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Evolution of domestic micropollutants in the water cycle

DIALLO Aminata

February 2017

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This synthesis « **Evolution of domestic micropollutants in the water cycle** » was performed by **Aminata DIALLO,** student in the AgroParisTech-ENGREF specialized master "Water Management" (post-master degree) in Montpellier.

SYNTHESIS

Evolution of domestic micropollutants in the water cycle

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PREAMBLE

This work illustrates the evolution of substances which are present in domestic products since the 20th century. It is included in a research and development program called BEEST (Biomass Equivalence Ecosystem Services Transfer) launched by SUEZ group and Sanitation Service of Marseille Metropolis (SERAMM). Three other French organizations are part of this program: SUEZ's research laboratory called LYRE, the Mediterranean Institute of Oceanography (MIO) and the UMR ESPACE of Aix-Marseille University. BEEST consists of assessing the anthropogenic impacts linked to the different uses of water on the marine environment at the level of Marseille region.

The data gathered during this work will allow the creation of a database on the evolution of domestic products. Further information related to this database is summarized in this report. This will allow the subsequent development of models of calculations of pollution flows from human consumption.

In addition, the development of this work faced several difficulties. The main difficulties are data access, their statistical representativeness, their heterogeneity and the reliability of bibliographic references. Faced with these constraints, we have chosen to combine data from surveys whose samples are different. Nevertheless, this method of work allows us to study and observe the evolutionary trends of domestic consumption systems.

ABSTACT

Micropollutants are chemicals which compose most of our domestic products. These substances are found in the environment especially in the water cycle at very small concentrations. Despite treatment in wastewater treatment plants and European and French regulations, they integrate the water cycle via domestic wastewater. Thus, to trace the evolution of these substances in the water cycle, it is important to know the French evolution of way of life related to domestic water use. The improvement of living conditions can be explained by the arrival of water in houses and the increasing of the volume of water consumed by hygiene and household chores. At the same time, an industry has developed around the manufacture of products for domestic use. They are subsequently sold to the population through supermarkets. Thus, since the beginning of the 20th century, the most popular products consumed by the French, containing micropollutants are foods, cosmetics, medicines and pesticides. These are also the most sold products in supermarkets.

Keywords: evolution, domestic micropollutants, water cycle, pollution

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ABBREVIATIONS

ADEME : Agence de l'Environnement et de la Maîtrise de l'Energie

AISE : Association Internationale de la Savonnerie, de la Détergence et des Produits d'Entretien

BEEST: Biomass Equivalency Ecosystem Services Transfert

CNCC : Conseil National des Centres Commerciaux

CNE : Conseil National de l'Emballage

ECHA : European CHemicals Agency

MEEM : Ministère de l'Environnement, de l'Energie et de la Mer

MIO : Mediterranean Institute of Oceanography

PGC : Produit de Grande Consommation

REACH : Registration Evaluation Autorisation of CHemicals

SERAMM : SERvice d'Assainissement de Marseille Métropole

UE : Union Européenne

UNIJUS : Union Nationale Interprofessionnelle de Jus de fruits

UIPP : Union des Industries de la Protection des Plantes

INTRODUCTION

Surface water have been the areas of discharges for domestic wastewater. Over the years, wastewater composition has been greatly modified, especially in industrialized countries such as France. These wastewaters have been discharged directly via the sewers into the environment from the end of the 19th century. The pollution was mainly related to faucal matter (CNRS, 2003). Aquatic environment pollution increased because of the rise in population, access to water in houses and increasing of urbanization during the 20th century (CNRS, 2003). According to various sources such as CNRS research (2003), peoples' awareness of hygiene and changes of the way of life have led to industrial development in the field of the manufacture of domestic products. Thus, the composition of wastewater changed throughout the century with the appearance of new chemicals. These chemicals are present at very low concentrations in water. They are called micropollutants. Despite efforts to reduce water pollution through the implementation of several wastewater treatment plants, some micropollutants are found in the water cycle.

To better understand these substances, and to reduce their environmental impacts, it is important to trace their evolution from the date of their appearance to the present day. This study is carried out through the evolution of domestic consumption. That concerns personal care products, medicines, maintenance products, foods, etc.… The main objective of this synthesis is therefore to present the evolution of micropollutants present in the water cycle which compose domestic products.

To carry out this work, we will define the term "micropollutant" and present the regulatory context that governs these molecules. Then a history of way of life of the French population will be carried out. This part explains the several reasons for the increasing of water consumption in France. We will then discuss about the development of consumer goods industries, namely food, domestic and medical products. We also in this part will talk about the growth of supermarkets and pharmacies. These parts enable us to understand the evolution of household consumption and to observe how the micropollutants integrate the water cycle. The evolution is about changes in consumption systems. Finally, a focus on the quantitative evolution of some families of food and domestic products will be presented.

DOMESTIC MICROPOLLUTANTS

DEFINITON

According to the French environment minister (MEEM, 2016), a micropollutant is a detectable undesirable substance in the environment at very low concentrations (microgram per liter or even nanogram per liter). Its presence is at least partly due to human activities. At low concentration, it can cause negative effects on living organisms due to its toxicity, persistence and its bioaccumulation. Many molecules with different chemical properties are concerned (over 110 000 molecules are listed by European regulations), whether organic or mineral, biodegradable or not, such as plasticizers, detergents, metals, hydrocarbons, pesticides, cosmetics or medication.

Some micropollutants are endocrine disruptors. According to the European Commission (2016), they are “substances, both natural and chemical, which can alter hormonal system functions and thus have undesirable effects on people and animals". They were introduced into our life after the industrialization and development of chemistry at the beginning of the 20th century especially during the period of the thirty years of post - war economics in France.

Thus, domestic products such as household, hygiene, cosmetic or pharmaceutical products, are made up of a group of chemicals. interactions between these molecules can be harmful.

"Cocktail effect" is the term used to characterize this phenomenon (Bourguet et al., 2015). Some micropollutants are found in wastewater. Wastewater goes then to the WWTP. However, WWTP in France treat "classical" macro pollutants, such as suspended solids, BOD5, COD, nitrogen and phosphorus. Micropollutants which are difficult to degrade, some of them are found at the outlet of the WWTP (figure 1). The AMPERES project (Analysis of Priority and Emerging Micropollutants in Releases and Surface Water) launched by SUEZ Environment and IRSTEA highlighted the effectiveness of the different wastewater treatment pathways in terms of micropollutants abatement. This study shows that most WWTP in France degrade more than 2/3 of the micropollutants (Coquery, 2009). The percentage of degradation of substances depends on their nature. That enables us to explain the presence of some micropollutants in surface water but also groundwater.

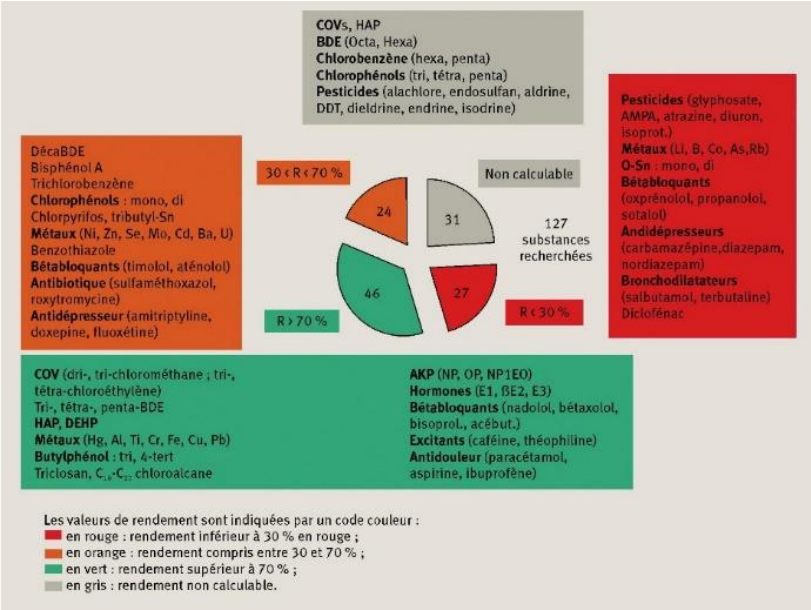


Figure 1: Distribution of different chemicals found at the inlet and outlet of WWTP (Source: Choubert et al., 2012).

REGULATORY CONTEXT

Prohibitions and restrictions on the use of domestic micropollutants, industrial and agricultural products are mainly linked to human health and the environment (ECHA, 2017). Most of them are associated to European directives. It is the example of REACH (Registration Evaluation Authorization of CHemicals) Regulation in force since the 1st June 2007 in all EU countries. The aim of this Regulation is to protect human health and the environment from the risks related to chemicals (ECHA, undated). It applies to fragile and imported substances used on the EU market and to highly critical substances.

In addition, the WFD, which sets the objectives for the good status of water in EU countries, updates the list of priority substances. This list goes from 33 substances to 45 substances, i.e. 12 new substances (European Parliament, 2013). Most of the micropollutants on this list are pesticides but also alkylphenols and heavy metals. For each substance, an Environmental Quality Standard is set and falls within the framework of the achievement of the good water status of the WFD. That completes the physicochemical and biological parameters defined previously.

Several studies highlight the impacts of micropollutants on the environment. Indeed, anthropogenic pollution linked to agricultural, industrial and domestic activities contributed greatly to the degradation of the water quality in France. According to WFD chemical

parameters, only 48.2% of surface water and 67% of groundwater enjoyed good chemical status in 2013 (Petit et Michon, 2015). This degradation of water quality leads to the implementation of a plan to fight against micropollutants at national scale with three main objectives (MEEM, 2016):

- The limitation of micropollutant emission in the water cycle,
- The consolidation of knowledge to adapt the fight against water pollution and preserve biodiversity,
- The preparation of a list of pollutants on which to act. In addition, action is already taken on the use of non-agricultural pesticides.

It has been prohibited since 1st January 2017 in France to apply pesticides to the level of green spaces, roads, walks and forests. This reform follows from the law of the energy transition for green growth of the 22nd July 2015 (MEEM, 2017). In addition, there is a prohibition on the sale and possession of any plant protection product used primarily by amateur gardeners from the 1st January 2019 (MEEM 2017).

DEVELOPMENT OF WATER CONSUMPTION IN FRANCE

The increase in water consumption by households during the 20th century is explained by several factors. They are mainly related to the lifestyles evolution. These factors will be detailed in the following sections.

CAUSES OF WATER CONSUMPTION INCREASE IN FRANCE

Factors of change

In France, some households had running water in homes in 1880 (CIEau, 2013). However, during that time, water was not treated before distribution, populations considered it as a vector of diseases (cholera, typhoid, etc.) (CIEau, 2013). The first processes of drinking water treatment (chlorine, or ozone) were developed around 1914 (CIEau, 2013). Thus in 1930 almost 23% of the French municipalities provided running water to homes (CIEau, 2013). Moreover, the arrival of water permits to improve the living conditions of populations with the presence of internal toilets and showers or bathtubs in the dwellings. Indeed, according to a survey carried out by INSEE, in 1954 only 10% of the dwellings were equipped with showers or bathtubs and 27% with internal toilets (Jacquot, 2006). Figure 2 shows the evolution of the percentage of dwellings with internal toilets and a shower or bathtub. Today, 99% of dwellings have sanitary facilities.

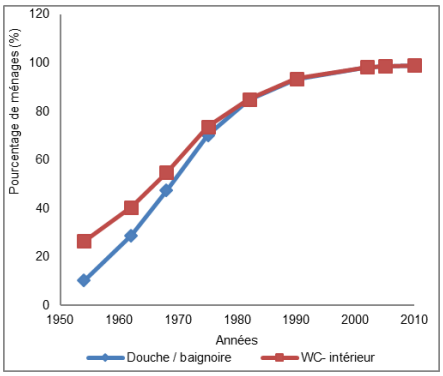


Figure 2: Evolution of percentage of houses with bath/ shower and toilets between 1954 and 2010 (sources: Jacquot, 2006; Ménard et Volat, 2012)

The second factor illustrating the improvement of living conditions related to water consumption is the development of domestic electricals in France. The main machines are washing machines and dishwashers since 1954. Laundry and dishes are household tasks whose water use is unavoidable. They contribute to the increase of the volume of water consumed per inhabitant. For example, a washing machine was present in 8% of homes and

a dishwasher in 5% of homes in the middle of the 20th century, whereas in 2013, 96% of the homes were equipped with washing machines and 57% (Figure 3) (Ménard and Volat, 2012).

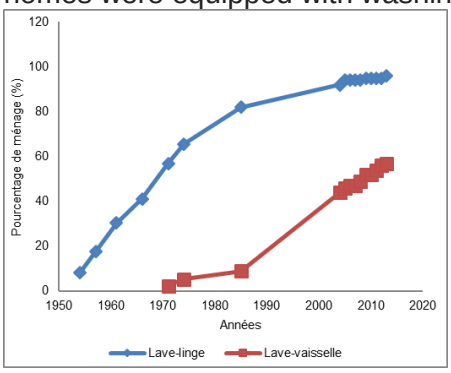


Figure 3: Evolution of the percentage of households equipped with a washing machine and a dishwasher (source: Jacquot, 2006, Ménard and Volat, 2012).

However, these results presented in the figures above must be taken with caution because of the difference in survey scales. For example, 17.3 million households made up INSEE surveys of the percentage of households equipped with dishwashers or washing machines between 1954 and 1974. As for those between 2004 and 2013, only 12,000 households were surveyed. In view of these several factors linked to water consumption, it is possible to trace the evolution of this consumption in volume from 1900 to the present day.

Evolution of the volumes of water consumed in France

In Metropolitan France, 5.5 billion cubic meters of water were destined for drinking water distribution in 2009, representing 17% of the total water abstraction (CIEau, 2015). With the changes in lifestyles explained above, this consumption increased strongly at the beginning of the 20th century. During this period, it varied between 15 and 20 liters of water per day and per inhabitant according to hygienists (CIEau 2015). Over the years, water consumption dropped from 50 l / day /person in the 1940s to 150 l / day/person in the 1980s. That shows an increase in consumption by a factor of 3 (Figure 4). Since the 1990s, the volume of water consumed per inhabitant has stabilized at around 150 l / day / person. However, a decrease in water consumption has been observed since 2004. This is mainly related to the willingness of households to reduce the cost of their water bills. Another reason is the various government awareness campaigns on reducing the consumption of water (MEEM, 2011). The French government thus encouraged households to adapt to the decline in water resources through various measures such as leaving baths to showers (MEEM, 2011). As a result, in 2012, the French consume an average of 145 l / day (ONEMA, MEEM, 2016).

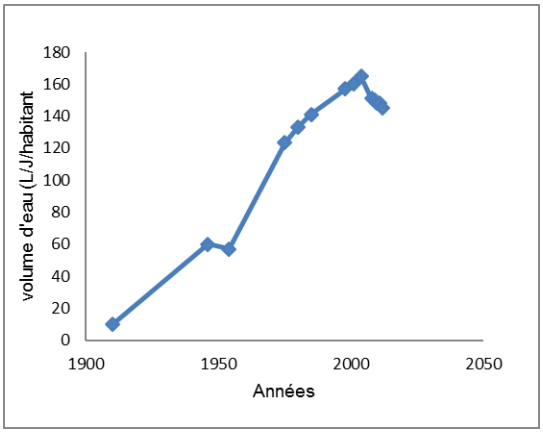


Figure 4 : Evolution of Domestic Water Consumption between 1900 and 2012 in France (source: Montginoul, 2002,) before 1998, SOeS-SSP - Water Survey 1998, 2001, 2004 and 2008, ONEMA DDT (M) as of 2009

These water uses caused the rise of families of domestic products used for personal and domestic hygiene, the maintenance of life spaces.

DEVELOPMENT OF FOOD AND DOMESTIC CONSUMPTION

CONTEXT

Birth of consumer goods

According to the literature, the beginning of the 20th century was strongly marked by the evolution of the way of life in the field of hygiene, health and food. It is also said that during this period of increasing industrialization, consumption patterns were changing. Several industrial groups / companies developed. In the world of consumer goods, four companies that are still major today were born: two American groups, Procter & Gamble and Colgate Palmolive and two other European companies, Unilever and Henkel (Mathé, 2011). These groups specialized initially in the manufacture of soaps and laundry before expanding their horizons in personal and domestic hygiene, cosmetology, pharmacy, but also in the agri-food industry. In addition, other companies also developed their skills in fields such as cosmetics with the world leader L'OREAL or pharmacology with the SANOFI group (Table 1).

Groups	P&G	Colgate Palmolive	Unilever	HENKEL	L'OREAL	LVMH	SANOFI	BAYER
Year of establishment in France	1954	1923	1930	1967	1909	1987	1973	1882
Sectors	Body hygiene and domestic hygiene, animal and human food	Body hygiene and domestic hygiene, animal and human food	Body hygiene and domestic hygiene, animal and human food	Body hygiene and domestic hygiene, animal and human food, adhesive	Fragance, cosmetics	Fragance, cosmetics	Pharmacy	Pharmacy, pesticides
Brands number	71	14	39	35	40	9	>4000	---
Example of brand	Pantenne, Oral B, Ariel	Colgate, TAHITI, Soupline	Dove, Cif, AMORA	Persil, FA, Mir, Schwarzkopf	Garnier, Maybeline, Vichy, Lancôme	Guerlain, Benefit Cosmetics	doliprane	Diane 35, aspirine protect

Table 1 : Leading consumer products companies (food, cosmetics, maintenance, pharmaceuticals and phytosanitary). (Sources: (Mathé, 2011), LVMH (2016), SANOFI (2017), L'OREAL (2016), BAYER (2017)

With the emergence of all these products, the improvement of hygiene conditions and health of the people was rising sharply, thus observing a change in the life expectancy not put during periods of wars (Figure 5).

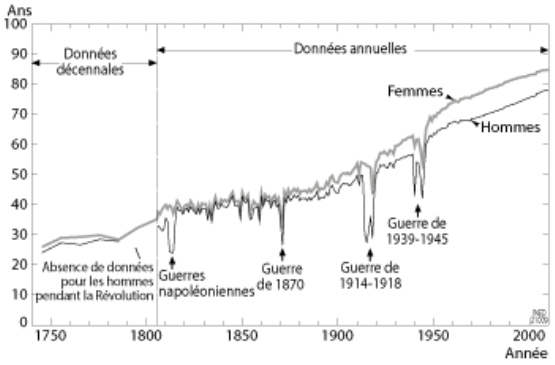


Figure 5 : Evolution of life expectancy at birth in France since 1750 (Sources: Corvol, 2012)

To make available all these products developed in the early 19th century, businesses started to grow. To meet the needs of customers, new forms of sales and distribution shops were gradually developing.

Development of mass retailing in France

With industrial development of products for domestic use, there appears in France a family of products called "consumer goods". The consumer goods are generally the most frequently purchased products by households in large-scale distribution (food brands, cleaning and hygiene products, etc. ... (Bathelot, 2015).
In France, during the thirty years of post -war economic growth, the sale of food products was made only by specialized traders. They represented 80% of the market (Peuples Solidaires, 2010). The concept of self - service was born in 1948. The first store was Goulet Turpin in Paris. However, these forms of concentrated businesses accounted for only 11.19% of the turnover (Daumas, 2006). Thus in 1963, France had only 323 supermarkets (Daumas, 2006). This year was also marked by the opening of the first CARREFOUR hypermarket. It is a store with an area greater than 2500 m² (Daumas, 2006).

Over time, the distribution landscape in France was marked by the birth of various distribution groups. Among these groups, we can cite CARREFOUR, E. LECLERC, AUCHAN, GIANT CASINO, THE MOUSQUETAIRES. There are also foreign bands, including two German groups, Aldi and Lidl.
Thus, these supermarkets have a surface greater than 2500 m². This encourages the gradual disappearance of small local businesses (CNCC, 2013).
The example of the E. LECLERC group shows a 4-fold increase in the number of hypermarkets, while the number of supermarkets has been declining since the 1990s (Figure 6). However, the general trend in the total number shows an increasing of hypermarkets and supermarkets by a factor of five since 1960.

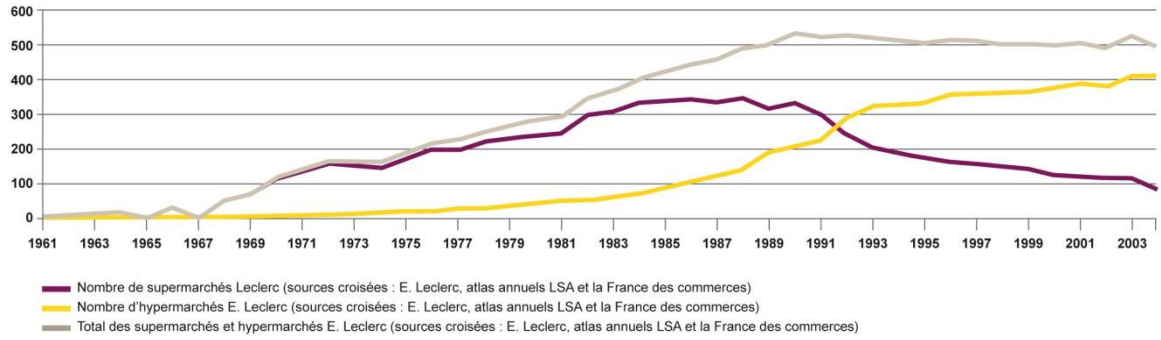


Figure 6 : Evolution of the number of distribution outlets in the E. LECLERC group in France since 1961 (E. LECLERC, 2016)

In addition, several studies show the development of specialist stores in specific fields. These are mainly cosmetics stores, household appliances and gardening. This facilitates the marketing of these types of products that become more accessible. This is the case of SEPHORA stores specializing in the sale of cosmetic products, the first of which opened in 1973. There are also garden shops – the brand Gamm Vert opened in 1977, DARTY for household appliances in 1957 and pharmacies. Their numbers have increased steadily since the 1970s, from 17,017 in 1971 to 22,723 in 2000 (Figure 7) (EcoSanté, 2017). However, between 2000 and 2015 the number of pharmacies decreased slightly. Para pharmacies, a concept created in 1981 by Michel Edouard LECLERC, also included the sale of dermo-cosmetic products, in addition to drugs (E. LECLERC, 2017).

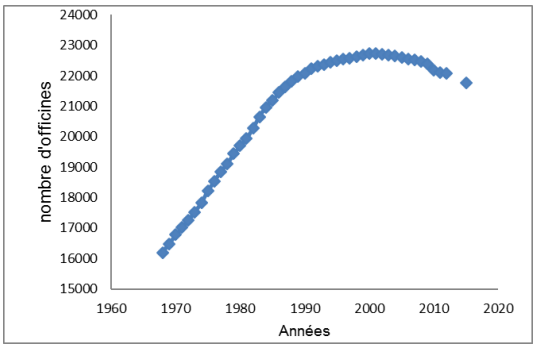


Figure 7 : Evolution of the number of pharmacies in Metropolitan France since 1968 (source: Eco-Santé, 2017)

These examples show the impact of changes in distribution patterns on mass consumerism and on products. Thus, the access to consumer goods led to the introduction of micropollutants contained in the marketed products (medicines, cleaning products, cosmetics, etc. ...) in our daily lifestyle. These products are composed of different chemicals in small proportions (Annex 2).

FOCUS ON THE EVOLUTION AND QUANTIFICATION OF THE CONSUMPTION OF SOME PRODUCTS

Food

At the beginning of the 20th century in France, nutritional requirements were very important because of manual physical activities carried out. Over time, with technological advances, mechanization of household tasks and development of transport, living conditions of populations improved considerably. That led to a reduction in daily energy requirements (Consales, Fesseau and Passeron, 2009). This change in food consumption subsequently led to new eating habits. The changes in food consumption are highlighted by several INSEE' studies in the early 2000s. Figure 8 shows an increase in expenditure related to the consumption of processed products. These processed products contain micropollutants such as preservatives (parabens), dyes, acidifiers and antioxidants.

Using the example of fruit juices, the average consumption in France rose from 3 to 4 L / inhabitant / year in the 1980s to 22 L / inhabitant / year since 2010 (UNIJUS, 2017). In parallel, expenses related to the purchase of these products are also increasing. The same trend is observed for all other processed products, be it vegetables, meat or fish, as opposed to fresh produce, where expenditure tends to fall.

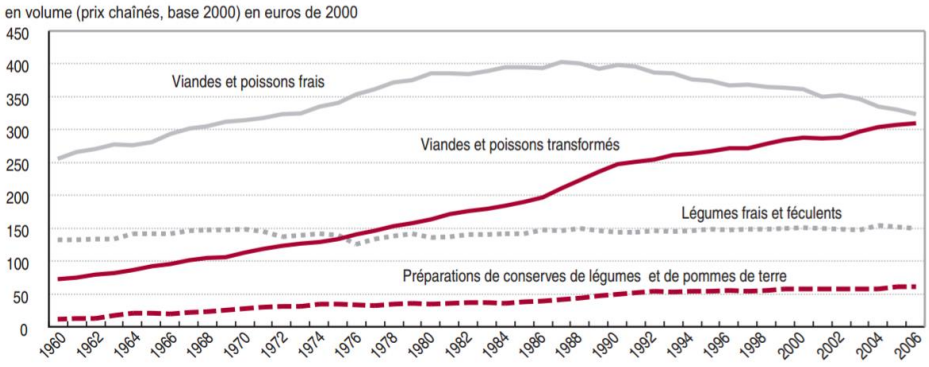


Figure 8 : Changes in household spending by food groups (Source: Besson, 2008)

Cosmetic products: shower gel and shampoo

In France, the most used cosmetic products are shower gels and shampoos. The main substances which compose these products are preservatives such as parabens and methylisothiazolinone (MIT), silicones and foaming cleansers such as sodium laureth sulfate (SLS) (Que Choisir, 2016). Other chemicals incorporate the composition of products, depending on their specificity. For example, selenium and zinc are used in anti-dandruff shampoos (Que Choisir, 2016).
The L'OREAL group, with DOP brand, manufactures and markets in 1934 the first shampoo dedicated to mass consumption (L'OREAL, 2017). The use of shampoos has increased sharply over the years. As a result, the DOP brand sold nearly 15 million bottles of shampoo in 2005, knowing that today the total number of shampoo bottles sold is around 174 million (Planetoscope, 2012).
As for shower gels, they replace over time the solid soaps essentially Marseille soap used at the beginning of the 20th century. They integrate the consumer market later than shampoos. TAHITI, brand of the group COLGATE PALMOLIVE was one of the first to market shower gels in 1973. Thus, nearly 186 million bottles of shower gels are sold in France each year (Planetoscope, 2012).

In addition, a study by CNE, ADEME and ECO EMBALLAGES (CNE et al., 2016) shows a volume change in the total amount of shower gels and shampoos used in metropolitan France between 2006 and 2012. Total consumption increased from 140 million liters in 2006 to 148 million liters in 2012. These values make it possible to approximate the quantity of products used per day per inhabitant in metropolitan France (Table 2). These two cosmetic products alone represent a considerable domestic pollution whose components are found in the environment.
These results will determine the per capita pollution flow as a function of the percentage of the substance (paraben) contained in the product.

Year	French population	Quantity of shower gel and shampoo (litres)	Quantity of shower gel and shampoo (Litres/habitant)	Quantity of shower gel and shampoo (litres/habitant/jour)	Quantity of shower gel and shampoo (ml/habitant/jour)
2006	61399733	140000000	2,28	0,0062	6,24
2012	63375971	148000000	2,34	0,0064	6,40

Table 2 : Evolution of the volume of shower and shampoo gels used per day and per capita in France between 2006 and 2012 (source: ADEME, 2012, INSEE, 2017)

Cleaning products: washing liquids / powder

In 1907, the HENKEL group manufactured the first PERSIL washing powder. This name comes from the combination of two bleaches: sodium perborate and sodium silicate (HENKEL, 2017). At the end of the second world war, several brands incorporated new substances such as optical brighteners and zeolite A (phosphate substitution material) into the composition of products. That led to the development of new detergent formulae for more specific uses (HENKEL, 2017).
Thus, by facilitating the washing of laundry, laundry detergents were spread to the large - scale distribution market. In France, a household uses an average of five laundry detergents per week, or nearly 7.3 billion laundry detergents per year (Planetoscope, 2012). However, since the 1990s, the products marketed have become increasingly concentrated. The main reason

for this change is the reduction in product packaging. Therefore, the International Association of Soap, Detergents and Maintenance Products recommends reducing the quantity of products on the market by 10% in 2001 in its code of good environmental practice. This target was reached in 2001, and since the laundry dose rose from 150g in 1997 to 85g in 2010 (CNE, 2010). It is for this reason that the volume of powders or laundry liquids did not increase sharply from 5647 million doses in 1997 to 5682 million doses in 2012, with a peak of consumption in 2000 with 5791 Million doses (ADEME, 2012).
This data enables us to calculate the average doses of detergents per day and per inhabitant, the same calculation performed for shower / shampoo gels. The same pollution flow calculation performed for shower / shampoo gels can be carried out. Table 3 shows the results obtained. The reduction in the quantity of detergents used is well linked to the reduction of the doses of detergents.

Year	French population	Annual dose of liquids	Weight of one dose	Dose of liquid per person	Dose of liquid per day person	Dose of liquid (g/habitant/jour)
1997	58 116 018	5 647 000 000	150	97,17	0,27	39,93
2010	62 765 235	5 682 000 000	85	90,53	0,25	21,08

Table 3 : Evolution of the amount of powders and liquids used per day per capita. (Source: CNE et al., 2016, INSEE, 2017)

Medicines

According to numerous studies, the development of the pharmaceutical industry and drug outlets has been growing in recent years. 85% of the drugs sold are reimbursed by social security in France (ANSM, 2012). These factors cause drug over-consumption in the country, especially in cities. In 2013, the National Agency for Safety of Medicines and Health Products accounts for nearly 2,800 substances on the French medicines market (ANSM, 2014). In big cities, pharmacy sales are dominated by analgesics with paracetamol, ibuprofen and codeine in combination, accounting for 20.1% of the market. For example, the number of paracetamol boxes sold in France increased sharply with 177,420,000 boxes sold in 1990 compared with 245 million in 2011. It means that the ratio in 1990 is about 3.1 boxes of paracetamol per person compared with 3.8 boxes per inhabitant in 2011.
In addition, a survey was conducted at a pharmacy located in Bordeaux on the evolution of the sale of some drugs, namely analgesics (paracetamol and ibuprofen), oestrogens and antidepressants between 2004 and 2015 (Figure 9). This study shows a sharp increase in the number of boxes of these drugs especially for analgesics. For example, the number of boxes of paracetamol sold by this pharmacy went from 4897 boxes in 2004 to 19 045 boxes in 2015, a factor close to 4 between the two data. The other families of medicines follow a similar evolution to that of analgesics, but with numbers of boxes sold which are less important. By 2015, the number of boxes of paracetamol sold was nearly 10 times greater than that of antidepressants.

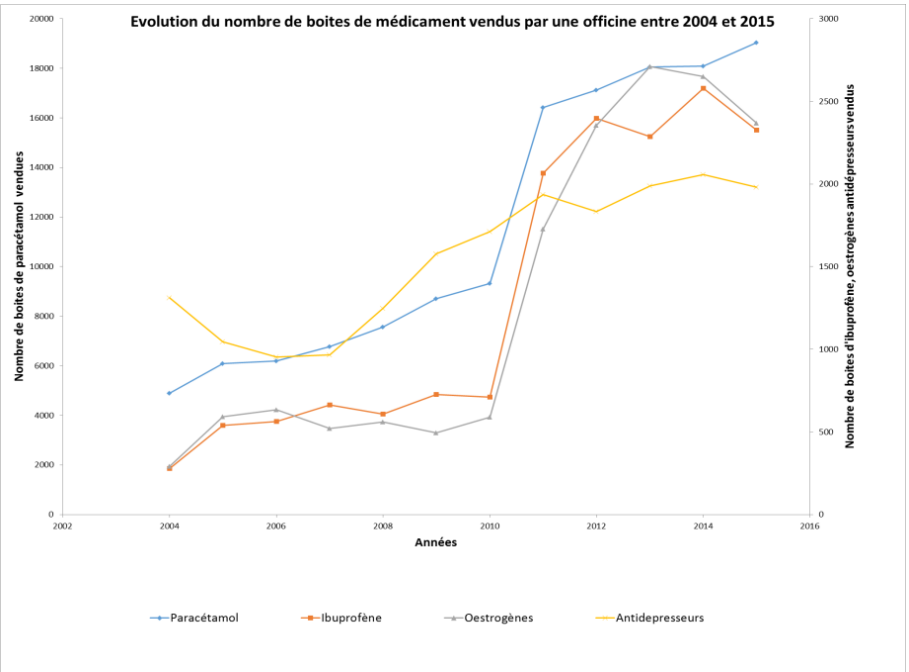


Figure 9 : Evolution of the number of boxes of paracetamol, ibuprofen, oestrogens and antidepressants sold by a pharmacy. (Source: Barbe, 2016)

In parallel, this same pharmacy saw its turnover increase between 2007 and 2015 rising from 641 827 € to 1 100 570 €. This can be explained by an expansion of the premises and the sale of cosmetic or dietetic products (Barbe, 2016). This turnover's rise show medicines are more and more used. This is the reason that explains the presence of medicine in aquatic environment.

Pesticides

Used since the beginning of the 20th century in France, pesticides are active substances whose role is to prevent, control or eliminate undesirable animal or plant species. There are three main families of active substances: insecticides, fungicides and herbicides. Each family is composed of several groups of molecules whose periods of appearance and prohibition are presented in annex 3.

According to the statistics of the UIPP in 2007, the sale of pesticides is not only intended for agricultural uses, which still account for 90.6%. Indeed, 8.1% of sales are attributed to domestic uses and 1.3% to the maintenance of roads and green spaces (MEEM, 2015).

Moreover, since the 1950s, more than 1,000 active substances have been introduced into the pesticides market. A general decline in the sale of phytosanitary products has been observed since 1996 (Figure 10). The main reasons are the ban on the use of certain molecules and the various regulations related to the use of plant protection products (UIPP, SOeS, 2013).

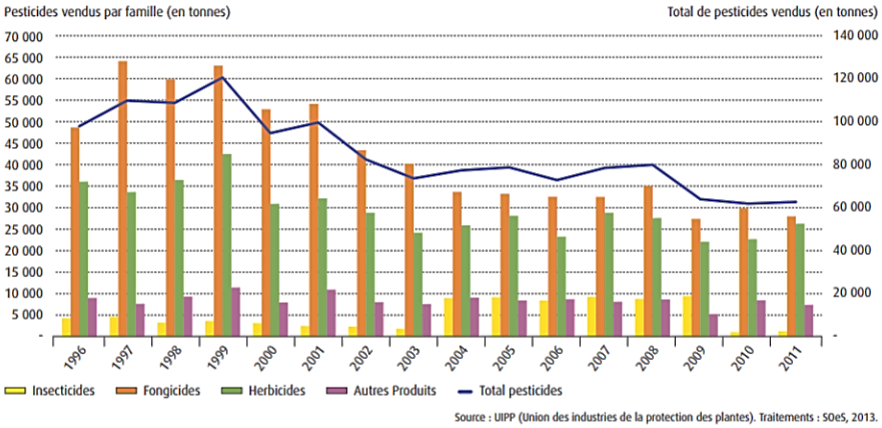


Figure 10 : Evolution of the quantities of pesticides sold since 1996 in France. (Source: MEEM, 2015)

However, despite the ban on certain pesticides and the decline in their marketing, these substances persist in the environment. They do not degrade completely in the environment. That is why they are called "Persistent Organic Pollutants". In France, The French Institute for the Environment (FIEN) notes that over the period 2004-2005, 96% of surface water and 61% of groundwater contain pesticides.

Packaging

The development of foods and domestic products has resulted in the development of packaging especially in steel, aluminium, cardboard, plastic and glass (ADEME, 2016). These containers ensure the preservation of products and are the main components of household waste. Among the types of packaging mentioned, plastic packaging is the most recovered in the environment. They are not degradable. Several studies show that the main plastics used for packaging are polyethylene, PVC, PET and HDPE. These plastics are composed of plasticizers, notably phthalates and bisphenol A. these micropollutants are on the list of priority substances of the WFD (Petit et Michon, 2016). A study by VALORPLAST in 2003 shows a general increase in household plastic packaging with a total value of 159 thousand tons (Figure 11). However, PVC packaging has been declining since 1997 and is only 800 tonnes in 2003.

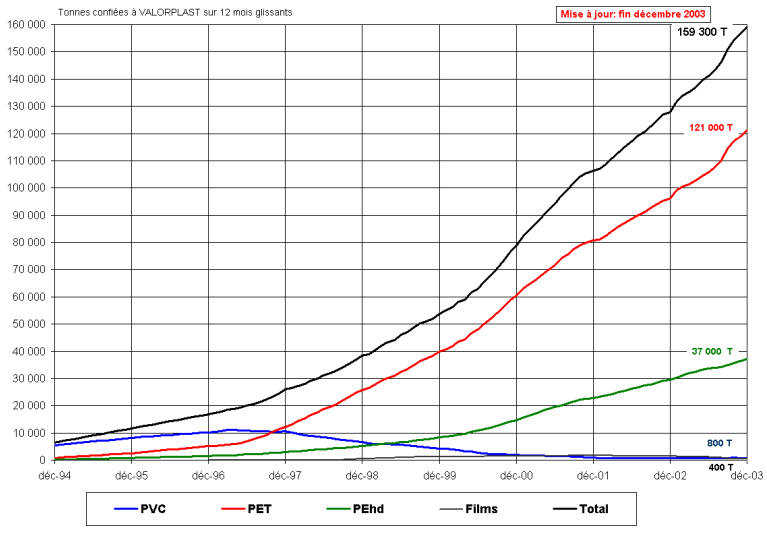


Figure 11 : Evolution of household plastic packaging in France since 1994 (Source: VALORPLAST, 2003)

CONCLUSION

The evolution of domestic consumption and that of living conditions since the early 1900s have been presented throughout this synthesis. A correlation between these two parameters can be observed. Moreover, the introduction of washing machines and dishwashers in homes has led to an increase in domestic products. However, it is possible to note a decline in the use of pesticides. Some molecules such as atrazine or DDT are still present in the aquatic environment.

Moreover, the results of this bibliographic research come from a compilation of quantitative data from different studies. This raises the question of the representativeness and comparability of information found. The reason is that the surveys are not carried out on the same samples. Some of information used was only available graphically. A graphical reading will allows us to recover as much data as possible on the evolution of products. This method enables us to then calculate the pollution flows per day and per inhabitant according to the type of molecule.

To obtain reliable data and information on such study of changes in domestic consumption, it is necessary that they come from the production companies of products (L'OREAL) or from one of the large groups in the large Distribution (CARREFOUR). But such information is confidential and difficult to access.

Thus, to go further in this study, agreements should be signed between the initiators of the program (SUEZ, SERAMM) and the various companies specializing in domestic products or groups dominating large-scale distribution. This would create a reliable and accurate database on the evolution of household consumption.

BIBLIOGRAPHY

ANSM., 2012. *Analyse des ventes de médicaments en France en 2011*. Paris, ANSM, 21p. Rapport, octobre 2012.

ANSM., 2014. *Analyse des ventes de médicaments en France en 2013*. Paris, ANSM, 36p. Rapport, juin 2014.

Besson D., 2008. *Le repas depuis 45 ans : moins de frais, plus de plats préparés*. Paris, INSEE, 4p. INSEE Première, N°1208.

Bourguet W., Balaguer P., 2015. *Les dessous de « l'effet cocktail » des perturbateurs endocriniens révélés*. Paris. Institut Thématique, INSERM, CNRS. 3p.

Choubert JM., Pomies M., Miège C., Coquery M., Martin – Ruel S., Budzinski H., Wisniewski C., 2012. Elimination des micropolluants par les stations d'épuration domestiques. *IRSTEA sciences eaux et territoires*. 2012/4 (9), pp. 6 -15.

CNCC., 2013. *Quel avenir pour le commerce de proximité dans les quartiers*. Paris, CNCC, 56p. Cahier, juin 2013.

CNE, 2010. *La prévention en action, vers une dynamique de ruptures*. Paris, CNE, 47p. Rapport, décembre 2010.

CNE, ADEME, Eco Emballages, 2016. *Le gisement des emballages ménagers en France*. Angers, ADEME. 36 p.

Commission Européenne, 2016. *La Commission présente des critères scientifiques permettant d'identifier les perturbateurs endocriniens dans le domaine des pesticides et biocides*. Bruxelles, Commission Européenne, pp. 1-3.

Consales G., Fesseau M., Passeron V., 2009. La consommation des ménages depuis cinquante ans. In : *Cinquante ans de consommation en France*. INSEE, 19p.

Coquery M., Choubert JM., Miège C., 2009. Synthèse des travaux du projet AMPERES. *ONEMA, CEMAGREF*. 26p.

Daumas JC., 2006. Consommation de masse et grande distribution. *Vingtième Siècle. Revue d'histoire,* 91 (3), pp 57 – 76.

Gabe H.A., Blake C., 2016. An Informatics Approach to Evaluating Combined Chemical Exposures from Consumer Products: A Case Study of Asthma-Associated Chemicals and Potential Endocrine Disruptors. *Environmental Health Perspectives*, 124 (8), pp. 1155 – 1165.

Jacquot A., 2006. Cinquante ans d'évolution des conditions de logement des ménages. *Données sociales, la société française INSEE Références*, pp 467 – 473.

Mathé J.C., 2011. Sphères d'influence et croissance conjointe Le cas des « Quatre Mousquetaires » de l'Hygiène. *La Revue des Sciences de Gestion,* 252 (6), pp 27 – 35.

Ménard S., Volat G., 2012. *Conditions de logement de 2005 à 2012, légère amélioration, moins marquée pour les ménages modestes*. 4p. INSEE Première, N°1396.

Montginoul M., 2002. *Consommation d'eau des ménages en France : état des lieux*. CEMAGREF et ENGEES. 41p.

ONEMA, MEEM, 2016. *L'eau et les milieux aquatiques, chiffres clés*. ONEMA, service de l'observation et des statistiques MEEM. Paris. ONEMA, MEEM. 60p. Rapport février 2016.

Petit K., Michon J., 2016. *Surveillance des micropolluants dans les milieux aquatiques : des avancées récentes*. Office National des Eaux et des Milieux Aquatiques. 12 p.

Other useful reference

GIP Seine – Aval., 2008. *Qualité de l'eau et contaminations : Contamination par les pesticides dans l'estuaire de la Seine*. Rouen. Seine Aval, Groupement d'intérêt public. 6p. Fiche thématique.

Web sites

Bathelot B., 2015. *Définition PGC*. Disponible sur internet : http://www.definitions-marketing.com/definition/pgc/ [consulté le 08/02/2017].

Bayer, 2017. *Historique*. Disponible sur internet : https://www.bayer.fr/historique [consulté le 11/01/2017].

CIEau., 2013. *L'eau potable pour tous, une conquête récente*. Disponible sur internet : http://www.cieau.com/l-eau-potable/l-eau-potable-pour-tous-une-conquete-recente [consulté le 01/11/2016].

CIEau, 2015. *Les usages de l'eau : les usages domestiques*. Disponible sur internet : http://www.cieau.com/les-ressources-en-eau/en-france/les-usages-domestiques [consulté le 02/10/2016].

CNRS., 2003. *L'évolution des causes de pollution depuis un siècle*. Disponible sur internet : http://www.cnrs.fr/cw/dossiers/doseau/decouv/degradation/02_evolution.htm [consulté le 22/11/2016].

Corvol P.,2012. *La prévention du risque en médecine*. Disponible sur internet : http://books.openedition.org/cdf/1665?lang=it [consulté le 22/12/2016].

Desiteratum., 2014. *La pollution des rivières à l'heure des micropolluants*. Disponible sur internet : http://desi2ratum.blogspot.fr/2014/09/la-pollution-des-rivieres-lheure-des.html [consulté le 10/01/2017].

ECHA, 2017. *Réglementation REACH*. Disponible sur internet : https://echa.europa.eu/fr/regulations/reach [consulté le 15/01/2017].

Eco-Santé, 2017. *Base de données*. Disponible sur internet : http://www.ecosante.fr/index2.php?base=DEPA&langh=FRA&langs=FRA [consulté le 11/11/2016].

E.LECLERC., 2016. *E. LECLERC et la parapharmacie partie I 1957 – 1989*. Disponible sur internet http://www.histoireetarchives.leclerc/thematiques/les-combats-de-l-enseigne/e-leclerc-et-la-parapharmacie-partie-1-1957-1989 [consulté le 09/12/2016].

HENKEL., 2016. *L'histoire de Persil*. Disponible sur internet : http://www.persil.be/fr/a-propos-de-persil/histoire.cky.html [consulté le 23/11/2016].

INED., 2017. *L'espérance de vie en France*. Disponible sur internet : http://www.ined.fr/fr/tout-savoir-population/graphiques-cartes/graphiques-interpretes/esperance-vie-france/ [consulté le 05/01/2017].

INERIS., 2005. *Etude de l'analyse des alkylphénols*. Disponible sur internet : http://www.ineris.fr/centredoc/alkylsphenols.pdf [consulté le 20/11/2016].

INERIS., 2009. *Glyphosate*. Disponible sur internet : http://www.ineris.fr/substances/fr/substance/1031 [consulté le 22/10/2016].

INERIS., 2010. *Le Bisphénol A : modélisation de la toxicocinétique du bisphénol A chez l'Homme*. Disponible sur internet : http://www.ineris.fr/rapports-etude/risques-chroniques/limpact-pollutions-homme/toxicite/bisphenol [consulté le 12/10/2016].

INERIS., 2013. *Les substituts du DEHP*. Disponible sur internet : https://substitution-phtalates.ineris.fr/sites/substitution-phtalates/files/documents/substituts_du_dehp.pdf [consulté le 25/11/2016].

INERIS., 2015. *Les parabènes*. Disponible sur internet : www.ineris.fr/substances/fr/substance/getDocument/9833 [consulté le 09/10/2016].

INERIS., 2017. *Triclosan*. Disponible sur internet : http://www.ineris.fr/substances/fr/substance/2723 [consulté le 20/02/2017].

L'OREAL., 2016. *1909 – 1956 : les premiers pas, la construction d'un modèle*. Disponible sur internet : http://www.loreal.fr/groupe/histoire/1909-1956 [consulté le 08/10/2016].

LVMH., 2016. *Temps forts*. Disponible sur internet : https://www.lvmh.fr/groupe/temps-forts-lvmh/1593-aujourdhui/ [consulté le 10/11/2016].

MEEM., 2011. *Eau potable : la consommation*. Disponible sur internet http://www.statistiques.developpement-durable.gouv.fr/lessentiel/ar/306/305/eau-potable-consommation.html [consulté le 07/11/2016].

MEEM., 2015. *Les pesticides vendus en France*. Disponible sur internet : http://www.statistiques.developpement-durable.gouv.fr/lessentiel/ar/2439/0/quantites-pesticides-vendues-france.html [consulté le 10/11/2016].

MEEM., 2017. *Mise en œuvre de la loi de transition énergétique pour la croissance verte : lancement de la campagne « zéro phyto » en 2017*. Disponible sur internet : http://www.developpement-durable.gouv.fr/mise-en-oeuvre-loi-transition-energetique-croissance-verte-lancement-campagne-zero-phyto-en-2017 [consulté le 20/01/2017].

Peuples Solidaires., 2010. *Brève histoire de la grande distribution en France*. Disponible sur internet : http://base.d-p-h.info/fr/fiches/dph/fiche-dph-8556.html [consulté le 10/11/2016].

Planétoscope., 2012. *Nombre de lessives faites en France* http://www.planetoscope.com/hygiene-beaute/385-nombre-de-lessives-faites-en-france.html [consulté le 30/10/2016].

Que Choisir., 2016. *Substances préoccupantes dans 185 produits cosmétiques : les consommateurs appelés à passer à l'action*. Disponible sur internet : https://www.quechoisir.org/action-ufc-que-choisir-substances-preoccupantes-dans-185-

produits-cosmetiques-les-consommateurs-appeles-a-passer-a-l-action-n11915/ [consulté le 22/11/2016].

Sanofi, 2017. *A travers le temps*. Disponible sur internet : http://www.sanofi.com/groupe/a-travers-le-temps/a-travers-le-temps.aspx [consulté le 12/01/2017].

UNIJUS., 2017*. Les jus de fruit*. Disponible sur internet : http://www.unijus.org/1-/545-unijus/546-espace-journalistes.aspx [consulté le 04/01/2017].

Valorplast, 2003. *Evolution des emballages plastiques ménagers recyclés*. Disponible sur internet : http://www.dechetcom.com/infos/depeche.html?fileid=4673 [consulté le 23/12/ 2016].

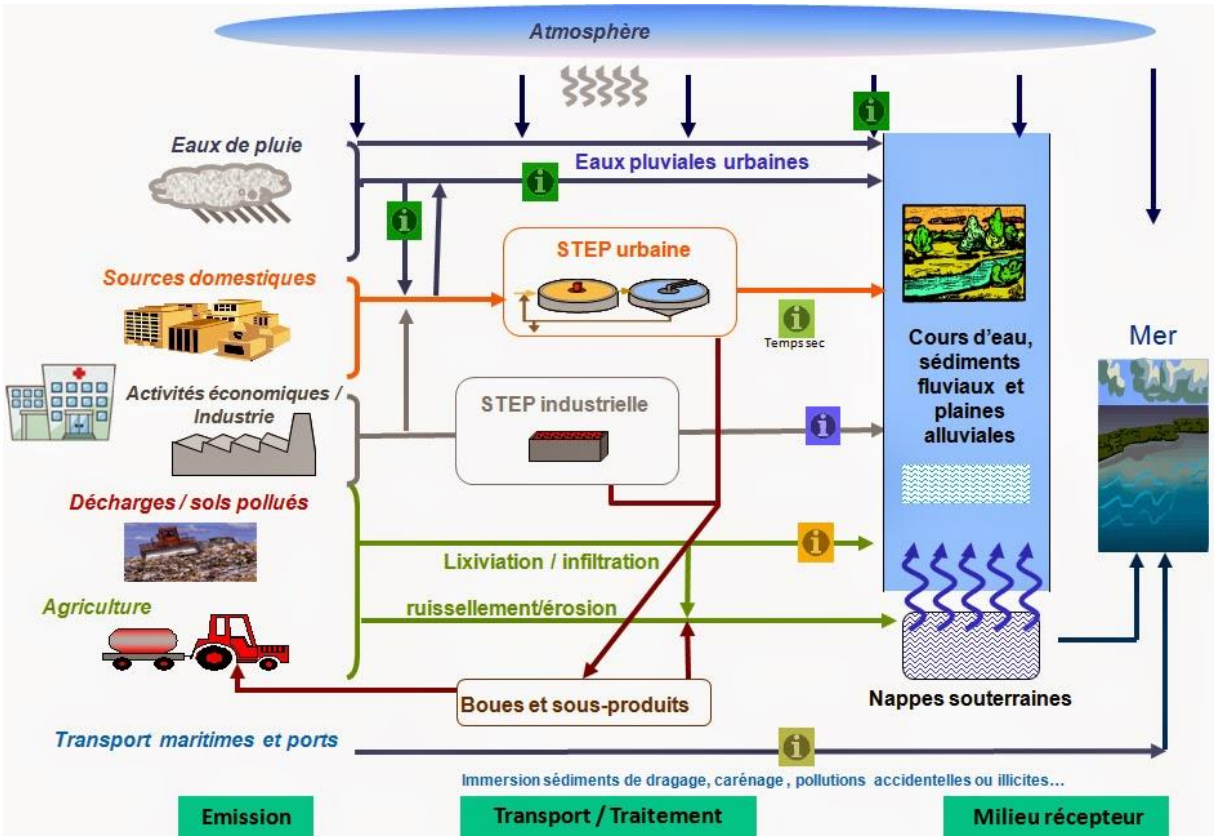
Regulation

Parlement Européen, 2013. *Directive 2013/39/UE du Parlement Européen et du Conseil du 13 août 2013 modifiant les directives 2000/60/CE et 2008/105/CE en ce qui concerne les substances prioritaires pour la politique dans le domaine de l'eau*.

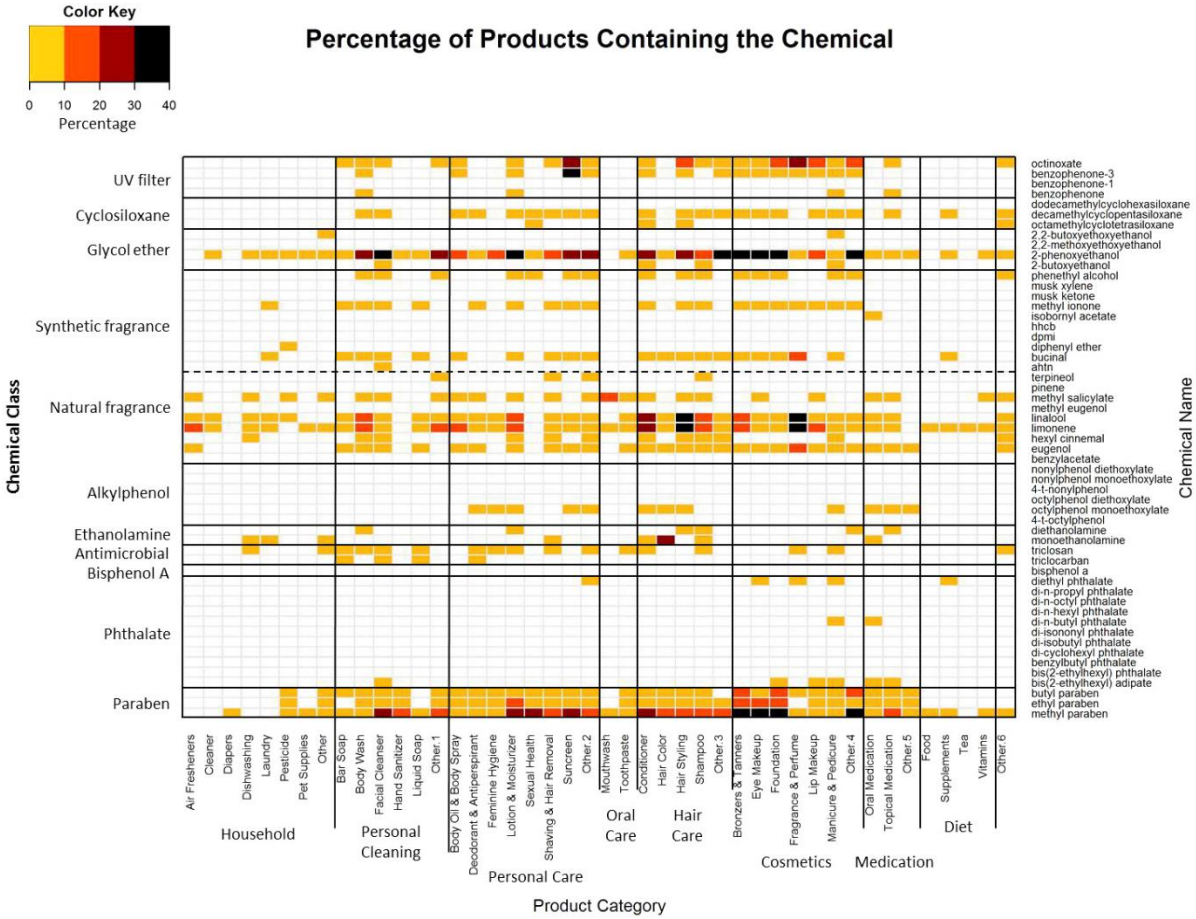
Interview

Barbe JC., 2016. Pharmacien, propriétaire d'une officine à Bordeaux. Interview : 17/11/201

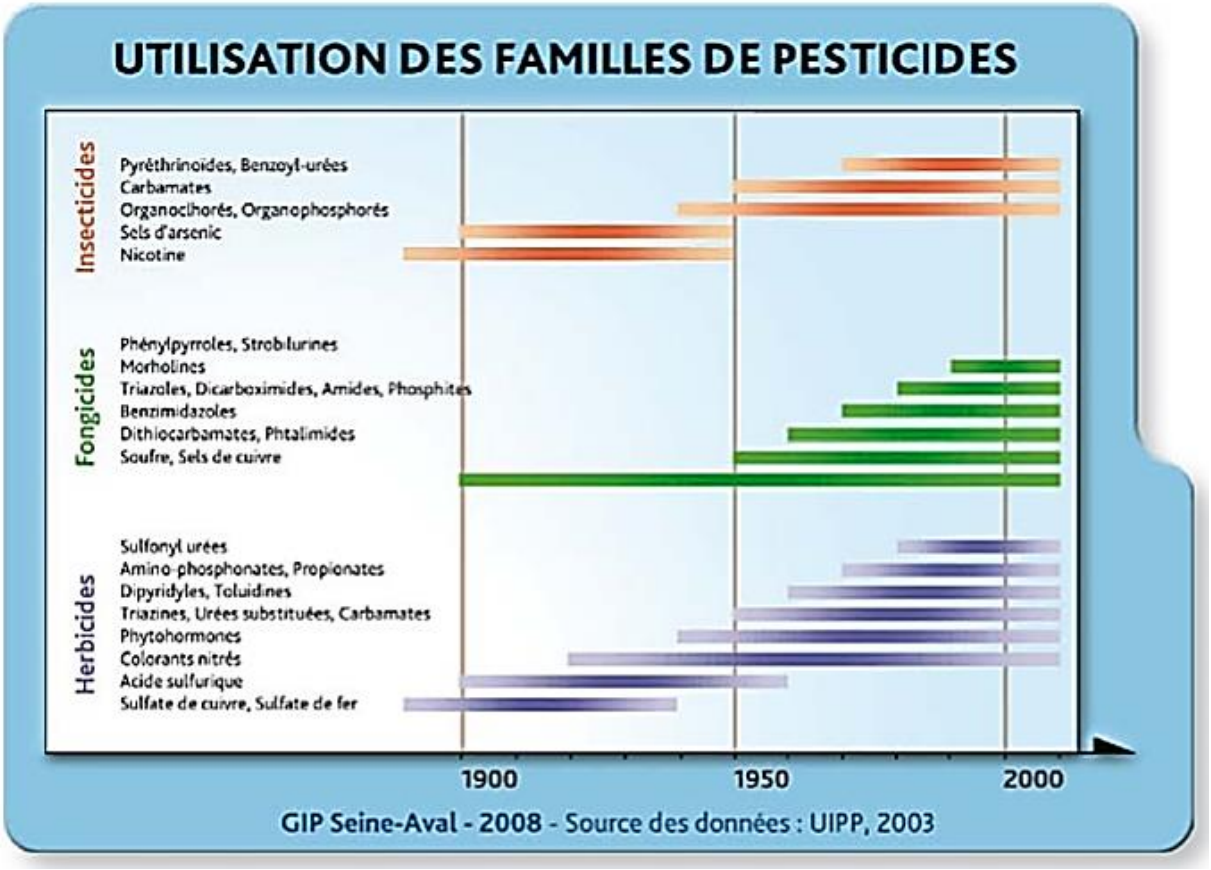
Appendix 1 : Compartments for the emission and use of products containing micropollutant (Desiteratum, 2014)



Appendix 2 : Percentages of micropollutants present in the different families of household products Gabe et al., 2016)



Appendix 3: Evolution of phytosanitary products used from the 1900s to 2000



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