

GENETICALLY MODIFIED ORGANISM TAXES AS A POSSIBLE SOLUTION TO NUTRITION-RELATED DISEASES: AN EXPLORATIVE STUDY

by

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ABSTRACT

GENETICALLY MODIFIED ORGANISM TAXES AS A POSSIBLE SOLUTION TO NUTRITION-RELATED DISEASES: AN EXPLORATIVE STUDY

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Nutrition-related diseases in South Africa are predicted to rise at an unprecedented rate in the next two decades. There is therefore a need for a solution. Food taxes are seen by many as a possible solution to nutrition-related diseases caused by the high consumption of unhealthy food. A number of foreign countries have implemented food taxes to curb consumption of unhealthy food. The South African government has shown willingness to use regulatory policy to improve public health.

There has been little research on genetically modified organism (GMO) taxes as a solution to discourage people from consuming unhealthy food. This study aims to explore whether GMO taxes should form part of the solution to curb nutrition-related diseases.

This was achieved by conducting a literature review on the health impact of GMOs and other unhealthy foods, as well as food taxes imposed in foreign countries.

Research results indicated that GMOs have adverse health impacts. The introduction of food taxes in foreign countries generally resulted in a decrease in the consumption of or demand for the taxed foods. This study concludes by proposing a policy for a tax on GMOs.

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DEFINITION OF KEY TERMS

Table 1: Definition of key terms used in this document

Key term	Definition
Body mass index	An index used to measure the weight of a person in relation to their height
Fat	A key macronutrient required for early development and growth, which influences the body's reaction to nutrition-related diseases later in life
Genetically modified organisms	Organisms whose original genes have been altered
Overweight or obese	"An abnormal or excessive fat accumulation that may impair a person's health" (World Health Organisation [WHO], 2014b)
Nutrition-related diseases	Nutrition-related diseases that cause illness due to excesses in the diet
Price elasticity	A one per cent change in consumption as a result of a one per cent change in price
Substitution	Replacing one good with another due to price changes
Sugar	Carbohydrate that provides the body with energy
Sugar sweetened beverage	A drink which contains added sugar
Taxation	A compulsory monetary payment by the public to the government
Tax base	A measure by which tax is determined

Source: Croome (2013:5); Smuts & Wolmarans (2013:S87 & S91); Voinea (2011); World Health Organisation [WHO] (2014b).

LIST OF ABBREVIATIONS AND ACRONYMS

Table 2: Abbreviations and acronyms used in this document

Abbreviation	Meaning
ACB	African Centre of Biosafety
AHA	American Heart Association
BMI	Body mass index
CVD	Cardiovascular diseases
DOH	Department of Health
ECSIP	European Competitiveness and Sustainable Industrial Policy
FOA	Food and Agriculture Organization of the United Nations
FBDGSA	Food-Based Dietary Guidelines for South Africa
GMOs	Genetically modified organisms
SARS	South African Revenue Service
SSBs	Sugar-sweetened beverages
VAT	Value-Added Tax
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Worldwide, it is estimated that at least 2.8 million people die each year as a result of being overweight or obese. In 2014 more than 1.9 billion adults (18 years and older) in the world were overweight and of these 600 million were obese. Overweight and obesity are defined as “abnormal or excessive fat accumulation that may impair health”. A person is considered to be overweight when the body mass index (BMI) is greater than or equal to 25 and obese when the BMI is greater than or equal to 30. BMI is an index used to measure the weight of a person in relation to their height (World Health Organization [WHO], 2014b). Overweight and obesity are weight ranges that are considered to be unhealthy given a certain height (Hojjat, 2015:82).

Excessive consumption of unhealthy food may impact on the health and weight of a person. The negative health impacts of obesity are non-communicable diseases such as Type 2 diabetes, strokes, musculoskeletal disorders and heart diseases. Heart diseases and strokes were the leading causes of death worldwide in 2012 (WHO, 2014b). The US national spending on nutrition-related diseases is estimated to be \$75 billion annually (Hojjat, 2015:82). Obesity is also on the rise in low- and middle-income countries, particularly in urban settings (WHO, 2014b). In South Africa, non-communicable diseases account for more than 40% of all deaths in the country (*Times Live*, 2014).

In 2011 South Africa was ranked third in the world in terms of obesity rankings, after the US and Great Britain (Ogunbanjo, 2013:3). In 2014, South Africa was considered to have the highest overweight and obesity rates in sub-Saharan Africa, with 52% of South African adults being classified as overweight or obese (*IOL Lifestyle*, 2014).

Child obesity in South Africa has become a public problem (Tsolekile, Lerebo, Muzigaba & Puoane, 2014). About 22% of South African children aged between 2 and 14 years are

overweight and obese (Mungal-Singh in *Times Live*, 2014). Research suggests that, due to child obesity, children may be the first generation in modern history to die before their parents (Hojjat, 2015). According to Mungal-Singh in *Times Live* (2014), South Africa's obesity problem is due to people's lifestyles.

Unhealthy eating habits can be reduced at an individual level by (World Health Organization [WHO], 2014b):

- limiting energy intake from fats and sugars;
- increasing consumption of fruits and vegetables, as well as legumes, wholegrain foods and nuts; and
- engaging in regularly physical activity

There is a need to address the abovementioned concerns regarding weight due to their negative health impact and consequential burden on government revenue. It is advisable that individuals' responsibility for their health needs is supported by communities and government policies in order to reduce obesity and overweight (WHO, 2014b). One way in which this can be achieved is by introducing a tax to facilitate behavioural change that results in the reduction of unhealthy food consumption and weight management.

1.2 PROBLEM STATEMENT

Unhealthy eating habits are caused by many factors, but the modern food environment has been identified as the major contributor (Pomeranz, 2013:1001). Another contributor is the increase in disposable income among a rapidly growing middle class in developing nations such as South Africa. Increased spending power allows individuals to indulge more and may lead to unhealthy overeating, prompting a spike in diabetes, hypertension and strokes (*Times Live*, 2014). Published scientific research suggests that obesity is caused by excessive consumption of protein, starch, fat and sugar (Hojjat, 2015:84).

Some experts have suggested taxing unhealthy foods at higher rates in order to deter consumers from making unhealthy food choices (Badilas, 2011:257). Some countries have

introduced some sort of taxation of so-called unhealthy foods to curb consumption and weight increases. There have been proposals in South Africa to impose taxes on unhealthy food in order to deal with the rising weight problems facing the country. South African authorities are considering imposing tax on food high in fat and drinks high in sugar, and using the revenue to cut the price of foods that are considered to be healthy (*Times Live*, 2014).

There is evidence that sugary drinks are the leading culprit in the rise in obesity. Reduced intake of sugary drinks would make a great difference (Hojjat, 2015:83). Sugar-sweetened beverages (SSBs) are considered to be the largest source of sugar in diets (Pomeranz, 2013:1006). SSBs are considered to be an independent risk factor for heart disease and diabetes. The association of SSB consumption and weight gain is higher than for any other food (Pomeranz, 2013:1006).

Likewise, excessive intake of foods high in fat can also be detrimental to health. Fats are the key nutrients for early growth and development and influence the body's response to nutrition-related non-communicable diseases later in life. Fats are also a good source of energy (Smuts & Wolmarans, 2013:S87 & S91). However, excessive consumption of saturated fats and trans-fats is associated with increased levels of cholesterol, risk of heart disease and strokes (American Heart Association [AHA], 2015).

As a result of the role that SSBs and food with a high fat content play in weight management, the focus of unhealthy food taxes worldwide has been mainly on these products.

Table 3 provides a summary of some of the SSB and fat taxes that have been imposed worldwide.

Table 3: Unhealthy food taxes in selected foreign countries

Country	Unhealthy foods taxed
US	SSBs (in 23 States)
France	SSBs
Hungary	Food high in fat, sugar and salt
Denmark	Products with more than 2.3% of saturated fat
Finland	SSBs
Mexico	SSBs and fat
Australia	Soft drinks, confectionary, biscuits, and bakery products

Source: Mytton, Clarke & Rayner (2012).

Current research on unhealthy food taxes has not considered the taxation of genetically modified organism (GMO) foods to assist with dealing with the excessive consumption of unhealthy food. GMOs may be found in a variety of foods which contain sugar, fats, proteins and other nutrients. GMO foods are believed to have harmful effects on the human body (Anilakumar & Bawa, 2013:1038). According to research, it is estimated that 75% of processed foods produced in the US contain GMOs. In South Africa, 80% of white maize is made from GMO seed (African Centre of Biosafety [ACB], 2015). It was found that GMOs have adverse life effects and consumption of GMOs translates into humans gaining weight faster and retaining the weight (Wright, 2014).

1.3 PURPOSE STATEMENT

Like SSBs and high-fat foods, the consumption of GMO foods is linked to weight gain and adverse health impact. There have been few studies conducted recommending the taxation of GMOs to curb consumption and moderate its direct and indirect negative impact on health. This study seeks to analyse the health impact of GMOs and to explore whether or not a tax on GMOs should be implemented in South Africa to deal with the obesity epidemic and to address its adverse impact on health.

1.4 RESEARCH OBJECTIVES

The study is guided by the following objectives:

- Conduct a literature review on the health impact of SSBs, fats and GMOs.
- Conduct a literature review on the measures governments use to change consumer behaviour.
- Conduct a literature review on the use of taxes to change consumer behaviour.
- Conduct a literature review on SSB, fat and GMO taxes in foreign countries.
- Conduct a literature review on the attributes of SSB taxes and fat taxes in foreign countries.
- Based on a critical analysis of the frame of reference created by conducting a literature review, draw conclusions on the implementation and design of GMO taxes.

1.5 IMPORTANCE AND BENEFITS OF THE PROPOSED STUDY

The South African Department of Health (DOH) has demonstrated willingness to use fiscal and regulatory policy tools for improving public health (Manyema, Veerman, Chola, Tugendhaft, Sartorius, Labadarios, & Hofman, 2014:2).

Non-communicable diseases are predicted to increase at an unprecedented rate over the next two decades, and without strong and innovative interventions government will not be able to meet its goal of a long and healthy life for all. South African health services could in the future become overwhelmed with patients requiring acute as well as long-term health care (Motsoaledi, 2013).

If South Africa decides to introduce taxes on unhealthy food, it is imperative that the tax not only decreases the consumption of unhealthy food, but that it is also representative of all unhealthy foods.

This study may provide insight for National Treasury and the DOH regarding which foods should be considered unhealthy, and consequently if and how taxes can be used to address the consumption of unhealthy food.

1.6 LIMITATIONS AND ASSUMPTIONS

1.6.1 Limitations of the study

Government can use a number of measures to alter consumer behaviour such as taxes, subsidies, food regulation and awareness programmes, to name a few. This study only focuses on taxes as a measure to alter consumer behaviour.

1.7 RESEARCH METHODOLOGY

For this study, critical literature reviews were used as a qualitative method of collecting data. A detailed description of this process is included in Chapter 2.

1.8 STRUCTURE OF THE MINI-DISSERTATION

This study consists of three chapters. The chapters are as follows:

- Introduction;
- Research methodology and literature review; and
- Analysis and conclusion.

1.8.1 Chapter 1: Introduction

Chapter 1 provides the introduction and background to present research on the topic. Chapter 1 also sets out the research objectives, limitations and the research design and methodology are discussed.

1.8.2 Chapter 2: Research methodology and literature review

Chapter 2 commences with a brief discussion of the research methodology and design. It then provides a review of the literature on the health impacts of sugar and fats. A literature review on consumer behaviour and government measures is also given. This is followed by a discussion on taxation as a measure to change consumer behaviour pertaining to the consumption of unhealthy foods.

A literature review is conducted on SSBs taxes and fat taxes in foreign countries and on the attributes that contributed to the success and/or failure of these taxes.

1.8.3 Chapter 3: Analysis and conclusion

Chapter 3 provides an analysis of the health impact of GMOs. It then provides a summary on food taxes in foreign countries and proposes a policy for GMO taxes. Chapter 3 concludes with a recommendation to implement GMO taxes in South Africa to improve public health.

CHAPTER 2: RESEARCH METHODOLOGY AND LITERATURE REVIEW

In Chapter 1, the adverse impact of obesity on health was identified as an epidemic of worldwide concern. The consumption of genetically modified organism (GMO) foods has been linked to weight gain and adverse health impact. The purpose of this study is therefore to analyse the health impact of GMOs and to explore whether or not a tax on GMOs should be implemented in South Africa to deal with the obesity epidemic and to address its adverse impact on health.

This chapter starts with a brief discussion on the research methodology and design. The purpose of this chapter is to provide an overview of the health impacts of sugar and fats. This chapter also reviews the literature on consumer behaviour and the governmental measures that can be imposed to alter people's consumption of unhealthy food. Furthermore, a review on sugar-sweetened beverage (SSB) and fat taxes in foreign countries is provided. The chapter concludes with an overview and analysis of the attributes (positive and negative) of SSB and fat taxes.

2.1 RESEARCH METHODOLOGY AND DESIGN

Critical literature reviews were used as a method of collecting data. A literature review is a non-empirical study. A literature review can be defined as a qualitative method of selecting available documents on a topic that contain information, ideas, data or evidence about views on the nature of that topic (Sekaran & Bougie, 2013:49). The literature review conducted facilitated the construction of a theoretical background to taxes on unhealthy food.

The benefits of a literature review can be summarised as follows (Sekaran & Bougie, 2013:50):

- It provides researchers with the type of research designs others have used to answer their research questions.
- It aligns the study with existing knowledge and builds on that knowledge.

- It contextualises the research within the wider research debate.
- It highlights pre-existing knowledge regarding the problem being considered.
- It provides a clearer view of the variable that requires consideration.

Literature reviews have limitations, which can be summarised as follows (Mouton, 2001:181):

- A literature review can only summarise, organise and evaluate existing studies.
- One may misinterpret the work of others.
- A literature review cannot produce new or validate existing empirical insights.

Despite these limitations, a literature review still facilitates the achievement of the research objectives of this study, due to its exploratory nature. Exploratory research forms the basis of more conclusive research. This is usually when a researcher has an idea or has observed something and to seeks to gain more understanding. Usually exploratory research tackles problems on which there is little or no previous research. Exploratory research can be either a new topic or a new angle on an existing topic (Kowalczyk, 2015). The aim of this study is to provide a new angle on food taxes by exploring whether or not GMOs should be included in the unhealthy food tax base. There has been no public domain research performed on GMO taxes. Thus, a literature review is useful for this study as it explores the negative health impact of GMOs and how GMO taxes can assist to improve public health.

Foreign public domain studies on SSB taxes, fat taxes and other unhealthy food taxes focused on (Badilas, 2011:263; Hojjat, 2015; Mytton, Clarke & Rayner, 2012; Mytton, Eyles & Ogilvie, 2014):

- the foods that should be taxed;
- natural experiments, controlled trials and modelling studies to evaluate the effectiveness of unhealthy food taxes;
- the cost-effectiveness of unhealthy food taxes;
- the economics underlying unhealthy food taxes; and
- the effect of unhealthy food taxes on consumption.

South African studies on unhealthy food taxes focused on aspects such as the impact of a SSB tax on obesity among adults, the perception of individuals in South Africa regarding fat taxes and whether the introduction of a fat tax would affect consumer consumption habits (Fouche, 2014; Manyema, Veerman, Chola, Tugendhaft, Sartorius, Labadarios & Hofman, 2014; Storum, 2012; Talbot & Pienaar, 2012:1281).

Evidently, there have been no studies suggesting a GMO tax as a solution to unhealthy food consumption.

This literature review was performed by evaluating, analysing and comparing available literature on SSB taxes, fat taxes, GMOs, unhealthy foods, consumer behaviour and government measures. Search engines such as Proquest, SA Publications (Sabinet), EbscoHost, online newspaper articles and Google Scholar were used to locate available data.

A literature review assists in creating a frame of reference regarding the attributes (both positive and negative) of current unhealthy food taxes. By referring to these attributes, this study proposes a possible GMO tax policy as a way to combat the high medical and social costs of consumption of unhealthy food.

The literature review begins with an overview of the impact of sugar and fat on health.

2.2 THE IMPACT OF SUGAR AND FAT ON HEALTH

Taste is considered to be an important factor in food choices made by consumers (Hojjat, 2015:84). Foods that contain fats, salts, carbohydrates and proteins are usually addictive (Cash & Lacanilao, 2007:176), while most of the food that people enjoy usually has sugar in it (Alpert, 2012:1).

A healthy diet should contain the right amount of carbohydrates, fats, proteins and vitamins. A diverse diet is an internationally accepted recommendation for healthy eating. A diverse diet is one that includes different food groups. However, an energy-dense diet is cheaper and most

prevalent, but does not have sufficient micronutrients (Steyn & Ochse 2013:S13 & S14). “Energy-dense” refers to the amount of energy for the given weight of food (Escobar, Veerman, Tollman, Bertram & Hofman, 2013). Among the foods that are most over-consumed, sugar and fats are usually the main nutrients (Health 24, 2013; Smuts & Wolmarans, 2013:S89).

2.2.1 Impact of sugar on health

Sugar is featured in food that is consumed at Christmas, birthday parties, weddings and everyday life (Alpert, 2012:1). Sugar is not only associated with dental decay and weight gain, but can also make people ill. There is consensus in the nutrition community that most people need to reduce their intake of sugar (Rust, 2013:2; Schmidt, 2014:525).

Sugar is carbohydrates that provide the body with energy. There are different forms of sugar (Alpert, 2012:1):

- sucrose: a natural sugar that is a derivative of all green plants which is produced through photosynthesis of carbon dioxide and water;
- fructose: a sugar found in fruits and vegetables;
- lactose: a sugar found in milk; and
- glucose: the primary source of energy that supports the body.

These forms of sugar occur naturally in foods. There is also another type of sugar, namely added sugar, which is added to food during processing (American Heart Association [AHA], 2014). The two major sources of processed sugar are sugarcane and sugar beet (Alpert, 2012:1).

Sugar and starch (carbohydrates) are the main sources of energy for the human body and brain (Australian Food and Grocery Council, 2011; Senekal & Naude, 2014). Energy is needed by the body for metabolism and physical activity. If more energy is consumed than is used for metabolism and physical activity, it is stored in the body as body fat, which is not beneficial (Australian Food and Grocery Council, 2011).

Most of the sugar people consume is contained in processed foods such as breakfast cereals, chocolate bars, prepared frozen foods, bread, soft drinks and sauces (Alpert, 2012:1; Australian Food and Grocery Council, 2011; World Health Organization [WHO], 2014a). There are also foods that contain good sugars which provide the body with minerals, vitamins, fibre and biologically active compounds. These foods include fruits, vegetables, legumes and unprocessed grains (Senekal & Naude, 2014).

The recommended daily total energy intake for sugar has been reduced to 10% of the total daily intake by the WHO. A further reduction of 5% (25 grams) of sugar was conditionally recommended by the WHO. This is approximately 6 teaspoons for an average adult with a normal body mass index (BMI) (WHO, 2014a). The sugar intake recommended by the Food-Based Dietary Guidelines for South Africa (FBDGSA) is 10% of total energy intake or less than 60 grams per day (Naidoo, 2013:S152). The total daily energy intake of SSBs, as recommended by the FBDGSA, is one can per day (approximately 355 ml), provided no other foods containing added sugar are consumed (Temple & Steyn, 2013:S100).

SSBs are the most consumed beverages in the US. In Mexico it is estimated that 3.6 million cans of Coca-Cola are consumed daily (Gallucci, 2015:2) but in South Africa, information on beverage consumption is limited. A study conducted in South Africa shows that soft drinks are mostly consumed by young adults (Van Graan, Bopape, Phooko, Bourne & Wright, 2013:S81).

Table 4 summarises the sugar content of some of the commonly consumed foods in South Africa.

Table 4: Sugar content in some of South Africa's popular foods

Food description	Sugar content (teaspoons)
Breakfast cereals (corn flakes per 100 grams)	2.4
Chocolate bars (milk chocolate bar– 44 grams)	5.75
Tomato sauce (100 grams)	6.75
Yoghurt (one cup)	5
Bread (one slice)	1

Food description	Sugar content (teaspoons)
Soft drinks (coca cola – one can)	7
Soft drinks (Red Bull – one can)	7.5
Orange juice (one glass)	2.5
Dessert – (ice-cream – one scoop)	3
Dessert – (muffin)	4.75

Source: *Medical News Today* (2014); *Health 24* (2013).

An analysis of Table 4 shows that, of the foods commonly consumed in South Africa, soft drinks have the highest sugar content.

While sugar may be beneficial to the human body, excess consumption may have adverse health consequences. Some of the health consequences of excessive consumption of sugar are (Alpert, 2012:3; Kendig, 2014:41; Naidoo, 2013:S151; Pomeranz, 2013: 1015; Schimidt, 2014; Temple & Steyn, 2013: S103):

- cardiovascular diseases (CVD) as well as many other chronic diseases, namely diabetes, liver cirrhosis and dementia;
- metabolic perturbations involving dyslipidaemia, hypertension and insulin resistance;
- weight gain, which can lead to obesity;
- toxicity of the liver;
- rise in insulin levels, which inhibits growth levels resulting in the immune system being depressed;
- cognitive dysfunction, which affects spatial learning and memory;
- hyperactive and aggressive behaviour;
- a reduced intake of micronutrients resulting in malnutrition; and
- deprivation of the mechanism of vitamin C, which increases the risk of infections.

SSBs are considered to be the largest contributor to added sugar consumption in the US and South African diets (Kendig, 2014:42; Schimidt, 2014; Temple & Steyn, 2013:S103). SSBs are also considered to be the largest contributor to the obesity and diabetes epidemic in these countries (Temple & Steyn, 2013:S103; Wang, Coxson, Shen, Goldman & Bibbins-Domingo,

2012:199). Studies show that SSBs reduce the control of appetite. This results in people consuming more SSBs, which are high in calories (Fischer, 2014). The link between the consumption of SSBs and non-communicable diseases is well established, and evidence of sugar-related health effects is the strongest for SSBs (Escobar *et al.*, 2013; Temple & Steyn, 2013:S103).

2.2.2 Impact of fat on health

Dietary fats are lipids in plant and animal tissues that are eaten as food. Lipids are defined as “small hydrophobic molecules that originate entirely or partly through condensations of thioesters and/or isoprene units” (Food and Agriculture Organization of the United Nations [FAO], 2008:21). The health effects of dietary fat have to be assessed according to its fatty acids composition (Cash & Lacanilao, 2007:176). Fatty acids are needed in human nutrition as a source of energy, for metabolism and structural activities (FAO, 2008:22). There are different types of fatty acid, namely saturated fatty acids (fats), trans-fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids (Cash & Lacanilao, 2007:176).

Saturated fats come from animal sources and plants. Foods that contain saturated fats include beef, lamb, pork, dairy products, coconut, coconut oil and palm oil. Trans-fats are produced in an industrial process when hydrogen is added to liquid vegetable oil to solidify it. Trans-fats are often referred to as partially hydrogenated oils. Foods that contain trans-fats include pastries, pizza dough, pies, biscuits and crackers. Trans-fats are considered bad fats, as they cause a rise in bad cholesterol levels and reduce good cholesterol levels. Mono-unsaturated and polyunsaturated fats represent unsaturated fats. These fats may help improve individuals’ blood cholesterol level when used in place of saturated and trans-fats. Foods that contain unsaturated fats include avocados, salmon, olives, walnuts, corn, soybeans and sunflower seeds (AHA, 2015).

Good-quality fats, such as unsaturated fats, provide essential fatty acids, cell membrane integrity, hormone production, protection of organs and absorption of vitamins (Senekal & Naude, 2014).

The recommended daily intake of fats is shown in Table 5.

Table 5: Recommended daily intake of fats based on an 8 400 kJ diet

Type of fats	Recommended daily intake (% of total energy)	Fat (g)
Total fats	Less than 30%	68
Saturated fats	Less than 10%	23
Trans-fats	Less than 1%	2
Mono-unsaturated fats	The difference (total fats less saturated fats less trans-fats less polyunsaturated fats). Approximately 10%	27
Polyunsaturated fats	6 to 10%	18

Source: WHO in Senekal & Naude (2014); Smuts & Wolmarans (2013:S96).

Table 5 indicates that the total fat that should be consumed daily should be less than 30% or 68 grams. Trans-fat should be the least consumed (WHO in Senekal & Naude, 2014; Smuts & Wolmarans, 2013:S96).

While Table 5 analyses the recommend daily intake of fats, Table 6 summarises the fat content of some of the popularly consumed foods in South Africa.

Table 6: Fat content in popular South African food

Food description	Total fat (per 100 grams)
Beef (raw)	14.20 grams
Lamb (raw)	6.79 grams
Pork (raw)	5.23 grams
Chicken (fresh, white meat)	2.70 grams
Eggs	10.30 grams
Cheddar cheese	32.30 grams
Pilchards in tomato sauce	5.40 grams
Maize porridge	0.6 grams
Brown bread	1.4 grams
Regular hamburger	14 grams
Large hamburger	29 grams

Food description	Total fat (per 100 grams)
Chips (French fries – medium portion)	11 grams
Milkshake	11 grams
Four seasons pizza (standard)	35 grams

Source: Smuts & Wolmarans (2013:S90)

From Table 6 it is evident that foods such as pizza, cheese and hamburger have the highest fat content, while maize porridge has the lowest. Among the fat-containing foods in South Africa, meats and offal were the most consumed, followed by milk and vegetable fats. Oils were the least consumed (Smuts & Wolmarans, 2013:S89).

Overconsumption of fats can lead to the following adverse health effects (Alpert, 2012:3; Ardon, 2012; Elliott, 2014:1886 & 1887; FAO, 2008:117, 118 & 136; Wahrburg, 2004):

- increased serum cholesterol and a higher risk of coronary heart disease;
- high cholesterol that can lead to mortality;
- high blood pressure;
- impairment of the endothelial function;
- depression, bipolar disorders, cognitive decline, aggression, hostility and antisocial behaviour;
- death from heart diseases;
- Alzheimer's disease; and
- development of atherosclerosis.

2.3 GOVERNMENT MEASURES

According to a report by the WHO cited in Cash & Lacanilao (2007:174), people should limit their intake of fats, sugars and salt and should increase their consumption of fruits, vegetables, whole grains, nuts and legumes, to prevent non-communicable diseases. Consumers are unlikely to achieve these goals on their own due to market failure. Governments usually intervene because of market failures, which occur when unrestricted operations of the market yield socially undesirable results. Market failure arises as a result of imperfect market

competition, high external costs or benefits, imperfect information and the need for the provision of public goods (Cash & Lacañilao, 2007:174–175).

A noticeable feature of food policy and health is lack of information, due to the absence of standardised labelling requirements in most countries (Cash & Lacañilao, 2007:175). Some argue that consumers consume unhealthy food due to ignorance about the health consequences, while others argue that the lack of information is due to education levels (Gil, Lopez-Casasnovas & Mora, 2013:121).

Another reason why people consume an excess of unhealthy food is limited financial resources. Consumers subject to financial constraints tend to consume food that is more affordable. This may be to the detriment of nutritional quality (Hojjat, 2015:84).

Due to the link between the consumption of unhealthy food and disease, it is submitted that governmental intervention may be justified. This is especially true due to the consequential burden imposed on the public health system, which is funded by governments (Cash & Lacañilao, 2007:175). Medical costs relating to unhealthy food consumption is the largest cost in the US (Hojjat, 2015:82). In South Africa the medical costs attributable to unhealthy food consumption are considered to be between 11% and 22% (Manyema *et al.*, 2014). Other indirectly attributable costs include those incurred by third parties, such as employers, due to lost productivity (Cash & Lacañilao, 2007:175).

High health costs are one of the justifications for government interventions. Government interventions can include taxation, subsidies, restriction on advertising, healthy eating programmes, food-labelling policies and direct pricing (Ruopeng, 2012:1215).

This study focuses on taxation as a form of government intervention to address the consumption of unhealthy food. Economists generally agree that the introduction of taxes to combat market failures is acceptable as a means of improving wellbeing (Mytton *et al.*, 2012).

Taxation can be defined as a compulsory monetary payment to government by the public as a whole (Croome, 2013:5). The primary objective of taxation is to raise revenue for government. In the case of unhealthy food taxes, the taxes raised can be used to subsidise healthy foods. In order to achieve the optimal results, the right tax base should be determined (Cash & Lacanilao, 2007:175).

A tax base is defined as “the amount on which tax is imposed and requires a determination of what is taxable”. The tax base can be based on income, consumption or wealth (Bronkhorst & Stiglingh, 2014:1185; 1187). New taxes are usually politically sensitive and the debate on their efficacy is between the monetary outcomes and health-related outcomes (Dharmasena, Davis & Capps, 2014:157).

Food taxes are seen as an excise tax; excise taxes are generally implemented to correct consumer externalities. The aim of excise taxes is to increase the price of the taxed product where the social costs are not already factored into the price. The externality targeted by food taxes is medical costs relating to non-communicable diseases and other diseases related to excess consumption of unhealthy foods. In practice, such taxes are levied at the producer’s level to simplify the calculation and revenue collection. When the producers are taxed, the prices will pass through to consumers (European Competitiveness and Sustainable Industrial Policy Consortium [ECSIP Consortium], 2014:24).

Therefore, taxing unhealthy food will mean that the price of the unhealthy food will increase. This may lead to a reduction in the consumption of the taxed foods, as people will either reduce consumption or stop buying the food, in order to alleviate the financial burden imposed. After taste, price is considered to be the most important factor that influences consumers’ purchasing behaviour (Hojjat, 2015:84). The price and quality of food plays a vital role in people’s health, as it impacts consumers’ food choices and diet (Mytton *et al.*, 2012; Pomeranz, 2013:1001). When the price of a product increases, taking the maximising rule into account, the consumer will allocate his or her income so that the last rand spent will yield the same amount of utility. The rational consumer will compare the extra utility from each product with the added price (Hojjat, 2015).

The main motivation for purchasing unhealthy food is its affordability. Because most of the less nutritious foods are available at a low cost, food taxes can be used to assist consumers to make healthier food choices (Badilas, 2013:263 & 267).

Dietary risk factors, which include the low intake of fruits, vegetables, whole grains, nuts, seeds and omega fatty acids, and less physical activity are the cause of 10% of global health loss (Escobar *et al.*, 2013). The goal of policy makers should be to make healthy food more accessible. The consumption of healthy food is generally associated with a lower BMI (Cash & Lacanilao, 2007:177).

Most health-related taxes are regressive, meaning that the poor pay a greater proportion of their income in tax than the rich do (Mytton *et al.*, 2012). A concern about taxes is that low-income households will spend most of their income on food, and any policy that supports price increases will affect these households the most (Cash & Lacanilao, 2007:178). Despite this, as the poor spend most of their income on food, a food tax will be progressive from a health perspective. This is because the poor will most likely consume healthier foods and therefore experience greater dietary improvements (Mytton *et al.*, 2012)

Price elasticity is another important factor to take into account when forecasting tax impacts on the consumption of unhealthy food (Franck, Grandi & Eisenberg, 2013:1949). Elasticity is defined as “the percentage change in consumption of one percentage in price”. It is generally accepted that there is an inverse relationship between price and consumption. In other words, as prices increase, the level of consumption is expected to decrease (Mytton *et al.*, 2012).

The relationship gradient depends on the demand elasticity. Studies suggest that food consumption is relatively insensitive to price changes as it is a necessity and has no substitute (Mytton *et al.*, 2012). People need food for good health, energy and life. Elasticity is also influenced by age and socio-economic status (Franck *et al.*, 2013:1953). When the price of a necessity such as food increases, the consumer will be compelled to pay the higher price or forgo the product (Nwonwu, 2009:44–45).

Finally, another concept that should be considered when implementing food taxes is cross-price elasticity. Cross-price elasticity is the change in the demand of one good in response to the change in price of another good (Escobar *et al.*, 2013). For example, if the price of butter increases, the demand for margarine may increase. This is regarded as positive cross-price elasticity and implies that certain foods can be replaced with other foods. If the price of bread increases, the demand for butter may decrease. This is considered to be negative cross-price elasticity and implies that certain foods are complements.

Complementary foods are foods that are eaten together, like bread and butter. Substitute foods are foods that can be replaced with other food types: for example butter can be replaced with margarine. Some studies show that increasing the prices of unhealthy food may be effective, as it could motivate consumers to substitute unhealthy food with healthy food (Cash & Lacanilao, 2007:176). A study performed on the own and cross-price elasticity of SSBs for the US, Mexico, France and Brazil shows that SSBs are usually compared to fruit juice, full-cream milk and diet soft drinks. Fruit juice and full-cream milk have a positive cross-price elasticity of 0.388 and 0.129 respectively in relation to SSBs, while diet soft drinks have a negative cross-price elasticity of -0.423 in relation to SSBs (Escobar *et al.*, 2013). This means that fruit juice and full-cream milk are substitutes for SSBs, and diet soft drinks are considered to be complementary.

When using tax as a measure to change consumer behaviour, the price and elasticity of the item should be considered. The demand for a food item is a function of the price of that item as well as the price of other food items, the purchasing power and factors that influence personal preference (Franck *et al.*, 2013:1953). Generally, tax distorts market functioning and reduces economic efficiency (Hojjat, 2015:90).

2.4 USING TAXES TO CHANGE CONSUMER BEHAVIOUR

The concept of using taxes to reduce the overconsumption of unhealthy food is not new. Food taxes were first proposed by Kelly Brownell after he noticed that unhealthy foods were cheaper

than healthy food (Badilas, 2011:262). Kelly Brownell is Dean of the Sanford School of Public Policy at Duke University, and is a professor of public policy. He also serves on the board of directors of the Duke Global Health Institute (Stadford, 2015). As the consumption of unhealthy food escalated, the WHO proposed that countries should tax unhealthy food to encourage people to make healthy food choices (Badilas, 2011:263).

Generally, researchers agree and some have proposed using taxation to encourage healthier eating habits by increasing the price of unhealthy food. Public-health professionals have also advocated using excise taxes to reduce the consumption of unhealthy foods (Pomeranz, 2013:1003; 1006).

When using taxes to change consumer behaviour, it should be noted that consumer behaviour is based on (Chetty, Greyling, van Zyl, Schoeman & Wentzel, 2008:107):

- logic
- necessity
- practicability

A rational consumer wants to get the maximum satisfaction from utilising his or her budget. When a product such as unhealthy food is taxed, the rational consumer will shift consumption of the product that is being taxed. Thus a consumer might purchase a product that is cheaper (which will be the healthy foods) (Chetty *et al.*, 2008:110).

There has been debate on whether to tax the nutrient itself or certain foods containing the relevant nutrient to change consumer behaviour (Gil *et al.*, 2013:124; Pomeranz, 2013:1006; 1013). Worldwide, several countries have introduced a SSB tax or fat tax. Such countries include Denmark, Finland, Australia, France, Hungary and the US (Fouche, 2014).

2.5 AN OVERVIEW OF SSB TAXES IN FOREIGN COUNTRIES

As SSBs are considered to be one of the largest contributors to energy intake in many populations, several countries have adopted SSB taxes in order to combat the consumption of

SSBs. These countries include (ECSIP Consortium, 2014:34-38; Escobar *et al.*, 2013; Franck *et al.*, 2013:1950; Gallucci, 2015; Gil *et al.*, 2013:125; Mytton *et al.*, 2012; Mytton *et al.*, 2014:434):

- Hungary: Hungary introduced a public health product tax in 2011. The tax covers products such as salty snacks, confectionery, SSBs, concentrates for soft drinks, energy drinks, flavoured beers, fruit jams and condiments. The tax is based on the weight or volume of the product and is payable by the producer of the product. The tax on SSBs is charged on added sugar that is greater than 8 grams per 100ml. SSBs that contain more than 25% fruit or vegetable content and drinks prepared with at least 50% milk are exempt from this tax. The tax is 7Ft per litre on SSBs. The tax was implemented to generate revenue to fund public health-care costs. The tax only applies to products that have healthier alternatives. Data analysis shows that the demand for SSBs declined by 10% between 2011 and 2013. It is believed that the decrease was due to the introduction of the SSB tax.
- Mexico: Mexico introduced a SSB tax in 2013 which took effect in 2014. The tax rate is 10% per litre of sugary drinks. The tax is on all SSBs without milk content. The policy, which was part of a fiscal reform package, was aimed at curbing obesity rates and diabetes. The revenue collected from this tax is earmarked for providing drinking water at schools. It is only just over a year since the tax was introduced and preliminary results suggest that consumption rates of sugary beverages have fallen, but the exact figure is not known. However, surveys by Mexico's National Institute of Public Health show that purchases of sugary beverages fell by 10% in the first three months after the tax was introduced.
- Finland: Finland has an excise duty on confectionery, ice cream and soft drinks. The excise duty on soft drinks is charged on sugar and non-sugar sweetened soft drinks, water and juices. Soft drinks used in the manufacture of other products are exempt from this tax. The tax rate changed between 2011 and 2014: in 2011 it was €0.075/litre and by 2014 the tax rate was €0.22/litre on SSBs and juices and €0.11/litre on sweetener-based soft drinks and water. The tax is paid by producers when the products enter the market.

Only products consumed locally are taxed; exports are not. Producers with an annual production of less than 10 000kg or 5 000 litres are exempt from this tax. The aim of the tax is to alter the eating habits of Finns, whose consumption of sugary foodstuffs was high. The tax is based on the weight of the product as included in the tax schedule of Finland. Finland uses CN codes to classify taxed products. CN codes are international codes used for custom tariffs. Research on the effect of the tax on consumption and demand shows that consumption of soft drinks declined by 3.8%, while demand declined by 3.1% between 2012 and 2013.

- France: In 2012 France introduced an excise duty on sugared and non-sugar sweetened drinks. A tax on energy drinks was introduced in 2014. Beverages with caffeine content greater than 220mg/litre are considered to be energy drinks and are taxed at different rates. The tax is based on all beverages with added sugar or sweeteners sold to the retail market and alcohol strength equal to or below 1.2% volume. The tax is paid by producers and importers of drinks from other European Union countries. The tax on sugared and non-sugar sweetened beverages is adjusted annually on the 1st of January. The tax rate was €7.16/hectolitre in 2012, €7.31 in 2013 and €7.45 in 2014, while the tax on energy drinks is €1/litre. The tax was introduced to combat obesity and to reduce the public health-care deficit. Data analysis showed a decline in the demand for SSBs of 6.7% between 2012 and 2013. It has been suggested that the change in demand is due to the introduction of the tax.
- Ireland: Ireland first introduced an excise tax on soft drinks in 1975 at a rate of IR£0.10 per gallon produced. The rate was increased to IR£0.37 per gallon in 1980, and then reduced to IR£0.29 in 1990. The tax was introduced due to the Irish government's need for additional revenue. The tax was imposed directly at the production level of SSBs. The excise tax was however abolished in 1992, and Value-Added Tax (VAT) on the supply of soft drinks, at a rate of 21%, was introduced. Consumption of soft drinks increased by 15% due to the tax reduction between 1990 and 1992.

- Australia: Australia introduced a 10% Goods and Services tax on sugary drinks in 2000. This tax is similar to Value-Added Tax (VAT) in South Africa and is borne by the final consumer. The tax was introduced to generate revenue for the state and was not for health purposes. No public domain studies on the effects of the tax on consumption could be found.
- The US: There are 23 states in the US that have introduced a tax on SSBs. The tax was initially implemented to raise revenue, but its objective has since changed to one that aims to reduce the effects of obesity. The tax rate varies between 1% and 8% of the price of SSBs. Studies suggest that the taxes had an insignificant impact on the consumption of SSBs, as the tax rates were believed to be too low.

Table 7 provides a summary SSB taxes that have been imposed in foreign countries.

Table 7: SSB taxes in foreign countries

Country	Tax rate	Results
Hungary	7Ft per litre on SSBs	10% decline in demand between 2011 and 2013
Mexico	10% on soft drinks	10% decline in purchases in the first 3 months
Finland	€0.22 per litre on SSBs and juices €0.11 per litre on sweetener-based soft drinks and water	Consumption of soft drinks declined by 3.8% between 2012 and 2013
France	€7.45 per hectolitre	Demand decline of 6.7% between 2012 and 2013
Ireland	VAT at a rate of 21% on soft drinks	No published public domain data
Australia	10% on sugar drinks	Not for health reasons: there is no published evaluation on impact
US	1–8% on the price of SSBs	Insignificant impact on consumption of SSBs

Source: ECSIP Consortium, (2014:34–38); Gil *et al.* (2013:215); Mytton *et al.* (2014:434).

Table 7 shows that the introduction of SSB taxes has resulted in a reduction in the consumption of the taxed drinks. The change in consumption ranges between 3.8% and 10%,

depending on the tax rate. The highest change in consumption was in Hungary and Mexico. The impact on consumption is a factor of the tax rate charged; in other words, consumption decreases as the tax rate increases.

Research shows that the decline in consumption was mostly due to the introduction of taxes in combination with information campaigns to better inform consumers about the negative health effects of the excessive consumption of SSBs (Gallucci, 2015:2).

2.6 AN OVERVIEW OF FAT TAXES IN FOREIGN COUNTRIES

Similarly, there are a few countries that have introduced fat taxes to reduce the consumption of unhealthy food. These countries include (Alemanno & Carreno, 2013:102; ECSIP Consortium, 2014:1-82; Fouche, 2014; Gil *et al.*, 2013:125; Mytton *et al.*, 2014:434):

- Denmark: Denmark introduced a fat tax in 2011 intended to promote the health of the population. The tax was imposed on foods with a saturated fat content higher than 2.3 grams per 100 grams. The tax was levied at €2.15/kg. The tax base was based on the weight of saturated fat in the food. Foods such as butter, cheese, milk, pizza, oils and meat were subject to the fat tax. The tax was payable by producers with an annual turnover of at least DKK50 000. The tax also applied to imports. The fat tax was repealed in 2012 due to the heavy degree of bureaucracy involved in establishing the amount of tax on domestically produced or imported goods. It is estimated that the taxes resulted in a decline of between 10% and 15% in the consumption of fat.
- Hungary: Hungary levied a junk food tax on packaged foods that are high in fat, sugar and salt. The tax is based on the weight or volume of the product and is payable by the producer of the product. The tax covers products such as salty snacks with a salt content of more than 1 gram per 100 grams and condiments with a salt content of at least 5 grams per 100 grams. Mustard and tomato sauces are exempt from this tax. The tax is 250Ft per kilogram containing fat and applies to products that have healthier alternatives. The tax was introduced as part of the public health product tax aiming to combat the

growing obesity in the country. Studies found that consumption of salty snacks declined by 13.8% between 2012 and 2013.

- Mexico: In 2013 Mexico introduced a tax of 8% on foods that are high in saturated fats, sugar and salt. No public domain studies on the effects of the tax on consumption could be found.

Table 8 summarises the fat taxes in foreign countries.

Table 8: Fat taxes in foreign countries

Country	Tax rate	Results
Denmark	€2.15 per content higher than 2.3 grams per 100 grams	There was a drop of 10–15% in consumption of fats.
Hungary	250 Ft per kilogram	There was a decline in consumption of 13.8% between 2012 and 2013.
Mexico	8% on foods high in fat	No published domain studies.

Source: ECSIP Consortium, (2014: 34-38); Mytton *et al.* (2014:434).

Table 8 shows that fewer countries have implemented fat taxes compared to SSB taxes. This might be because SSBs are perceived as having no nutritional value and are one of the most consumed products worldwide. Table 8 also suggests that the introduction of fat taxes does impact consumption of the taxed products. The reduction in consumption of products subject to fat taxes seems to be higher than for SSBs that are also subject to tax. This might be due to the wide range of available fat substitutes (ECSIP Consortium, 2014:40).

Using data from Table 7 and 8 and other research, the next section analyses the attributes of food taxes that change consumer behaviour.

2.7 ATTRIBUTES OF FOOD TAXES THAT CONTRIBUTE TO SUCCESSFUL CONSUMER BEHAVIOUR CHANGES

A number of countries have implemented food taxes to change consumer behaviour. In this section an analysis is performed on the attributes that contribute to the success of food taxes. The following are regarded as the keys to a successful food taxes (Manyema *et al.*, 2014; Mytton *et al.*, 2012):

- taxing a wide range of nutrients or unhealthy foods;
- the type of tax base (specific tax – based on a particular ingredient of the product);
- charging tax at producer level in order to limit administration issues;
- the tax rate should be high enough to change consumer behaviour. Research suggests that a tax rate of at least 20% will positively impact public health;
- consideration of the substitution effect; and
- taxes on unhealthy food should be combined with healthy food subsidies.

Each of these attributes is discussed below.

2.7.1 Taxing a wide range of nutrients or unhealthy food

Experts believe that taxes that include a wide range of unhealthy foods or nutrients are likely to result in greater health benefits than would narrow tax bases. An analysis of Tables 7 and 8 shows that more countries have implemented taxes on SSBs than have implemented taxes on fat. This might be due to the strong correlation between the consumption of SSBs and non-communicable diseases (Mytton *et al.*, 2012).

2.7.2 Type of tax base

The tax base of food taxes is usually specific or based on the weight/volume of the product. In Denmark the tax was levied on the saturated fat used in the production process. This gave rise to many administrative issues, as importers had to obtain letters of declaration from producers on the amount of saturated fat used in the production of the imported and intermediate goods (ECSIP Consortium, 2014:57).

2.7.3 Person who pays the tax

Food taxes are considered to work well when they are imposed at the production level. Generally, taxes imposed at this level reduce bureaucracy and collection time, because there are relatively fewer producers than consumers (ECSIP Consortium, 2014:60).

2.7.4 The tax rate

Tables 7 and 8 show that Denmark's fat tax, set at a rate of 15%, was the most successful in reducing consumption. Experts support this notion and recommend that, for food taxes to be effective, the tax rate should be at least 20% (Manyema *et al.*, 2014; Mytton *et al.*, 2012).

2.7.5 Substitution effect

Before food taxes can be considered, the substitution effects of the taxed products or nutrients should be considered. Research has shown that the decline in consumption of the taxed product is coupled with an increase in consumption of the taxed products' substitutes. It was noted that substitution is more common for products with a high fat content than for SSBs. Change in consumer behaviour is influenced by the design and scope of the tax as well as the nature of the product being taxed. Substitution is important in food taxes, as the aim of such taxes is to reduce the consumption of the food or nutrient taxed. Substitution can therefore either support or erode the desired effect of improved health (ECSIP Consortium, 2014:40).

2.7.6 Combining food taxes with subsidies

Experts believe that the revenue received from food taxes should be used to subsidise healthy food to make it more affordable. One of the theories on the excessive public health costs for unhealthy food consumption is because unhealthy foods are relatively cheaper than healthy ones. Thus a subsidy on healthy food could assist in reducing unhealthy food consumption (Mytton *et al.*, 2012).

The above attributes suggest that in order for food taxes to work effectively, they should be as simple as possible.

2.8 CONCLUSION

Research shows that small tax rates are likely to yield government revenue, but unlikely to have an impact on the overconsumption of SSBs and saturated fat. Likewise, high rates of tax will have an impact on the overconsumption of SSBs and saturated fat, but are less likely to be politically sustainable (Franck *et al.*, 2013).

One of the key effects of the introduction of food taxes is the increase of product reformulation. With the introduction of food taxes in Europe, reports show that products were reformulated to reduce the amount of salt, sodium and saturated fats contained in traditional mainstream products. However, product reformulation depends on the design of the food tax and the type of product taxed. For example, where a food tax is imposed on sugar content, manufacturers may replace the sugar content of a product with artificial sweeteners in an attempt to avoid the tax. This may mitigate against achieving health objectives, in that the reformulated product contains ingredients that are equally as or even more harmful than the substituted ingredient (ECSIP Consortium, 2014:31).

Another key effect that should be considered is the impact of food taxes on public health. Food taxes are relatively new and the impact on public health needs long-term assessment (ECSIP Consortium, 2014:46). Table 9 summarises the attributes of SSB taxes and fat taxes.

Table 9: Attributes of food taxes

Country	Year introduced	Food taxed	Results
Denmark	2011	Saturated fat	Despite a reduction in fat consumption of between 10% and 15%, the tax was repealed in 2012.
Hungary	2011	Packaged food high in fat, salt or sugary drinks	There was a 13.8% decline in foods high in fat and salt between 2012 and 2013, and a 10% decline in demand of

Country	Year introduced	Food taxed	Results
			SSBs between 2011 and 2013.
France	2012	SSBs	There was a 6.7% decline in demand of SSBs between 2012 and 2013.
Finland	2011	Tax on sweets, ice-cream and soft drinks	There was a 3.8% decline in consumption of soft drinks between 2012 and 2013.
Ireland	Not available	VAT at a rate of 21% on soft drinks	No published domain data.
Australia	Not available	Sugary drinks	There is no published evaluation of the impact.
Mexico	2013	Sugary drinks and foods high in fats	There was a 10% decline in purchases of SSBs in the first 3 months. No public domain studies on fat tax.
US	Various	SSBs	There was insignificant reduction in consumption of SSBs.

Source: ECSIP Consortium (2014:34–38); Gil *et al.* (2013:215); Mytton *et al.* (2014:434).

Table 9 suggests that the implementation of food taxes does reduce consumption of the taxed product. Using the attributes that contribute to successful food taxes discussed in section 2.7, an analysis of the food taxes implemented in foreign countries is given below. This analysis identifies the attributes of existing or previous food taxes.

Experts believe that food taxes should tax a wide range of nutrients or foods. This is validated by Hungary and Denmark having the highest reduction in consumption. Foods high in fats include a variety of items, namely meat, dairy products, pre-packaged meals, processed foods and desserts, hence the high reduction in consumption. The tax base and the person paying the tax also play an important role in the design and implementation of food taxes. This is evidenced in Denmark's saturated fat tax. Although Table 9 shows that Denmark's saturated fat tax had the highest impact on consumption, the tax was repealed due to bureaucracy issues as a result of the tax base. The tax base was based on fat in the production process. This proved difficult to administer, especially for importers, as they had to obtain declarations from suppliers on the amount of saturated fat used for the imported goods (ECSIP Consortium, 2014:57).

The tax rate is also considered to be an attribute that contributes to the success of food taxes. This is validated by Table 9, which shows that the higher the tax rate the greater the decline in consumption of the taxed product. Substitution also plays a role in the success of food taxes. Table 9 shows that fat taxes yielded a greater positive impact on consumption than did SSB taxes. This is due to demand for foods high in fat being more elastic than the demand for SSBs (see section 2.3).

Experts have suggested that food taxes should be combined with subsidies on healthy food or educational programmes. This can be validated by Mexico's soft drinks tax. Research has confirmed that reduced consumption is better achieved where the food tax is combined with educational programmes on the dangers of excessive consumption of unhealthy food, especially SSBs (Gallucci, 2015:2; Mytton *et al.*, 2012).

The analysis above suggests that the attributes discussed in section 2.7 could contribute to the successful implementation of food taxes. The next chapter draws from this analysis to make a recommendation on whether taxes on GMO products should be implemented in South Africa to address the health impacts thereof.

CHAPTER 3: ANALYSIS AND CONCLUSION

The purpose of this study is to analyse the health impact of genetically modified organisms (GMOs) and to explore whether or not a tax on GMOs should be implemented in South Africa to deal with the obesity epidemic and to address its adverse impact on health.

In Chapter 1, the adverse health impact of obesity was identified as an epidemic of worldwide concern. The consumption of GMO foods has been linked to weight gain and adverse health impacts. In Chapter 2, a literature review on the adverse impact of sugar and fats and an analysis of sugar-sweetened beverages (SSBs) and fat taxes implemented in foreign countries were presented.

The purpose of this chapter is to provide an overview of the health impacts of GMOs and to recommend a tax policy to address the consumption of GMOs. This will be achieved by referring to the attributes of SSB and fat tax policies that have been implemented in foreign countries (refer to Chapter 2).

3.1 THE IMPACT OF GMOS ON HEALTH

With the increasing world population and growing hunger in developing countries, some experts view GMOs as a food panacea, while others view them as a serious threat to human civilisation (Jefferson, 2013:33). The likely effects of GMOs on health are a controversial issue (Anilakumar & Bawa, 2013:1035; Voinea, 2011:128). GMOs are organisms that allow for the unnatural modification of genes, without conducting selective breeding. GMOs are also referred to as Genetically Modified (GM), genetically engineered, biotech or genetically altered foods (Bongyu, Billingsley, Younis & Nwagwu, 2009:191; Rust, 2013:1). These words are used interchangeably throughout this study.

There are two generations of GMOs. The first generation refers to “input characters” and consists of tolerance to one or more herbicides, pests, insects and abiotic stress. The second generation refers to “output characters” such as changes to the content of starch, protein, oils and sugars (Voinea, 2011:129).

Research conducted in Europe indicated that GMO technologies are rated the worst of 18 technologies by members of the public, and are considered by some to be hazardous to human and environmental health (Dhan, Sonika, Ranjana & Tiwary, 2011; Sjoberg, 2008). The subject of GMOs raises many ethical issues related to agriculture and foodstuffs, as its safety is believed to be questionable (Rust, 2013; Voinea, 2011:128).

In South Africa there is a GMO Act No. 15 of 1997 (“the Act”), which regulates the release of GMOs in South Africa for commercial use. New regulations were published in 2010 under the auspices of the South African Department of Agriculture, Forestry and Fisheries (Morris, 2011:1067). South Africa is rated eighth in the world in GMO acreage (Stewart, 2009:321). South Africa currently has three GMOs approved for planting and commercial use, namely maize, soya and cotton (Luntulwandile & Anise, 2014; Stewart, 2009:321). Labelling requirements for GMOs were passed two years ago in South Africa, but the specific wording is being contested by producers and supermarkets (Green Audits into Action [GAIA], 2013).

Some of the GMO crops that are grown commercially worldwide are soybeans, corn, canola, tomatoes, bananas and sweet potatoes (Anilakumar & Bawa, 2013:1035). Table 10 shows some of the GM crops widely grown in South Africa.

Table 10: GMO crops grown in South Africa:

Crops	% of GMO acreage in South Africa
Soy	85
Maize	70
Cotton	98
Commonly consumed foods in South Africa that may have been made from GM crops:	
Maize meal	Baked products
Bread	Wheat

Cooking oil	Sorghum
Sour milk	Veggie burgers
Flour	Beverages
Pre-packaged meals	Infant products
Processed meat	Soybeans used in chocolate
Dairy products (Milk, eggs and cheese)	Cereals

Source: Stewart (2009:325).

From Table 10, it is evident that GMOs are contained in a variety of foods which also contain proteins, fats and carbohydrates. The content of GMOs in food is not known, due to disputes between the government and producers on the labelling of GM foods. As GMOs are found in a variety of foods, the health effects of GMOs should take into account the health effects of sugar and fats discussed in sections 2.2.1 and 2.2.2, as well as the health effects discussed below.

The main health concerns associated with GMOs are allergies, gene transfer and outcrossing (Dhan *et al.*, 2011; Rust, 2013). GM foods are said to be less nutritious and may contain lower amounts of phytoestrogen, which provides protection against heart disease and cancer (Bongyu *et al.*, 2009). Consumption of GMOs can alter the genetic make-up of one's digestive system, and could also increase the risk of infections that are resistant to antibiotics (Anilakumar & Bawa, 2013:1040; Asante, 2008:1207).

GMOs are believed to contain less protein (Bongyu *et al.*, 2009). Most processed food contains GMOs. Research estimates that 75% of all processed food in the US contains GMOs (Wright, 2014). For the reasons stated above, the GM content and consumption in South Africa is unknown. However, it is submitted that it is likely that a significant percentage of processed foods consumed in South Africa contains GMOs. Processed foods can have negative effects on health (Morris, 2011:1064). Processed foods are less nutritious, as they have usually been stripped of their vitamins, minerals and dietary fibre (Voinea, 2011:128).

GMOs contain enzymes that cause enzyme depletion in enzymatic substrates and this leads to the build-up of enzymatic products. These enzymes alter the biochemical pathways in the body

(Anilakumar & Bawa, 2013:1040). Consumption of GMOs alters the sensitivity of pathogens, resulting in the spread of diseases and creating new vectors (Voinea, 2011:130). Farm workers who were exposed to *B. Thuringiensis* pesticide (a GMO), developed skin sensitisation and *IgE* anti-bodies to the *Bt* spore extract (Anilakumar & Bawa, 2013:1039). Some manufacturers do not want to disclose that foods are genetically modified, as they fear that this may affect their businesses negatively (Anilakumar & Bawa, 2013:1038).

Consumption of GMOs can also affect the digestive system, respiratory organs (can cause tonsillitis and asthma), and cause autistic spectrum disorders and hormone issues. Studies conducted on rats that were fed on GMO potatoes indicated that the GMO potatoes were less nutritious than non-GMO potatoes. The rats that fed on the GMO potatoes had damaged immune systems, kidneys, brains and testes. GMOs contain a pesticide that can be harmful to the bacteria in the human gut. This pesticide causes a deficiency of minerals such as zinc, calcium, manganese, cobalt and iron (Perro, 2014).

Although there is no consensus among scientists and researchers on the harmful effects of GMOs, the fact remains that GMOs, like SSBs and fat, may have a negative impact on health (Bongyu *et al.*, 2009).

3.2 AN OVERVIEW OF GMO TAXES IN FOREIGN COUNTRIES

A number of countries such as the US, Argentina, Brazil, Canada, India, China, Paraguay and South Africa have GM crops. The US has the largest GMO acreage in the world. GMOs are contained in most foods popularly consumed, as shown in Table 10. GM foods are commercially traded in most of the countries in the world (Stewart, 2009:323–324).

From Table 10 (see section 3.1), there is evidence that most of South Africa's staple foods such as maize meal and bread may contain GMOs. GMOs are also included in a number of popular foods such as cereals, pre-packaged foods, dairy products, most baked products like biscuits, crisps and desserts, and beverages (Stewart, 2009:324).

No public domain studies or published data could be found to suggest that any country has considered or implemented a tax on GMOs as a measure to alter consumption of GM foods. The next section applies the analyses of food taxes in foreign countries, performed in Chapter 2, to GMOs.

3.3 ANALYSIS OF FOOD TAXES IN FOREIGN COUNTRIES TO GMOS

No public domain studies provide evidence that any country has implemented GMO taxes to combat consumption of unhealthy food. This may be due to the conflicting views of experts, some of whom believe that GMOs are harmful to human health while others refute these views (Jefferson, 2013). While no country has implemented GMO taxes, several countries have implemented SSB taxes and fat taxes.

The European Competitiveness and Sustainable Industrial Policy Consortium (ECSIP Consortium) conducted a study on the unhealthy food taxes implemented in Europe. Some of the countries in Europe that have implemented these taxes are (refer to Chapter 2 section 2.8):

- Denmark
- Finland
- France
- Hungary

Other countries outside Europe which have implemented unhealthy food taxes include Mexico, some states in the US and Ireland. Currently South Africa does not have taxes on unhealthy food and has shown an interest in introducing them to combat non-communicable diseases caused by consumption of unhealthy food (Manyema, Veerman, Chola, Tugendhaft, Sartorius, Labadarios & Hofman, 2014).

The above countries introduced food taxes in order to deter consumers from consuming unhealthy foods. The broadness and simplicity of the tax base plays a vital role in the implementation of food taxes. The tax base was defined in Chapter 2 as the measure upon

which tax is determined. In the countries that have already implemented food taxes, the tax base of each country differs. The tax bases of three countries are compared in Table 11 (ECSIP Consortium, 2014:18–19):

Table 11: Tax base

Country	Tax base	Exclusion
Finland	Sugar and non-sugar sweetened soft drinks, water and juices	Soft drinks used in the manufacture of other products
France	All beverages containing added sugar or sweeteners Energy drinks	None
Hungary	Soft drinks with added sugar of > 8g/100ml Syrups Concentrates Energy drinks	Soft drinks with more than 25% of fruit or vegetable content or 50% milk

Source: ECSIP Consortium (2014:18&19).

Table 11 shows that the definition of SSBs in each of the countries differs slightly, and France seems to be the country with the widest tax base, covering all beverages that have added sugar or sweeteners. When implementing food taxes, the tax base should be as wide as possible to cover all the ingredients and food technologies that are considered to be detrimental to health. Thus the food taxes implemented should be based on scientific evidence so as to have an impact on the health of consumers. Taxes should not merely be a revenue-generating tool; they should prioritise reducing the negative externalities associated with unhealthy food consumption.

The next section provides a summary of food taxes in foreign countries.

3.4 SUMMARY OF FOOD TAXES IN FOREIGN COUNTRIES

The results of the analysis of food taxes imposed in foreign countries that was given in Chapter 2 is summarised in Table 12.

Table 12: Summary of food taxes

Question	Yes	No	Unknown
Did the introduction of food taxes in foreign countries result in a decrease in consumption or demand of the taxed foods?	✓		
Did the introduction of food taxes in foreign countries result in an increase in the consumption of the taxed foods?		✓	
Did the introduction of food taxes in foreign countries result in the consumption of the taxed food remaining the same as before the introduction of the taxes?			✓
Did any of the foreign countries reviewed have a GMO tax?		✓	
Was the tax rate in any of the foreign countries at least 20%?		✓	

Of the eight countries reviewed, six experienced a reduction in consumption of the taxed food due to the introduction of food taxes. There was no public domain data on the impact of food taxes in two countries. None of the countries reviewed shows that after the introduction of food taxes the consumption of the taxed foods was the same as before the introduction of the taxes, or that the consumption of the taxed food increased. Of the eight countries reviewed, none has implemented GMO taxes. The average reduction in consumption of the taxed food for the countries reviewed was as follows:

- SSB taxes: 3.8% to 10%
- Fat taxes: 10% to 15%
- GMO taxes: no public domain studies on GMO taxes

With reference to the preceding summary and the literature review conducted, a tax policy for GMO taxes is proposed in the next section.

3.5 TAX POLICY FOR GMO TAXES

In order to address all the research objectives of this study, a tax policy for GMO taxes should be proposed. There is evidence in Chapter 1 that the South African government is willing to use regulatory policy tools to improve public health. This study focuses on taxation as a form of government measure to improve public health. Taxation has been proven to change consumer behaviour (see Chapter 2).

An efficient and progressive tax system is the cornerstone of South African democracy and acts to support social solidarity, as reflected in the Constitution. An efficient tax system will not unduly influence the taxpayer's economic decisions or make compliance burdensome. Therefore a tax system needs to be fair, transparent, efficient and flexible to keep up with economic activity changes (National Treasury, 2015). The proposed GMO tax policy should attempt to internalise the external costs of the adverse health effects of GM foods and should create correct incentives to change the behaviour of consumers and producers (National Treasury, 2013).

While the design of a tax policy that accommodates all stakeholders may be difficult, such a policy can be benchmarked against the following fundamental principles of taxation (Bronkhorst & Stiglingh; 2014:1197; Mytton, Clarke & Rayne, 2012; National Treasury, 2013):

- The Equity Principle – This principle is based on the concept of fairness. When a tax is perceived to be unfair, it could affect the compliance behaviour of taxpayers. South Africa's overall income tax system is progressive, meaning that the tax rate increases as the tax base or economic income increases. Most of the health-related taxes are perceived to be regressive, meaning that the poor pay a greater proportion of their income in tax than the rich do. The GMO tax will only be regressive if consumers do not change their purchasing behaviour. However, if consumers alter their behaviour and purchase healthy food, then the tax will be less regressive.
- The Certainty Principle – The GMO tax policy should be clear and certain. Government should ensure that consumers know the purpose of the tax, when the tax will be effective,

who will pay the tax and how much tax will be charged. The process of implementing GMO taxes should be transparent. This can be achieved by government ensuring that consumers have sufficient information about the proposed tax system and are kept up to date on the process of implementing the tax policy.

- The Convenience Principle –The tax policy should be convenient for all stakeholders concerned. The GMO taxes should be included in the sales price of GMO products. This will be convenient for the consumers as they will not have to calculate the tax amount they owe the South African Revenue Service (SARS); it will already be included in the sales price. For the tax policy to be convenient, it is recommended that suppliers or producers should pay the taxes to SARS.
- The Economic Efficiency Principle – A tax will be economically efficient if it does not unduly influence the economic decision-making of taxpayers. Despite the aforementioned, a tax policy that is not economically efficient is not necessarily negative if it meets the objective of the proposed tax policy. The objective of the GMO tax is to change consumer behaviour in order to reduce medical costs associated with nutrition-based diseases. Therefore, the GMO tax will be economically inefficient by design in order to unduly influence decision-making in line with the aim of the policy.
- The Administrative Efficiency Principle – The tax system should not be complicated and costly from an administrative perspective for taxpayers and SARS. To achieve this, GMO tax policy rules should be well written and fairly simple to follow. Documents (hard copy or online) that need to be completed should be easy to understand and comply with. SARS should be able to know if taxes are paid on time and if the correct amount is paid, and they should also be able to perform audits efficiently. The cost of collecting taxes should be minimal compared to the revenue collected.
- The Simplicity Principle – The GMO tax should be simple. This principle interacts with the Administrative Efficiency principle, i.e. if the tax is simple then it will not be administratively burdensome to comply with. To implement this principle, it is

recommended that suppliers and producers should be liable for paying the GMO taxes to SARS. It is likely that there are fewer suppliers and producers than consumers, and the former are likely to have controls already in place to track sales of products; thus they will only need to amend their existing controls to be in line with the new GMO taxes.

The priority of application of these principles depends on the objective of the tax policy to be achieved. The hierarchy of the principles is as follows:

1. Economic efficiency: The key aim of the policy is to change consumer behaviour, thus this principle will take precedent over the Equity principle. Although the tax may be regressive, the aim of changing consumer behaviour is more important.
2. The other principles (Convenience, Certainty, Administrative Efficiency and Simplicity) are equally important, as erosion of these principles may cause a non-achievement of the key policy objective.

To ensure that the tax principles are applied and the tax policy objectives are achieved, the following GMO tax is proposed (African Centre for Biosafety [ACB], 2015; Consumer Protection Act; 68:2008; ECSIP Consortium, 2014; Manyema *et al.*, 2014; National Treasury, 2013):

- a. The proposed tax base

The tax base plays a vital role in the success of any tax policy. When setting a tax base, the objective of the tax policy should be kept in mind. Table 10 shows some of the types of food that contain GMOs (see section 3.3). GMOs are included in a wide range of foods. An efficient tax requires that the tax base should be sufficiently wide to cover all unhealthy foods, including GM foods, as is practically feasible. Research has shown that GMOs have adverse health impacts (see section 3.1). In order to meet the objective of discouraging consumers from consuming GMO foods, the GMO tax base should be carefully formulated to include all foods and drinks containing GMOs.

Currently the GMO content contained in most of the consumed food in South African is unknown due to the lack of labelling by producers. Currently the Consumer Protection Act (68/2008) requires that foods containing at least 5% of GM content should have this information disclosed on the packaging. The labelling requirements only require products to have the following words displayed: “contains GMOs”, “produced using gene modification” or “may contain GMOs”. The exact GMO content is not required to be disclosed. As a complement to a GMO tax, labelling requirements will have to be aligned with the formulated tax base. This will facilitate the determination of the tax liability. More rigorous regulation of labelling requirements will also empower consumers to make better-informed decisions when purchasing food.

Due to the absence of labelling requirements, formulating the tax base for GMOs might be a challenge. Organisations such as the ACB have performed tests on South Africa’s staple foods, namely maize meal and bread. These tests indicated that 20% to 90% of these products consist of GMOs.

Most of the foreign food taxes are based on weight/volume. In Hungary (the country with the greatest reduction in consumption) the tax base was also based on the weight/volume of the tax product. It is therefore recommended that the tax base of GMOs should be based on percentage content of GMOs in the foods.

b. The proposed tax rate

An efficient and effective GMO tax should aim for comprehensive coverage with minimum exclusion and exemptions. It should be applied at a rate which is equivalent to the marginal social damage costs, although these costs are difficult to estimate. The GMO tax should attempt to reflect the cumulative external costs. Using 2013 prices, medical costs associated with nutrition-based diseases in South Africa were estimated to be between R7.4 billion and R21.3 billion (Manyema *et al.*, 2014:2).

The aim of a GMO tax is to correct the prices of existing GM foods that cause nutrition-based diseases. The absence of international GMO taxes might influence the recommended effective level of GMO tax. It has been suggested that the rate of food taxes should be relatively high to have a significant impact on consumption of the taxed foods. The literature review conducted shows that the tax rate and consumption are negatively correlated. Experts have suggested that the tax rate should be at least 20% to have a significant impact on public health (see Chapter 2). It is therefore recommended that 20% be used as the base percentage. This base should then be adjusted to reflect the external costs, which should be internalised by adjusting prices to reflect the social costs of nutrition-based diseases.

The tax rate should be equivalent to the marginal external costs of adverse health effects associated with GM food consumption. Due to the absence of global pricing and labelling requirements for GM foods, a modest tax rate should be proposed. It is therefore recommended that the tax rate be 20% of foods in which the GM content is above 5%. The tax rate should be increased annually by the inflation rate until the rate reflects the social damage costs of nutrition-based diseases.

While exemptions narrow the tax base and are therefore not advisable, consideration could be given to exempting those foods with GMO content that are considered to be unimportant from a health perspective. This will also assist in managing the regressivity of the tax and may encourage manufacturers to reduce the GMO content of their food in order to manage costs and improve profitability.

c. Educational programmes

Based on the literature review performed, research has shown that food taxes are most effective when combined with educational programmes (see Chapter 2). It is therefore recommended that the tax policy should be complemented by educational programmes. This will empower consumers to make better-informed decisions with reference to a comparative analysis of the adverse effects of GMOs and alternatives on health.

The proposed GMO tax policy attempts to incorporate a broad policy framework to identify nutrition-based diseases caused by unhealthy food, which includes GM foods, as a public concern. The next section presents a conclusion and recommendation on the proposed GMO tax policy.

3.6 CONCLUSION AND RECOMMENDATION

The research objectives of this study are:

- Conduct a literature review on the health impact of SSBs, fats and GMOs.
- Conduct a literature review on the measures governments use to change consumer behaviour.
- Conduct a literature review on using taxes to change consumer behaviour.
- Conduct a literature review on SSB, fat and GMO taxes in foreign countries.
- Conduct a literature review on the attributes of SSB taxes and fat taxes in foreign countries.
- Based on a critical analysis of the frame of reference created by conducting a literature review, draw a conclusion on the implementation and design of GMO taxes.

The literature review conducted suggested that foods high in fat and SSBs and food containing GMOs are detrimental to health. The literature review also suggested that food taxes do change consumers' behaviour by reducing the consumption of the taxed products. Consequently, it can be deduced that food taxes may play a role in altering consumption of unhealthy food, such as food containing GMOs. GMOs have been linked to adverse health consequences and weight gain and no country has implemented a GMO tax to deal with unhealthy food consumption.

GMOs are included in a variety of foods. Thus it may be beneficial to South Africa to implement a food tax on GMOs to deal with the excessive consumption of unhealthy food. This food tax should be combined with educational programmes on the health impact of consuming GMOs, as well as subsidies on healthy food.

3.7 FUTURE RESEARCH

This study was limited to taxation as a government policy to combat excessive consumption of unhealthy food. Possible future research could be conducted on other government policies to combat consumption of unhealthy food. Other future research could include the impact of food taxes on public health.

3.8 CONCLUDING REMARKS

There is no doubt that an intervention is needed to deter consumers from eating GMO foods. Taxation is one solution and has proved to be successful in other countries. In order to improve public health, the taxation of unhealthy foods should have a wide tax base to ensure that all unhealthy foods are covered. While the South African government is still considering a possible solution to nutrition-based diseases, consumers need to be educated on the dangers of GMO foods. This can be achieved by regulations that prescribe labelling requirements and education road shows on GM foods, presented by the Department of Health (DOH).

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