

# Gender and Environmental Chemicals

Report by Iliana del Rio Gomez, Ph.D. and  
Helen Lynn Campaigns and Health Co-ordinator  
Health Team, Women's Environmental Network

March 2007



**Women's  
Environmental  
Network**

*'Masculine/feminine, male/female are the categories which serve to conceal the fact that social differences always belong to an economic, political, ideological order.'*

**Monique Witting, 1982**

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**Women's  
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## Executive summary

In 2006, Women's Environmental Network was commissioned by the Department of Environment, Food and Rural Affairs (Defra), to conduct an initial scoping study to identify key gender-related issues for international policy-making on chemicals management and safety, and to recommend how best to have a gender perspective and input to environmental policy and processes.

This report reviews existing research and data to establish why a gender perspective is required. It is not exhaustive but clearly points to the need for gender to be considered and for women to be involved in chemicals policy-making. An accompanying report on two pilot focus groups begins to identify women's concerns and their perceptions of decision-making processes and barriers to greater involvement.

Synthetic chemicals bring many benefits to society and modern life would be unrecognisable without them. The UK chemicals industry makes a huge contribution to the economy. Some 100,000 substances are listed in a European inventory of existing commercial chemicals. Yet for many of the chemicals in daily use we do not have sufficient information on whether they are harming human health, wildlife or the environment.

Studies have shown we all carry a burden of synthetic chemicals in our bodies: up to 280 synthetic chemicals have been detected in umbilical cord blood, and up to 300 synthetic chemicals have been found in body fat and breast milk. Many have been shown to be cancerous, toxic to the brain and nervous system or to have the potential to cause birth defects or abnormal development in animal tests.

Disease trends show increases in various cancers, allergies, infertility, reproductive and developmental problems in humans. The role of environmental, lifestyle, diet or occupational factors is unknown, as is the combination and interaction of multiple factors in the life of an individual.

Sex (the biological difference between male and female) and gender (the social construction of identity as man or woman) are two significant factors among a multiplicity of factors affecting human susceptibility to disease, and to the effects of environmental pollutants.

Since women and men are different biologically, physiologically and sociologically, diseases and medical problems show up in them in different ways and gender roles mean the sexes are exposed to chemicals differently. Involvement in policy-making is also affected by gender: women are still far less likely to be involved. Despite advances in equality, many women still do not have access to the education, the time, resources and

the experience to feel confident about getting involved.

Among the physical differences are that women have more body fat than men (many chemicals build up in body fat); men and women have different levels of specific hormones (hormonal systems are sensitive to chemical exposures) and have different reproductive systems (also sensitive to certain chemicals). Biologically, there are multiple differences in basic cellular biochemistry that can affect health. Research has shown that some contaminants can alter gene behaviour at extremely low doses, so adult diseases and sensitivities to subsequent exposures can be programmed during development in the womb.

Males and females have different patterns of disease – men die younger but women are more frequently ill; more boys get hay fever before puberty, more girls get it during puberty; women's diseases tend to appear at certain times of life, such as endometriosis in the childbearing years and osteoporosis after menopause. Such differences raise questions about how biological differences are determined and susceptibility to different chemical influences at different stages of life.

Historical approaches to scientific research tended to exclude women: they were often left out of drug trials or chemical risk assessments so results were based only on the effects on men who took part and results analysed only from a male point of view. This means potential side-effects on women may not become apparent until the drug, chemical or substance is in use.

Gendered roles mean women and men are exposed differently to environmental factors. In most societies, women's lives have been lived mostly in the domestic/private sphere, men's in the public sphere. So women are exposed more at home, in caring for others and through personal care, men have greater exposure at work and less in those other roles. As traditional roles change, so exposures are likely to change. Social factors such as access to education, involvement in scientific research, political representation and access to power have all limited women's participation in decision-making, leading by omission to gendered decisions.

Women have been celebrated as 'custodians of the environment' and there are widespread perceptions that women care more about the environment than men. However, research shows it is not gender so much as having a feminist consciousness – identifying with women's rights – that increases a person's environmental awareness.

## Recommendations

- The biological, physiological and sociological differences between men and women need to be taken into account when considering how exposure to chemicals in the environment may affect them.
  - A gender equality approach needs to be taken to protect women's health and help women participate more in environmental decisions about policies, processes and forums.
  - It is essential that women are brought into the mainstream of environmental decision-making processes, whether community based or those initiated by governments, for programmes – for instance, to protect humans from exposure to toxic chemicals - successfully to fulfil their purpose, ensuring women can actually benefit from them.
  - Women's groups, and the NGOs that work with and support them, should be strengthened and funded to enable women to develop greater understanding of the issues and participate more fully in decision-making.
  - Further study is needed to:
    - › assess the impact of existing programmes to involve women in public life;
    - › investigate the barriers to participation as seen by women themselves;
    - › to identify the cumulative and combined exposures to toxic chemicals;
    - › provide disaggregated data for men and women on disease trends, chemical effects and public involvement in decision-making;
    - › find out what changes occur in a woman's body over time that may make her more or less susceptible to particular diseases as she ages;
    - › understand further how women and men perceive risks differently and to better understand the influence of different factors on the gender identity and sex differences in the brain.
2. A cross Government and NGO website with full information on current and future Government consultations.
  3. Improved processes for Government consultations such as longer lead times and resourcing of women's organisations to take part.
  4. Provision of core funding to women's organisations to enable them to continue to exist and commissioning of them to undertake activities such as creating easy to read versions of consultation documents and reaching women in hard-to-reach groups/communities.
  5. Improve arrangements for meetings and consultation events including appropriate venues, timing, chairing and immediate reimbursement of expenses.
  6. Improve publicity to enable participation.
  7. Provide incentives to employers to enable women to participate in public life.
  8. Ensure reserved seats for women in all decision making forums and also consultation processes.
  9. Free full day childcare.
  10. Leadership and assertiveness training for women.

### Focus Group recommendations

In conjunction with this literature review, WEN commissioned two pilot focus groups, to begin to identify some of the concerns and perceptions of women, both in relation to chemicals and risks, and in relation to decision-making. The collated recommendations from the two groups for increasing women's participation on public decision-making are listed below.

1. Well-resourced independent (of government and industry to police legislation implementation) inspectors.

## Objectives

To identify the key gender-related issues which are linked with chemicals policy-making and to recommend how best to have a gender perspective and input to environmental policy and processes.

## Topics of scoping study

1. Why a gender perspective is required in chemicals policy making.
2. Identify and explain the specific concerns of women, e.g. perceptions of risk, adequacy of public information, eg product labelling?
3. Compare and contrast these concerns with those of a wider set of public groups.
4. Relate the above discussion to current UK and international chemicals policy and policy activities and what changes are recommended?

## Background

Synthetic chemicals bring many benefits to society. Modern life would be unrecognisable without the chemicals that go into almost all the objects and materials we use at home and at work. The UK chemicals industry makes a huge contribution to the economy, through direct and indirect employment, investment and trade surplus.

The European Inventory of Existing Commercial Chemical Substances contains a list of about 100,000 substances. More recently it has been estimated that there are currently around 30,000 chemicals on the EU market at volumes of one tonne per year or more [1]. For many of the chemicals in daily use we do not have sufficient information on whether they are harming human health, wildlife or the environment.

Studies have shown that we all carry a burden of chemicals in our bodies, independent of lifestyle or region. The WWF publication *Bad Blood* reported the results of tests done on 14 environmental ministers from 13 EU countries [144]. Other studies have reported that up to 280 different chemicals have been detected in umbilical cord blood; of these 180 may cause cancer in human or animal studies, 217 may be toxic to the brain and nervous system and 208 may cause birth defects or abnormal development in animal tests. [3]

There is evidence of an increase in trends in a number of human health problems like cancers [4] [5], allergies [6], infertility [7] [8] [9], reproductive and developmental problems etc. This is associated with an increase in public concern about what factors may be causing them. The role of environmental, lifestyle, diet or occupational factors is unknown, as well as the combination and interaction of these different areas in the life of an individual.

### Media messages

The media sends mixed messages about impacts on human health. Often these can be misleading or may cause anxiety. Many people may feel unsure what to believe and what actions they can take to reduce possible health risks. Frequently we receive environmental news that may reduce our sense of safety, making us wonder if what we are eating is safe, or if the use of our appliances is safe. Finding explanations of news we may receive through the media is not always straightforward; explanations found do not necessarily reduce our worries. A search for 'toxic environment' on the Daily Mail newspaper website, for example, found 2,810 items with headlines like 'Prozac found in drinking water'; 'Poisoned: Toxic timebomb inside our children'; 'Fish toxic to unborn children'; 'Toxic chemicals 'found in blood' '; 'Waste fumes 'can

damage children's fertility' ; 'Pesticide poisoning'. Using the search words 'Toxic chemical', 1,362 items appeared with titles like: 'Babies being poisoned in the womb'; 'How toxic is your food?'; 'Toxic chemicals found in blood'; 'Toxic cocktail 'threat to unborn' ; 'Hazardous chemicals in everyday products'. For the search term: 'Toxic plastic' 1,667 items were listed, with headings like: 'Is tap or bottled water best for our bodies?'; 'Is packaging poisoning your food?'; 'Brain damage risk to children in the home'; 'The toxic cocktail in our bodies'.

These reports may create high anxieties about whether we are doing what is best for our families and ourselves. WEN wants to avoid this and give women, truthful, accessible information, as well as listening to women's environmental concerns.

### Multiple factors

Associations between environmental exposures and health consequences depend on the environmental pollutants and diseases being considered, but are also influenced by factors such as genetic constitution, age, nutrition, lifestyle and socio-economic factors such as poverty, level of education, sex and gender. This means associations are characterised by their multi-causality, and there are different strengths of association depending on which factors apply and how many are involved. When we mention gender as one of the factors involved [10], we also need to consider all other factors involved within this concept.

In the past, women were often not included in medical research studies [11]. Therefore, results of these studies were based only on the effects on men who took part. Those results were often analysed only from a male point of view.

Women and men are different biologically, physiologically and sociologically and will therefore react differently to external influences. Not only are some body parts specific to women and men, like the uterus and prostate, but also diseases and medical problems show up in different ways in women than they do in men. The participation of women and men in their different social roles also represents a multi-factorial influence on how other differences affect on their health status. Such social differences encompass how women and men express their gender in relation to the constantly changing and culture-dependent social demands for preferred body types as feminine, masculine, fashionable or elegant; such expressions uniquely determine individuals' activities and their consumption of different products, from vitamins, dieting pills and contraception to cosmetics, fragrances, dry-cleaning and beyond.

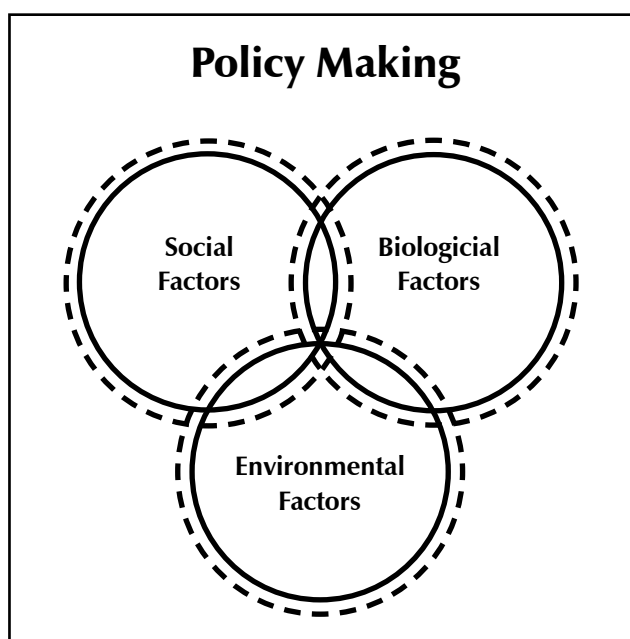
In order to understand these differences, doctors and

scientists study female and male medical problems as well as diseases. Understanding the bases of these sex-based differences is important to develop new approaches to prevention, diagnosis and treatment which can protect women to the same degree as men, creating 'safe' levels of exposure to toxic substances based on women too. Dr Anita Holdcroft, from Imperial College, London, recently voiced her concerns regarding women's lives being put at risk because drug companies don't include them in drugs trials. This means potential side-effects on women may not be exposed until the drugs hit the shelves [12, 13].

Human health for women and men cannot be understood without including other frameworks related to gender roles and women's work in the domestic sphere [14], as well as the interaction between gender and other social stratifiers, like socio-economic class, race and ethnicity. Figure 1, below shows the interactions between social, biological and environmental factors. We have tried to represent with the two different lines in each circles, areas involving men (the solid line) and areas involving women (the interrupted line), expressing how women and men have specific factors which may modify differently their status of health or disease, through the combination of factors from each sphere (Figure 1.). It may prove very difficult to separate these interactions.

In the same way, given that women and men have different factors in their shaping spheres, each get involved in policy-making differently due to their degree of participation which is also modified by the way each perceives risk for themselves and for their families [15].

**Figure 1. Interactions determining the participation of women and men in policy making and from which their health is being shaped.**



This document defines the differences between females and males, provides reasons why they should be considered as different entities and gives recommendations for this to happen. It will also consider the role of women in environmental decision-making and in setting the environmental agenda for current and future generations.

To protect future generations it will be important to protect the health of future mothers and fathers.

For the purpose of this report, the term 'sex' will be used to refer to the biological phenomena of being male or female, whilst the term 'gender' will be used to refer to the social expression of living as a man or a woman.

Understanding the sex similarities and differences in how organisms respond following exposure to environmental chemicals is important if we are to determine the relative risk of these agents to women and men [16].

## Physical differences

On average, women are shorter than men, have softer and less oily skin, have less body hair than men and have a smaller waist-hip ratio.

An important difference is that usually women have a higher body fat percentage than men [17]; this has been associated with a larger storage of lipophilic chemicals.

Female fertility declines after the age of 35, unlike men who are able to father children into old age. Women and men have different levels of certain hormones. Women have higher concentrations of oestrogens while men have higher concentrations of androgens. Girls begin puberty approximately two years before boys and finish their fertile life with menopause. Women have lower blood pressure than men, although their hearts beat faster [18].

Obviously the reproductive system is the biggest difference: women get pregnant, deliver children, lactate, menstruate and go through menopause.

### Menstruation

Menstruation occurs in healthy women on a monthly basis. It begins with the menarche in puberty and goes on until the end of the reproductive years, or menopause. The onset of menarche occurs on an average at 12 years of age, normally between eight and 16 years old.

Exposure to certain chemicals has been linked to an earlier menarche, as well as an earlier onset of puberty [19] [20] [21]. The estrus cycle in animals has also shown to be affected [22].

Menstruation can be painful, particularly on the first days of each cycle where women may take painkillers to reduce the sensation of pain and bloating that comes with it, exposing themselves to chemicals. They would also need to use protection during the days they are menstruating, in the form of sanitary pads, or tampons. These usually are white and have been bleached, exposing women to chemicals through intimate contact with their internal genitalia [23].

### Pregnancy

During pregnancy, certain synthetic chemicals stored in a woman's body fat have the ability to cross the placenta where they have the potential to cause birth defects or other more subtle damage to development of the foetus [24] [25] [26] [27] [28].

### Lactation

Chemical residues that have accumulated in a woman's body over her life-time and stored in fat may

be mobilised and enter breast milk. This is a special concern for women and a rising cause for concern as breast milk monitoring and analysis is an increasingly common method to monitor the body burden of persistent contaminants. At least 60% of the fat in breast milk is drawn from fat reserves in the mother's body, only 30% comes from her daily diet, and 10% is manufactured on the spot within the breast itself. So, protection to clean up breast milk needs to start before puberty [29]. It seems it is never too early to take care of the girls and boys of future generations.

### Hormones

Neuro-endocrinology and reproductive endocrinology, which explore the functional relationships between hormones and the brain and the effects of those interactions on the functioning of other organs and on behaviours, have become influential in science over the past decade. The part of the brain primarily involved in the regulation of the endocrine system is the hypothalamus, which is situated in the middle of the base of the brain and connected functionally with the pituitary gland. This is the body's principal endocrine organ, regulating by its hormones the hormonal output from the other endocrine glands in the body, including ovaries, testes, thyroid, breast and adrenals. Women have specific regulation of the ovaries, the hypothalamus secretes hormone-releasing factor (LH-RF), which stimulates the release of follicle stimulating hormone (FSH) and luteinizing hormone (LH) respectively from the anterior pituitary. By the end of the cycle, the levels of FSH and LH have fallen so low, as a result of the suppressive effects of oestrogen and progesterone on the hypothalamus or pituitary, that they no longer sustain ovarian production of oestrogen or progesterone.

Males too have FSH-RF and LH-RF production by the hypothalamus and FSH and LH production by the pituitary, all of which regulate the production of androgens by the testes. The ovaries, testes, and adrenal glands all produce progestins, androgens, and oestrogens, though in different relative quantities in females and males of all species. The main difference between female and males is that the secretion of the hypothalamic and pituitary hormones is considered to be constant in males rather than cyclic [30].

### Menopause

Menopause in women occurs when the ovaries stop producing oestrogens, causing the reproductive system to slow down until it gradually stops. The body needs to adapt to the natural difference in hormone levels: hot flushes and palpitations can be present and women feel diverse psychological symptoms [31]. There is a move towards the medicalisation of the menopause which once again exposes women to chemicals in the form of HRT.

## Biological differences

Historically, beyond the reproductive system, the research community has assumed that there are no other significant differences between women and men. However, there is scientific evidence that there are abundant differences throughout the life span of women and men [32] [33].

The increase in information during these past decades has given rise to the awareness of how much women and men are different. Many normal physiological functions as well as pathological ones are influenced either directly or indirectly by biological sex-based differences. Health is highly influenced by the individual anatomy and physiology that results from having two X-chromosomes (XX) or a X and a Y-chromosomes (XY).

There are multiple differences in the basic cellular biochemistries of women and men that can affect their health, where genetic differences can be the main cause of these differences.

In the prenatal period, sex determination and differentiation occur in a series of sequential processes governed by genetic and environmental factors. During the pre-pubertal period, behavioural and hormonal changes manifest the secondary characteristics that reinforce the sexual identity through the individual's adolescence and into adulthood. The action of hormones during development lays a framework for biological differences that persist all through life, contributing to the diverse progression and onset of disease in females and males [34].

John Peterson Myers suggests we need to take a new approach to disease since we now know that some contaminants can alter gene behaviour at extremely low dose and high dose experiments don't predict these low dose impacts. Adult diseases and sensitivities to subsequent exposures can be programmed during development in the womb. The old premise is that a disease is linked to genes under hereditary control whereas the new theory is that a disease linked to genes is one vulnerable to environmental causes [35].

Women and men have different patterns of disease as well as different life spans. Men die younger but women are sick more frequently, differences that might lead us to ask how are these biological differences determined?

Scientific literature is abundant on gender research trying to understand differences that can improve the way diseases are treated and most importantly prevented. Some examples are presented below.

A study in Spain reported that men died younger than women (76.6 +/- 10.3 versus 82.3 +/- 8.0 p < 0.002)

and that they had more frequent antecedents of chronic bronchopulmonary disease (43% versus 19%,  $p < 0.04$ ) [36]. In Japan, research to detect gender differences in association with cardiovascular risk factors found a significant sex-specific difference in the correlation between triglycerides (TG) and rank transformation of high-sensitivity C-reactive protein (CRP), even after adjustment for age; this suggests that the existence of 1 additional risk factor may increase the risk of cardiovascular disease more steeply in women than in men ( $P < 0.01$ ) [37]. In this same field, the American Heart Association followed research to support the measurement of C-reactive protein (CRP). Results showed that women had higher median CRP levels compared with men: 2.56 vs 1.43 mg/L,  $P < .0001$ ). Even after excluding women using oestrogen and those with CRP > 10 mg/L women still had higher levels than men (1.85 vs 1.33 mg/L,  $P < .0001$ ). Researchers concluded that CRP in women was higher compared with men despite Body Mass Index and other confounders. This difference was maintained across all ethnic subgroups, suggesting the benefit of considering the evaluation of gender-specific CRP cut points to determine cardiovascular risk [38].

Regarding the outcome of the presence of melanomas, male patients have a worse outcome than females. To understand the reasons a multi-institutional study was carried out with a total of 3,324 patients aged 18 to 70 years with melanomas bigger or equal to 1.0 mm (Breslow thickness). Results on univariate analyses, found that men ( $n = 1,906$ ) were more frequently older than 60 years in comparison with women ( $P < 0.0001$ ), men have thicker melanomas ( $P < 0.0001$ ), primary tumour regression ( $P = 0.0054$ ), axial primary tumour location ( $P < 0.0001$ ), and ulceration ( $P < 0.0001$ ); the study concluded that men have a greater incidence of adverse primary tumour characteristics and worse survival prognosis, but a decreased risk for nodal metastasis [39].

Airway development is different between sexes, being slower in males compared with growth of lung volume [40] [41]. In females there is a proportionate growth of airways to lung volume and a resulting larger airflow rates at fixed area of total lung capacity. Boys have lesser expiratory air flow rates at all comparable lung volumes [42]. During childhood boys have more non-specific bronchial hyper responsiveness (BHR) in comparison to girls [43]. However, adult women have more BHR, even when considering gender differences in baseline expiratory volume in one second (FEV1) [44]. Young males have higher skin reactivity to inhalant allergens; even when the reactivity may remain for some time it has been seen to reverse in later adult life [45]. Boys have higher prevalence of reported hay fever before puberty, but prevalence is higher in women during adolescence [46]. However, girls have greater reported eczema prevalence during early childhood, which keeps

increasing with time.

Women's diseases tend to appear at certain times in a woman's life. For example, endometriosis affects women during their childbearing years while osteoporosis is largely a disease of postmenopausal women. More research is needed to find out what changes occur in a woman's body over time that may make her either more or less susceptible to particular diseases as she ages [47].

During recent decades reproductive disorders have become prominent issues. The male reproductive system is vulnerable to the effects of chemicals, possibly being affected during spermatogenesis or from pre birth exposures [48]. The female reproductive system is also vulnerable to persistent chemicals, however there is less data on women's reproductive impairment. This may be because male reproductive endpoints can be studied easier than females'.

Reproductive hazards to females are difficult to identify at an early stage, as it is only when exposed women are interested in childbirth that they begin to find they have problems. Infertility has increased in industrialised countries from 8% to 15% over the past twenty years [8].

Reproductive organ malformations and defects in their offspring have enormous emotional and practical implications, not only for those affected directly but also for their families and society.

Effects are diverse and multiple, including different bodily systems, and can appear at different stages during the lifespan of a woman, from spontaneous abortions [49] [50] [51], congenital malformations and prematurity [52] [53] [54], low birth weight and low IQ to breast, ovarian, endometrial cancers, neurodegenerative disease like Alzheimer disease, diseases of the reproductive system [55] due to disruption of the ovarian function [56], endometriosis [57] [58] and female endocrine system dysfunction within infertility [59] [9].

## Social differences

Historically, societies have prescribed women and men certain roles (such as being masculine and tough or feminine and in need of protection); these can develop within the private sphere of the household as well as public life. Women and men are being exposed differently to environmental factors depending on their activities and the amount of time each spends in their given roles. Traditionally, in most societies, women have been involved in more domestic activities including childcare and care of other dependants. Exposure to chemicals and substances can take place at work, in the home, garden and leisure and in the wider environment [60]. In the developing world, these tasks are increased by growing food for the household, collecting water and sometimes firewood.

All of these activities are indicative of how the environment is cared for or depleted of its natural resources [61]. However, in modern times these traditional roles are changing so our exposures are likely to change too.

The impact of environmental degradation is felt more deeply by women who have to interact with their environment for survival. Women who depend upon the environment for sustenance for themselves and their family may, due to environmental degradation, have less food which impacts on women's health. In the same way, when the workload of these women increases, girl children will be required to take some of the extra workload and thereby be prevented from attending school. A study has recently showed that in India, girls were the first to be pulled out of school [62]. This is one of the situations that would impact on women's potential to be assertive and make decisions. It is not the purpose of this document to point to all the different situations depending on different socio-economic classes but it is important to notice that women from lowest classes will receive increased impacts.

### Age and socio-economic status

In an effort to determine what makes some individuals more environmentally conscious than others, socio-political literature has examined the capacity of various factors such as age, gender, economic class, education, religion and region. These measurements of social bases of environmental concern are useful due to their policy implications. Age has been shown to be one of the strongest and most consistent predictors of environmental concern [63].

Malkis and Grasmick's theory of cohort differences says that younger cohorts would be more committed to environmental improvement due to their continued exposure to alarming information on environmental decline and living through environmental disasters

in their formative and impressionable years. It says this would result in a generation committed to environmental issues, whose ecological mind would not disappear as they moved into adulthood [64]. In general, there seems to be an agreement that there has been some sort of generational change in influencing perspectives towards the environment as we receive more frequent news on endangered species, climate change and increased risks for the future.

Other studies have found that public attitudes regarding the environment are influenced by age, education and income [65], showing that highly educated people are more aware of environmental problems. Results from a 1993 American survey, showed that women and men of higher social status, with more knowledge and trust in science, are more likely to engage in pro-environmental action [66]. Additionally, Maslow's theory of hierarchy of needs proposes that the upper and middle classes with solved basic material needs are free to focus on the more creative side of human existence. Even when education is more positively associated with environmental concern, the relationship between income and environmental support is more mixed [67].

The proximity of an environmental health risk and dramatic events such as the Bhopal gas leak, the Exxon Valdez oil spill or Love Canal (toxic waste disposal site on which homes were built) are also factors that can play a dominant role in stimulating concern for environmental issues as well as a general increase in public awareness about the environment [68] [69] [70].

'Feminist consciousness' has been defined as 'an awareness of and sensitivity to the unequal and gendered nature of society and a commitment to ending the inequalities' [71]. It has been found also that feminist consciousness was mostly found in those who were young, college educated, professionally employed, with high income, urban, liberal, and those showing less religiosity. Reingold and Foust showed in the USA that ideological beliefs of both women and men were rooted in their feminist consciousness [72]. A feminist or somebody sympathetic to feminist concerns, regardless of the gender of the person, is better able to understand both domination of women and the exploitation of natural resources [72]. As will be shown below, it is not being a woman in and of itself that leads to environmental concern or action. Although there are social differences between men and women there does not appear to be a gender difference in environmental awareness, only a difference in those who have or do not have a 'feminist consciousness'.

There is a general perception that women play a predominant role in activities relating to natural

resources and that the degradation of these resources in turn has a disproportionate effect on women.

Another line of thought supports women's special consciousness of ecological issues which supposedly makes them better managers of natural resources. However, there is a vast diversity among women, between rural and urban women, as well as between different classes of women, which prevents all women being grouped together. Women's consciousness of the environment and therefore their conservative approach is not something inherent, arising out of their being women as is often publicised, but it is rooted in their roles and work tasks, which lead them to interact extensively with natural resources for survival [62].

In 2002 M. Gupte [63] studied the relationship between gender and the environment using the concept of feminist consciousness to understand what role gender plays in influencing support on environmental issues in America. Her study constructed an alternate model that examined whether feminist consciousness, along with other socio-demographic factors such as age, education, income, race, ideology, and party identification, can explain support for the environment. The importance of this study is that it incorporates not only the gender differences in explaining support for the environment but also feminist consciousness to determine public opinion regarding the environment. Gupte's study argues that even when women may seem to be more concerned about the environment, this is not only based on their gender.

It can be seen that men express more support for the environment while protesting and taking part in environmental rallies, while women may emphasise other actions like green shopping and recycling [73]. Similarly, not all women will be equally concerned about the environment. However, age, education, income, and ideology will mediate support for the environment. Thus, men and women who have a liberal orientation and belong to the same age and class may show similar patterns of support for the environment. Given this premise, it is necessary to construct a testable alternative model to explain the relationship between gender and environment.

Gupte took a sample of 1,714 subjects from the 1996 National Election Studies data set, where 768 (44.80%) were male respondents and 946 (55.19%) were women. Four statements were used to monitor respondents' support for environmental policies: Spending on the environment; efforts to protect the environment; environmental regulation; and protecting jobs versus the environment. Coding was correlated with level of support, where lower scores meant lower support. To assess the extent of variation in environmental attitudes, analysis included: gender, age, education, income, party identification, political ideology, race and feminist

consciousness to measure support for women's rights, which was measured on a scale where 1 = a woman's place is in the home and 7 = women and men should have equal rights.

Results showed a statistically significant positive association between age, political ideology, party identification and support for the environment. However, income and education were negatively associated as were gender and race, confirming that gender does not play a significant role in determining support for the environment. Respondents who held feminist beliefs showed support for policies for protecting the environment, showing that feminist consciousness was statistically significant in this association (0.01 level). Thus, variation in environmental attitudes is positively related to younger age, liberal political ideology, identification with the Democratic Party, and feminist beliefs.

This research also found that citizens who show feminist consciousness, irrespective of their gender, were more supportive of the environment than people who believed that a woman's place was at home. Some previous studies have showed conflicting results, where the driving force behind gender differences in environmental surveys is not necessarily differences in ecological sensibilities but rather differences in perceived vulnerability to risks from the environment [74].

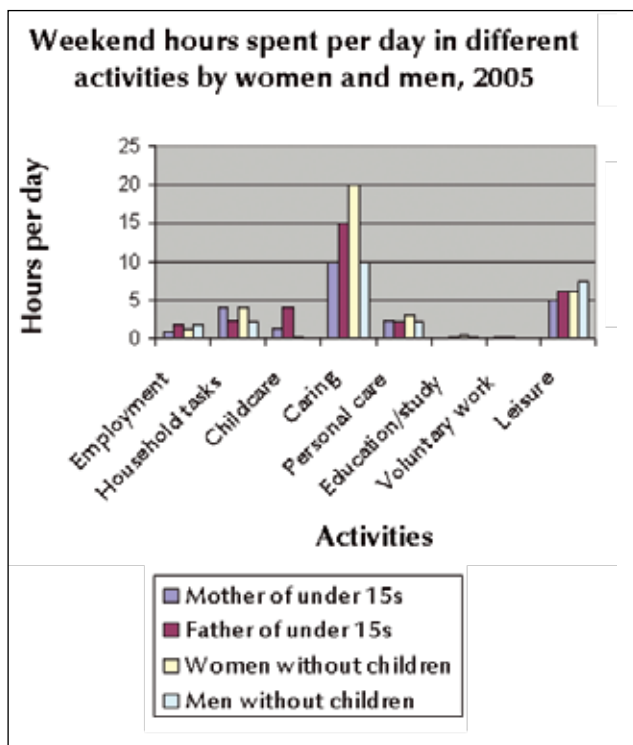
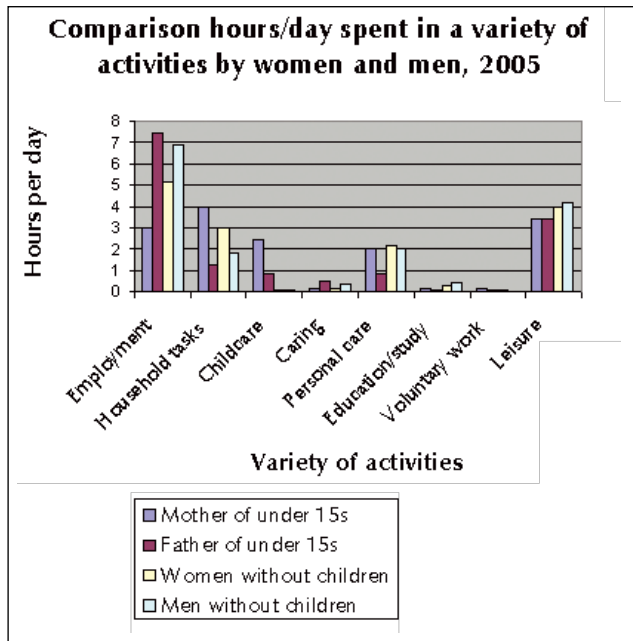
The possibility is that gender may not have a direct broad effect, but a more subtle one mediated by effects of race, class, and ideology. Thus, as the results of this study have shown, it is not biological determinism per se that determines support for the environment, other factors also shape feminist consciousness (which in this context can be understood as identification with women's rights). Irrespective of one's gender, those citizens that exhibit feminist consciousness are more likely to support the environment. Perhaps holding feminist beliefs is likely to sensitise men to environmental concerns like the exploitation of resources. It could also be assumed that those who are more liberal in their outlook are more likely to support feminist beliefs and support environmental concerns. These results from an American survey could be different from others from different parts of the world, in particular of developing countries where rural women more than men interact more with nature on a daily basis, when they go out to collect water, fuel-wood and fodder.

### **Division of work**

Traditionally, in their role as mothers, carers and domestic workers, women have been associated with the private sphere of the home whereas men have been associated with the public one. There is an intermediate area which overlaps the private and public spheres, that incorporates the community and neighbours, and

leisure activities. This area has been seen as a physical extension of the family or household and is generally an area in which women can be more active [61]. Figure 2 shows the average time spent on a variety of activities by men and women 2005 [75]

**Figure 2. Comparison hours/day spent in a variety of activities by women and men, 2005 [75].**



## Routes of exposure to chemicals

### 1- Exposure through employment

In the same way that women and men perform different roles in the household, they may also take different roles in the public sphere. Outside the home, most activities are controlled by paid work but also include unpaid work in the community and political activities. It has been mentioned how particular valued activities are financially rewarded [76] and that in a capitalist society, housework and care of dependants are unpaid and tend to be undervalued. Positions that are paid highly are valued highly. It is universal that men dominate in each of the highly esteemed, better paid professions, while women dominate in those sectors where pay and esteem are lowest. There are fewer women than men in individual professions which are paid more and which have senior positions [77]. In our society, earnings and money are directly associated with power, which has significant consequences.

Women often choose their jobs to be closer to home so that they can maintain contact with their children during the day or at the end of their working time; therefore, lower percentages of women work full-time. In 2005 in Great Britain, only 58 percent of women worked full-time in comparison with 91 percent of men. Fewer than three-fifths (58 percent) of full-time workers were women, and over four-fifths (81 percent) were working in part-time jobs [78]. In the UK, women earn 78.8 percent of a man's average weekly wage (£371.8) compared to (£471.5) in full time paid work [75].

Women are entering a different workforce era, sharing jobs which had previously been occupied only by men, like working in pesticide factories [7]. However, women who may be exposed to the same substances in the same working environments as men may develop different responses. For example, while men exposed to pesticides like DDT have been reported to have an increase in testicular cancer [79] reduction in sperm concentration and infertility [48], atrophy of the seminiferous epithelium, testicular dysfunction [80], Cryptorchidism and hypospadias [81] high levels of serum LH and FSH and reduced sperm count [82] [83], epidemiological studies have also shown that women's exposure to pesticides is associated with an increase in menstrual cycle disturbances [84], reduced fertility [7], prolonged time to pregnancy [85] [86], spontaneous abortion [87] [54] stillbirths and developmental effects [88].

If we work in an office, we may be exposed to any of the chemicals listed in Table 1 below, which are present in the products listed in the first column as sources.

**Table 1. Office equipment emitting toxic chemicals**

Sources	Known toxic chemical contaminants	Health effects from source
Carbonless copy paper	Chlorobiphenyl, Cyclohexane, Dibutylphthalate, Formaldehyde and Paratoluene sulfinate.	Mucous membrane irritation, skin rashes, headaches, fatigue and memory loss.
Computers and video display terminals	n-Butanol, 2-Butoxyethanol, Butyl 2-methylpropyl phthalate, Ethylbenzene, 4-Hydroxy Benzaldehyde, 3-Methylene-2-Pentanone, 2-Methylene-2-propenoic Acid, Ozone, Phenol, Toluene and Xylene. Thiourea	Vision impairment. Headaches and musculoskeletal symptoms.
Copy machines	Ethanol, Methanol, Methyl Alcohol, 1,1,1- Trichloroethane and Trichloroethylene.	Dizziness, nausea. Vomiting, eye irritation eyes and blurred or temporary loss of vision.
Photocopiers related supplies	Ammonia, Benzaldehyde, Benzene, Butyl Methacrylate, Carbon Black, Cyclotrisiloxane, Ethylbenzene, Isopropanal, Methylmethacrylate, Nonanal, Ozone, Styrene, Terpene, Toluene, 1,1,1-Trichloroethane, Trichloroethylene, Xylenes and Zinc.	If unventilated, ozone will cause irritation to mucous membranes, headaches and vision impairment.

Source: Bradford Brooks & William Davis, *Understanding Indoor Air Quality*, 1992, Occupational Safety and Health Administration. Ronald Turner, Bruce Lippy, and CIH Aerosol Monitoring and Analysis, Inc., *Guidelines For Controlling Indoor Air Quality Problems Associated With Kilns, Copiers, and Welding In Schools*, Maryland State Department of Education, February, 1991.

If we work or study in a science laboratory, chemicals presented in Table 2 are some of the most common we can be exposed to.

**Table 2. Toxic chemicals in science laboratories**

Toxic Chemicals	Carcinogens	Corrosives and reactives
Ammonium Metavanadate	Aniline	Bromine
Brucine Sulfate	Arsenic	Hydrofluoric Acid
Thiourea	Benzene	Osmium compounds
Colchicine	Carbon Tetrachloride	Titanium Tetrachloride
Lead compounds	Chloroform	
Leaking or improperly stored gas cylinders	Formaldehyde	
Mercury and Mercury compounds	Lead Acetate	
Potassium, Silver and Sodium Cyanide		
Sodium Azide		
Thioacetamide		

## 2 - Exposure through household tasks

Due to the division of work in the household, women and men are exposed differently to particular chemicals. The role of women as prime carers of dependants and as the main providers of cooking, cleaning, laundry and food collection services is surprisingly persistent and universal across cultures [61].

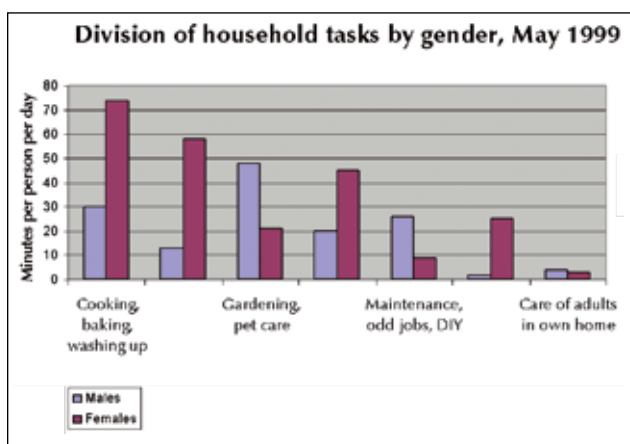
This division of tasks is more accentuated in non-Western households where women are more likely to prepare meals for the family and farm-workers and do the laundry, as well as feeding hens and pigs and fetching water. Men have been more likely to be engaged in gardening, milking, agriculture and cattle work.

### Division of household tasks

Frequently, women are not only exposed through the food that they select for the family, but through the plastics in toys, clothes, household goods and flooring, and through flame retardants sprayed on furniture.

Most studies still show that women are more involved in keeping the household organised, even when they are working in a part-time or even full-time occupation. Figure 3 shows how many minutes per day men and women spend in household work; gardening and DIY are the two areas in which men spend more time (they spend marginally more time caring for adults in the household but the difference is insignificant).

**Figure 3. Minutes per day spent doing household tasks by gender [37]**



Women and men who carry out these activities, may be exposed to different chemicals; we will try to include some of the most commonly involved chemicals in each of these areas as well as some of their associated risks.

Every day we consume a great variety of food, which can be a big source of chemicals. Many of these chemicals form an integral component of the food and are important for maintaining biological processes and keep food fresh for longer, preserving shelf-stable foods, or to impart distinctive flavours or colours. Other

synthetic substances are used as veterinary drugs in animals or pesticides and fertilisers. These substances can sometimes remain in the food and need to be assessed and regulated while chemicals from plastic and other packaging can migrate into foods, particularly fatty foods.

Indoor exposure at home can also happen through use of insecticides, carpets and other flooring materials, wallpaper and paints, furniture, electronics with flame retardants, textiles with phthalates; gloves, rain gear, plastic boots, umbrellas; cosmetics and perfumes.

The problem is that, as a consequence of their use in consumer goods, we are constantly exposed to these chemicals and the potential hazards they pose. Little is known about the cumulative or combined exposure to low levels of these potentially harmful chemicals on a daily basis. Toxic ingredients can escape from products during normal use, or through wear and tear over time, contaminating the indoor environment of our homes.

From carpets and curtains to toys and televisions, computers and printers to cosmetics and perfumes, chemical additives and ingredients are a hidden fact of modern life. In many products they are not labeled or an obvious constituent, which does little to inform the consumer.

### Cleaning products

Cleaning agents can contain toxic chemicals due to their need and ability to dissolve substances and evaporate quickly. Typical cleaning products, which are toxic, are ammonia-based cleaners, bleach disinfectants, drain cleaners, floor and furniture polish, scouring powder, rug and upholstery cleaner, toilet cleaners and window cleaners.

**Table 3. Toxic cleaning supplies**

Type of cleaning product	Toxic chemical ingredient	Known health effects
Floor and Furniture Polish	Diethylene Glycol, Nitrobenzene and Petroleum Distillates	Skin discoloration, shallow breathing, vomiting, and death; associated with cancer and birth defects
Window Cleaners. Solvents in a large number of industrial, household and cosmetic applications. EGE can be found in water paints, varnishes, inks, household products.	Glycol ethers: ethylene glycol ethers, propylene glycol ethers. Butyl Cellosive, Diethanolamine (DEA), Ethyl Cellosive, Ethylene Glycol, Kerosene, Methanol, Monoethanolamine, Naphtha, Propylene Glycol, Stoddard Solvent, Toluene and Xylene	Disorders of the nervous system, bone marrow, immune system, kidneys as well as fertility, reproduction and embryofetal development. Several EGE are mutagenic. The carcinogenic risk is not known. The most toxic derivatives EGME, EGMEA, EGEE and EGEEA alter male and female fertility, and induce malformations
Rug and Upholstery	Diethylene Glycol, Oxalic Acid Naphthalene, Perchloroethylene	An irritant and causes burns. Contact dermatitis, allergen. Possible human carcinogen. Carcinogenic to humans.
Toilet Cleaner	Calcium Hypochlorite, Muriatic Acid and Oxalic Acid	An irritant and causes burns. Strong poison when taken internally. Conjunctivitis, corneal damage; gangrenous ulcerations of skin. Inhalation: Irritation of respiratory tract; ulceration of mucous membranes, epistaxis, headache, nausea, vomiting, muscular irritability, weakness, albuminuria. Swallowing: Burning & corrosion of the mouth, esophagus, stomach; nausea & vomiting with hematemesis; abdominal pain, diarrhea, bloody stool, numbness & tingling of fingers & toes; muscular irritability, tetany, convulsions; shock, oliguria, anuria, hematuria, albuminuria; cardiac irregularities & circulatory collapse.
Disinfectants, sometimes used as preservatives for food, drugs, and other domestic and industrial products	Alkylphenols like glutaraldehyde, formaldehyde, sodium bisulfite, chloramine T, hexachlorophene, chlorhexidine, benzalkonium chloride, isononanoyl oxybenzene sulfonate, lauryl dimethyl benzyl ammonium chloride, and isothiazolinones. Cresol, phenol	Rapid absorption and severe systemic toxicity can occur after any route of exposure including skin. Death and severe toxicity are usually due to effects on the CNS, heart, blood vessels, lung, and kidneys. Effects from acute exposure may include: shock, delirium, coma, pulmonary distress, phenolic breath, scanty/dark urine, and death. Corrosive; can cause diarrhea, fainting, dizziness, and kidney and liver damage.
Chlorine bleach	Sodium hypochlorite	From mild asthmatic symptoms to more serious respiratory problems. After ingestion, exam revealed focal necrosis, hemorrhage, superficial erosion of the gastric mucosa, but the cause of death was an acute tracheobronchitis, & obstructive atelectasis.
Metal polishes	Petroleum distillates	short-term exposure can cause temporary eye clouding; longer exposure can damage the nervous system, skin, kidneys, and eyes.
Ammonia based cleaners, glass cleaners.	Ammonia	Hazardous by all routes (ie, dermal, ingestion, inhalation), with the liquid capable of burning the skin, causing permanent eye damage, or corroding the digestive tract upon contact; and the gas capable of causing severe eye damage, pulmonary edema, and even death from spasm, inflammation, and edema of the larynx.

### 3 - Exposure through childcare and caring for others

Women who stay at home caring for their children can also be exposed to toxic chemicals. Some of these chemicals may come from outside sources, like lead from pollution, others may come from their deliberate use, like cleaners, disinfectants and insecticides. By staying at home, women are exposed to chemicals such as brominated flame retardants from curtains, cushions and other household furniture.

A study conducted for the Healthy Flooring Network tested flooring samples of carpet and PVC linoleum and found in their analyses of samples of new carpet high levels of organotins, in particular TBT (up to 47,500 ppb). One sample contained high levels (1600 ppb) of 2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether (BDE-209), a brominated flame retardant chemical. Three samples had significant levels of permethrin (up to 78 ppb), a pesticide used against dust mites which has shown neurotoxic effects in animal studies. Five of the samples contained low levels of the carcinogen formaldehyde. Phthalate plasticisers like Diisononyl phthalate (DINP) were found in PVC flooring samples at levels ranging from 4.7 to 15.8% by weight and butyl benzyl phthalate (BBP) was present at levels between 1.6 to 5.0%. The presence and quantity of DINP and BBP in PVC flooring is of concern given the potential for human exposure in the indoor environment and their potential toxicity [89].

When a carpet is installed, toxic fumes can be released. There are over 120 different toxic chemicals which may be emitted by carpeting [90, 91]. A study conducted by Anderson Laboratories in 1992 found mice exposed to toxic emissions from various carpets sustained neurological problems and soon died from the exposure [92]. Carpets may continue to emit fumes for several months [93].

Phthalates are also used as softeners in flexible vinyl toys, to which both children and mothers are exposed and which are known to be toxic in the development of mammals' reproductive systems. Phthalates have typically been used as softeners in soft PVC toys and childcare articles. Health concerns have existed for a number of years about a large variety of materials that contain phthalates. The list includes treated wood, polymers, coated metals, textiles and [synthetic] rubber. A large number of toys are made with phthalates like bath toys, activity toys, books, action figures and dolls, vehicles, games, puzzles and ride-on toys.

Exposure to lead may occur when a house has been decorated with lead paint or while stripping old paint. The household may also have unhealthy flooring and carpets which gather dust. Other hazardous chemicals may include: immunotoxic organotin compound used to stabilise PVC or to kill dust-mites or mould;

brominated flame retardants used as fire retardants in furniture and electronic goods - decabromodiphenyl ether (deca-BDE or BDE-209, at 3.8 to 19.9 ppm) being the most abundant, used widely to flame-proof plastics and textiles. [94]; chlorinated paraffin which is used in plastics, paints and rubbers and has been found to be carcinogenic.

### 4 - Exposure through personal care

Cosmetics may have ingredients that can penetrate the skin. There are evidence-based concerns that some ingredients may have long-term or delayed effects on the functions of the body. Some of these ingredients and the concerns about them are listed below. Cosmetics are covered by European regulations (The European Cosmetics Directive 76/768/EEC) and many harmful ingredients are banned from use in cosmetics. However, some ingredients of concern are still permitted to be used (in some cases in controlled amounts).

One example is the group of substances known as parabens, which evidence suggests may disrupt normal oestrogenic activity in the body. Although parabens [95, 96] are mentioned on product labels and we could potentially choose the products we want to buy and use on the basis of their ingredients, most women do not have enough information on how these ingredients act to make informed decisions about whether they wish to avoid them. Even when they are informed about what is known about these ingredients they see much more publicity from different cosmetic brands which advertise the intended positive properties of the products that contain them, such as the promise that they will reduce the appearance of wrinkles, make hair shinier or make us smell more attractive. A common assumption is that if its on sale it must be safe. The pressure to use these products from the industry and society at large fuels the belief that we need to be beautiful and young in order to succeed as women [97]. The cosmetics industry spends millions of pounds advertising and promoting its products [98, 99] and the power of advertising has been well studied and documented.

Society and fashion has determined that slim people are attractive. Women are more likely to diet than men, particularly after a pregnancy or having delivered a baby when their weight increases and their levels of exercise decrease. When anyone changes their dietary intake very suddenly and loses weight quickly, they may release pollutants accumulated in their fat into their blood stream; this release can give rise to higher levels of toxins circulating in the liver, brain and other organs.

For women and increasingly, men, cosmetics are an important health and environmental issue. More and more products on the market may contain ingredients which can impair fertility, increase the effects of aging, disrupt hormones and are linked to cancer, allergies

or other health problems. The products and their packaging are often made of petrochemicals and carry a raft of environmental implications. A list of some toxic chemicals, concerns and used names follows.

**'Parabens'** appear frequently as preservatives in cosmetic products, pharmaceuticals, and in food and beverage processing. In vivo and in vitro studies have revealed weak oestrogenic activity of some parabens [95]. Widespread use has raised concerns about the potential human health risks associated with paraben exposure [96].

**'Triclosan'** is an antibacterial agent 'found in deodorants, toothpaste, vaginal washes, clothing, liquid soaps, mouthwashes; triclosan has been found in breast milk and in fish' [100]; during its manufacture and incineration, the by-product 'Dioxin' is released into the environment [101], [102], [103].

**'Toluene'** spontaneous abortion has been linked with women's exposure to toluene [104]; skin irritant; may cause liver damage; narcotic in high concentrations; found in lacquers and nail polish.

**'Xylene'** is a skin and respiratory tract irritant, may cause liver damage and is a narcotic in high concentrations [104]

**Para-phenylenediamine (PPD)** is found in dark hair dyes and black henna (used for temporary tattoos) are potential allergens [105, 106].

**'Alkylphenols'** are used in cosmetics, shampoos and other personal care products and have been reported to be toxic, as well as phthalates in perfumes.

Other ingredients of concern include: **Butylated Hydroxytoluene BHT, Propylene glycol, Alpha Hydroxy (AHAS), Sodium Lauryl Sulphate; phthalates;**

In June 2004 WWF took blood samples from 14 Ministers from 13 European Union countries. The blood samples were analysed for a total of 103 different man-made chemicals from seven different chemical families: organochlorine pesticides, polychlorinated biphenyls (PCBs), synthetic musks, perfluorinated chemicals, brominated flame retardants, phthalates and anti-bacterials. 'The Bad Blood Report', results showed that every blood sample had been contaminated with a combination of at least 33 hazardous chemicals and 25 of the same chemicals were found in every individual, with an average of 37 chemicals. The chemical found with the highest concentration was DEHP, a phthalate. A list of the number of chemicals found is below.

### **Bad blood contaminating chemicals**

- 12 Organochlorine pesticides (including DDT, Chlordane, Lindane and HCB)
- 40 PCBs
- 32 Brominated flame retardants (30 PBDEs plus HBCD and TBBP-A)
- 8 Phthalates
- 7 Perfluorinated chemicals
- 2 Synthetic musks
- 2 Anti-bacterials (triclosan and its breakdown product, methyl triclosan)

### **5 - Exposure through education/study**

Chemicals can be found throughout school grounds in pesticides, building materials, school supplies, cleaning products and office equipment. Schools are usually sprayed with pesticides, both outdoors and indoors. Table 4. shows some of the most common pesticides used and their known effects in humans.

**Table 4. Common pesticides and their health effects**

Type of pesticide	Pesticide use	Toxic chemical contaminants	Known health effects of the pesticide
Insecticides	Chemicals designed to kill insects	Acephate, Aldrin, Aspon, Baygon, Bendiocarb, Boric Acid, Carbaryl, Chlordane, Chlorpyrifos, Diazinon, Dichlorovos, Dicofol, Heptachlor, Lindane, Malathion, Methoxychlor, Parathion, Phorate, Piperonyl Butoxide, Safrotin, Sulfuryl Flouride, Trichlorofon and Toxaphene.	Headaches, nausea, rashes, aching joints, disorientation, various forms of cancer.
Fungicides	Chemicals designed to kill molds and fungus	Benomyl, Captan, Chlorthalonil, and Maneb.	Headaches, nausea, rashes, aching joints, disorientation, various forms of cancer.
Herbicides	Chemicals designed to kill unwanted weeds and plants	Alachlor, Atrazine, Benefln, Betasan, Bromacil, Dacthal, Dicamba, Dichloran, Diquat dibromide, Diuron, Endothall, Ferric sulfate, Glyphosate, Metolachlor, Prometon, Sodium metaborate, Simazine and Tebuthiuron.	Headaches, nausea, rashes, aching joints, disorientation, various forms of cancer, soft tissue sarcoma, and non-Hodgkin's lymphoma.

Source: National Coalition Against the Misuse of Pesticides

**Pressed Wood Products**

Cabinets, wall sheathing and furniture in schools are frequently made from pressed wood products such as chipboard and particle board. The wood finishing and glue used in these products is made from urea-formaldehyde which may emit toxic fumes for up to five years [93]. Urea-formaldehyde has been linked to health effects on the eyes and upper respiratory tract and to skin irritation. If these materials are placed in areas of high heat and humidity, off-gassing may occur for the life of the product.

**Paints, Stains and Varnishes**

Paints, stains and varnishes used in schools may off-gas for weeks after application. Most paints dry through the evaporation of solvents. Fumes emitted by paint may affect the occupants of a room if it is not properly vented after application. Although the use of lead in paint is now prohibited, older school buildings may still contain surfaces covered with lead-based paint which is a significant health hazard when ingested [107].

**Cleaning products as mentioned above**

**Curriculum-based school supplies**

Students may be exposed to toxic materials in art classes and science laboratories. Materials that could potentially expose them to ingredients of concern include paints and chemicals used for laboratory experiments. See table 5 below for a list of toxic art supplies. This review does not address whether training and guidance to teachers and controls within schools are adequate to protect children from the risks these materials pose.

**Art Supplies**

Many solvents, metal pigments, mineral dusts, dyes and preservatives used in art classes are toxic. In the US Congress passed the Labeling of Hazardous Art

Materials Act requiring toxic art supplies may be labeled with a warning of the hazardous contents, this law does not preclude a teacher from purchasing toxic art supplies. Rather, it permits the Consumer Product Safety Commission to sue a school which has purchased art materials with a chronic hazard warning label for use in pre-kindergarten through to sixth grade. So c hildren in grades 7–12 may be permitted to use hazardous materials. Recent findings indicate there may be toxic chemical exposure from art supplies which are labelled as non-toxic. Table 5 lists the most toxic art supplies and their known health effects.

**Science Laboratories**

Science laboratories present significant health risks to children in grades 7-12. Laboratories are home to chemicals that may cause harm if not properly stored and if the room is not properly vented. Common toxic compounds found in a lab include inflammable liquids, oxidizing materials and solvents. Table 5 is a partial list of high-risk chemicals found in school laboratories.

**6 - Exposure through voluntary work**

Depending on our field of voluntary work, any or all of the previously mentioned exposures can apply.

**7 - Exposure through leisure**

During our chosen leisure activities, we may also be exposed to chemicals, such as fertilisers and pesticides used in gardening.

As mentioned in the education section, art supplies can be toxic. Table 5 below shows some materials and toxic substances found in art supplies and their known health effects.

**Table 5. Toxic art supplies**

Toxic substance/materials children should avoid handling	Art supply where toxic substance may be found	Known health effects
Solvents, including acetone, benzene, hexane, heptane, xylene, carbon tetrachloride, toluene and turpentine.	Permanent markers, woodstains, spray fixatives, spray adhesives, rubber cement and silkscreen inks.	Brain and nerve damage, irritation of the eyes, nose and throat, irritation to the nervous system and cancer.
Metal pigments, including lead, lead chromate, cadmium, manganese, zinc, arsenic, copper and their compounds.	Artists' acrylics, oil paints, silkscreen inks, ceramic glazes, artist's pastels and metal enamelling glazes.	Lead may cause brain damage and learning disorders;  cadmium has been linked to prostate cancer, lung cancer and kidney damage;  manganese poisoning has been linked to neurological disorders.
Mineral dusts, including silica and asbestos.	Earth clays, artists' pastels, instant papier mache and glazes.	Silica in free crystalline form causes respiratory illness;  Asbestos is a known cause of several cancers, including mesothelioma and lung cancer. It also caused chronic respiratory problems including potentially fatal silicosis..
Preservatives, including formaldehyde and pesticides.	Artists' acrylics, poster paints, silk screen inks, mucilage (a polymer), wheat pastes and plasticine clays.	Formaldehyde can cause eye, nose and throat irritation, coughing, skin rashes, headaches, dizziness, nausea, vomiting, depress the nervous system and is a human carcinogen.

Sources: *Common Hazardous Components Of Art Materials*, VPIRG, and *Toxics in Art Supplies in Washington, DC Area Public Schools*, U.S. Public Interest Research Group, April 1986.

## Impact of chemicals on human health

Health is intimately connected to the environment. Our bodies take in substances from our environment whether in the air we breathe, the food we eat or the water we drink. The food chain biomagnifies the concentrations of chemicals we receive via our food. Although it is very difficult to identify cause and effect for diseases with total certainty, environmental chemicals have been linked to human health changes and conditions. Other factors such as diet and lifestyle have also been identified as contributors to health changes. However, impacts from the environment have until now received less attention than those focused on lifestyle adjustments and individual action. This is most apparent when we look at information on the potential causes of cancer.

Studies have shown adverse reproductive health outcomes among women exposed to pesticides, solvents and organic pollutants [108]; [109], [110], [111]. A special concern for women and their offspring is contamination of breast milk through exposure to chemical compounds being manufactured and used for industrial, agricultural and domestic purposes. In fact, breast milk analysis is an increasingly common method to monitor body burdens of persistent contaminants [112], [113], [114], [115], [116]. For example, DDT in breast milk is reported to be associated with short lactation periods [116], [117]. Lack of or limited breastfeeding is of concern, particularly in poor populations, as it can have an adverse impact on infant health [118], [79]. It can also interfere with the fertility-suppressing effects of breastfeeding and increase a woman's chance of conceiving before she is ready.

Many industrialized countries have seen an increase in the proportion of female births. This has been associated with paternal exposure to persistent organic pollutants [119], [120]. In particular, two accidents where humans have been exposed to high levels of chemicals have attracted public and scientific attention, the Yucheng poisoning [121] and the Seveso accident [122] have both reported changes in the sex ratio.

We continue to use certain chemicals without considering whether they are really safe to use, even when we do not know if they have been properly tested, how they pass through the environment, whether they are bio-accumulative, whether they are transformed or dispersed in our environment nor how they affect living things at different concentrations.

Although emissions of some chemicals of concern have fallen in recent years, many others are still in the environment at high concentrations. Their presence in the environment and concomitant (existing with

something else) levels in humans are prevalent, although the sources of these contemporary-use industrial chemicals are not entirely identified.

### Effects on women through their lifetime

Humans are being exposed to several thousand exogenous chemicals used in industrial processes, developmental activities and also through the food chain [123]. Women's health is an area that is gaining increasing attention with the realisation that women's and men's bodies not only look different, but they also react differently to environmental agents [124].

It is important to have a broader perspective when looking at women's health; such a perspective takes into account not just the primary effects but also the secondary and tertiary effects of a particular exposure. Different diseases may be manifested at different ages during a woman's life and have been linked with exposures at different times. The table below shows the diseases that may be manifested at specific stages in a woman's life.

## Chemical impacts on women's health

**Table 6. Diseases associated with chemical exposures at different stages of women's lives.**

Childhood		Reproductive years	Peri-menopause	Elderly years
<b>Prenatal</b>	<b>Adolescence</b>			<b>Menopause</b>
↓	↓			↓
Congenital defects	Miscarriage			Breast cancer
Prematurity	Infertility			Ovarian cancer
Mortality	Ovarian dysfunction			Autoimmune disease
Low birth weight	Lactational defects			Endometrial cancer
Neural tube defects	Higher abortion rates			
Childhood cancer	Cervical cancer			
Early puberty	Endometriosis	Uterine fibroids		Stroke
Asthma	Migraines			Ischemic heart disease
Low IQ	Premature menopause			Osteoporosis/osteoarthritis
	Early onset breast cancer			Neurodegenerative diseases
	Early onset ovarian cancer			- Alzheimer's disease
	Myalgic encephalopathy			- Cognitive function
	Allergies			
	Eczema			

### Women's Lifespan

## Science

Historically, in Western society women were largely excluded from engaging in scientific research and even the participation of men was largely confined to an elite, due to class and economic constraints. This has helped shape both the knowledge and the way in which science is practised that currently underpins Western society.

Science education in primary schools is a relatively new subject. Before the 1920s little or no science was taught, and only 30 per cent of girls attended school regularly. Teachers had little understanding of scientific methods themselves; in some schools the teaching of science was banned. It wasn't until the middle of the 20th century that some science training became compulsory in education. Boys were given a broader education, as the predominant view was that girls should be educated to be a social asset. However, this view was not shared by women of that time and by the 1980s, they outnumbered men at the British Association for the Advancement of Science meetings.

Before science became compulsory in primary school, it was thought that offering science to girls in secondary schools would increase the interest and participation of women in science, as they would engage in an equal way with boys. However, this did not counter the influence exerted on girls by their upbringing and learned roles from an early age. For change to occur an 'equal opportunities' approach to science teaching is needed, one that acknowledges gender differences and seeks to remove stereotyping and help girls engage in science [11, 125].

The lack of science achievement is not to do primarily with girls' lack of confidence and early socialisation, it seems that the role of teachers and schools in dissuading girls from science is very important, as it may be observed that science is a masculine area [11, 125, 126].

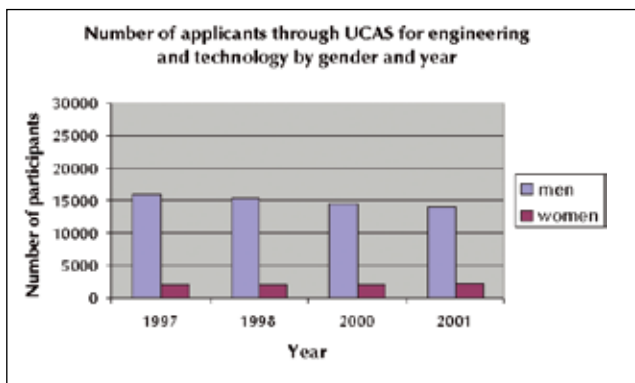
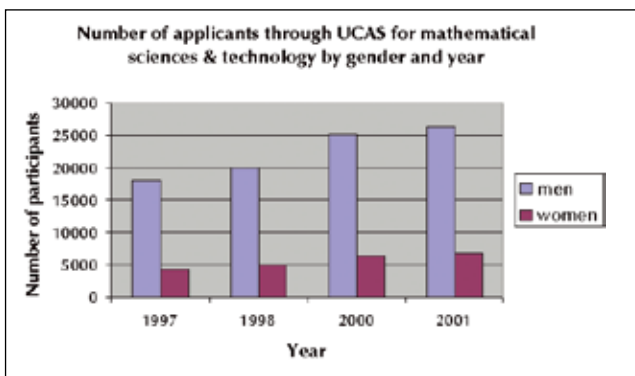
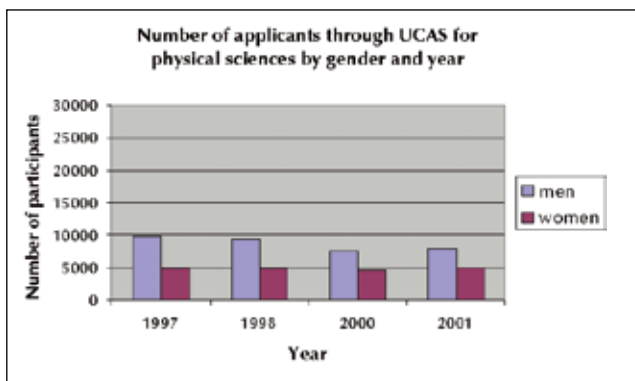
On the other hand, the differentiation of experience bears a relationship to girls' avoidance of mechanical and construction tasks in general and such avoidance leads directly to powerlessness and dependence. The lack of some experiences is significant in terms of vocational aspiration and can eliminate girls from career paths currently awarded status and power in society such as science and engineering [11].

From birth, expectations around us build up our earliest identity of who others perceive us to be. Our decision-making abilities are shaped from our earliest perceptions, experiences, memories, associations, values, beliefs and expectations. These initial experiences will determine how each person

will interact with the world later in life. Although we all have a brain structurally and functionally capable of permitting a nearly limitless variety of behavioural responses, we may be constrained from reaching our full potential and ability to make decisions by the cultures in which we have grown and which have delimited our roles [30].

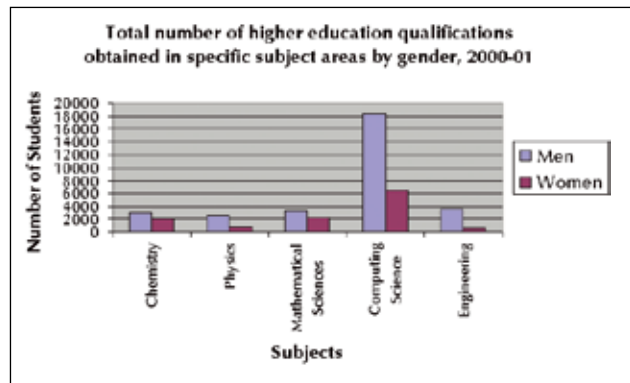
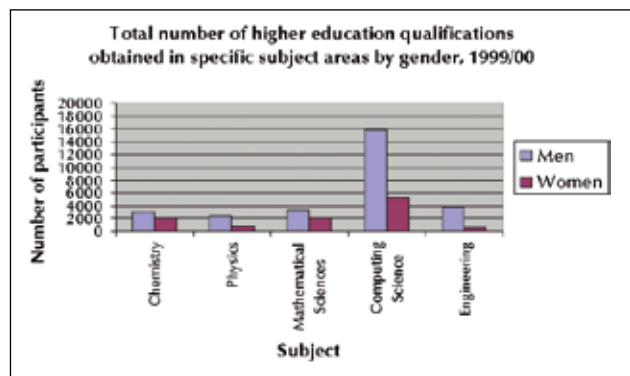
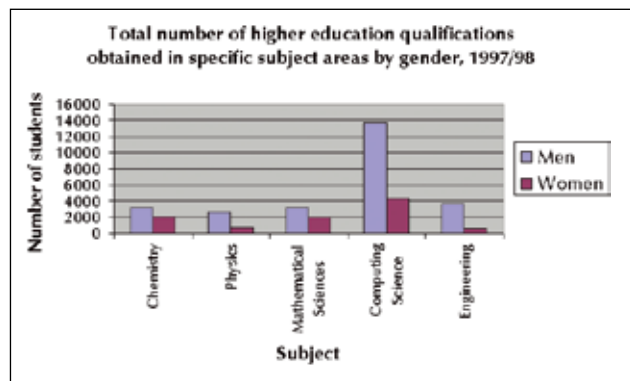
Decision-making for women – particularly involvement in community or societal decision-making - may seem more difficult when in our Western industrialised and scientifically advanced countries, woman's value is defined by her biological ability to bear children. Woman's nature has been defined biologically to be a mother and wife and it may seem that the rest of the social construct of woman 'naturally' follows: nurturing, passive, dependent, weak, intuitive, non-intellectual. Woman's nature is seen to be the given; her roles and functions are the results. Feminist analysis shows the situation is quite the reverse. Patriarchal social orders need and assign rigidly set and subordinate functions or roles for women, which, in turn, require and mould certain characteristics and behaviours. In a social order that requires women to gain and maintain male approval, women become sensitive to clues indicating disapproval and, in general, to others' feelings and thoughts. Women, assigned the care, loving and nurturing of children, develop caring, loving, nurturing 'natures' [61, 74]. Women's predominant roles confine them mostly to the private/domestic rather than public sphere so they have less experience of contributing to public decision-making. This is relevant to the ability of women to be decision-makers, engaged in their communities and to participate with confidence in their knowledge, beliefs and opinions.

Figure 4. Number of applicants through UCAS for specific subjects by gender



[127]

Figure 5. Total number of higher education qualifications obtained in specific subject areas by gender



[128]

# Politics

**Table 7. Women's representation in the UK's governing institutions with latest figures available**

UK Statistics				
	Total no.	No. men	No. women	% women
Europe — European Parliament UK members (2004)	78	58	20	25.6
Westminster - House of Commons	646	520	126	19.5
Westminster - House of Lords	753	611	142	18.9
Westminster Cabinet (May 2006 reshuffle)	23	15	8	34.8
Scotland - Scottish Parliament (2006 data)	129	79	50	38.8
Wales - National Assembly for Wales (2006 data)	60	29	31	51.7
Northern Ireland	108	91	17	15.7

[129].

In the political sphere, women have lower representation and less power than men. Representation follows a pyramidal structure similar to science, where women form 25.6% of the European Parliament and less than 20% of Westminster Houses of Parliament. Table 7 below shows number and percentage of women in several governing institutions.

However, simply increasing the numerical representation of women in politics will not necessarily make a difference to the substantive issues dealt with, or the processes involved. Generally, women entering typically male dominated fields are required to fit into a pre-existing structure and often have to achieve higher goals than men to be considered for promotion [130]. There needs to be a critical mass of women in positions of power to support each other in policy initiatives, to be able to allocate and control resources and be a catalyst for other women to become involved.

## Non governmental organisations

It might be expected that women would have a large role in NGOs, as they are more likely to be involved in grassroots community action. Nevertheless, beyond the grassroots, women are much less prominent. Although women undertake 60-80 per cent of grassroots activity, there are few women in senior positions in environmental NGOs [61].

Women who have been integrated into programmes through NGO groups, usually address their direct needs of income or work reduction, and also gain in confidence, in status and in finding a voice to articulate their concerns, views and problems [62].

The need to involve women into the mainstream of environmental decision making processes, whether community based or those initiated by governments, is essential for programmes to successfully fulfil their

original purpose, ensuring women can actually benefit from them. Involvement should be propagated through local, national and international women's groups.

To address issues of women's integration into programmes, it is essential to first undertake studies on existing programmes and assess their impact on women.

Experiences across the world testify to the importance of collective action in achieving success. It is therefore imperative to strengthen and promote women's groups. NGOs have demonstrated their capacity to provide these groups with the kind of support that is required to create the necessary consciousness amongst the women. Thus, NGO involvement in the promotion of such groups also needs to be financed, supported and strengthened [62].

Several original efforts have been started by NGOs across the country to involve women in decision-making and environmental protection. Not only could other groups gain from their experiences, but these efforts could also contribute to government programmes. It is therefore necessary to disseminate the learning from such experiences extensively and plan ways and funds for networking between NGOs working in similar areas.

## Risk perception

Women's and men's cognitive ability and behaviour are influenced by basic genetic and physiological differences in combination with environmental factors. Therefore, gender identity and behaviour linked with sex differences in the brain should be studied to understand further how women and men perceive risks differently, with expanded investigation of sex differences in brain organisation and function, to better understand the influences and roles of factors that may lead to sex differences [2], [131], [132].

Gender differences in perception and thresholds for reporting symptoms may also influence detection and diagnosis of disease.

There is an argument that women "naturally" care for the environment as an extension of their caring roles, being socialised as mothers and caregivers, more sensitive and nurturing than men. Motherhood has been explained as the reason for women's perceived closer relation to nature. Consequently, women would tend to support environmental issues and causes more than men. This special relationship between environment and women, with the resultant altruistic behaviour of women in the protection and defence of the environment, is a theme often repeated [133].

Different priorities for environmental issues may rise depending on the position of women in society [134]. Environmental thinker Vandana Shiva tends though to regard women from developing countries as a unitary category, declining to differentiate between women by class, race and ethnicity [135].

It has been argued that minority communities, such as Hispanic and African-Americans face environmental hazards differently to white communities, consequently women from these communities may exhibit more concern towards environmental issues. M Gupte's research (see p13) suggests this is not the case, though women in Black and ethnic minority communities, facing multiple discrimination or disadvantage, may well have more negative experience of their environment, and less power to address it, than white middle class men or women who have not been disadvantaged by their background, education or position in society. Cultural understandings, experiences and expectations will certainly affect people's perceptions of risks from environmental sources.

### WEN enquiries

Women do care about the environment, the association with health and how to protect their families. Women try to find reliable information and clarify those doubts that the media raises in them. WEN's website, which contains a wealth of information to help people live

more sustainably, receives 34,000 visitors a month; pages containing information on real nappies, household cleaning and cosmetics are consistently the most popular [136]. In addition, WEN receives on average three enquires per day/820 enquiries per year. The enquiries focus on where women can purchase 'safer products' or services. Information on where to purchase, launder or exchange real nappies is the top issue for callers followed by callers seeking information on green cosmetics, and products for use in the home. Callers never ask what's cheaper only what's 'safer'.

## The role of women in decision-making

Increasingly, international and national agencies are seeking to involve women in environmental programmes, both to use their knowledge as well as to ease the environmental burden they bear. There is an inherent danger in focusing exclusively on women's current roles as this can too easily reinforce perceptions of those roles as 'natural' and work against women trying to break out of this mould. A fine line needs to be drawn between respecting and utilising women's knowledge derived from the roles they have played and consigning them forever to these roles.

Demographic and health surveys give direct sources of information on household decision-making dynamics. These have shown enormous gender gaps. In 20 out of 30 developing countries, less than 50% of women participate in all household decisions, including those regarding their own health care, major purchases, daily spending and their visits with family or relatives outside of the house. Decisions on daily household expenditure impact on the well-being and education of children. In particular of girls whose likelihood of attending school will increase directly with her mother's empowerment of household decision-making [137].

In most societies there are indications regarding gender roles. From laws to traditions, society often directs certain career choices and lifestyles as appropriate for men, as well as other career choices and lifestyles appropriate for women. In recent years, many have strongly challenged the social forces that would prevent people from taking on non-traditional gender roles, such as women pursuing careers in chemistry or men becoming house workers.

From the top levels of government to local councils and industry, women are the minority in terms of positions of power and influence. For example there are 12 women directors in the top FTSE 100 companies and there is one woman in the G8 group of World leaders, German Chancellor, Angela Merkel. Such ratios prevail throughout the media and other institutions, which can contribute to a feeling of powerlessness among women. Women can feel that decisions are being made which impact on them but over which they have no control [138-141]. Research by the Fawcett Society in 2005 found the corridors of power were still closed to Black and ethnic minority women, at every level of society [140].

In 2005 the UN celebrated women as custodians of the environment and highlighted the environment's role in delivering gender equality [142]. Given that women only own 2% of the world's land and the majority of the 1.5 billion people living on one dollar a day or less are women. [143], this custodianship adds nothing but yet

more work to women's existing roles as carers, workers in the home and in paid employment.

Geneva, Switzerland, 7 October 2004 – An exclusive analysis of the Gallup International Voice of the People survey for the World Economic Forum in 2004 [77] showed women were more pessimistic than men about the state of security and prosperity in the world. More than 43,000 citizens in 50+ countries across the globe were interviewed in the survey – representing the views of almost 1.2 billion citizens (more than 575 million women and 540 million men).

A press release announcing the results said: "Despite huge strides in recent decades towards full equality for women, it is still true that most governments and much of the global infrastructure are still run by men. Assessing this global environment, women see the world as less secure and less prosperous than do men. They also see little cause for optimism about the future."

# Legislation

## Chemical safety

Regulations on chemical safety have proliferated with the intention of protecting the health of humans and the environment. As a major producer of chemicals the European Union is increasingly becoming a global leader on environmental policy. Currently Europe supplies 29% of the world's chemicals, second to USA. Europe is also a market with 493 million people in 27 countries.

### International

- The Strategic Approach for International Chemicals Management: SAICM.
- Stockholm Convention on Persistent Organic Pollutants (POPs).
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.
- Montreal Protocol on Substances that Deplete the Ozone Layer.
- 1992 OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic.

### European Union

#### Current EU regulations covering chemicals

- Existing Substances (Regulation 793/93/EEC).
- New Substances (Directive 92/32/EEC).
- Marketing and Use Directive (76/769/EEC).
- The Controls on Dangerous Substances and Preparations Regulations 2006.
- Classification and Labelling of Substances (Directive 92/32/EEC).
- UN Economic Commission for Europe (UNECE) Convention on Long Range Transboundary Air Pollution.
- ÅARHUS convention.
- Strategic Approach for Chemicals Management: SCALE.
- Children's Environment and Health Action Plan for Europe (CEHAPE).

#### Future EU regulations

- Registration, Evaluation & Authorisation of Chemicals: REACH.

### Health and Safety [UK]

- The Chemicals (Hazard Information and Packaging for Supply) Regulations 2005, CHIP 3.1.

- Health and Safety at Work etc Act 1974 - Section 3: Enforcement.
- Control of Substances Hazardous to Health Regulations (COSHH).

### Pesticides

- The Control of Pesticides Regulations 1(COPR) 986
- The Food and Environment Protection Act
- Plant Protection Products Regulations (PPPR).

### Gender Equality

#### UK legislation

- Equal Pay Act 1970
- Sex Discrimination Act 1975
- Employment Protection Act 1975
- Employment Acts (various)
- Human Rights Act 1998
- Gender Equality Duty (enters into force, April 2007)

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