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Effects of climate change on rice production: The case of Turkey

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The scope of this study is rice scarcity and the increase of rice prices as a result of the drought in Turkey. It is obvious that drought is occurring in the world and producer countries are suffering smaller crops as a result. Therefore, rice exporters have partially limited their exports. Rice production per capita in Turkey is 6 to 6.5 kg. Rice per capita in 2005 was 5.3 kg, and it was 6.2 kg in 2006. There was a decline of 6.9% in rice production in 2006; however, rice production per capita in 2007 was 5.5 kg. The protective tariff for domestic producers which Turkey abolished in 2006 and the drought affected rice production negatively. The production deficit calculated at 70.000 tons in 2007 was determined to fall in the following years after increasing for some time according to the long-term trend analysis in 2008.

Key words: Rice production, total rice demand, rice supply deficit, climate change.

INTRODUCTION

Recent price increases occurring as a result of reduced supply of some food products on the world market and in Turkey are an urgent issue on the agricultural agenda. No matter what level of civilization a society has, this issue cannot be ignored because agriculture is a strategic sector. Nutritional problems cannot be overlooked. Rice production still continues to increase in spite of global warming, drought and the other factors restricting the capacities of agricultural facilities. However, the exposure of rice production to the global warming threat is a key point. Studies have estimated several climate change scenarios, countries, and put forward some projections about rice production mainly in Asian (Kropff et al., 1993; Horie et al., 1997; Matthews et al., 1997; Hayashi and Jung, 2000; Aggarwal and Mall, 2002; Tao et al., 2008). This is where the discussions begin regarding the agricultural sector's recent worldwide crisis.

Rice is not only a basic food source for human nutrition but is also of strategic significance for some countries. For instance, a considerable part of the U.S. population consumes rice, and the reason for rice consumption is rather dietetic (Batres-Marquez and Jensen, 2005).

Egypt and Bangladesh consume rice in order to feed their growing populations and to establish food security (Hossain et al., 2006). Rice is the basic food source in Asian countries such as China, India and Japan. China and India are understood to play important roles in both rice production and consumption (Alias Bin et al., 2006). That is why China has introduced important economic and institutional reforms so that agricultural production will increase and the agricultural sector will grow (Heerink et al., 2007).

Indonesia rank among these countries as the growth in rice production there is generally regarded as the most important indicator of agricultural development. Rice is perceived as a meaningful product, and the key to growth for the rural economy is the small-scale agricultural facilities. Furthermore, rice is regarded as a national food that assures food security in Indonesia.

It can be said that rice importer countries monitor

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production policies and current situation of rice exporter countries. However, it is possible to come across information in several studies that the actual production of some countries is much lower than their published statistical data and that most of them are in fact net importers. For example, one of these countries is Indonesia (Rosner and McCulloch, 2008).

Recently there has been a production decline in Turkey in terms of almost all types of cultivation such as cereals, fruits and vegetables. Given the low precipitation rates in 2008, we must recognize a partial drought at least on a regional basis (South-East Anatolia). If climate change persists, a world food crisis is inevitable.

Turkish production in 2007 fell 15.5% in 2007 when compared to 2006, only reaching 29 million tons. Accordingly, wheat, grain corn, barley and paddy production declined (13.9, 7.2, 23.5 and 6.9%, respectively) and the production was approximately 648.000 tons (Anonymous, 2008). The minimum three months for paddy cultivation restricts rice output (İşçan, 2002). However, we can say that paddy producers in Turkey benefit from sophisticated cultivation techniques and fertilizer; agricultural pesticide use and mechanization, especially in the Thrace region, reached important levels (Dönmez, 2007).

In order to protect domestic producers in Turkey and to increase rice production, “Tariff Quote on the Importation of Some Paddy and Rice Species” was implemented by official notification no. 25943 dated 21 September 2005, thus making it obligatory to buy domestically produced rice. Turkish paddy production in 2005-2006 increased 62% when compared to the 2003-2004 period, reaching 600.000 tons. With the help of this system, producers had the chance to market their products at higher prices. However, the U.S.A. complained about this policy and reported it to the World Trade Organization on 2 November, 2005. Turkey abolished this policy on 1 January, 2006 (Dönmez, 2007).

The purpose of this study is to reveal the conditions of paddy cultivation, rice production and output in Turkey, to examine whether there is rice scarcity and how the supply deficit in Turkey will be shaped in coming years.

MATERIALS AND METHODS

The main data source for this study is the data obtained from the Turkish Statistical Institute (TUIK) and FAO. Also, essays and journal articles contributed to the study.

The data were treated, transformed into tables and interpreted. The simple index of the rice cultivation, rice production and output within the scope of the study:

$$İ = (Pi/Po)*100$$

Chain index; $İ = (Pi/Pi-1)*100$ and annual average increase rates

$$=\{[(LastYear/FirstYear)^(1/n)]-1\}*100$$

were calculated according to the above formula and they became more meaningful.

Non-linear trends were in the long-term analysis, but least square method, which was appropriate to the data, was used. This method helped calculate average value and increase rate (Güneş and Arıkan, 1988). The trend line in his method is expressed mathematically as:

$Y = a + bx$

b coefficient gives the long-term trend (annual average value);

$$b = \frac{\sum xy - n\bar{X}.\bar{Y}}{\sum x^2 - n\bar{x}^2}$$

$$a = \bar{y} - b\bar{x}$$

X: Coding according to year in the lead of the series, Y = the factors to be analyzed, n = number of years, $\bar{X}$: the average of the sum of the years coded, $\bar{Y}$: the average of the sum of the factor within the scope of the long-term analysis according to the years. Accordingly, the rice production was long-term analysis, trend equation and then some estimates were made with the help of the average increase and fall in rice production.

RESULTS

Global warming and recent developments in world rice production

Paddy production in the world was 645.000 million in 2007. This is equal to 430 million tons of rice. Asia was the most important country contributing to world paddy production (Anonymous, 2007). The use and combination of different modern technologies in recent times increased the opportunities for fertilizer use. Likewise, as a result of the developing irrigation, agricultural rice production rose in southern and southeastern Asian (Flinn and Hazal, 1988). However, adverse weather conditions caused declines in rice production in Africa, Oceania, Latin America and the Caribbean (Anonymous, 2007).

Globalization and integration of markets contributed to unprecedented economic growth in China and most of South and South East Asia. It is estimated that the paddy production will rise to 585 million tons with production increases in China, India and Indonesia, as well as Myanmar, Iran, Japan, Malaysia, Nepal, the Philippines and Thailand. On the contrary, rice production in Bangladesh, Cambodia, Korea, Republic of Korea, Sri Lanka and Turkey is estimated to fall (Anonymous, 2007).

African rice production is concentrated in the sub-Saharan and western regions of the continent. Rice production is concentrated in these areas because of population density, easy market access, availability of water etc. (Sakurai, 2006). Rice production in the interior parts of the African continent--where extraordinary

Table 1. Rice production in Turkey.

Year	Cultivation (da)	Production (Ton)	Output (kg/da)
1987	530.000	165.000	311
1988	510.000	157.500	309
1989	660.000	198.000	300
1990	530.000	138.000	260
1991	404.000	120.000	297
1992	430.000	129.000	300
1993	448.500	135.000	301
1994	405.000	120.000	296
1995	500.000	150.000	300
1996	548.500	168.000	306
1997	550.000	165.000	300
1998	600.000	189.000	315
1999	650.000	204.000	314
2000	580.000	210.000	362
2001	590.000	216.000	366
2002	600.000	216.000	360
2003	650.000	223.200	343
2004	700.000	294.000	420
2005	850.000	360.000	424
2006	991.000	417.600	421
2007	-	388.800	-

Source: Turkish Statistical Institute, Herbal Production Statistics, 2008.

drought conditions are dominant--and in rather fertile parts of the continent was anticipated to fall behind 2006 production to 21,6 million tons. On the other hand, the prediction made for Egypt suggests a fall in paddy production. Besides, a similar situation may be valid for the Ivory Coast, Guinea Bissau, Mali and Nigeria. However, Benin, Chad, Guinea, Madagascar, Mozambique, Senegal and Tanzania had good harvests (Anonymous, 2007a).

Rice production was negatively affected by adverse weather conditions and tornados that destroyed crops in Central America and the Caribbean. The production rate for sub-regions suggests that 7% less than 2006 will be harvested. The production is envisaged to be low in Cuba, Dominican Republic, Guatemala, Haiti, Honduras, Mexico, Nicaragua and Panama. Similarly, adverse weather conditions had negative effects on rice production in South American countries such as Argentina, Bolivia, Brazil, Chile, Ecuador and Uruguay. Contrarily, increases in rice production occurred in Colombia, Guinea, Peru and Venezuela. Production increased in the E.U., the U.S.A. and Russia. The situation in Australia did not change, and the country continues its normal production (Anonymous, 2007).

According to the commercial estimation report on rice in 2008 issued by FAO, it is anticipated that rice trade in 2008 will increase 1% and rise to 30.3 million tons when compared to the year 2007. In addition, the report suggests that rice importation in Bangladesh, China, Iraq, Democratic People's Republic of Korea, Nepal and Turkey, which are the importer countries in Asia, will increase. These imports will decline in Indonesia, Iran, the Philippines and Sri Lanka. On the other hand, Argentina, Brazil, China, Guinea, Myanmar, Pakistan, the U.S.A., Uruguay and Vietnam expect that their exports will increase whilst Egypt and India are anticipated to restrict their exportation. In addition, Thailand, the world's biggest exporter, is expected to reduce its exports (Anonymous, 2007).

Rice production in Turkey

Overall paddy cultivation area which was 530.000 acre in 1990 reached 580.000 acre with a slight increase ten years later in 2000 and peaked in 2006. Similarly, 260 kg of rice per acre in 1990 brought total production to 138.000 tons. Production and output continued increasing in 2000, and 417.600 tons of rice were produced in 2006, suggesting 421 kg of rice per acre (Table 1).

Paddy cultivation fell between 1990 and 1997 compared to the 1987 to 1989 period. This shrinkage of paddy cultivation fields can be said to have an impact on rice production to for the predicted period, the 5.88% increase observed in area in 1998 had a positive effect on production (8.93%) and output (2.61%). However, with the aid of technology, cultivation fields became more resistant to shrinkages and expansions, thus allowing for a much higher output per acre. In 2006 a 74.88% increase in paddy cultivation area led to an increase of 40.69% in terms of production and 37.26% in terms of output per acre. There was a fall in rice crops in 2007 as a consequence of drought, global policies applied in paddy production and their reflections in domestic production (Table 2).

During a 20-year period, there were increases in paddy cultivation fields each year for 14 consecutive years. Although the rates of cultivation and production were different than previous years during the 2001 to 2006 period, the rates continued rising. The increases in cultivation area had positive impacts on production no matter if these increases were at the same rate or much higher. However, an increase in production did not result in a direct increase in output; on the contrary, output fell in some years.

The point which should be emphasized here is that a 30.3% crop decline occurred in 1990, whereas a 19.70% fall occurred in 1990 when compared to the previous year. A similar situation was experienced in the year s 1991 and 1994. However the question lies behind why a 6.90% crop decline in 2007, when compared to the previous year, posed a problem as though there was rice scarcity (Table 3). The answer to this question is obvious: Dwindling rice production in the past only affected

Table 2. Simple index of rice production.

Year	Simple Index		
	Cultivation (da)	Production (ton)	Output (kg/da)
1987-89	100.00	100.00	100.00
1990	93.53	79.54	84.81
1991	71.29	69.16	96.75
1992	75.88	74.35	97.72
1993	79.15	77.81	98.05
1994	71.47	69.16	96.51
1995	88.24	86.46	97.72
1996	96.79	96.83	99.77
1997	97.06	95.10	97.72
1998	105.88	108.93	102.61
1999	114.71	117.58	102.23
2000	102.35	121.04	117.94
2001	104.12	124.50	119.25
2002	105.88	124.50	117.26
2003	114.71	128.65	111.85
2004	123.53	169.45	136.81
2005	150.00	207.49	137.96
2006	174.88	240.69	137.26
2007	-	224.09	-

Table 3. Chain index of rice production.

Year	Chain Index		
	Cultivation (da)	Production (ton)	Output (kg/da)
1988	96.23	95.45	99.20
1989	129.41	125.71	97.14
1990	80.30	69.70	86.79
1991	76.23	86.96	114.08
1992	106.44	107.50	101.00
1993	104.30	104.65	100.33
1994	90.30	88.89	98.44
1995	123.46	125.00	101.25
1996	109.70	112.00	102.10
1997	100.27	98.21	97.95
1998	109.09	114.55	105.00
1999	108.33	107.94	99.63
2000	89.23	102.94	115.37
2001	101.72	102.86	101.11
2002	101.69	100.00	98.33
2003	108.33	103.33	95.38
2004	107.69	131.72	122.31
2005	121.43	122.45	100.84
2006	116.59	116.00	99.50
2007	-	93.10	-

Turkey; however, now it is regarded as a global scale

Table 4. Annual increase rate of rice production.

Year	Annual average increase rate		
	Cultivation (da)	Production (ton)	Output (kg/da)
1987	-	-	-
1988	-1.90	-2.30	-0.40
1989	13.76	12.12	-1.44
1990	-10.39	-16.52	-6.84
1991	-12.69	-6.75	6.81
1992	3.17	3.68	0.50
1993	2.13	2.30	0.17
1994	-4.97	-5.72	-0.78
1995	11.11	11.80	0.62
1996	4.74	5.83	1.04
1997	0.14	-0.90	-1.03
1998	4.45	7.03	2.47
1999	4.08	3.89	-0.18
2000	-5.54	1.46	7.41
2001	0.86	1.42	0.56
2002	0.84	0.00	-0.84
2003	4.08	1.65	-2.33
2004	3.77	14.77	10.59
2005	10.19	10.66	0.42
2006	7.98	7.70	-0.25
2007	-	-3.51	-
1987-06	3.18	-	1.53
1987-07	-	4.17	-

because of the contraction experienced in 2007 to 2008 and the resulting scarcity. The annual average increase rate of paddy cultivation area in the 1987 to 2006 period was 3.18% and that led to a 1.53% increase in output. On the other hand, within 21 years, that is to say from 1987 to 2007, the annual average increase rate of rice production was 4.17%. On a yearly basis, the annual average increase rate of rice production in the year 2006 was 7.7%, whereas it was -3.51% in the year 2007. Nevertheless, the negative rate was obtained in rice production during seven years (Table 4).

Rice production per capita and production deficit

Annual average rice consumption amount per capita in Turkey varies between 6 kg and 6.5 kg (İşcan, 2002). The amount of rice produced which is spared per capita fluctuated as years went by. However, 3.3 kg of rice, which was the consumption amount in the 21 year term between 1987 and 2007, can be said to have been supplied by domestic production. Domestic rice

Table 5. Rice production per capita in Turkey (Person/kg).

Year	Rice production per capita (Person/kg)	Chain index	Annual increase rate
1987	3.3	-	-
1988	3.1	95.45	-2.30
1989	3.9	125.71	12.12
1990	2.4	62.53	-20.93
1991	2.1	86.96	-6.75
1992	2.3	107.50	3.68
1993	2.4	104.65	2.30
1994	2.1	88.89	-5.72
1995	2.7	125.00	11.80
1996	3.0	112.00	5.83
1997	2.6	88.23	-6.07
1998	3.0	114.55	7.03
1999	3.2	107.94	3.89
2000	3.1	95.44	-2.30
2001	3.2	102.86	1.42
2002	3.2	100.00	0.00
2003	3.3	103.33	1.65
2004	4.3	131.72	14.77
2005	5.3	122.45	10.66
2006	6.2	116.00	7.70
2007	5.5	89.43	-5.43

Source: Turkish Statistical Institute (TUIK).

production per capita showed upward trends particularly from 2004 onward. Accordingly, rice consumption per capita in the year 2004 rose 31.72% compared to the previous year, and the annual average increase rate was calculated at 14.77%. Annual average increase was 10.66% in 2005 and 7.70% in 2006. Nonetheless, the annual average increase rate of the year 2007 was negative (-5.43%). In other words, rice production per capita in the year 2007 declined 10.57% compared to the previous year (Table 5).

Total rice demand in Turkey increased gradually based on periods. Annual population growth rate may be effective in these increases. However, domestic rice production in Turkey showed fluctuations and sometimes it increased the annual average rate. Therefore, it may be concluded that Turkey need for imported rice diminished during these periods because the annual average population growth rate was lower at a stable rate and, most importantly, the annual average increase of rice production was higher. Hence, Turkey's rice production deficit, which was over 200.000 tons in 2003 and in the previous years, was gradually reduced. Provided that there are no significant scarcities in the following periods and as long as rice production growth rate is over population growth rate, the deficit of rice production will gradually be overcome (Table 6).

According to the long-term trend analysis, production deficit in the year 2007 was 70.000 tons. This number rose to 142.000 tons in the year 2008. Production deficit will decline after 2008 and fall to 86.000 tons by 2020 in accordance with the projections. The fact that the deficit was low in the year 2007 and (estimated) high in 2008 can be closely related to the policy change concerning Turkey's paddy production, partial drought and water scarcity. Turkey implemented a protective tariff for domestic paddy producers. Rice production in Turkey increased thanks to this resolution but the tariff was abolished in the year 2006 as a result of pressure from the World Trade Organization in 2005.

Therefore, policy change and the droughts can be considered as underlying factors of low rice production rates in 2007 and of the currently low production estimates.

Rice prices and annual increase rates

There were fluctuations in rice prices in the 1992 to 2001. When compared to the previous year, a ton of rice rose Source: FAOSTAT, 2008.22.02% in the year 2002. However, after this prices rose and fell. Prices rose 8.34% in the year 2005 when compared to the year 2004.

While the annual rice increase was 10.46% in the year, they fell 4.09% in 2005 (Table 7).

Table 6. Supply deficit of rice in Turkey and long-term trend.

Year	Total rice demand (ton)	Rice production (ton)	Production deficit (ton)	Projection Period (2008-2020)	Production deficit Estimation (000, ton)
1987	329.319	165.000	164.319	2008	142.1
1988	329.319	157.500	171.819	2009	137.5
1989	329.319	198.000	131.319	2010	132.8
1990	367.075	138.000	229.075	2011	128.1
1991	367.075	120.000	247.075	2012	123.5
1992	367.075	129.000	238.075	2013	118.8
1993	367.075	135.000	232.075	2014	114.1
1994	367.075	120.000	247.075	2015	109.5
1995	367.075	150.000	217.075	2016	104.8
1996	367.075	168.000	199.075	2017	100.2
1997	408.626	165.000	243.626	2018	95.5
1998	408.626	189.000	219.626	2019	90.8
1999	408.626	204.000	204.626	2020	86.1
2000	440.726	210.000	230.726		
2001	440.726	216.000	224.726		
2002	440.726	216.000	224.726		
2003	440.726	223.200	217.526		
2004	440.726	294.000	146.726		
2005	440.726	360.000	80.726		
2006	440.726	417.600	23.126		
2007	458.811	388.800	70.011		

The average per capita in total demand calculation was considered 6 kg rice supply amounts are the rice production amounts registered by the Turkish Statistical Institute (TUIK).

Table 7. Rice Prices in Turkey.

Year	US Dollar/ton	Chain Index	Annual average increase rate
1991	658.71	-	-
1992	772.42	117.26	8.29
1993	658.99	85.31	-7.63
1994	435.45	66.08	-18.71
1995	444.58	102.10	1.04
1996	485.35	109.17	4.48
1997	423.23	87.20	-6.62
1998	444.73	105.08	2.51
1999	407.86	91.71	-4.23
2000	398.66	97.74	-1.13
2001	305.46	76.62	-12.47
2002	372.68	122.01	10.46
2003	446.36	119.77	9.44
2004	510.46	114.36	6.94
2005	553.05	108.34	4.09

Climate relations of rice

In this study, relationship between the monthly mean temperatures of rice growing provinces of Turkey and yield was investigated. The best fit in yield temperature interaction was found in August. The significance of the relation was tested by regression analysis and found to be significant. Results suggest that for a better rice growth high temperature climate was needed. At present condition, yield increases as the temperature increases. However, above mentioned results can only be achieved with the availability of water.

We can also conclude that the increasing temperatures due to global warning may be an advantage for growing rice in Turkey. Same conclusion also applies for the countries that are in similar conditions. Results are also important for the rice producing countries. Because the rice has an important place in human diet thus rice producing countries may came an important strategically position (Table 8 and Figure 2).

DISCUSSION

This study showed that if there are no restrictions inwater resources of Turkey, the rising temperatures resulting from climate change can make a positive contribution to the production of rice study conducted in the GAP region of Turkey gave similar results, confirming the results of this study (Koç and Tonkaz, 2010). Another study

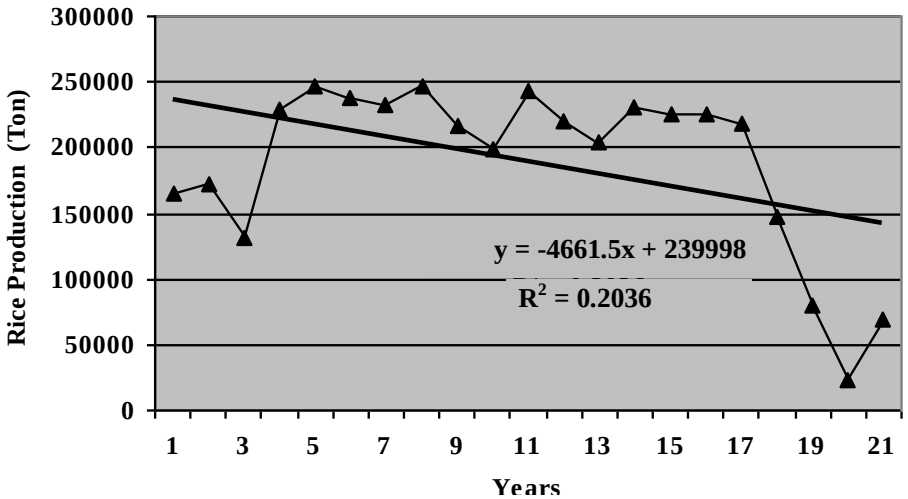

Figure 1. Long-term linear trend of rice production in Turkey in 1987-2007 period.

Table 8. Relationship between rice yield and temperature in the regression results.

Predictor	Coef.	SE Coef.	T	P
August	13.5151	0.3320	40.70	0.000

S=34.9602; The regression equation is yield = 13.5 August.

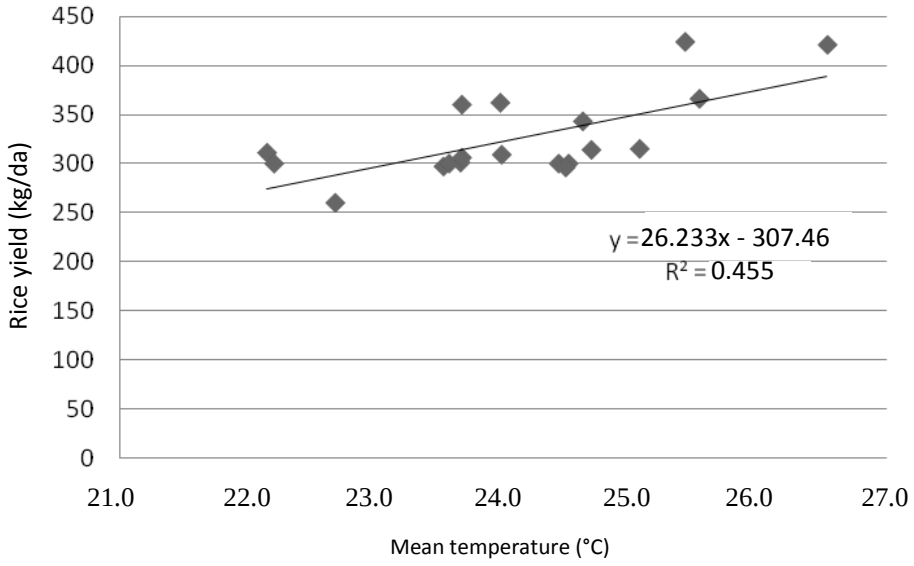

Figure 2. Turkey's average temperature and the relationship between rice yield (The association was strongest in August).

conducted in China suggested similar findings, but when one evaluated global average temperature, water use and rice production all together, the identification of food security risk in the context of climate change who found to be very important (Tao and et al., 2008).

Conclusion

It was determined that rice production levels fell because of global climate change and scarcity, thus putting foreign trade relations in dire straits few many rice producer

countries in the world and foreign trade trends. There is no rice scarcity in Turkey and in the world when the current situation is taken into consideration, although there are some problems in rice distribution and rice deliveries from producer countries. If global climate change and the resultant scarcity continue in 2008 to 2009, there may be shortages not only in rice but in all cereal production.

Turkey seems under better conditions than the years before 2005 to 2007. The production deficit was lowered by increasing domestic production. Rice output per acre in Turkey increased over years. A 1.5% increase in output was observed in the 1987 to 2006 term. The average temperature in August in Turkey, the rice yield has positive and significant impact.

A protective tariff for domestic producers had positive effects on domestic rice production. However, it is envisaged that rice production will be adversely affected due to global warming after abolition of the tariff. It was determined that rice prices based on the U.S. dollar had a tendency to decrease from 2002 to the year 2005.

REFERENCES

Aggarwal PK, Mall RK (2002). Climate change and rice yields in diverse agro-environments of India. II. Effect of uncertainties in scenarios and crop models on impact assessment. Clim. Change 52:331-343.

Alias Bin A, Shoich I, Kelali A (2006). Estimate of Rice Consumption in Asian Countries and the World Towards 2050, Japan Science and Tecnology Agency, Journal Code: N20062659, pp. 28-43.

Anonymous (2008). Plant Production, 2007. TURKSTAT News Bulten, Volume: 53, 27 March 2008.

Anonymous (2007). Rice Market Monitor, December 2007, Volume X-Issue No. 4, www.fao.org (27 Nisan 2008).

Anonymous (2007a). Rice Trends in Sub-Saharan Africa, The Africa Rice Center (WARDA), www.warda.org (27 Nisan 2008).

Batres-Marquez SP, Jensen HH (2005). Rice Consumption in the United States: New Evidence from Food Consumption Surveys, Center for Agricultural and Rural Development (CARD) Puplication, Number: 05-sr100, www.card.iastate.edu (27 Nisan 2008).

Dönmez D (2007). Rice, Situation and Estimation 2006/2007, Agricultural Economics Research Institute, Publication no: 151, Ankara.

Flinn JC, Hazal PBR (1988). Production Instability And Modern Rice Technology : A Philipine Case Study, The Developing Economies, XXVI-I 8 (March 1988).

Hayashi Y, Jung YS (2000). Paddy rice production under possible temperature fluctuation in East Asia. Global Environ. Res. 3:129-137.

Heerink N, Qu F, Kuiper M, Shi X, Tan S (2007). Policy reforms, rice production and sustainable land use in China: A macro–micro analysis. Agric. Syst. 94:784-800.

Horie T, Centeno HGS, Nakagawa H, Matsui T (1997). Effect of elevated carbon dioxide and climate change on rice production in East and Southeast Asia. In: Oshima, Y. (Ed.), Proceedings of the International Scientific Symposium on Asian Paddy Fields. University of Saskatchewan, Saskatchewan, Canada. pp. 49-58.

Hossain M, Bose ML, Mustafi BAA (2006). Adoptıon And Productıvıty Impact Of Modern Rıce Varıetıes In Bangladesh. Dev. Econ. XLIV(2):149-66.

İşçan L (2002). Report of Paddy, Tarım ve Köyişleri Bakanlığı, Araştırma Planlama ve Koordinasyon kurulu Başkanlığı, Ankara.

Kropff MJ, Centeno G, Bachelet D, Lee MH, Mohan Dass S, Horie T, De Feng S, Singh S, Penning de Vries WT (1993). Predicting the impact of CO_2 and temperature on rice production. In: IRRI Seminar Series on Climate Change and Rice, International Rice Research Institute, Los Ban˜ os, Philippines.

Koç B, Tonkaz T (2010). Pady Production in the GAP Region with the Climate Relationship and Long Term Trend Analysis of Rice Production, Turkey IX. Agricultural Economics Congress, 22-24 September 2010, Volume 2. pp. 622-628, Şanlıurfa, Turkey.

Matthews RB, Kropff MJ, Horie T, Bachelet D (1997). Simulating the impact of climate change on rice production in Asia and evaluating options for adaptation. Agric. Syst. 54:399-425.

Rosner LP, McCulloch N (2008). A Note on Rice Production, Consumption and İmport Data in Indonesia, Bull. Indones. Econ. Stud. 44(1):81-92.

Sakurai T (2006). Intensification of rainfed lowland rice production in West Africa: Present status and potential Green Revolution. Developing Economies 44(2):232-51.