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FROM PAPER TO E-DOCUMENTS: A DREAM OF ECOLOGICAL BALANCE

Bahattin YALÇINKAYA[1]

Abstract

Extending information technologies pave the way for the paper-free office dream where printed materials exist. Until the middle of the 2000, contrary to popular belief, increase in the information technologies has not decreased the paper consumption in the business world and public sector and on the contrary it increased significantly. Thanks to the some legislative arrangements as of 2010, they help work more stable in e-state and e-document management for the countries. The restructuring of e-state concept in public services both decreases the bureaucratic procedures and clearly increase the service quality in the world. The most critical factor is that document production is started to decrease. We can give the social media and the use of web technologies by the press as another factor.

In this study, striking statistics will be revealed for the paper consumption in the world. Their damages to the environment will be analyzed. Furthermore, it will be discussed how to decrease the paper consumption through use of electronical environment and widespread internet technology. The objective of this study is to reveal the contribution of the states to the nature by facilitating the use of technology and importance of emphasizing the nature in their legislation concerning the information and document management.

Keywords: Paper Consumption, Paperless Office, Environmental Pollution

1. INTRODUCTION

Today, in the European Union as well as other regions in energy production and usage preference focuses on biofuels. The European Union ministry of environment have declared that they aim to reduce the gas causing climate change by up to %60-80 from 1990 until 2050. The emissions of paper industry have increased globally and steadily since the 1990s.[1] The increased consumption has been balanced with the emission obtained per ton. A plethora of research has been carried out on this subject and initial findings can be said to be as follows, reducing the paper consumption, change of carbon emission and increasing the energy efficiency paper at every stage of the life cycle.[2] The damage caused by paper production and consumption must not by any means. be underestimated.

Having such an impact on environment, with developing technology, paper production continued to increase until 2010. Despite the developing technology, paper consumption has not decreased. On the contrary, it increases, almost creating a paradox and the reason for that is none other than the thought of the increase number of copy machines also make it easier to copy materials.[3] Even though the term “paperless office” has been a discussing

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matter for a long time, a significant increase in the success rate has not been achieved. The term "paperless office" refers to removing or decreasing the number of papers in offices.[4]

The term "paperless office" was first introduced in a Business Week article published in 1975 for the purpose of defining the future office.[5] This idea was representing a dream with the idea that every document kept in paper form could be kept in electronic form. With the increasing number of personal computers, the idea of achieving this dream started to get stronger but this was a vision suggested without thinking the possibility that the number of documents could also increase.[34] Because the documents reflected their activity, in 2000s depending on the technology they began to face an increase on the number. Contrary to the popular belief that young people, in particular, use the screen to read something, the surprising fact that they actually print the documents lasted until 2010s.

2. THE ENVIRONMENTAL IMPACT OF PAPER

The environmental impact of paper is important both as industrial sense and personal and work level. With the use of technology, single use papers have become cheap commodities. This caused a increased paper consumption and became a growing like an avalanche contaminant for industrial society. Paper made from raw materials has been effective on industry and governments as a regulatory with the intention of spreading the idea of sustainable environment awareness. However, it is important for a habitable world to take certain measures that will reduce the paper consumption since recycling paper is not at a desired level. In paper production it is obvious that only in recent years a reduction can be seen. Insensible use of paper causes some environment problems.

Table 1. World Paper Production in Million Metric Ton from 1950-2010 [6]

Particulars	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**
Europe (East)	2,84	5,77	10,56	14,1	3,54	11,26	22,32
Europe (West)	10,35	20,06	34,82	45,39	62,33	88,81	87,14
USA	22,11	31,26	45,19	57,79	71,52	85,83	75,85
Canada	6,18	8,14	11,14	13,39	16,47	20,77	12,79
Japan	0,873	4,51	12,97	18,09	28,09	31,83	27,29
China	0,511	1,91	3,75	5,1	13,72	30,9	92,6
Others	0,876	3,28	11,26	18,26	43,14	54,58	75,92
World	**43,74**	**74,93**	**129,69**	**172,1**	**238,8**	**324**	**393,9**

2.1. Deforestation

Paper consumption around the world has caused %35 of trees to be destroyed for the production of paper. This rate has increased by %400 for the last 45 years.[7] Cutting trees is not important only for the reducing oxygen level, but it is also alarming for the ecological habitats of the tree structure. [8] The deforestation to obtain pulp is especially high in developing countries thank the others.[9] Deforestation for paper production refers to the destruction of %1,3 of all trees in the world.[10] This rate means that a horror movie is being filmed for the next generations. Deforestation may be the most important impact on environment of paper production. Each ton of paper consumption leads to destruction of 17 trees. These cut trees cover an area of 85 m2.[12] Considering the paper production in 2010, around 7 billion trees were cut for production. This number corresponds to approximately 40,000 km^2.

2.2. Environment and Air Pollution

It is a known fact that the toxic gas emitted by the paper producing factories is at too high a level. These gases are nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and, carbon dioxide (CO_2) which emit into the atmosphere during paper production. CO_2 is one of the most effective one on the climate change.[11]

The pollution caused by paper consumption can be explained partially with the benefits of recycling paper. The amount of CO_2 emitted during the production and the consumption of a ton paper is 36 tons.[12] Considering the paper production in 2010, every year around 15.000 million metric ton CO_2 is emitted into the atmosphere. However, considering the same statistics, 116 million metric ton toxic gas is emitted into the atmosphere every year.

Chlorinated organic substances, phenols, dioxins and furans released during paper production damage the environment. In recent years, even using eco friendly chemicals has proved not to be sufficient. Advanced delignification cooking, oxygen delignification, elemental chlorine replacing with chlorine dioxide and ozone, bleaching oxygen and peroxide should be applied in every factory. Also, regulations about pollution parameters and limits in pulp and paper industry should be updated.[18]

Chlorine, one of the used elemental in paper production contains significant amount of dioxin.[13] Dioxins are generally considered as environmental pollutants which also cause permanent damage to human health.[19]

In terms of environmental pollutant, for pulp production sulfur based components are used both during crafting process and sulphite process. Sulfur dioxide is a particular concerning material in terms of environment and it causes acidic rains. In 2006, Canadian paper industry alone emitted 60.000 tons of sulfur dioxide (SO_X) into the atmosphere.[13][20]

In terms of environmental pollutants, the other components emitted by factories are; hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and other volatile sulfur compounds. Again, during paper bleaching process some of the components spreading through water are; carbon monoxide, ammonia, nitrogen oxide, mercury, nitrates, methanol, benzene, volatile organic compounds, chloroform. In 80s, nongovernmental organization succeeded to affect the paper industry and governments concerning this issue with the increasing public awareness. [21] This pressure is mainly concentrated in the Scandinavian countries. As a result of this pressure, components used as elements, chlorine dioxides and organic components for paper bleaching have been accepted as international environmental pollutants with the Stockholm Convention.[22]

2.3. Water Pollution

Wood pulp found in the waste water of paper factories causes dissolved organic materials to mix into the nature in a solid form through waste water canal. Also, these waste waters contain alcohol, chelating agent and chlorine, inorganic materials such as transition metal components. These released wastes into the water systems cause the death of some ecologically important water organisms. Chlorine used for paper bleaching is also a substance which effects substantially the pollution of the water.[13] The pulp and paper industry is the third largest industrial buyer of elemental chlorine.[15]

In paper production as well as the pollution caused by factories, the consumption of papers during production also refers to a significant amount. For every ton of paper consumption 26.500 liters of water loss is experienced.[14] The amount of wasted water during the process of a tree growing and transforming that tree into paper reaches quite a significant number.

2.4.Waste

Waste is one of the biggest problem in the world. In USA alone % 40 of papers are wasted and every year almost 72 million metric ton paper is thrown.[16] Every US household throws out the equivalent of 4 trees in paper waste.[17]

Table 2. Paper consumption per capita/kg (Selected Countries) [6]

Country		Per Capita Consumption (Kg./year/person)	Country		Per Capita Consumption (Kg./year/person)
1	**Germany**	242	**14**	**Saudi Arabia**	101
2	**U.S.**	229	**15**	**China**	75
3	**Japan**	219	**16**	**Turkey**	68
4	**Sweden**	215	**17**	**Mexico**	60
5	**South Korea**	184	**18**	**South Africa**	50
6	**Italy**	169	**19**	**Brazil**	49
7	**Australia**	156	**20**	**Russian Federation**	46
8	**Canada**	155	**21**	**Ukraine**	30
9	**UK**	147	**22**	**Indonesia**	29
10	**France**	142	**23**	**Bosnia & Herzegovina**	26
11	**Spain**	133	**24**	**Iran**	22
12	**Malaysia**	109	**25**	**India**	10
13	**Portugal**	105			

When analyzing table 2, it can be seen that in developed countries the use of paper is high per person. The amount of paper consumed is given as an annual kilogram basis. When this table is predicated on, world average of paper consumption per person is 110 kg. The main consumption areas of paper are, Corrugated/Packaging, Newsprint, Writing & printing and Other. In particular, Newsprint and Writing & Printing related consumption is rather high.

3. MITIGATION OF PAPER EFFECTS

3.1. Reducing Paper Consumption

Paper has become an indispensable material in life. The use of valuable papers can be listed as following; books used for information stocking, magazines, newspapers, notebooks, documents, files, paper used for personal use, paper use for communication, paper used for packaging, paper used for cleaning, construction and building industry.

Table 3 shows the annual paper consumption of countries. When compared with the population, while Republic of China ranks 16th in consumption, it is in first place in production. When these countries are taken into consideration, the amount of paper per country is 13,7 million tons. It is necessary for countries to reduce the consumption at least to half by raising awareness of their population.

Table 3. Paper consumption Selected Countries (MT - Million Metric Tones) [6]

Country	Net Consumption Million Tons	Country	Net Consumption Million Tons
1 China	105,456	**14 Spain**	6,200
2 U.S.	72,604	**15 Canada**	5,397
3 Japan	27,877	**16 Turkey**	5,023
4 Germany	20,038	**17 Australia**	3,596
5 India	12,123	**18 Malaysia**	3,178
6 Italy	10,265	**19 Saudi Arabia**	2,869
7 Brazil	9,734	**20 South Africa**	2,608
8 UK	9,268	**21 Sweden**	2,327
9 France	9,055	**22 Portugal**	1,792
10 South Korea	9,028	**23 Iran**	1,711
11 Mexico	7,225	**24 Ukraine**	1,375
12 Indonesia	7,064	**25 Bosnia & Herzegovina**	0,105
13 Russian Federation	6,643		

3.2. Paper Production Methods

Various methods have been tried for paper production throughout history. Especially the times od handmade paper, paper related world pollution was not a major player. However, with developing technology, paper production methods also changed. This change causes new technologies for paper production and also still causes pollution. Paper production uses mainly chemical pulping, mechanical pulping and deinking methods. Moreover, while using these methods, the amount of additives used is not so low to disregard. For manufacturers to take this matter in hand choosing more eco friendly additives, more respectful production techniques towards nature, and more technological investments in recycling paper will reduce the environmental factors.

Table 4. Important large-scale techniques for manufacturing chlorine dioxide [23][24]

Reducing Agent	By-Products in the ClO2 Product	By-Products	Process Technologies		Potential Specific environmental concern
			Vacuum	Atmospheric	
Methanol	Formic Acid	Sodium Sulphate (1)	SVP-LITE, SVP-SCW, R8, R10	(Solvay)	NA
Hydrogen Peroxide	(Oxygen)	Sodium Sulphate (1)	SVP-HP, SVP-Pure, R11	HP-A	NA
Sulphur	NA	Sodium	NA	Mathieson	Handling of

Dioxide		Sulphate (1)			SO2
Chloride Ions	Elemental Chlorine	(Sodium Sulphate(1)) Sodium Chloride	(SVP-Classic) (R3), R6, (R7), SVP-Total HCI, Lurgi, Chemetics	(Day-Kesting), (R2), (R3)	The CIO2 water becomes saturated with CI2

NB: Processes mentioned wihtin brackets are no longer relevant for new plants; some units are still in operation

NA=not available

(1) The genrated salt can be used as a make-up chemical in the recovery boiler or for pH adjustments

(2) Chlorine dioxide is not traded as such. Important trade does however exist for various large-scale processes.

* SVP-SCW, SVP-LITE, HP-A, SVP-HP, SVP-PURE, SVP-Classic and SVP Total HCI are trademarks of Akzo Nobel
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*Some other common names are Mathieson and Solvay porcesses

3.3. Paper Recycling

The basic raw materials of recyclable paper production can be analyzed in three categories which are mill broke, pre-consumer waste and post-consumer waste.[25] Mill broke process is to grind paper turning it into junk. Later, in the factories it is turned into pulp again. Pre-consumer waste refers to taking preventive measures related to consumer waste. Post consumer waste is the process of recycling printed material the consumer possesses such as old magazines, newspapers and so on. Papers suitable for recycling are called scrap paper.[25]

Today, more than %40 of pulp are obtained completely from trees. Every one of three cut trees is used for paper production and this means that %1,3 of trees in the world are cut for paper production.[8] Each ton of recycled newspaper equals to a ton of pulp and two tons of newspaper pulp.[8] To produce kraft paper, twice of the normal amount raw material is needed. In fact, the number of trees a ton of recycled paper saves depends on the size of the tree. However, the crucial question is how many times it can be recycled.[26] It is estimated that recycling paper saves 81.000 km forest areas and cover half of the paper need in the world.[27]

Table 5. Recovered Paper:Consumption/Usage Selected Countries (MT - Million Metric Tones) [6]

Country		Recovered Paper:Consumption/Usage (MT)	Country		Recovered Paper:Consumption/Usage (MT)
1	**China**	48,840	**14**	**Canada**	2,705
2	**U.S.**	46,350	**15**	**India**	2,640
3	**Japan**	21,750	**16**	**Russian Federation**	2,100
4	**Germany**	15,293	**17**	**Turkey**	1,534
5	**South Korea**	8,827	**18**	**Sweden**	1,327
6	**UK**	8,154	**19**	**Malaysia**	1,200
7	**France**	5,259	**20**	**South Africa**	1,151
8	**Italy**	4,649	**21**	**Saudi Arabia**	1,000
9	**Spain**	4,552	**22**	**Portugal**	0,735
10	**Brazil**	4,363	**23**	**Ukraine**	0,339
11	**Indonesia**	3,934	**24**	**Iran**	0,080
12	**Australia**	3,179	**25**	**Bosnia & Herzegovina**	
13	**Mexico**	3,039			

The contribution of recycling paper on energy saving is also very important. There are two different claims on this issue. One of them is EIA's (The Energy Information Administration) claim saying it provides almost %40 of energy saving. The other one is that this rate is %65 claimed by BIR (Bureau of International Recycling).[28][29] It is claimed that recycling a ton of newspaper provides 4.000 Kwh (14GJ) energy.[30]

4.PAPERLESS SOCIETY AND INSTITUTION

The idea of creating a paperless society was a theory proposed in the beginning of 80s.[31] This became a reality when in 90s computer technologies started to be developed making possible for society to follow the communication in the electronic media rather than the printed media. In a paperless society, relations between citizens and government was going to on electronic media so that bureaucratic processes was going to be reduced

and a serious paper saving around the world was going to be maintained. Society would be able follow the press and reading a book, magazine and so on would be possible through electronic media.

This idea started to host the arguments that might become reality since the beginning of 2000s. The rapid spread of computer technologies helped paperless society strategy to be accepted by society with various developments such as social media and e-government investments. Although these technological developments have increased paper production until 2010, since 2010 it tends to move towards reduction. However, it seems hard to expect a paperless society anytime soon. Because business world was keeping %95 of their information created in 1995 in paper form.[32] This rate, although it has been 20 years since then, remained at %75. Today, still 3.5 trillion printout papers are obtained. Until 2018, it is estimated that this rate will increase by %1.7. In the business world, %80 of works and processes are still done paper based.[33]

Table 6. Various Type Paper Production in 2010 (MT - Million Metric Tones) [6]

Paper & Board Category	Production Million Tons (MT)	%
Newsprint	33.0	8.4
Other Writing & Printing Papers	110.0	27.9
Packaging Paper & Paperboard	204.0	51.8
Hygiene & Sanitary Paper	29.0	7.4
Others Papers & Paperboards	18.0	4.6
Total	394.0	100

Table 6 shows the basic types of paper production. %36,3 of papers are produces as Newsprint, Writing & Printing Papers. This equals to 1/3 of whole paper production. In other words, with the goal of creating a paperless society, it is possible to reduce the paper production by 1/3 rate. Particularly transferring the papers used in press and business world will reduce this rate and the goal of creating a paperless society will be reached.

4.1. Reduction of paper use and what to do for transition towards a paperless office

Every organization must act to support paperless office activities. The importance of paperless office is obvious in terms of environmental protection. Nevertheless, paperless institutionalization is not only a term in terms of being eco friendly, but it is also a term appropriate for the current age that helps corporations, organizations, even governments create their vision of more efficient service, commercial activities, democratic and transparent management approach. From the perspective of the basic functions of the business world and the government, to prevent paper consumption, the existence of some preventive measures can be mentioned that should be done to reduce consumption. These are;

- Putting some reminders near duplicating machines that reminds the employees the environmental damage of printing.
- Keeping the duplicating machines under control and putting a paper use limit for employees to reduce the paper consumption.
- Sharing monthly paper consumption with the employees to attract attention and controlling copy machines to reduce the printing amount.
- Encouraging employees to reduce their paper consumption by sharing that paperless office is all about using technology.
- Contributing to following newspaper news by using technology and social media, especially developing a habit of reading e-books in schools.

In addition to preventing waste of paper, we can list the elements that need attention as the following;.

- Giving importance to spreading online systems, use of e-mail, use of database and electronic files (Records) management or building an electronic document (Documents) system,
- Persuading all employees to achieve the goal of creating a paperless office,
- Strengthening the corporate IT and establishing a backup mechanism for electronically generated documents and files,
- Creating a more reliable mechanism than the paper form about information and document protection and making investments taking into account the growth of business in the future;
- Making individuals who can manage the process of transition to a paperless office become a part of this system,

- Helping systems such as document management systems, electronic fax, scanner, data backup systems, security system, file converting techniques and process management system to integrate into a paperless office ,
- Proceeding the goal of creating a paperless office with small and secure steps.[35]

4.2. Processes of Paperless office

There are two methods of transforming a company into paperless office. The first is by automating the processes that generally use paper as an essential tool. Technologies that exist in facilitating that process are:

- Enterprise Data Automation Software. Software used to integrate forms and data with systems that processes them.
- Form Technology. Software used to design various types of forms. Using forms is no longer necessary if people performing business transactions have personal computers with form technology in it.
- Databases. Device to replace the function of a filing cabinet. Data is made into digital form and then stored in a database with sufficient security technology in it.
- Digital Signature. Software allows evidence of signature in digital form. Papers are generally used as business evidences. This is required in business transactions to generate legal binding between two or more parties.
- Workflow Platforms. Process flow of an office. Paper documents are generally used totransfer a data to other departments so that it can continue doing what is needed next. This flow of work can now be documented and transferred in digital form, using the workflow platforms.

The second method of pursuing the paperless office is data storage transformation. In a general office, the data is conventionally stored and protected in a filing cabinet or in warehouses. This generally ends up creating piles of useless scrap paper rather than useful files. Using the “Paperless Office” technology, all this data can be transformed to a digital form very easily. Some of the tools available to support this process are scanners, book copiers, photo scanners, microfiche scanners, negative scanners, fax to PDF converter, and document management systems. [36]

4.3. Benefits of Paperless Office

Although removing papers out of sight seems only an approach towards being eco friendly, it has more effects on corporate and organizations. Cost and efficiency can be as important as the environmental approach. The most important issue of transitioning from paper form to electronic form would be the advantages on institutionalization. Advantages of paperless office are;

Organizing document and files becomes extremely ergonomic for corporations. Paperless office contributes to institutionalization by providing a more secure storage. It gives the ability to process more effectively than the works and processes done in paper form. All transactions made in paper form can be carried out through the use of electronic signatures in electronic form. Having a document management done in electronic form helps corporations to be transparent and accountable.

Paperless office is the main factors that speed up the document management and communication in electronic form. It provides a rapid internal and external communication between institutions. Particularly, it helps government institutions to stay away from bureaucratic tendencies and makes them more citizen-oriented state institutions. It contributes positively to forming an e-government term in an appropriate manner.

Documents are easier to access in electronic form. Moreover, it is obviously a more secure environment in terms of backup and data loss. Providing a registration on financial, administrative and legal rights of the institutions means to be able to overcome the various problems they might encounter in their future.

Paperless office is the key to create a better world to live in. It will contribute in short and medium terms to create an environmental awareness and to make people adopt a more eco friendly approach. Paperless offices will reduce the environmental damage so that the world that has been entrusted in the hands of humans will be handed to next generations.

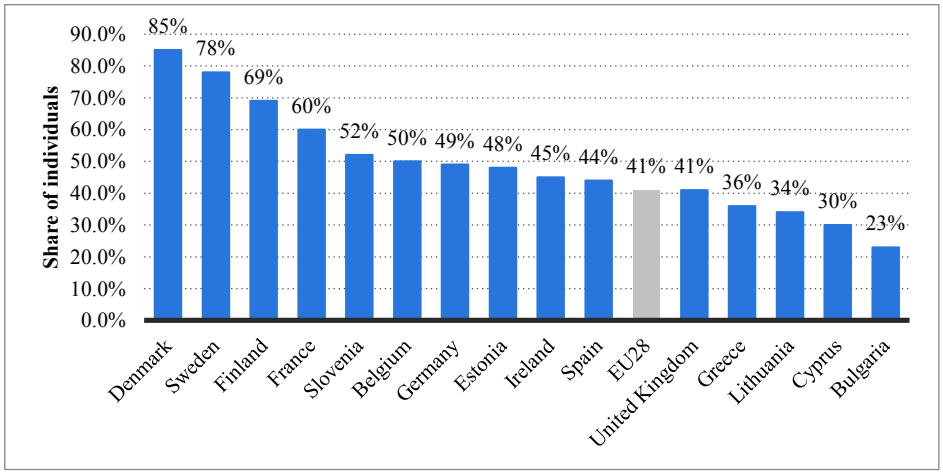


Figure 1. Individual usage of e-government services in selected European countries in 2013 *[37]*

5.CONCLUSIONS

In this research paper in which the effects of paper on the environment were studied, the environmental damage of paper is evaluated over the paper production numbers in the world. The damage caused to the environment by paper was examined under the titles of; deforestation, air and environment pollution, water pollution and waste. The reduction of the environmental damage of paper, reduction of paper consumption, various changes which can be done on production techniques and the contribution of paper recycling were listed.

Having such an importance, the situation of paper production has been analyzed in the world of press and office. The results show that 1/3 of paper production is used in press and office fields. In order to reduce this rate, paperless society and paperless institutionalization is discussed. The advantages of document management in electronic form for from small companies to countries all over the world are highlighted. What must be done for reducing paper consumption and for paperless offices are listed. The process of paperless office is analyzed. The terms paperless society, paperless office and paperless government are evaluated through various scientific numbers which lays the groundwork of the necessity of these terms.

In conclusion, the possibility of reducing the use of paper was discussed, critical questions about spreading the use of systems such as e-institution, e-document management and e-government were tried to be clarified. The main purpose of this research intended to put conscious management in the forefront is to help spread the technological based solutions while considering the environmental damage caused by paper. This purpose is also about the imagination of a world where the paper consumption is reduced and the world becomes a better place to live in.

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