \cdots & \cdots & a_{1n} \\ \vdots & a_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{n1} & \cdots & \cdots & a_{nn} \end{bmatrix}_{t=T} \bullet \begin{bmatrix} s_1 & 0 & 0 & 0 \\ 0 & s_2 & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & s_n \end{bmatrix}^m = \begin{bmatrix} a'_{11} & \cdots & \cdots & a'_{1n} \\ \vdots & a'_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ a'_{n1} & \cdots & \cdots & a'_{nn} \end{bmatrix}_{t=T+m}$$

Fig.1 Formula of RAS method

Table 3 Estimation of Input Coefficient Function

Grain

Variables	Coeff	t-value	p-value
const.	-5320.633	-5.90	0.010
RainK	0.268	1.70	0.189
TempK	6.527	2.34	0.101
RainA	-0.038	-0.30	0.786
TempA	-9.018	-2.24	0.111
DMdt	-25.913	-5.90	0.010
DM93	2.499	0.59	0.598
DM94	-2.186	-0.31	0.775
DM99	2.190	0.54	0.624
DM01	-7.015	-1.31	0.282
year	2.741	6.06	0.009

R^2(adj)= 0.791 DW= 1.807

Vegetable

Variables	Coeff	t-value	p-value
const.	-1266.381	-16.16	0.001
RainK	0.014	1.04	0.374
TempK	0.076	0.31	0.774
RainA	-0.019	-1.71	0.185
TempA	0.091	0.26	0.811
DMdt	-2.284	-5.99	0.009
DM93	-0.939	-2.54	0.085
DM94	0.267	0.44	0.690
DM99	-0.395	-1.13	0.340
DM01	0.149	0.32	0.770
year	0.649	16.52	0.000

R^2(adj)= 0.983 DW= 1.997

Fruit

Variables	Coeff	t-value	p-value
const.	-1059.882	-6.87	0.006
RainK	0.042	1.57	0.215
TempK	1.194	2.51	0.087
RainA	-0.006	-0.27	0.806
TempA	-1.636	-2.38	0.098
DMdt	-5.778	-7.69	0.005
DM93	0.584	0.80	0.481
DM94	-0.356	-0.30	0.786
DM99	0.150	0.22	0.841
DM01	-1.427	-1.56	0.217
year	0.548	7.08	0.006

R^2(adj)= 0.863 DW= 1.863

Livestock Product

Variables	Coeff	t-value	p-value
const.	-1408.864	-5.87	0.010
RainK	0.059	1.41	0.253
TempK	2.000	2.70	0.074
RainA	-0.001	-0.03	0.976
TempA	-2.805	-2.62	0.079
DMdt	-7.673	-6.57	0.007
DM93	1.458	1.29	0.288
DM94	-0.729	-0.39	0.722
DM99	0.190	0.18	0.871
DM01	-2.636	-1.85	0.162
year	0.749	6.23	0.008

R^2(adj)= 0.829 DW= 2.008

Forestry

Variables	Coeff	t-value	p-value
const.	-89.595	-0.78	0.494
RainK	0.033	1.65	0.197
TempK	0.869	2.44	0.093
RainA	-0.003	-0.19	0.862
TempA	-1.223	-2.38	0.098
DMdt	-3.103	-5.52	0.012
DM93	0.473	0.87	0.449
DM94	-0.276	-0.31	0.778
DM99	0.296	0.57	0.606
DM01	-0.973	-1.42	0.251
year	0.059	1.02	0.381

R^2(adj)= 0.892 DW= 1.878

Fisheries

Variables	Coeff	t-value	p-value
const.	-9328.142	-3.54	0.038
RainK	0.770	1.67	0.193
TempK	19.237	2.37	0.099
RainA	-0.064	-0.17	0.874
TempA	-27.104	-2.31	0.104
DMdt	-66.717	-5.21	0.014
DM93	9.687	0.78	0.492
DM94	-7.405	-0.36	0.741
DM99	7.884	0.67	0.550
DM01	-21.098	-1.35	0.270
year	4.850	3.68	0.035

R^2(adj)= 0.734 DW= 1.863

2) Estimation of R (substitution change coefficient) & S (processing degree change coefficient),

In order to predict the Input Coefficient matrix, the following relation are utilized. Here, matrix A is the original input coefficient matrix at base year T and matrix A' is the coefficient matrix at predicted year T+m.

By solving the above relation of the RAS method, matrix R and S are derived. Here, matrix R is row wise correction matrix of the original input coefficient matrix A and it indicates the substitution change effect matrix. Similarly, matrix S is column wise correction matrix of A and it indicate the processing degree change effects matrix. In other word, the elements ri of matrix R show the increase rate of intermediate demand for sector i by every sector. The elements si of matrix S show the increase rate of intermediate input in sector i from every sector. Thus, the sectors with combination of ri bigger than one and si smaller than one can be considered as the growing sectors while the sectors with combination of ri less than one and si bigger than one can be considered as the declining sectors.

3) Prediction of Input Coefficient and Impact of Climate Factors on Agricultural Productivities.,

By multiplying R and S to the Input Coefficient Matrix in the base year, time series of the input Coefficient Matrix are obtained. The reverse of input coefficient indicates productivity or efficiency of input in each sector. Then, the following regression equation are estimated to investigate impacts of climate factors on agricultural productivity.

$$a_j = a_{(\Sigma i)j} = f(Prec, Temp, DM, ...)$$

Here, aj; Input Coefficient in Sector j
Prec; Precipitation in Konya, Adana
Temp; Temperature in Konnya, Adana
DM; dummy variable corresponding to

difference in data source, abnormal weather, etc

Table 3 shows the results of this regression analysis. According to the major statistical criteria such as adjusted determination coefficient, Durbin Watson ratio and t-value, considerably good results are shown for all of rural industries. Among error terms, serial correlation were not observed and most of coefficient estimates are statistically significant.

4. Impacts of Climate Change on Productivities

By using the results of RAS method on the Input-Output tables, and the current and predicted climate conditions in the 3.5th run of GCM and the CCSR/NIES-GCM, the impacts of global warming and decreasing trend of rainfall on Turkish rural industries were calculated.

In this calculation, the rainfall and the temperatures in May in the case of Konya and the temperatures in May and the rainfall in December in the case of Adana were used as the analysis by Tsuji & Ufuk suggested that those factors affected the productions substantially.

The changes in productivities of the 6 rural industries due to 1% increase in rainfall and temperature are estimated for each of Konya and Adana in the first place.(Figure [2])

And then, the changes in the productivities between 2070s and current year were calculated (Figure [3]). Here, the productivities in 2070s were derived from the rainfall and temperature in 2070 predicted by the simulated results of the 3.5th run of GCM and the CCSR/NIES-GCM.

Those implications were derived from the combination of the "rural industries based Input-Output table" related information and the results of the 3.5th run of GCM and the CCSR/NIES-GCM,.

As shown in the Figure [2], the impacts of climate change on productivities in the rural industries are summarized in the following way. The increase of rain in May in both Konya and Adana does not affect any rural sectors so much but the temperature increase in Konya will affects all of rural sectors positively while the temperature increase in Adana will affect all rural sectors except vegetable negatively. The reasons for these results are explained as follows.

As the climate in Konya is very cold, the increase of the temperature affects the growth of the productivity positively. But in Adana the climate is already relatively warm enough and so, additional increase of temperature may cause the heat damage and give negative impact on the growth of productivity.

And the relative impacts in percentage are very small in vegetables and rather big in grain, forestry and fisheries.

It is considered that as for vegetables, they have already been grown by the capital intensive and efficient methods and so, the climate change does not affect so much.

Under the 3.5th run of GCM and the CCSR/NIES-GCM, as for the total impacts of climate change on productivity in each rural industry, the forestry and fisheries sectors are most negatively affected. Also, grain, fruits and livestock sectors are negatively affected although the effects are less than the former 2 sectors. Only vegetable sector is seldom affected by the climate change. The reason for these seems to be that the negative effects of temperature increase in Adana dominate the effects of other factors except vegetables which are not affected significantly. As a whole, the predicted negative effects under the CCSR/NIES-GCM are more significant than under the 3.5th run of GCM

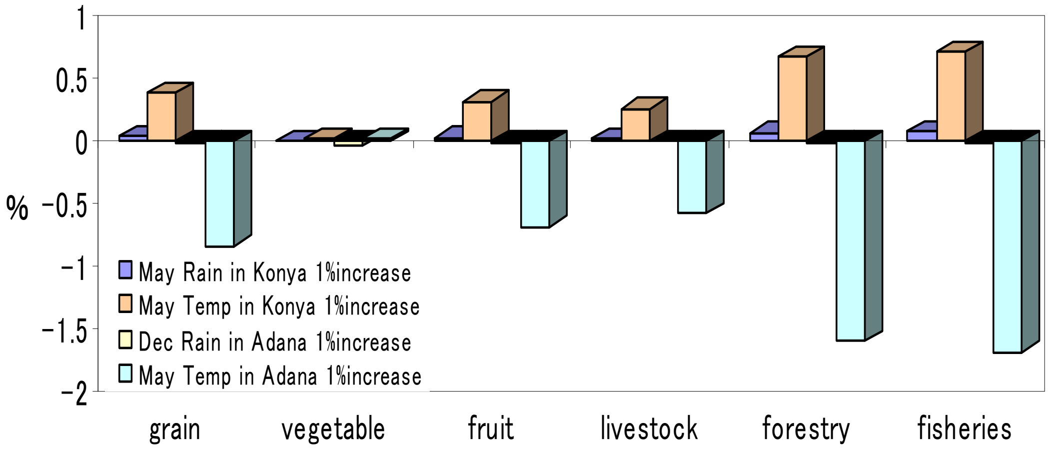

Fig. 2 Impacts of Climate Change on Productivities

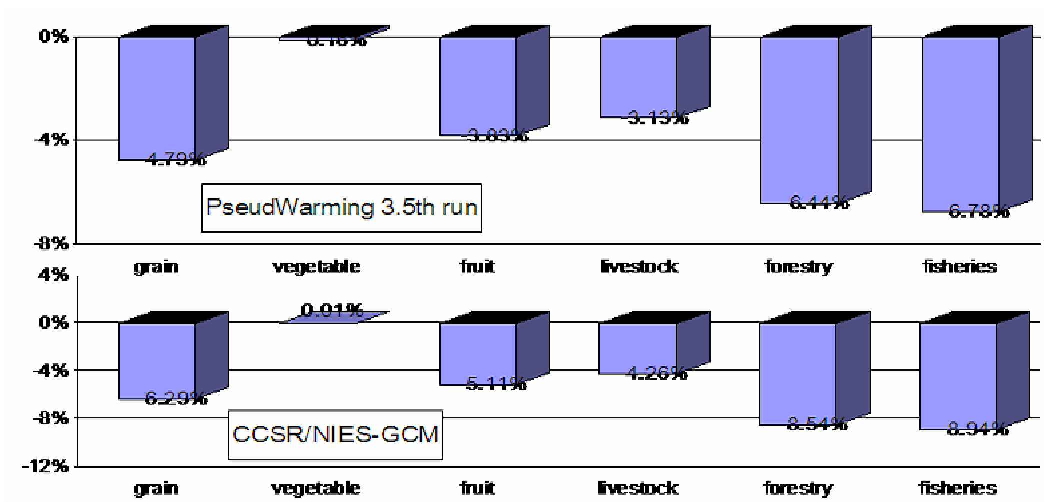

Fig.3 Change of productivities between 2070s and current year.

5. Impacts of the EU accession on Production Amount Shares

Based on the total production column vectors ([X86] and [X96]) in the input output tables in basis year (1986) and comparison year (1996) shown in the first section of this paper, the Markov transition probability matrix can be estimated in the following way. First of all, total production column vector in comparison year can be shown as multiplication of a matrix and total production column vector in base year. In the next stage, this matrix can be expressed by the multiplication of the diagonal matrix and Markov transition probability matrix.

In this process, it is necessary to adjust the original Matrix by dividing the elements by the row's (i.e. row wise) sum. By substituting the corresponding values estimated in the IO tables into total production column vectors in two time point, the diagonal matrix whose non-zero elements are sum of the elements in each row are calculated. In this case, the non-zero diagonal elements are so called the "production amount shares" in each industry, which are supposed to be the function of repetition number of prediction.

By multiplying Markov transition matrix in the center position of this relation formula for m times, total production column vector in m periods future can be estimated.

This relation can be expressed in the matrix formula of Figure 4 and the estimated results of the Markov transition probability matrix is shown in Table 4.

In the equation of Figure 4, the vector in the left hand side [X_{t+m}] shows the column vector of total productions amounts for 6 rural sectors in comparison year t+m, and the vector [X_t] in right hand side shows the column vector of total productions amounts for 6 rural sectors in base year t, in this case 1985.

$$\left[X_{t_{0+m}}\right] = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ r_{n1} & \cdots & \cdots & r_{nn} \end{bmatrix} \bullet \left[X_{t_0}\right]$$

$$= \left[A_{ii}(m)\right] \bullet \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ p_{n1} & \cdots & \cdots & p_{nn} \end{bmatrix}^m \bullet \left[X_{t_0}\right]$$

Where $p_{ij} = r_{ij} / a_{ii}$

$$a_{ii} = \sum_{j=1}^{n} r_{ij}$$

$$, \quad a_{ij} = 0 \quad (\text{for } i \neq j)$$

r_{ij} : Element of the relation matrix between X_{t_0} and X_{t_1}.

m : Repetition number of forecasting.

Fig.4 Formula if Markov Transition Matrix

By following the procedure expressed in Figure 4, the elements of the matrix [r_{ij}] satisfying this identity formula can be obtained.

As the Markov transition matrix is probability matrix, the elements have to be adjusted by dividing each elements of the matrix with the sum of the corresponding row. In order to satisfy the identity formula in Figure 4 and to predict the total production amount in each time period [X_{t+m}], the diagonal matrix which has sum of elements in each row as its non-zero elements is multiplied from left hand side together with the production amount shares matrix [A(m)] to the column vector [X_t] for the number of prediction.

By the above procedure, under the assumption that original structural relation between 1985 and 1996 is hold in the future, given the column vector of total production in one time point, the corresponding column vector of total production in 11 years ahead can be obtained by the first multiplication.

By repeating this process for 7 times from 1996 on, the situations in 2070s are forecasted. The result of this simulation run is used as the baseline case for analysis on the effects of the EU accession in this paper.

1) Timing of the EU Accession for Turkey

According to the paper "Turkey and the EU Budget –Prospects and Issues－" by Dervis [7], Turkey is assumed to join the EU in 2015. The reason for this is that the effects of Turkey accession on EU budget is so large that it should be after the 2014 when the Turkish current budget plan is completed.

Also, as the EU budget is reviewed every six years, it is expected that the year when Turkey is integrated into the EU budget entirely is, at earliest case, some year between 2018 and 2024.

Accordingly, here in this simulation, the earliest case for Turkey to join the EU is considered. Based on the above assumption, the accession year for Turkey to join the EU is set at 2015. In this simulation, calculation is carried out every 11 years. So, the period from 2007 to 2018 is defined as the "pre-accession period" i.e. the period for preparation to join and adaptation to the EU budget. Then the period after 2018 is defined as the "period for Turkey to join the EU entirely".

Table 4 Markov Transition Probability Matrix

Sector (t_1) / Sector (t_0)	grain	vegetable	fruit	livestock	forestry	fisheries
grain	0.7767	0.0629	0.0393	0.0856	0.0262	0.0094
vegetable	0.0099	0.9526	0.0080	0.0224	0.0054	0.0016
fruit	0.0118	0.0099	0.9471	0.0061	0.0250	0
livestock	0.0425	0.0212	0.0022	0.8930	0.0391	0.0020
forestry	0.0120	0	0.0259	0.0041	0.9580	0
fisheries	0.0067	0.0004	0	0.0130	0	0.9799

2) Effects in the “Pre-Accession period”

In the “pre-accession period”, there are 3 assistance from the EU. Those are i) PHARE for democratization, ii) ISPA for infrastructure and iii) SAPARD for agricultural structure adjustment.(cf. “Turkey and the EU Budget”). Among those, what affects agriculture directly is SAPARD. The important assistant items of SAPRD are i) improvement of processing and marketing of farm products, ii) investment in farm management, iii) repair of rural regional infrastructure and iv)diversification of economic activities (secure of off farm income). Judging from these items, the following two items are taken into account and based on these items, the “production amount shares” are adjusted as the scenarios for the simulations.

(a)The repair of rural infrastructure will expand the irrigated farmland, which contribute to the increase of fruits and vegetable production and the mixed farming of grain and livestock sector. In the non-irrigated areas, it is expected that the grain monocultures increase and the livestock industry production decreases.

(b) shift to the farm crop diversification and the cash crop will contribute the expansion of fruits and vegetables.

3) Assumed Changes in the EU Accession

As for the assumed changes in the EU accession, the information described in “Structural Change and Market Opening in Turkish Agriculture” (Erol H.Chakmak [8]) and the “ICCAP Scenario Families ”impacts are applied.

In the paper by Chakmak, the change in one year after the EU accession of Turkey assumed in 2005 is simulated by applying the non-linear optimization model, i.e. PMP model. In this paper, following the EU accession, 5 conditions are assumed such as i) application of CAP, ii) abolition of current agricultural policy in Turkey, iii) continuation of current population growth (the annual rate of 1.5 – 2.0%), iv) increase of irrigated farmland, and v) price adjustment due to the adaptation to the EU common market. As the results of this simulation, it is pointed out that wheat, oilseed and livestock products will decrease and also barley, beans, timber, vegetable, fruits, nuts will increase. Based on characteristics of these changes, the following situation is suggested. i.e. (a) a little decrease of grain sector, (b) big expansion of vegetables, (c) increase of fruits, (d) sharp reduction of livestock products and (e) a little increase of forestry.

In addition, as the other change due to the EU accession, there is the application of “fish resources managements”. It was disclosed that Turkey had exceeded the fishing quota of ICCAT in 2005 and so, it is not satisfying the international standard. However, due to the strict application of international rules following the EU accession, (f) a little reduction of fishery sector is also suggested. These tendencies in the above 6 sectors are taken into account in our simulation analysis and these are reflected in the values of the “production amount shares” as shown in Table 5.

Table 5 Production Amount Shares

Production Amount Share	2007-2018 Pre-Accession	2018-2073 EU Fully Accession
53.4	54.8	48.1
44.6	46.9	53.5
51.6	54.2	54.2
40.3	41.3	36.3
25.1	25.1	30.1
46.2	46.2	41.6

As shown in Figure 5, in the case of baseline simulation under the assumption that Turkey keeps the current situation without joining the EU, the relative production shares for fruit and fishery sectors will increase and those for livestock and forestry sectors will decrease constantly until 2073 while those for the grain and vegetable sectors will expand until 2030 or so but begin to decrease after 2030.

As shown in Figure [6], in the case of the EU accession scenario simulation, again, the production shares for fruit sector will increase and those for livestock sector will decrease constantly until 2073 but more sharply than the baseline case. Those for grain sector will show the similar pattern to the baseline case where the production share will expand for some years and then begin to decline after 2018. However in this case, the production share for vegetable sector will keep expanding until 2073, which is different from the baseline case. Those for fishery sector will increase until 2029 but begin to decline after 2040, which is also different from the baseline case. Those for forestry sector will decline for some years and then begin to increase slightly after 2018, which is also different from the baseline case.

Figure 7 shows the comparison of the simulated prediction results between the two scenarios for each sector. The above mentioned implications can be confirmed in these Figures.

Finally, Figure 8 shows the increased rate of production amount for each sector in the EU accession scenario case compared to the baseline scenario case. It can be observed that all sectors will increase their production amounts in absolute term but the increased rate of each sector is not the same with each other. Vegetable sector shows the biggest increase rate. Forestry and fruit sectors are second and third biggest respectively. Fisheries sector shows the smallest increased rate, followed by livestock and grain sectors in this order from the lowest rate.

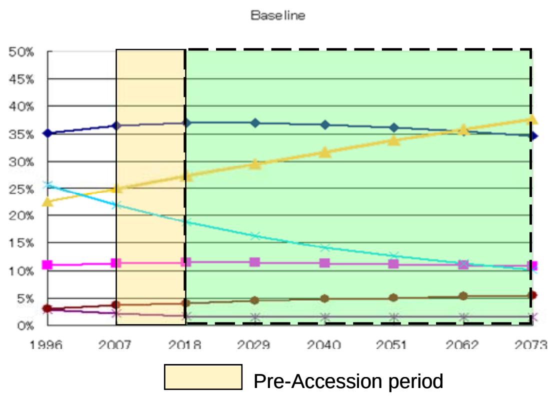

Fig.5 Prediction under the Baseline scenario

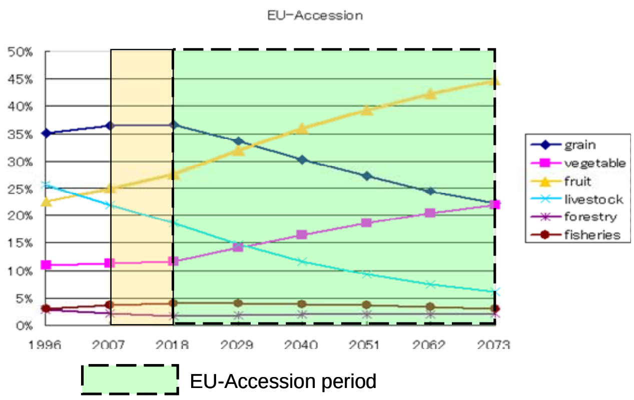

Fig.6 Prediction under the EC accession scenario

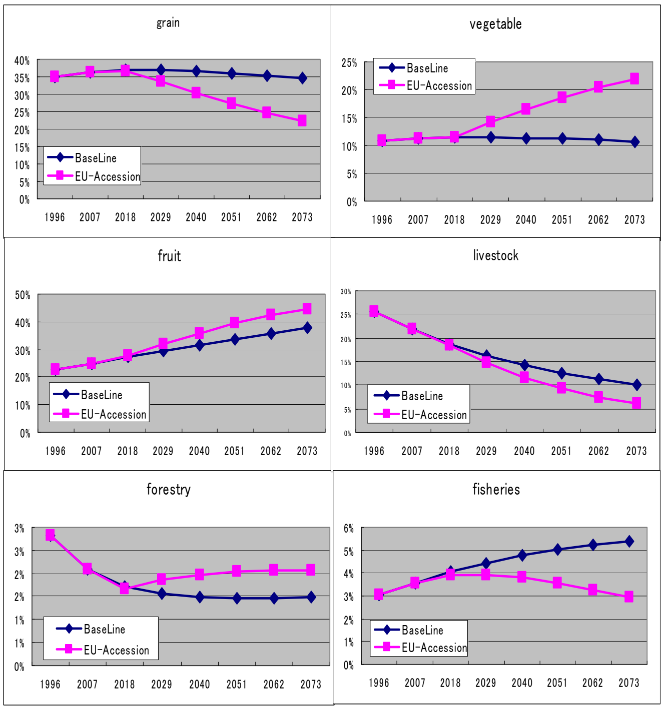

Fig.7 Compaison of production amount shares in each sector between the EU accession scenario and baseline scenario

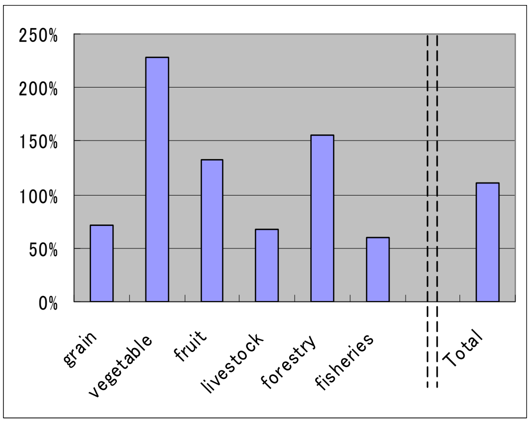

Fig.8 Changes of production amounts in the EU accession

6. Findings and Some Implications

From the above estimation and prediction results, as for impacts of climate change and the EU accession on Turkish rural industries, the following points are observed.

For the marginal effects of each climate change on the productivities, the following points are confirmed.

i) the increase of rain in May in both Konya and Adana does not affect the productivities in any rural sectors so much but the temperature increase in Konya will affects all of rural sectors positively while the temperature increase in Adana will affect all rural sectors except vegetable negatively.

ii) the relative impacts in percentage terms are very small in vegetables and rather big in grain, forestry and fisheries.

iii) as for total impacts of climate change on productivity in each rural industry, the forestry and fishery sectors will be affected positively and significantly while grain, fruit and live stock sectors will be affected positively but less significantly. Only vegetable sector will be affected negatively.

From the prediction results for impacts of the EU accession on the relative production amount, the following points are confirmed.

i) in the case of baseline simulation, the production shares for fruit and fishery sectors will increase and those for livestock and forestry sectors will decrease constantly until 2073 while those for the grain and vegetable sectors will expand until 2030 but begin to decrease after 2030.

ii) in the case of the EU accession scenario simulation, the production shares for fruit sector will increase and those for livestock sector will decrease constantly until 2073 but more sharply than the baseline case. Those for grain sector will show the similar pattern to the baseline case where the production share will expand for some years and then begin to decline after 2018.

iii) the production share for vegetable, fishery and forestry sector showed the different pattern from those in the baseline case.

iv) finally, as for the increased rate of production amount for each sector in the EU accession scenario case compared to the baseline scenario case, all sectors will increase their production amounts in absolute term but the increased rate of each sector is not the same with each other . Vegetable sector shows the biggest increase rate. Forestry and fruit sectors are second and third biggest respectively. Fisheries sector shows the smallest increased rate, followed by livestock and grain sectors in this order from the lowest rate.

7. Reference

[1] Masaru KAGATSUME, "Input Output Analysis on the Environmental Resources Conservation in Rice Growing Areas in Australia",Journal of Oceania Economy Studies], No.7, October, 1993, Association of Oceanian Economic Studies

[2] Masaru KAGATSUME, "Global warming and methane emission from the rice growing", The Farm Accounting Studies, No.24, December 1991

[3] Masaru KAGATSUME, "An Econometric Analysis on the Interrelations among Rural Industries Structure, Agricultural Productivities and Climate Changes", The Natural Resource Economics, No. 10, pp49-70, Dec 2004

[4] Lashof, D & Tirpak, D., "Policy options for stabilizing global climate" (draft), US. EPA, Washington, DC., 1989

[5] Yuzuru MATSUOKA, "Effects estimation model of global warming alleviation measures", Environmental Research, No.77, 1990

[6] State Institute of Statistics, Prime Ministry, Republic Of Turkey, The Input-Output Structure of The Turkish Economy, 1996

[7] Kemal Dervis, et al., "Turkey and the EU Budget --- Prospects and Issues ---", EU-Turkey Working Papers, Centre for European Policy Studies, Aug.. 2004.

[8] Erol H. Cakmak, "Structural Change and Market Opening in Turkish Agriculture", EU-Turkey Working Papers, Centre for European Policy Studies, Sep. 2004.

[9]Tsujii and Watanabe, "ICCAP Scenario Families", Nov. 2005