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Measuring Impact of Air and Agricultural Soil Pollution on Social Development in Saudi Arabia

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ABSTRACT

This research aimed to measure the impact of air and agricultural soil pollution on social development in Saudi Arabia from the period 1995–2019 by using social development indicators, concentrating on the percentages of expenditure on education and health, and the Human Development Index. In addition, this study uses multiple regressions in estimating the model to study the impact of air pollution and agricultural soil on social development. Results of the study showed that a 10% change in the number of chemical fertilizers and pesticides used in Saudi agriculture leads to a change in the total number of inpatients by 0.7% and 0.5%, respectively. It was also found that an increased percentage of health expenditure to total government spending by 10% leads to a decrease in the total number of patients in the hospital by 1.8%. An increase in air pollution, expressed as a 10% increase in CO_2 emissions, increases the total number of hospitalized patients by 11.1%. The increasing total number of patients by 10% leads to a decrease in the total productivity of the worker, as an indicator of 1.8%. Furthermore, a change of 10% in the ratio of education expenditure to total government expenditure leads to a change in the same direction of the Human Development Index by 9.6%. In light of these results, it can be recommended that the country need to reduce air pollution by expanding the use of natural gas in the industrial and transportation sectors, in addition to reducing the use of nitrogenous fertilizers and pesticides in Saudi agriculture through the expansion of clean farming and good agricultural practices.

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1 Introduction

Environmental pollution is one of the most severe problems that threaten human resources. It is associated with industrial, mining activities, transportation, and some agricultural practices. Among the most common pollutions, air pollution is the most common one and it is caused by desalination fumes, vehicle exhaust, industrial cities, rubbish burning, and agricultural waste in Saudi Arabia. Water pollution results from the disposal of sewage, landfills in the Red Sea, and the Arabian Gulf. Electricity and heat production are the most important sources of carbon dioxide emissions (49.2%), followed by transportation (25.9%), manufacturing and construction industries (24.1%), then buildings and services (0.8%). Further, the average per capita emissions of carbon dioxide (CO_2) increased from 10.25 tons in 1990, to 17.69 tons in 2015, and then decreased to 14.15 tons in 2020 (World Bank 2020). Like air and water pollution, agricultural soil pollution is also a major problem and is caused by residues of nitrogenous fertilizers, fungicides, and insecticides. Over the past decades, economic development plans have targeted an increase in industrial and mining activity, which has led to an increase and accumulation of pollutants and chemical and radioactive solid waste. Some governments dump this waste and bury it in the ground, which results in a negative impact on humans, animals, and plants in the long run. In light of the scarcity of water resources and the increasing population pressure, the state has tended to vertical agricultural expansion through the expansion of the use of chemical fertilizers and pesticides, which has led to the destruction of the biological life of the soil. Which confirms the excessive use of chemical fertilizers in Saudi agriculture and is an increase in the share of the land unit (ha) of fertilizers from 180.9 kg/ha in 2012 to 3500.5 kg/ha in 2019 (FAO 2020). Undoubtedly, the accumulation of chemical fertilizers (nitrogen, potassium, and phosphate) and pesticides of all kinds, had led to the pollution of soil and groundwater and an increase in their nitrogen content (Nashwan and Ghanem 2010). Due to the low environmental awareness and lack of commitment to environmental controls, the cost of environmental degradation in the Kingdom had increased to 86 billion riyals, representing 3.0% of GDP. The Kingdom of Saudi Arabia's ranking in the Environmental Performance index was 86 out of 180 countries (World Bank 2014). Al-Fraih (2010) studied the environmental pollution caused by electric power plants in the city of Riyadh. This study revealed the presence of environmental pollution inside electric power plants, which led to the emission of odors from fuel waste, and an increase in the number of workers suffering from health and hearing diseases. This study also showed the weakness of the Saudi Electricity Company in the Central Region in achieving environmental security. Kjellstrom et al. (2007) examined health risks and the relationship between social and environmental determinants in urban areas, and interventions to improve health equity through the environment that includes actions and policies that deal with risks surrounding urban areas such as providing drinking water, improving the living conditions of the poor in developing countries, reducing air pollution and limiting emissions and financial resources for emergency interventions for health equity. Khan (2011) studied the impact of environmental pollution on life and ways to treat it in Pakistani cities and reported that about 80% of the population lived in a polluted industrial environment. Pakistani cities suffer from overcrowding, deteriorating air and water quality, and waste management. The study indicated that environmental pollution is one of the main causes of human death around the world. The population increase, the expansion of industrialization, and the increased demand for energy and automobiles are among the main causes of air pollution that affected the level of public health in Pakistani cities. Azari (2014) focused on measuring the impact of environmental pollution on sustainable development, identifying the sources of pollutants, and reducing their effects on human health and the environment. This study showed that the owners of industrial activities refrained from paying the expenses of treating their waste, which led to an increase in environmental pollution and deterioration in the level of public health. Najm al-din (2016) estimated the cost of environmental degradation resulting from air pollution in the city of Kirkuk in northern Iraq, which is one of the most important oil-producing cities in Iraq. This study showed that the cost of environmental degradation in the city of Kirkuk amounted to 68.8 billion Iraqi dinars, representing 12% of the gross domestic product of the province of Kirkuk in 2013. Ministry of Environment, Water, and Agriculture in the Kingdom of Saudi Arabia (2018) prepared the National Environment Strategy. The strategy dealt with wildlife, marine and coastal environment, vegetation, air quality, climate change, water resources, waste management, chemical safety, and meteorology. On the air quality axis, it was reported that air pollution increased through the emissions of the energy and industry sector, the density of cars in large cities, dust storms, and landfills.

There is no doubt that environmental pollution harms public health, life expectancy, and the productive capacity of human resources. Due to the magnitude of the negative effects of environmental pollution, this study focused on (i) identifying the most important sources of environmental pollution in the Kingdom of Saudi Arabia, and (ii) the relative impact of air and soil pollution on the human development index as an indicator of social development. This study is distinguished from the previous studies referred to, in that it deals with measuring the impact of air and soil pollution on social development through building and measuring an econometric model, consisting of four behavioral equations that include the most important internal and external variables related to the subject of the study. This study aimed to measure the impact of air and agricultural soil pollution on social development during the period 1995-2019, by studying the (i) determine the sources of air pollution in the Kingdom of Saudi Arabia, (ii) the evolution of the use of nitrogenous, potassium and phosphate fertilizers and

pesticides in Saudi agriculture, and (iii) estimating the proposed model for studying the impact of air and agricultural soil pollution on social development.

2 Materials and Methods

In achieving its objectives, this study relied on social development indicators, the most important of which are: (1) the ratio of spending on health in total government spending, (2) the ratio of spending on education in total government spending, and (3) the Human Development Index which is a composite criterion, as it consists of three partial criteria: life expectancy criterion (health indicator), educational attainment criterion (educational indicator), and average real national income per capita criterion (economic indicator). The value of the Human Development index ranges from zero to one. The closer the human development index is to one, the more advanced the country in the field of human development, and vice versa. The United Nations classifies countries into three groups as per the Human Development Index: the first group is high-level countries, where the value of the human development index is greater than or equal to 0.8, and the second group is medium-level countries, where the value of the human development index ranges from 0.5 to less than 0.8, and the third group is low-level countries, with an HDI value of less than 0.50 (UNDP 2020).

In achieving its objectives, this study relied on estimating the proposed model to study the harmful effects of air and agricultural soil pollution on social development during 1995-2019. The proposed model consists of the following behavioral equations:

$$Y_{1t} = a_0 + a_1 X_{1t} + a_2 X_{2t} + a_3 X_{3t} + a_4 X_{4t} + e_{1t}$$

$$Y_{2t} = b_0 + b_1 \hat{Y}_{1t} + e_{2t}$$

$$Y_{3t} = c_0 + c_1 \hat{Y}_{2t} + c_2 X_{5t} + e_{3t}$$

The proposed model equations include the following variables: (i) The three endogenous variables are: the total number of inpatients in hospitals of the Ministry of Health (Y_{1t}), the average total worker productivity in thousand riyals (Y_{2t}), the human development index (Y_{3t}). (ii) The five Exogenous Variables are the total amount of chemical fertilizers used (X_{1t}), the total amount of pesticides used in Saudi agriculture (X_{2t}), the ratio of health expenditures to government spending (X_{3t}), the amount of carbon dioxide emissions generated from cars and water desalination (X_{4t}), the ratio of education spending to government spending (X_{5t}). The proposed model was estimated using the ordinary least squares method (Greene 2003).

3 Results

3.1 Main sources of air pollution in Saudi Arabia

Air pollution is the exposure of the atmosphere to chemicals, solid particles, or biological compounds that cause damage to humans,

Table 1 Total emissions (in kiloton) of air pollutants in Saudi Arabia in 2014

Sector	Sulfur oxides (SO_2)	Nitrogen oxides (NO_2)	Inhaled lingering transcriptions (IP)	Non-methane-containing volatile organic compounds ($NMVOC_s$)	Carbon monoxide (CO)
Electrical and thermal power generation and water desalination					
quantity	2120	386	52.14	33	62
%	66.46	12.03	24.45	0.10	0.40
Oil extraction and refining					
quantity	262	1122	3	358	100
%	8.21	34.96	1.41	1.04	0.65
Transportation					
quantity	52	1447	113.99	2579	15151
%	1.63	45.09	53.46	7.52	98.59
Petrochemical industrie					
quantity	0	10	0.29	0	0
%	0	0.31	0.14	0	0
Cement					
ytitnauq	83	22	3.66	2	9
%	2.60	0.69	1.72	0.01	0.06
Other sectors (iron and steel, agricultural, residential, and commercial)					
quantity	673	222	4015	31311	45
%	21.1	6.92	18.83	91.33	0.29
Total sectors					
quantity	3190	3209	213.23	34283	15367
%	100	100	100	100	100

Source Meteorological and Environmental Protection Authority and World Bank (2016); State of the Environment Report in Saudi Arabia

other organisms, and the natural environment. Air pollution is one of the most serious environmental problems resulting from industrial development, expansion of energy use, increased land, air, and sea transport, and associated emissions of carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_X). It is clear from the data given in Table 1 that the main sources of air pollution in the Kingdom of Saudi Arabia are (i) electric and thermal power generation, and water desalination, and these are contributed about 66.46% of total sulfur dioxide and 24.45% of minute emissions; (ii) oil extraction and refining sector, responsible for about 8.21% of total sulfur dioxide and 34.96% of nitrogen oxide emissions; (iii) transport sector is the main source of air pollution, especially in major cities, where vehicles account for about 7.52% of total emissions ($NMVOC_s$), 45.09% of total NO_X, and more than 98% of total CO emissions; and (iv) the petrochemical industry sector, which contributes a small percentage to air pollution because the petrochemical industries in Jubail, Yanbu, and other economic cities depend on natural gas as input for production and source of energy. Other sources of air pollution include the cement industry, construction and other similar activities, iron and steel industry, pesticide spraying, and municipal waste incineration.

3.2 Current situation of the use of chemical fertilizers and pesticides in Saudi agriculture

Developing countries suffering from population pressure tended to increase agricultural production through the excessive and unregulated use of chemical fertilizers and pesticides. By studying the evolution of the quantities used of chemical fertilizers in Saudi agriculture during the period 2000-2019, it is clear from the data presented in Table 2 that nitrogen fertilizers were the most widely used fertilizer with a rate of 60.79% in Saudi agriculture, this was followed by phosphate and potassium fertilizers with a rate of 33.69, and 5.52% respectively during the period 2000-2019. It was also shown that the share of the land unit (ha) increased from 344.84 kg/ha in 2000 to 3500.5 kg/ha in 2019, with an annual average of about 285.55 kg/ha during the period 2000-2019.

Table 2 Evolution of the amount of chemical fertilizers used in Saudi agriculture during the period 2000–2019

Year	Nitrogen in thousand tons	Phosphate per thousand tons	Potassium per thousand tons	Total per thousand tons	Ground unit share kg/ha
2000	228.0	137.2	21.0	386.2	344.8
2001	223.1	141.7	19.0	383.8	316.7
2002	224.3	132.2	9.00	365.5	208.7
2003	235.0	138.0	9.20	382.2	361.9
2004	238.0	139.0	22.00	399.0	340.2
2005	194.0	120.0	21.70	335.7	303.3
2006	206.0	137.0	23.00	366.0	340.7
2007	221.0	151.0	22.50	394.5	367.0
2008	140.0	74.0	17.00	231.0	217.6
2009	130.0	70.0	10.00	210.0	197.9
2010	125.0	65.0	10.00	200.0	188.4
2011	127.5	63.0	10.00	200.5	188.9
2012	122.0	60.0	10.00	192.0	180.9
2013	176.6	86.5	13.50	276.6	265.6
2014	170.1	86.0	17.00	273.1	260.6
2015	202.7	98.0	17.70	318.4	306.7
2016	210.7	94.5	14.20	319.4	311.0
2017	210.7	94.5	14.20	319.4	314.0
2018	178.20	93.0	29.4	300.6	345.6
2019	178.20	93.0	29.4	300.6	350.5
average	187.06	103.68	16.99	307.73	285.55
%	60.9	33.69	5.52	100	-

Source: Compiled from:

1. Ministry of Environment, Water and Agriculture, Statistical Book, Miscellaneous Issues, 2020.
2. FAO, website, 2020.

The Kingdom of Saudi Arabia tended to import pesticides, herbicides, and fungicides, data are given in the table 3 revealed that the total imported quantities of pesticides of all kinds increased from 13.23 thousand tons in 2000 to 25.52 thousand tons in 2015, and then decreased to 11.61 thousand tons in 2019. The quantities used of pesticides in Saudi agriculture also increased from 3.02 thousand tons, representing 22.86 percent of the total amount of pesticide imports in 2000, to 10.50 thousand tons, representing 90.4% of the total amount of pesticide imports in 2019. Despite the importance of the use of chemical fertilizers and pesticides in increasing agricultural production, however, the accumulation of chemical fertilizers and pesticides led to the pollution of both soil and groundwater (renewable and non-renewable) and an increase in their nitrogen content, then this pollution is transmitted to plants, animals, and humans. The Ministry of Environment, Water, and Agriculture realized the necessity of eliminating inappropriate agricultural practices that increased environmental pollution and adopted the Good Agricultural Practices Project known as Saudi Gap (S.G.A.P.). This project aimed to rationalize the consumption of irrigation water, chemical fertilizers, and pesticides, and increase the use of organic fertilizers to improve soil properties and increase its ability to retain irrigation water (Ministry of Environment, Water and Agriculture 2020).

3.3 Estimating the proposed model for studying the impact of air and agricultural soil pollution on social development

By studying the development of the internal variables of the proposed model, the total number of inpatients in hospitals affiliated with the Ministry of Health increased from 1171.3 thousand in 1995 up to 1423.8 thousand in 2019 (Table 4). The value of productivity for the worker also increased from 95.32 thousand riyals in 1995 to 312.44 thousand riyals in 2019. Given the country's interest in human capital development, the value of the Human Development Index increased from 0.742 in 1995 to 0.854 in 2019. The internal variables of the proposed model were characterized by relative stability during the study period, evidenced by the low value of the estimated coefficients of variation, as it reached 5% for the human development index and increased to 33.47% for the value of the worker's productivity.

Table 3 Evolution of the total quantity of Saudi imports of pesticides and their use in Saudi agriculture in tons during the period 2000-2019

year	Import quantity per ton	Used quantity per ton	Percent of used quantity to the import one
2000	13229.49	3024.0	22.86
2001	16108.50	3194.0	19.83
2002	17023.85	3365.0	19.77
2003	19871.78	3535.0	17.79
2004	18124.67	3706.0	20.45
2005	21576.31	3876.0	17.96
2006	18210.68	4046.0	22.22
2007	21108.47	4217.0	19.98
2008	19644.36	4378.0	22.29
2009	17662.79	4539.0	25.70
2010	22695.24	4700.0	20.71
2011	22780.91	4861.0	21.34
2012	25493.13	5022.0	19.70
2013	23280.79	5413.0	23.25
2014	14887.59	6260.0	42.05
2015	25523.64	7107.0	27.84
2016	20634.21	7954.0	38.55
2017	12537.40	8801.0	70.20
2018	11785.93	9648.0	81.86
2019	11610.00	10496.0	90.40
average	18689.49	5407.1	28.93

Source: Food and Agriculture Organization (FAOSTAT) 2020.

Table 4 Descriptive analysis of the variables used to measure the impact of soil and air pollution on economic and social development during the period 1995–2019

Statement	Internal variables			External variables				
	Total number of patients admitted to hospitals per thousand inhabitants	Worker productivity value in thousand riyals	Human Development Index	Chemical fertilizers in thousand tons	Total pesticides in thousand tons	Ratio of health expenditure to government expenditure (%)	CO_2 emissions thousand kilotons	Expenditure on education to government expenditure (%)
1995	1171.3	95.32	0.742	284.0	994.0	6.5	235.2	21.6
2000	1312.5	110.98	0.765	386.2	3024.0	11.7	296.9	27.0
2005	1655.1	154.27	0.773	335.7	3876.0	11.6	397.6	26.4
2010	1699.4	201.42	0.815	200.0	4700.0	11.9	518.5	27.9
2015	1705.9	188.85	0.847	318.4	7107.0	13.7	601.0	28.8
2016	1648.7	180.06	0.850	319.4	7954.0	13.1	638.5	30.3
2017	1377.2	186.15	0.853	319.4	8801.0	13.5	650.0	30.5
2018	1410.1	298.88	0.857	300.6	9648.0	12.94	514.6	30.7
2019	1423.8	312.44	0.854	300.6	10496.0	17.0	582.3	30.5
Average period	1486.52	159.14	0.802	314.78	4727.2	11.47	410.45	26.59
Minimum limit	1171.30	92.91	0.742	200.0	994.0	6.50	207.70	19.80
Maximum limit	1705.90	246.37	0.853	386.2	10496.0	17.0	650.0	30.5
SD	177.07	53.26	0.04	123.37	2455.71	2.51	138.80	3.29
COV (%)	11.91	33.47	5.00	31.93	51.95	21.88	33.82	12.37

SD – Standard Deviations; COV - Coefficient of variation

Source: Compiled from:

1. Saudi Arabian Monetary Agency, Annual Statistics 2020, 31/5/2021.
2. United Nations, United Nations Development Program, Human Development Reports, 1995–2020.
3. Ministry of Environment, Water and Agriculture, Statistical Book, 2020.

About the development of the external variables of the proposed model, it is also clear that despite the decline in the cropping area, the number of chemical fertilizers used in Saudi agriculture increased to 300.6 thousand tons in 2019. There was also an overuse of pesticides, as the number of liquid pesticides used increased from 994 tons in 1995 to 10.49 thousand tons in 2019. Given the country's interest in the health sector, its relative share of government spending increased from 6.5% in 1995 to 17.0% in 2019. The education sector's share of government spending increased from 21.6% in 1995 to 30.5% in 2019. Finally, about the emission of Carbon dioxide as an indicator of air pollution, it ranged from a minimum of 207.7 thousand kilotons in 1998 to a maximum of 650.0 thousand kilotons in 2017, with an annual average of about 410.46 thousand kilotons. The external variables of the proposed model were characterized by relative stability during the study period, except for the liquid pesticides variable used, where the estimated coefficient of variation reached about 52.0% (Table 4).

The impact of agricultural soil and air pollution on social development was studied by the equations of the proposed model by successive applications of the Ordinary Least Squares (OLS) method during the period 1995-2019. It is clear from the behavioural equations of the model presented in Table 5 that: (i) the increase in the degree of agricultural soil contamination, expressed as an increase of 10% in the use of both chemical fertilizers and pesticides, leads to an increase in the total number of patients admitted to hospitals affiliated with the Ministry of Health by 0.7%, 0.5% each, respectively, (ii) an increase in the degree of air pollution, expressed as a 10% increase in carbon dioxide emissions, leads to an increase in the total number of hospitalized patients by 11.1%, (iii) an increase in the relative share of the health sector in government spending by 10% leads to an overall decrease in the number of inpatients in hospitals affiliated with the Ministry of Health increased by 1.8%, (iv) an increase in the estimated total number of patients by 10% leads to a decrease in the productivity value of the worker by 1.8%, (v) an increase of

Table 5 Equations of the proposed model for studying the impact of agricultural soil and air pollution on social development during the period 1995–2019

Statement	Equation
Number of inpatients	$Ln\,\hat{Y}_1 = 7.434 + 0.07\,\mathrm{Ln}\,X_1 + 0.05\,\mathrm{Ln}\,X_2 - 0.18\,\mathrm{Ln}\,X_3 + 1.11\,\mathrm{Ln}\,X_4 + 0.72AR(1)$ $(11.67)^{**}(1.96)^{*}(2.09)^{*}(-2.13)^{*}(3.22)^{**}(5.27)^{**}$ $R^2 = 0.85 \quad F = 124.48 \quad D.W = 1.96$ $LM\ test = 0.95 \quad Arch\ test = 0.25$
Worker productivity value	$\mathrm{Ln}\,\hat{Y}_2 = 5.333 - 0.18\,\mathrm{Ln}\,\hat{Y}_1 + 0.91\,AR(1)$ $(1.97)^{*}(-2.01)^{*}(11.32)^{**}$ $R^2 = 0.88 \quad F = 66.84 \quad D.W = 1.88$ $LM\ test = 0.88 \quad Arch\ test = 0.29$
Human Development Index	$\mathrm{Ln}\,\hat{Y}_3 = -0.511 + 0.05\,\mathrm{Ln}\,\hat{Y}_2 + 0.02\,\mathrm{Ln}\,X_5 + 0.89\,AR(1)$ $(-2.43)^{*}(1.96)^{*}(2.56)^{*}(8.15)^{**}$ $R^2 = 0.92 \quad F = 68.82 \quad D.W = 2.93$ $LM\ test = 0.11 \quad Arch\ test = 0.76$

** Significant at 1% probability level; * Significant at 5% probability level.
Source: Calculated from data in Table (4).

Table 6 Indicators for measuring the efficiency of the proposed model for measuring the impact of pollution of agricultural soils and air on social development during 1995–2019

Indicator	Behavioral equations		
	First	Second	Third
Root mean squares error R.M.S.E.	0.09	0.19	0.01
Average absolute error M.A.E.	0.08	0.16	0.01
Average percentage of absolute error M.A.P.E.	1.11	3.24	5.68
Unequal coefficient of Thiel (U)	0.006	0.02	0.03

Source: Compiled and calculated from the behavioral equations of the proposed model, listed in Table 5

10% in the estimated productivity of the worker leads to increase in the value of Human Development Index by 0.5%, (vi) The relative share of the education sector increased by 10% in government spending, which led to an increase in the value of the Human Development Index by 9.6%. Finally, the proposed model was efficient for the data used in the estimation, according to the efficiency indicators, the most important of which was the U-Theil inequality coefficient, whose value is close to zero (Table 6).

The development in the various sectors of the Saudi economy has grown fast. While the environmental dimensions don't consider, that led to an increase in the degree of air pollution in some areas where thermal and electric power generation, water desalination, and the number of cars increased, especially in major cities where concentrated. Despite the decline in the crop area to rationalize water consumption, the consumption of chemical fertilizers and pesticides in Saudi agriculture has increased, intending to increase the productivity of the various crops prevailing in the cropping structure led to an accumulation of chemical fertilizers and pesticides over many decades. The pollution of both agricultural soil and groundwater (renewable and non-renewable) increased their nitrogen content. Then this pollution was transmitted to plants and animals, and then to humans. Fingers point to the responsibility of chemical fertilizers, especially nitrogenous ones, and pesticides, for the outbreak of many incurable diseases, the most important of which are kidney failure and cancers, in addition to an imbalance in the environmental balance, which negatively affects the value of worker productivity and the human development index as an indicator of social development.

In light of the results of this study, it recommends the need to reduce air pollution by expanding the use of natural gas in the industrial and transportation sectors, in addition to reducing the use of nitrogenous fertilizers and pesticides in Saudi agriculture through the expansion of clean farming and good agricultural practices.

4 Discussion

Given the increase in environmental pollution caused by the increase in the level of carbon dioxide in the atmosphere and its link to the increase in average temperatures worldwide and global warming, the group of twenty meets annually to discuss air pollution and other components of the environment. Environmental pollution is linked to economic and social development, as reciprocal relations are established between

them, affecting the productive capacity of economic resources. It is known that economic policies in most countries focus on sustainable development. It is not possible to improve indicators of sustainable development in any country without preserving the environment and reducing pollution. In the Kingdom of Saudi Arabia, the Ministry of Environment, Water, and Agriculture has prepared the National Environment Strategy and the General Authority for Meteorology and Environmental Protection has been assigned the task of supervising its implementation. Finally, His Royal Highness, Crown Prince Mohammed bin Salman, announced on March 27, 2021, the Green Middle East Initiative, intending to address climate change by intensifying efforts and enhancing cooperation among the countries of the region. The Kingdom of Saudi Arabia has also adopted a system of good agricultural practices to preserve agricultural soil and water resources and reduce the use of chemical fertilizers and pesticides in Saudi agriculture. There is no doubt that the Kingdom of Saudi Arabia has made remarkable progress in the Human Development Index as an indicator of social development, as it increased from 0.744 in 2000 to 0.854 in 2020, due to the increase in the percentage of spending on health and education from 38.75% in 2000 to 43.59% in 2020 (The World Bank, 2020), in addition to the regulations and legislation issued to preserve the environment.

Conclusion

Air pollution has increased in Saudi Arabia because of a boom in thermal and electric power generation, water desalination, and car numbers, especially in major cities. Despite the decrease in crop area, the average per-unit share of total chemical fertilizers increased from 180.9 kg/ha in 2012 to 350.5 kg/ha in 2019. The accumulation of chemical fertilizers and pesticides leads to contamination of both soil and groundwater (renewable and non-renewable) with nitrogen content. This pollution is then transmitted to plant and animal life, and then to humans. Thus, chemical fertilizers and pesticides are seen as responsible for the spread of many incurable diseases, in addition to the imbalance in the environment, which affects overall productivity and human development as an indicator of social development in Saudi Arabia. Through successful international experiences in preserving the environment, it has been found that air pollution can be reduced, through the expansion of the use of clean energy (natural gas) in economic sectors. Also, developed countries turned to organic agriculture intending to produce healthy food, by reducing the use of nitrogenous fertilizers and pesticides on the one hand and increasing organic fertilizers on the other hand. In Saudi agriculture, there has been an expansion in clean farming and agricultural practices. The Saudi GAP project leads to saving and improving the consumption of irrigation water in agriculture through the use of modern irrigation methods, rationalizing the use of pesticides and chemical fertilizers, and increasing the use of organic fertilizers, which improves the properties and fertility of the soil, and then improves its ability to retain with irrigation water. Therefore, preserving and maintaining the environment and protecting it from deterioration and pollution is an essential pillar to ensure the continuity of life.

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