Dietary Recommendations in the Report of a Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases (WHO Technical Report Series 916, 2003):

Potential Impact on

Consumption, Production and Trade of Selected Food Products

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Executive Summary

- The report investigates the potential impact of WHO/FAO norms with respect to fat, protein and sugar intake on the consumption, production and trade of selected food products – meats, dairy products & eggs, vegetable oils & animal fats and cereals. A programming approach is used to predict how country-level food consumption, as described by the FAO's nutritional balance sheets, would have to adjust in order to meet the WHO/FAO norms.

- A similar study on the potential impact of WHO/FAO norms on the sugar economy was previously done by the same authors.[***]

- The results demonstrate that forty-nine countries are in excess of the thirty percent upper limit set by the WHO/FAO for the share of total energy intake from fat, while the norm on protein intake is rarely violated. Most of the countries violating the norm with respect to fat energy intake are either developed countries of the Western hemisphere and Oceania, or Eastern European countries.

- The analysis of consumption impacts in this study is based on average national food intakes. However, even in countries which are currently in conformity with the norms on average, large segments of the population might be consuming fats in excess of the recommended norms. The study does not take into account the adjustment in consumption patterns required for these segments of the population.

- Analysis of the consumption impacts reveals that the adjustments necessary to adhere to the norms are substantial. The general direction of the change is a shift away from human consumption of meats, vegetable oils, eggs and dairy products towards consumption of more cereal-based products, pulses, fruits and vegetables.

    - The aggregate impact on meat consumption is a decrease of almost six million tons due primarily to reductions in demand for meat in the US, France and Germany. However, all meats are not affected equally: the negative impact on pig meat consumption is largest at five million tons representing more than sixteen percent of current consumption in the group of countries violating the WHO/FAO norms. The negative impact on consumption of mutton and goat meats is also substantial in relative terms, while the estimated impacts on poultry and beef consumption are small.

    - The model suggests that adherence to the WHO/FAO norms would depress demand for dairy products. While milk consumption would be marginally affected, butter and cream consumption would decline by thirty-five and twenty-five percent of their current levels in the group of countries violating the norms, with North America and the EU accounting for the bulk of the decline.

    - The estimate of the consumption impact for animal fat is a decrease of 1.3 million tons representing thirty-one percent of current consumption in the group of countries violating the WHO/FAO norms, with the US, France and Germany accounting for most of the reduction.

    - The calculated consumption impacts of the norms for all oils are negative and range from thirty to thirty-five percent of their original levels for the group of countries violating the

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[**] The Study was sponsored by the International Federation of Agricultural Producers and the Institute of European Food Studies.

[***] Irz, X (2003). *Impact of WHO Dietary Recommendations on World Sugar Consumption, Production and Trade.* Report prepared for the World Sugar Research Organisation.

norms. The contraction in volume is largest for soybean oil at 2.7 million tons, followed by rapeseed oil and sunflower oil. Almost half of the total reduction would come from the US, with Germany, France and Italy also reducing their consumptions of vegetable oils sharply.

- The calculated increase in human consumption of cereals following the introduction of the norms amounts to 30 million tons. However, once the reduction in demand for feeds related to the decrease in meat consumption is netted out, the growth in demand for cereals due to the WHO/FAO norms becomes marginal (five million tons).

- The production and trade impacts differ across products but in some cases are found to be large; hence, in many countries, the WHO/FAO norms have significant implications for farm incomes and farmers' livelihoods.

- Large decreases in production and trade of vegetable oils would result from implementation of the WHO/FAO norms but the impacts vary greatly for different types of oils:

  - Production of soybean oil would decrease by almost three million tons or eleven percent worldwide, with US producers bearing the bulk of the adjustment, but international trade in soybean oil would only be marginally affected by the WHO/FAO norms.
  - Production of rapeseed oil would shrink by one million tons or seven percent worldwide, and EU producers would be the most adversely affected. International trade in rapeseed oil would decrease by fourteen percent.
  - Palm oil production would only be marginally affected with Malaysia and Indonesia accounting for most of the 220,000 tons worldwide reduction.

- The analysis concludes that some meat producers would be negatively affected by the WHO/FAO norms:

  - The largest decline in production would occur in the case of pig meat at five million tons, which represents only a modest share of world production (five percent). However, the impact on individual countries would be large, with ten countries likely to incur reductions in production of more than twenty percent as a result of the norms. International trade in pig meat would also be affected negatively with a decline of nearly twenty percent. Countries like Brazil, Poland, Vietnam, Chile, Belarus, Ukraine, Thailand, Swaziland and Zimbabwe stand to lose a quarter to one-third of their exports of pig meat.
  - The calculated decrease in mutton and goat meat production is small at less than 400,000 tons or less than four percent of world production but here again the trade impact is much larger (seventeen percent).
  - Production of poultry meat would decline marginally (less than one percent) worldwide while production of beef would increase slightly (by less than four percent).

- The potential effect of the norms on dairy producers around the world is substantial:

  - The estimated impact on production of butter and ghee is a decrease of almost one million tons or thirteen percent of world production. Most affected are New Zealand, which loses almost half of its export market, the USA and the EU. Altogether, the volume of international trade in these products contracts by more than a third.
  - Cream production would shrink by half a million tons or eighteen percent of world production, mostly in the EU and North America. International trade in cream would decline by a third due to the implementation of the norms.

- Besides the effects of the WHO/FAO population nutrient goals evaluated in this report, consumer preferences for specific food products are also likely to be influenced by the references in the WHO/FAO report to the harmful effects of the intake of these products. These additional effects, however, are difficult to quantify. Yet, it is clear that these specific references to individual food items will be of great importance when countries set food-based (as opposed to nutrient-based) dietary guidelines. The potential impact of the WHO/FAO report on consumer preferences for individual food products could be large.

Introduction

In April 2003, The UN Food and Agriculture Organization (FAO) and the World Health Organization (WHO) launched an independent expert report on diet and nutrition, which is expected to serve as the basis for developing a global strategy to combat the growing burden of chronic diseases. *Diet, Nutrition and the Prevention of Chronic Diseases* (WHO: 2003), the report on a two-year-long Joint WHO/FAO Expert Consultation, reviews the currently available scientific evidence on the relationship of diet, nutrition and physical activity to chronic diseases. The report concludes that a diet low in saturated fats, sugars and salt, and high in vegetables and fruits, together with regular physical activity, will have a major impact on combating the high toll of death and ill health caused by cardiovascular diseases, several forms of cancer, diabetes, obesity, osteoporosis and dental disease. The dietary recommendations contained in the report are expected to play an important role in WHO's global strategy to combat chronic diseases. The report notes that chronic diseases are no longer rich country problems, but are increasingly occurring in the developing world.

WHO/FAO Dietary Intake Goals

The WHO/FAO dietary recommendations for combating chronic diseases specify the share of energy (calorie) intake that should be contributed by fats (and their various components), proteins and sugars. In addition they also prescribe certain absolute consumption levels for cholesterol, sodium chloride (salt), fruit and vegetables and dietary fibre. The range of population dietary intake goals contained in the WHO/FAO recommendations are summarised in Table-1 below. The norms recommended by the WHO/FAO have emerged after a wide-ranging consultation. However, these recommendations have led to a vigorous debate on the appropriateness of these norms for a wide range of populations in different countries and the extent to which these recommendations are based on definitive/conclusive scientific evidence.

Table-1: Ranges of Population Dietary Intake Goals

Dietary factor	Goals
Total fat	15-30% energy
Saturated fatty acids	<10% energy
Polyunsaturated fatty acids (PUFAs)	6-10% energy
n-6 Polyunsaturated fatty acids (PUFAs)	5-8% energy
n-3 Polyunsaturated fatty acids (PUFAs)	1-2% energy
Transfatty acids	<1% energy
Monosaturated fatty acids (MUFAs)	By difference [a]
Total carbohydrate [b]	55-75% energy
Free sugars [c]	<10% energy
Protein	10-15% energy
Cholestrol	<300 mg/day
Sodium chloride (sodium)	<5 g/day
Fruits and vegetables	>= 400 g/day
Total dietary fibre	From foods
Non-starch polysaccharides (NSP)	

[a] This means "total fat – (saturated fatty acids + polyunsaturated fatty acids + trans fatty acids)"
[b] The percentage of total energy available after taking into account that consumed as protein and fat, hence the wide range.
[c] The term "free sugars" refers to all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey syrups and fruit juices.
Source: (WHO: 2003)

The key recommendations relate to the share of total energy intake that should be obtained from fat, sugars and proteins. In the case of total fat, the norms are intended to prevent obesity and unhealthy weight gain and reduce the risk of certain chronic diseases. WHO/FAO reckon that highly active groups with diets rich in vegetables, legumes, fruits and whole grain cereals may sustain a total fat intake of up to 35% without the risk of unhealthy weight gain. The recommendations for total fat are formulated to include countries where the usual fat intake is typically above 30% as well as those where the usual intake may be very low, for example less than 15%. Total fat energy of at least 20% is consistent with good health. However, for countries where the usual fat intake is between 15% and 20% of energy, there is

no direct evidence for men that raising fat intake to 20% will be beneficial. For women of reproductive age at least 20% has been recommended by the Joint WHO/FAO Expert Consultation on Fats and Oils in Human Nutrition that met in 1993. The key reasons advanced for recommendation relating to sugar intake are (1) free sugars threaten the nutrient quality of diets by providing significant energy without specific nutrients (2) free sugars contribute to the overall energy density of diets and induce higher levels of energy intake and (3) increased consumption of free sugars is associated with increased problems of oral health, especially dental caries. The report, however, acknowledges that a goal for free sugars of less than 10% of total energy is controversial.

Objectives of the Study

The adherence to the WHO/FAO norms is likely to involve major changes in the dietary and food habits for the population in almost all the countries of the world. The precise nature and magnitude of the dietary adjustments will depend on how the recommendations of the WHO/FAO are taken forward through legislative, regulatory or information measures in different countries. While enforcement of dietary norms is generally difficult, consumer choice can be influenced through recommendations of health authorities and labelling requirements that may be put in place, e.g., labelling requirements related to sugar/fat content of processed foods. Major changes in consumption patterns are likely to have significant implications for the production and trade of food products, for the pattern of land use in agriculture and the environmental sustainability of food production. Policies designed to promote adherence to these norms will have to take into account the impact of these norms on agricultural producers worldwide.

This study, undertaken for the International Federation of Agricultural Producers, France, attempts to assess the potential impact of the implementation of the WHO/FAO norms on the consumption, production and trade of certain important food products, *viz*, cereals, meat, dairy products and vegetable oils. The study will mainly focus on the impact of the norms

relating to total fat consumption, though adherence to norms relating to protein and sugars will also be taken into account in assessing the impact on consumption of different food products. The key objectives of the study are the following:

1) Assessment of the current situation of developed and developing countries with respect to these norms. Our analysis will quantify the extent of excess consumption of fat in these countries.

2) Quantitative assessment of the impact of adherence to WHO/FAO norms on the consumption of the selected food products by country and region.

3) Qualitative assessment of the impact of WHO/FAO norms on production and trade of the selected food products following from the changes in consumption predicted in the second step of the analysis.

Methodology Overview

The assessment of the current situation of countries with respect to the WHO/FAO norms will be attempted using food balance sheet data contained in the FAOSTAT Nutrition database (FAO: 2001). In countries where the current consumption of fat exceeds the recommended norm, we will estimate the dietary changes required to adhere to the norms for fat, sugar and proteins[1]. Fats are derived from a large number of food products and, therefore, a large number of diets that conform to the norms are theoretically possible. We propose to use a programming approach to predict the changes in consumption of selected food products most likely to occur if consumers were to adhere to the WHO/FAO norms. Given the persistence of dietary patterns and preferences, our analysis will assume that in adjusting their consumption of food products to adhere to these norms, consumers will prefer to modify their current diet as little as possible.

[1] The norms related to various sub-components of fats (e.g. saturated and unsaturated fats) are not explicitly considered in our programming model. However, we do check whether the recommended dietary patterns that result from our model are in conformity with the norms for different subcomponents of fats.

The production and trade impacts of consumption changes will depend on the policy responses of different countries relating to imports and support for domestic production. Faced with large changes in consumer demand for certain products (say for instance, a sharp decline in consumption), countries could choose policies that protect domestic production and only reduce imports. Alternatively, they could choose a policy mix that affects both domestic production and imports. We will evaluate the production impact under the assumptions that (1) when net importing countries are faced with a decline in consumption, they will first reduce imports and attempt to protect domestic production to the extent possible (2) when net exporting countries are faced with a decline in consumption, there will be corresponding decline in their production (i.e., it will not be possible for net exporting countries to increase their exports in a situation of declining international trade). While these assumptions are not entirely realistic, especially in the context of the provisions of the WTO Agreement on Agriculture for liberalisation of agricultural trade, these assumptions are likely to give us the "upper bound" estimates of trade impacts.

This study is based on average food consumption data aggregated at the national level. Changes in dietary patterns required for conforming to WHO/FAO norms are estimated only for those countries, which are currently exceeding the fat consumption norms, *on average*. As we shall see later these countries are mainly developed countries. Diets and energy/nutrient intake in these countries could vary significantly across different socio-economic and demographic groups. The estimates of changes in consumption required, based on *average* intakes, could be biased downward if there are large groups in the population whose intake is considerably higher than the average. Using consumption data for the United Kingdom for different income groups, we will assess whether this downward bias is likely to be significant.

It must be noted that even in countries that are currently in conformity with the norms on average, there may be large sections of the population whose consumption patterns are not in conformity with the recommended norms. Our study does not attempt to estimate the

adjustment in consumption required by these sections of the population in "conforming" countries. However, the "double burden of malnutrition" in developing countries, where malnutrition co-exists with excess consumption of nutrients and resulting obesity is now recognised in the literature (Gillespie and Haddad: 2003).

Our objective in the study in the study is to produce "quick" estimates of the consumption, production and trade impacts and indicate the direction of change and broad orders of magnitude. We have, therefore, not attempted an econometric estimation of the impacts, owing to constraints of time and data availability.

Review of Current Levels of Fat Consumption

The principal WHO dietary norm of relevance to this study concerns the share of fat in total energy intake – the fat to energy ratio (FER). The norm requires this to be in the 15% to 30% range. Using the FBS dataset for 2000, we calculated the current status in each of the 173 countries in the dataset. This information is presented in regional format in Figure 1 below, and in detail in Appendix 1, in descending order of FER. Appendix 1 shows forty-nine countries (in red) are in excess of the 30% upper limit, while 20 countries (in blue) are below the 15% lower limit. There is a clear and unsurprising pattern in the ordering of the list. Most of the 49 countries with Fat Energy Ratios greater than 30% are either developed nations of the western hemisphere and Oceania, or East European countries[2].

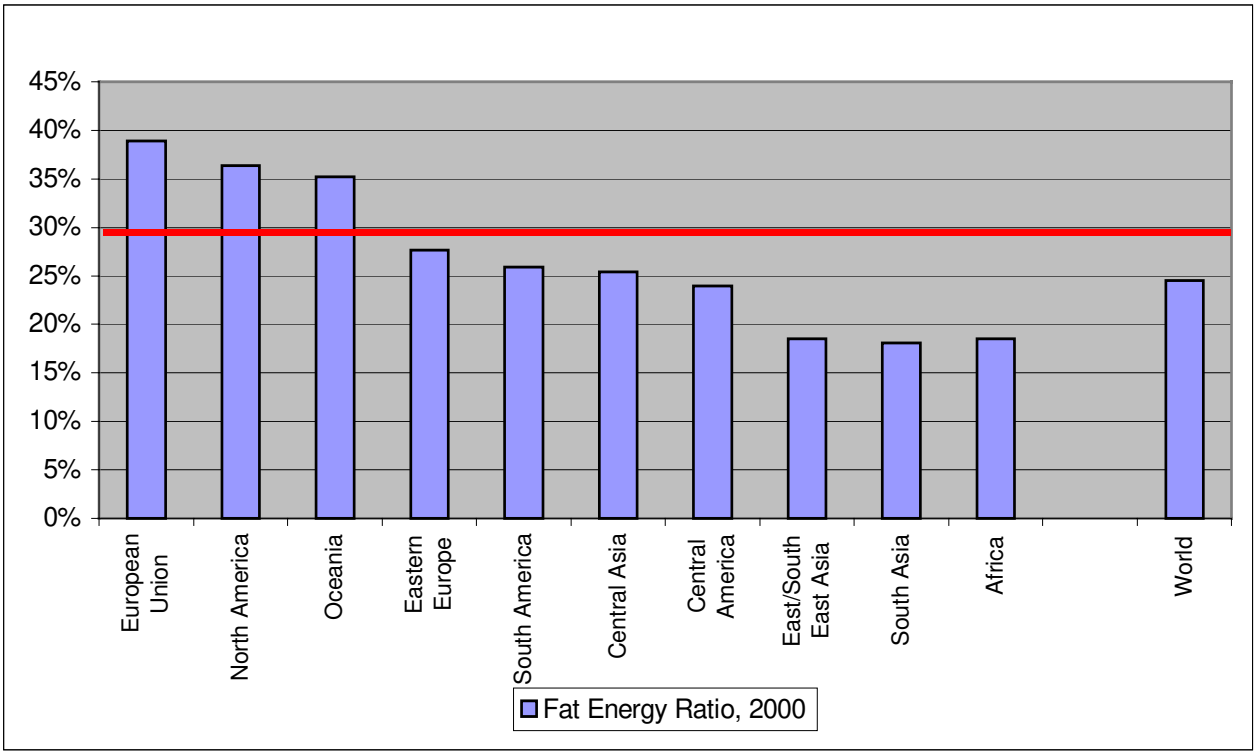
Clearly, although the fat composition of diets in several developing countries has been increasing over time as per the WHO/FAO report, most developing countries are still below the 30% benchmark[3]. Developing countries with relatively large populations and large economies, such as India, China and Brazil, are in the 'acceptable' 15 to 30% range. The 20

[2] There are also a number of small island-states (Bermuda, French Polynesia, Fiji, etc.) in this group of 49, possibly reflecting their inability to produce diversified items for their diets given their land and natural resource constraints, and their limited capacity to import.

[3] Of course, there are the occasional exceptions such as Mongolia and Paraguay, where dietary preferences, climatic factors and resource endowments cause local diets to be centred on animal products. Diets in these countries are therefore relatively high in fat composition in spite of the underdeveloped status of these countries.

countries below the minimum 15% mark are predominantly poor countries with relatively small economies.

Figure 1: Share of Fat in Total Energy Intake, All Countries 2000



Our ultimate objective in this study is to analyze the potential production and trade impacts of adherence to the new WHO norms, and the analysis of consumption changes is a first step towards that goal. Since the countries below the 15% mark are mostly relatively small economies that are small players in the world market, we ignore the changes implied by these countries raising their fat intakes to the recommended 15%. In other words, we focus exclusively on the changes implied by countries *above* the norm adjusting their dietary patterns to meet the recommendations. From this list of countries (red in Appendix 1), we also drop very small nations (such as Bermuda, Kiribati, Seychelles, etc - red but non-bold in appendix 1) that are unlikely to have a major impact on global production and trade patterns. The remaining 35 countries (red **and** bold in Appendix 1) are retained for analysis. They comprise mostly West European and North American countries, but also include a number of

middle-eastern and East European countries. Since many of the largest economies in the world are represented in this list, significant changes in their consumption patterns to meet the WHO norms are also likely to have significant implications for international trade as well as producers around the world.

Consumption Impacts

Data

The assessment of changes in consumption across the world in response to the hypothetical implementation of new WHO guidelines requires cross-country consumption data that are recent and consistently defined across countries. Ideally, data collected from dietary surveys, such as the National Diet and Nutrition Survey in the UK, and the National Health and Nutrition Examination Survey in the US, would form the basis of such analysis. However, such surveys are only available for a limited number of countries, and even those are subject to wide differences in definitions and data collection methodologies. Hence, we adopt FAO's Food Balance Sheet (FBS) dataset as the basis for this work.

The FBS dataset records the sources of supply of major foods in each country and their utilization. On the supply side, it accounts for production, imports and changes in stock during the year. On the utilization side, it records exports, livestock and feed uses, use in manufacture for food use and non-food uses and losses during storage and transportation, thereby arriving at estimates of food supplies available for human consumption[4]. Thus, it provides estimates of 'supplies available for per-capita consumption' rather than registering actual household consumption itself. Its prime advantages from the point of view of this study are its international coverage, its consistency of definitions, categories and data across countries, and its ready availability. In addition to food balances itself, the FBS also provides estimates of per capita calorie, fat and protein intake deriving from each food category, which is of considerable help to this study. On the other hand, a major disadvantage in using the FBS dataset for our exercise is that food supplies available for per-capita consumption do not

[4] FAO (2001): Food Balance Sheet Explanatory Notes: http://www.fao.org/waicent/faostat/agricult/fbs-e.htm

always reflect actual consumption accurately. For example, household waste and spoilage is not accounted for in these data, and the nutrient calculations do not take account of the transformation of nutrient composition during the process of cooking. Another disadvantage is that the FBS data only present an average picture, not capturing the heterogeneity inherent in diets within a country. When we extrapolate from these average figures for a country to the entire country, some inaccuracies can arise. For instance, using the average per capita food supplies in a country one may find that a dietary norm is not violated, and proceed to apply this result for the entire country. However, it may well be that certain sections of the population (for example, people in certain income groups or belonging to a certain ethnic classes) have diets that violate the norms, but this is not reflected when extrapolations are made from the average.

In spite of these drawbacks, it is our opinion that the FBS data do provide a good basis for rough and ready 'big picture' international comparisons. It has been put to such use previously in the WHO/FAO report under consideration, previous FAO documents (FAO: 1994), as well as academic research[5]. We make note of the inherent deficiencies, and move on to discussion of methodology.

Methodology

While the existing baseline consumption and nutrition patterns are available for each country from the FBS, we need to simulate the changes that would occur if countries around the world were to adhere to the new WHO/FAO guidelines. Mathematical programming is one way to estimate plausible reformulations in diets in response to nutritional constraints, and is the approach adopted here.

[5] For example, Guo, X, *et al.* (2000).

Mathematical programming has a long history in the analysis of human diets[6]. Linear programming (LP) models, typically involving minimization of costs while meeting specific nutritional requirements, have been constructed for several countries. A variety of approaches have been taken, based on various underlying assumptions. For instance, some studies restrict themselves to the problem of providing adequate nutrition at minimum cost, with no palatability considerations, while others build in extensive information on palatability and substitutability between specific foods.

Alternatives to LP models include multiple-objective programming and goal programming, where several considerations relating to diets are optimized simultaneously. Another approach is that of quadratic programming (QP), where deviations from actual consumption levels are minimised while satisfying nutritional considerations[7]. This approach is based on the paradigm that consumer preference and palatability considerations are manifested in the observed food choice. Radical changes from the observed choices are unrealistic, and hence deviations from the original diet are made as small as possible when estimating the new diet that meets the nutritional constraints.

QP is the technique used in this study. One reason for adopting this specification is its intuitive appeal, described above. Another consideration is the lack of availability of detailed cross-country price information to cost diets, due to which model specifications based on diet costs are ruled out. Whilst recent food price data are readily available for some countries, such as the USA and the UK, they are far more difficult to obtain for many other countries under consideration. Given the QP model formulated here completely abstracts from prices, there is some comfort to be taken in knowing that, since the new diet is chosen to deviate

[6] In fact, diet optimization was one of the early uses to which linear programming techniques were applied, when the US Army attempted to formulate diets that would meet nutritional requirements of GIs at minimum cost.

[7] This was the basis for the United States Department of Agriculture's 'Thrifty Food Plan', which informs the Food Stamp Program.

minimally from observed diets, the cost of the new diet is unlikely to stray radically from the observed one.

The QP model constructed can be informally described as below:

Objective function: Minimise the weighted sum of squared deviations between the components of the new diet and the observed one (the weights being the contributions of the food products to the total energy intake).

Choice variables: The new diet, *i.e.*, new per-capita consumption quantities for each food item in the FBS.

Constraints:

(a) Total fat to energy ratio (share of energy derived from fat in the total supply of energy in kcal) does not exceed 30%.

(b) Total protein to energy ratio (share of energy derived from protein to the total supply of energy in kcal) does not exceed 15%.

(c) Total sugar to energy ratio (share of energy derived from sugars and sweeteners to the total supply of energy in kcal) does not exceed 10%.

(d) Consumption of alcoholic beverages should not increase compared to the observed baseline.

(e) Total energy in kcal should not decline relative to the observed baseline.

The following points are worth noting:

(i) As is usual in quadratic programming, the sum of squared deviations is minimised instead of the sum of the deviations themselves, in order to prevent a 'cancelling out' effect. Deviations are expressed in percentage terms. This prevents an unnatural situation where items that are consumed in relatively small amounts at the baseline expand or contract in large percentage terms when the diet is reformulated.

(ii) Constraints (a), (b), and (c) are the principal dietary guidelines contained in the WHO/FAO report.

(iii) Constraint (d), although not formally a part of the WHO guidelines, is included in order to prevent the obviously undesirable new diet outcomes that may emerge if

alcoholic beverages are allowed to freely expand within new diets. Such expansion is particularly likely if alcoholic items are unconstrained, since they typically are a source of calories with relatively modest fat content.

(iv) Constraint (e) appears so that the changes in the diet can be solely attributed to the imposition of the WHO/FAO guidelines. In the absence of this constraint, *i.e.* if calorific reductions are allowed, it would become harder to attribute changes in diets solely to the guidelines. Additionally, changed diet scenarios involving significant reductions in energy intake are also unrealistic.

(v) Some sub guidelines included in the FAO report are not explicitly included in the optimization model here. The most important among these is the requirement that saturated fats provide no more than 10% of the total energy intake. The primary reason for the omission of a saturated fat constraint here is data non-availability. The FBS dataset provides estimates of energy, total fat, protein and carbohydrate contents of each food item, but does not break those figures down into sub-categories such as saturated fat. Of course, nutrient content databases, such as the USDA's nutrient calculator are available, listing the nutritional composition (including saturated fat content) of individual food items. However, the FBS dataset is composed of food categories that are aggregated from individual food items. It does not provide break-ups of the categories into individual food items, thus making it impossible to accurately match FBS and nutrient content databases[8].

Nevertheless, it is recognized here that the saturated fat guideline is an important one. Hence, although an explicit constraint is not included in the QP model for saturated fat, we perform informal checks for estimated saturated fat content of the revised diets produced by the QP model. We do this by matching each FBS food category with a representative food item in USDA's nutrition database, and using the saturated fat levels given by the latter. Although

[8] For instance, the FBS dataset includes an item called 'Bovine Meat' and provides information on consumption, calories, fats, etc derived from this category. However, there are hundreds of individual food products that make up 'bovine meat' and the breakdown used to construct the aggregate is not available. These individual food products vary widely with regard to saturated fat content.

our derived saturated fat estimates for each FBS food category are too approximate and informally derived to be worthy of inclusion in our formal modelling, they are still viewed as useful in making *ex-post* informal checks.

Results

Dairy & Animal Fat Products[9]

An aggregated summary of the consumption impacts on dairy and animal fat products is presented in Figures 2 and 3. Milk is by far the most important dairy item in terms of volume of consumption, with more than 200 million metric tons of milk currently being consumed across the 35 countries studied. Somewhat surprisingly, the reduction in milk consumption predicted by the model is small enough to be negligible, 0.02% of current levels in the set of countries analysed[10].

There are several good reasons for this. Firstly, note that the fat content of milk is typically small compared to the fat content of other dairy products such as butter, ghee and cream[11]. Increasing proportions of globally consumed milk volumes are low fat or skimmed. Secondly, while our modelling predicts significant consumption reductions for some large consumers of milk, such as France and Italy (consumption reductions of 1.2 million tons each), it also predicts increases in milk consumption in some countries such as Argentina, Australia and Belgium. Thirdly, note that our estimates refer only to the consumption of milk itself, and not products based on milk. If other dairy products were converted into their milk equivalents, the impacts on milk would be more pronounced. However, we analyse other dairy products separately from milk in this document.

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[9] Raw animal fats have been grouped together with dairy products here for convenience.

[10] Note that the percentage reductions referred to here are relative to the baseline consumption in the 35 countries above the total fat benchmark, *not* relative to world consumption.

[11] The fat content per unit of butter can typically be expected to exceed the fat content of an equivalent unit of milk (in weight) by a factor of 20 to 30.

Figure 2: Changes in Milk Consumption (35 Countries)

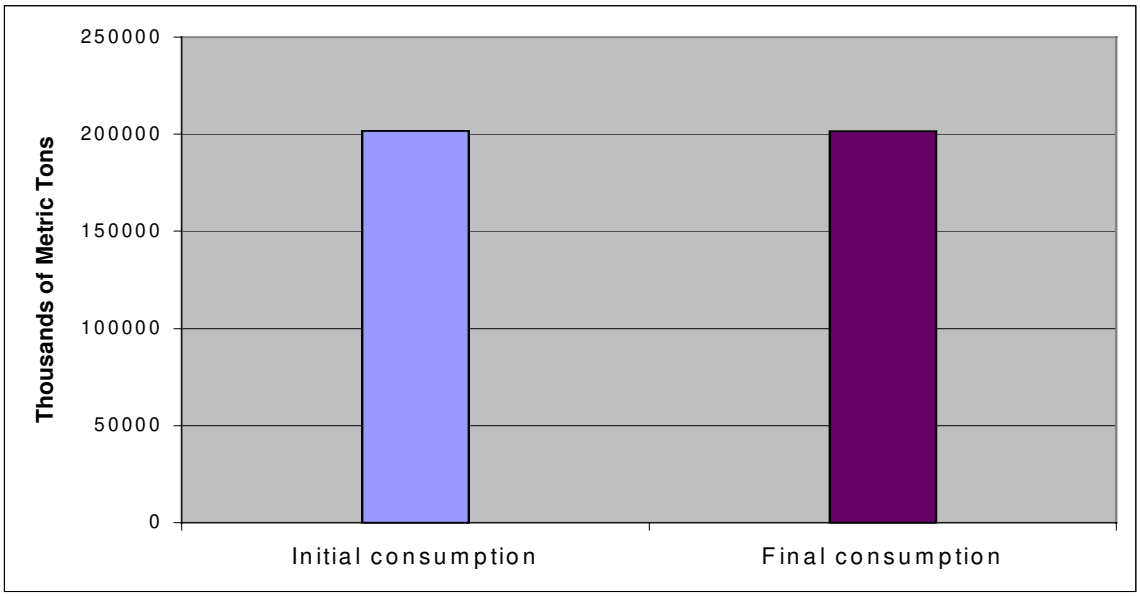
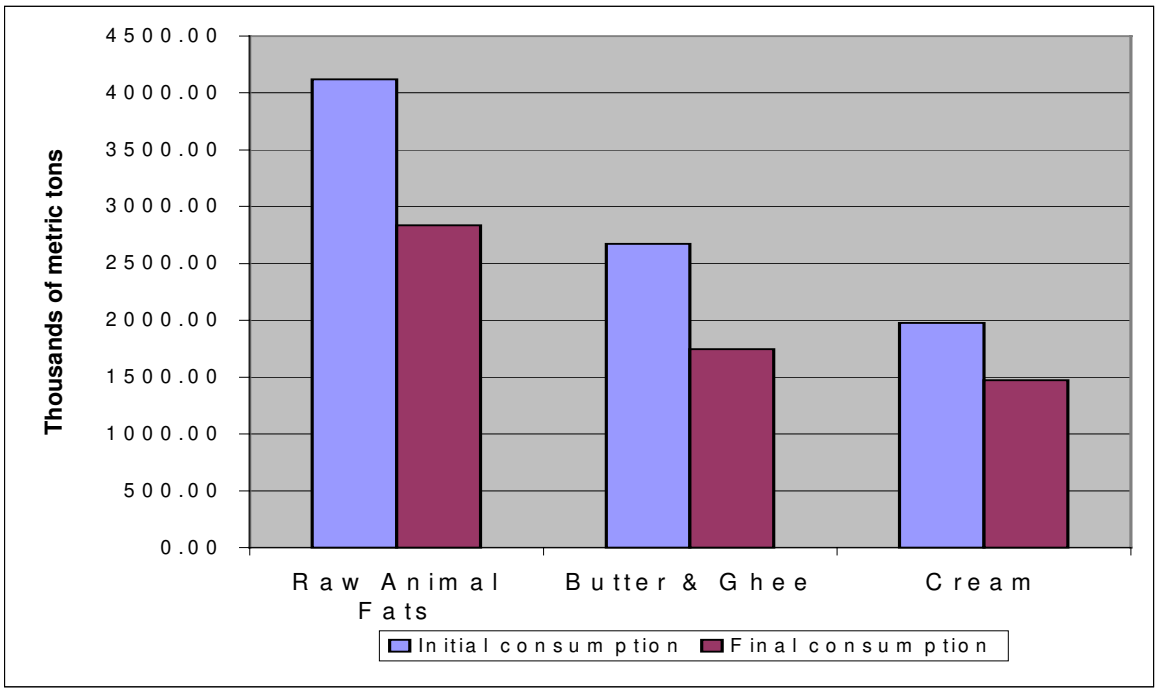
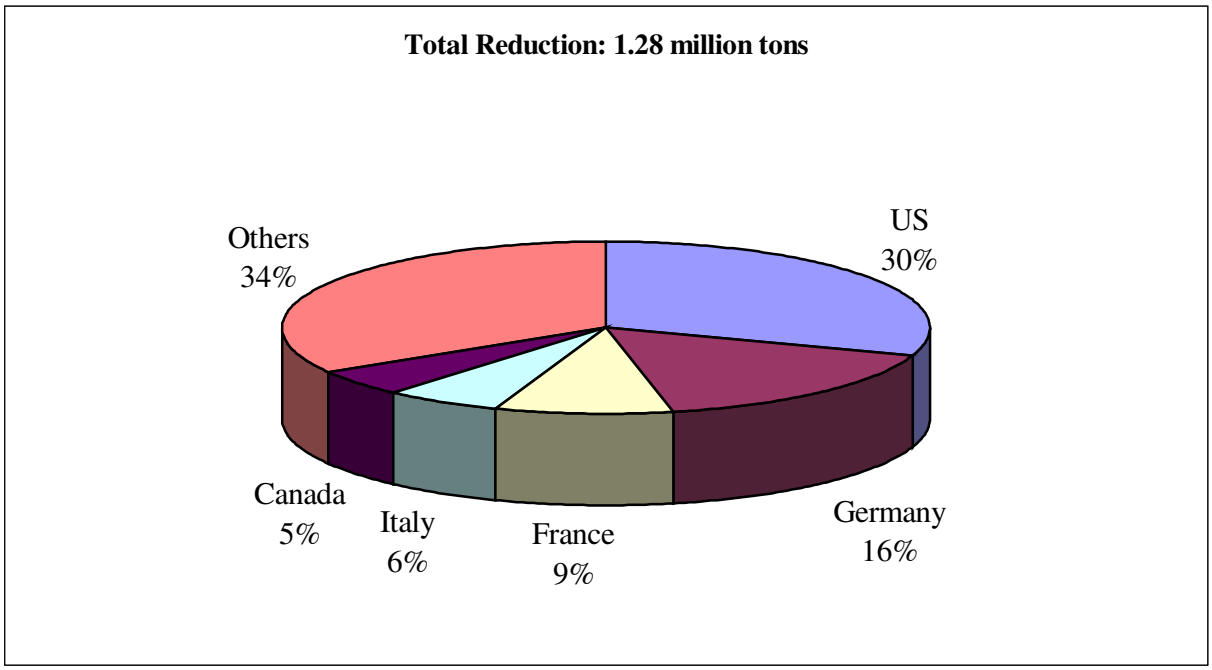


Figure 3: Changes in Consumption of Dairy Products & Animal Fats



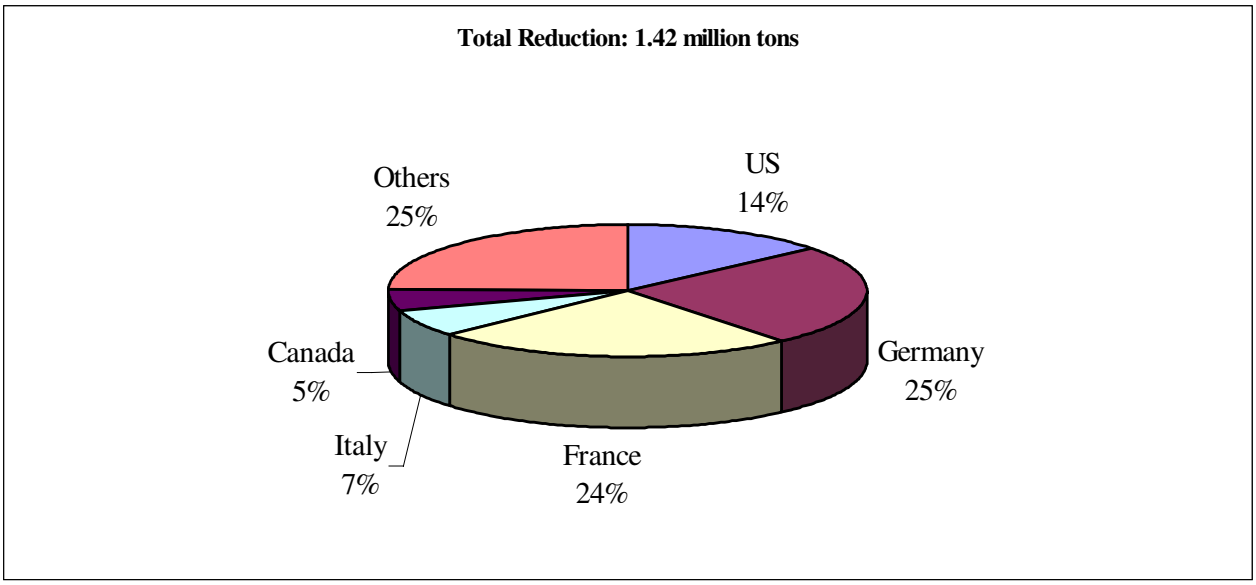
Total consumption of raw animal fats is seen to decline considerably, by some 1.3 million tons, or about 31% of current consumption in the countries analysed. This volumetric decline is large particularly considering that two of the largest animal fat consumers, India and China, are unaffected by the WHO norms. The country-wise break-up is shown in Figure 4 below. Almost a third of the predicted reduction comes from the consumption adjustment of another very large consumer of animal fats, the USA, while Germany and the US together account for almost half of the predicted reduction.

Figure 4: Reduction in Consumption of Animal Fats



Consumption of dairy products apart from milk (butter, ghee and cream aggregated together) is seen to decline in the 35 countries by 1.42 million tons. The decline in butter & ghee consumption is more pronounced at 35% than that for cream, at 25%. As in the case of animal fats, half of this reduction derives from only two large consumers, in this case, France and Germany (Figure 5). This significant decline computed for butter, ghee and animal fat volumes is in spite of some of the largest consumers in the world not being affected by the WHO norms – for example, India accounts for almost 2 million tons, more than 30% of total world consumption.

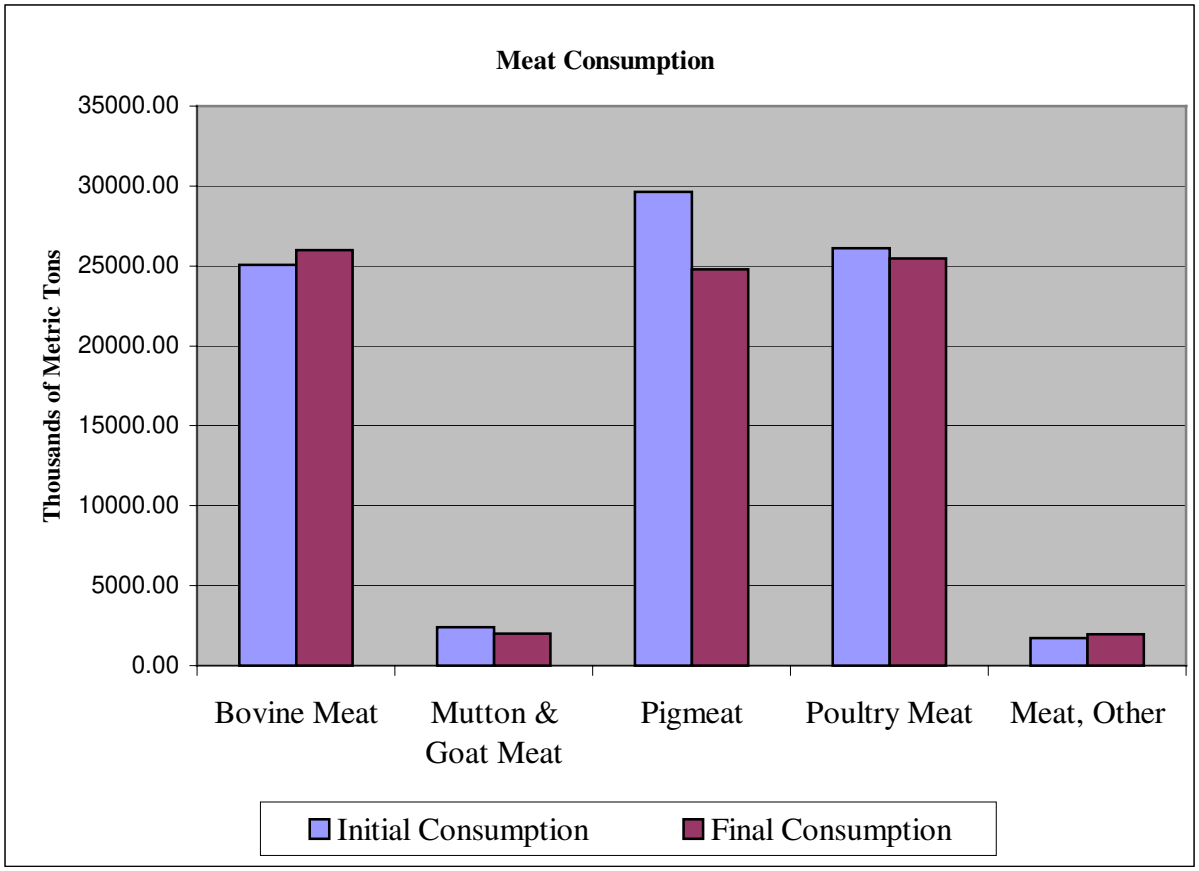
Figure 5: Reduction in Consumption of Dairy Products



Meats

About 85 million tons of meat were consumed across these countries in the year 2000. Pig meat was the largest constituent, at 29 million tons of consumption, while poultry and bovine meats were almost as important, at 26 and 25 million tons each. Mutton, goat and other meats were relatively minor, making up the remaining 4 million tons. Our modelling revealed an asymmetric consumption change across these categories, however (Figure 6 below). Pig meat consumption registered a significant drop in response to adherence to the WHO norms, declining by a little less than 5 million tons, or 16.3%. Mutton and goat similarly declined by about 16% of their original, relatively modest levels. However, there was only a small effect on world poultry consumption, with consumption shrinking by 646,000 tons, or 2.4% of original intake in the 35 countries. Surprisingly, meat from bovine sources was predicted to increase in consumption by 916,000 tons.

Figure 6. Changes in Consumption of Meats (35 Countries)

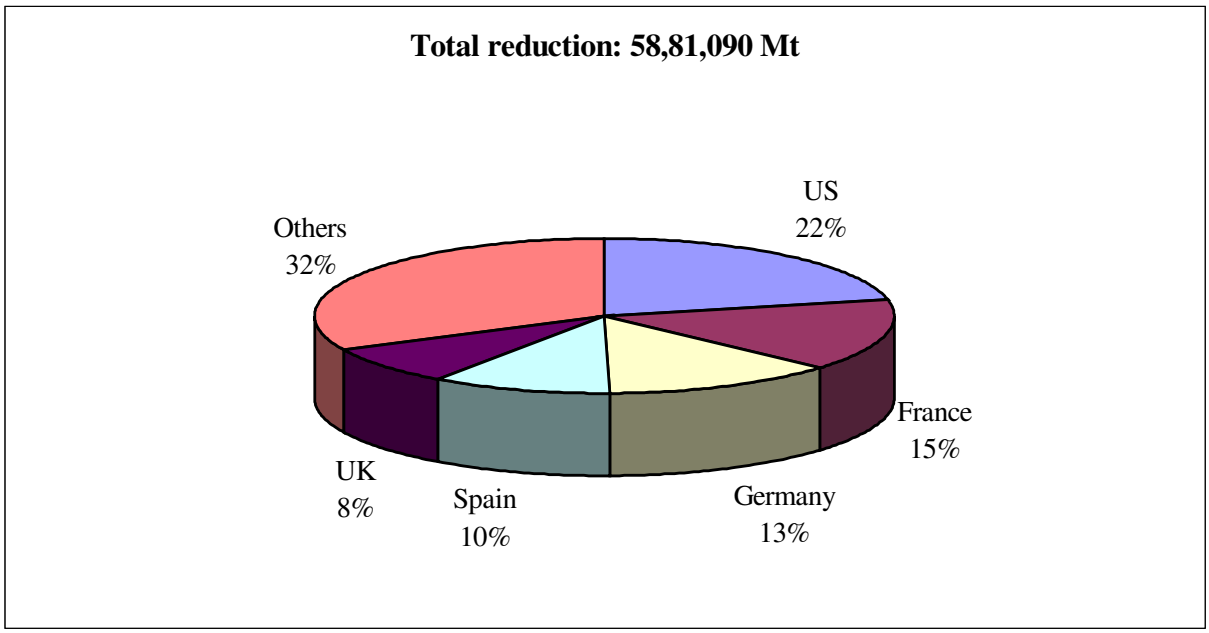


This seemingly curious result is explained by the fact that the fat content per (weight) unit of bovine meats, is *on average*, significantly lower than that for pig meat. Thus, although certain individual items under bovine meat may contain high levels of fat, the average of all the consumed bovine meat items has lower total fat content than the average for pig meat and mutton/goat items. Since meats are substitutes for each other, and are all significant providers of total energy and protein, the model predicts that many countries attempting to adhere to the WHO norms would substitute lower fat meats for higher fat meats in their diets. To take one example, our model predicts that Australia's pig meat consumption would contract by 84,000 tons, while its bovine meat consumption would expand by 8,000 tons

We now restrict our attention to the meat products that are predicted to experience reduced consumption, i.e., pig, poultry and mutton/goat meat, and consider them in an aggregated fashion. The total reduction in the consumption of these meats is about 5.8 million tons. The

US, France and Germany account for half of this reduction (Figure 7), while Spain and the UK also experience significant declines. If the total reduction in meat consumption volumes appears more modest than expected, it is primarily due to the absence of China from the countries taken to be affected by the WHO norms. China alone consumes 41 million tons of pig meat a year, which is a little less than half of world consumption. It also accounts for almost a tenth of world bovine meat consumption and a fifth of poultry consumption.

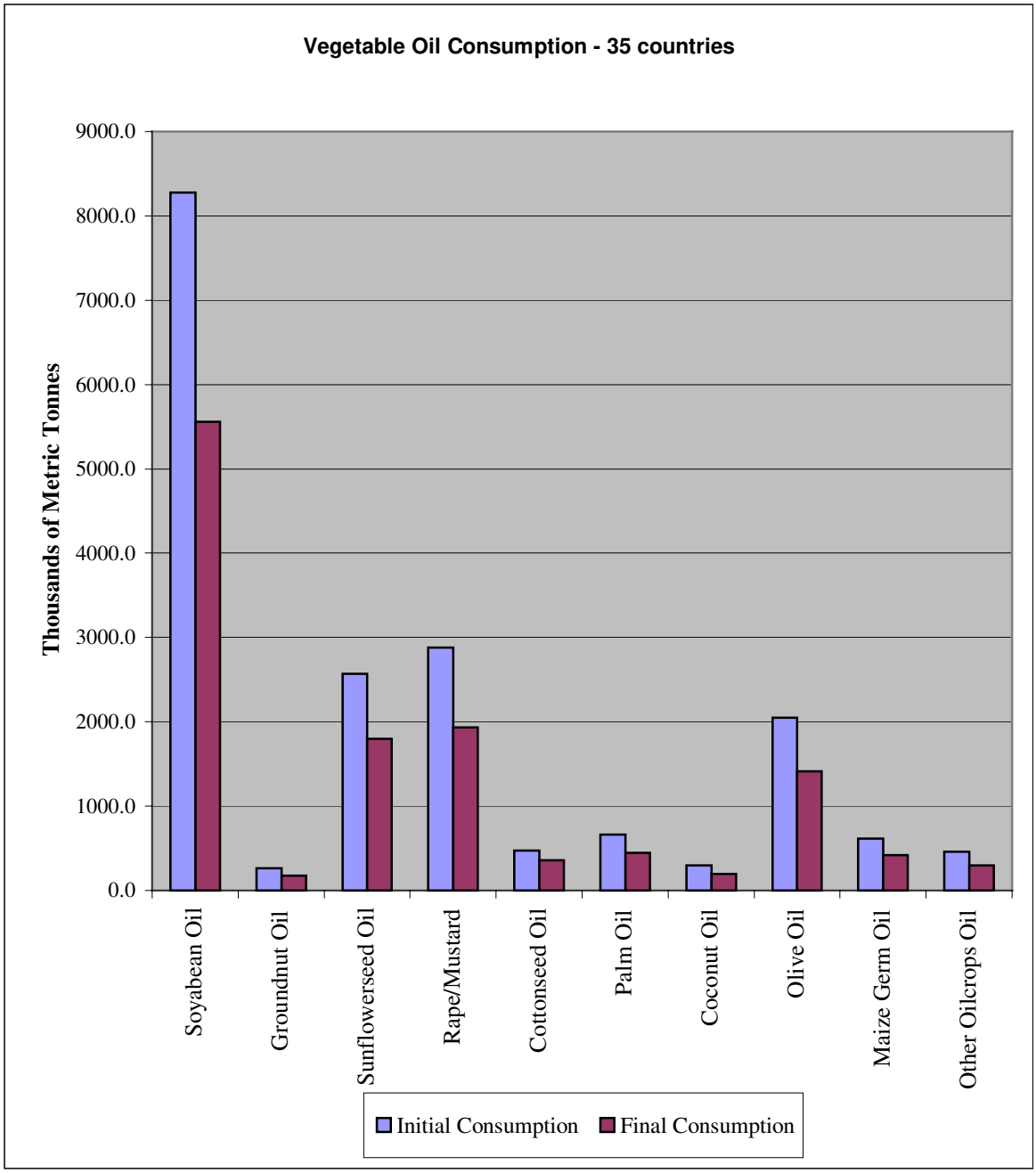
Figure 7: Reduction in Mutton, Pig and Poultry Meat Consumption



Vegetable Oils

Since oils are relatively high in fat content and are consumed in significant quantities across the world, significant reductions of oil consumption in response to adherence to WHO norms might be expected. Although the saturated fat content of various oils can differ significantly (with Palm and Coconut Oils at the top of the saturated fat content list), the total fat composition per unit varies much less across various vegetable oils. Accordingly, our model predicts significant and fairly even reduction (in percentage terms) of vegetable oils across the board. As illustrated in Figure 8, all vegetable oil categories are forecast to experience a drop in consumption of 30 to 35% for the set of countries analysed.

Figure 8. Changes in Consumption of Vegetable Oils

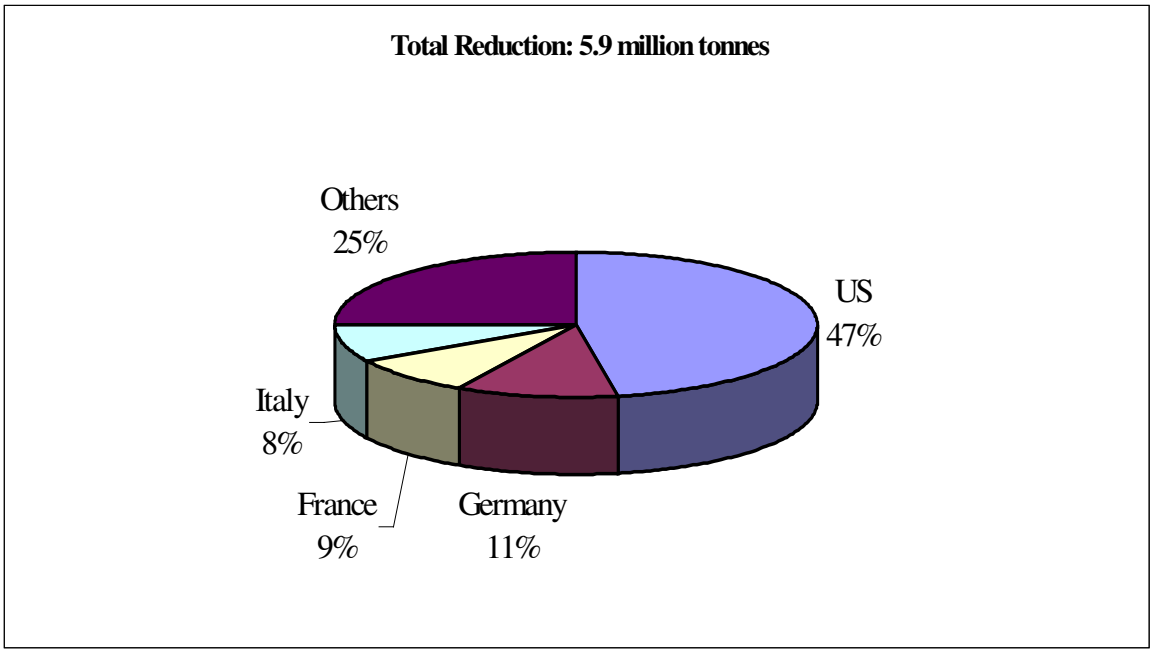


Soybean oil is the most consumed vegetable oil in the set of countries analysed and its current consumption of 8.2 million tons in the 35 countries is predicted to contract to 5.5 million tons. Of this 2.7 million ton reduction in global soybean oil consumption, 2.1 million tons would come from the US alone. Other prominent oils in this set of countries are sunflower oil, olive oil and rape/mustard oil. These oils are commonly consumed in the EU, and the source of the reduction in their consumption is therefore also mostly the EU. Rape/Mustard

oil consumption is predicted to shrink globally by 943,000 tons, while sunflower and olive oils contract by 770,000 and 631,000 tons respectively. Some oils such as palm and coconut oils are primarily consumed in the developing world. With the majority of developing countries not being part of the 35 countries above the WHO fat energy ratio norm, palm and coconut oils appear only as a minor item in the consumption analysis here. Their baseline consumption in the 35 countries is low, and although their percentage reduction compared to baseline is similar to the other oils, it is a relatively small reduction in volumetric terms (219,000 tons for palm oil and 97,000 tons for coconut oil).

The country wise break-up of aggregate vegetable oil consumption reduction is shown in Figure 9. The bulk of the reduction in total consumption comes from the US, with Germany, France and Italy contributing smaller fractions.

Figure 9: Reduction in Consumption of Vegetable Oils



Cereals

When diets are reformulated so that countries currently above the fat guidelines are brought in line with the norms, products with relatively high fat content will naturally be substituted for by those with lower fat content. It is also worth remembering that, in accordance with

intuition, our model is formulated to minimise deviations in percentage terms from existing diets. Cereals, as good providers of energy at low fat content, and already constituting significant portions of existing diets in the analysed countries, are obvious candidates to replace the declining dairy, oils and meat product demand described above.

The model does indeed predict very significant gains to the cereal sector. Global wheat consumption alone is predicted to increase by 25 million tons. Maize, barley, rye, oats, millet and sorghum jointly contribute another 4 million tons to bring the global increase in cereal demand predicted by the model to 29 million tons.

A 29 million ton increase in cereal consumption would appear to constitute a very significant boost for this sector. However, it is important to note one aspect that shows this increase to be illusory: changes in final demand for some products may also generate changes in intermediate demand for some other commodities. For instance, the calculated decrease in meat consumption would result in a decrease in demand for animal feeds (mainly cereals). This effect is likely to be large because about half of world cereal production is consumed by non-food uses (FAOSTAT). It is important to calculate such effects and adjust the demand change figures for cereals accordingly.

In order to measure the final effect of the WHO norms on demand for cereals, we applied a methodology previously used by FAO (Bouwman: 1997). First, the change in demand for animal products was converted into a change in 'feed intensity weighted livestock production', denoted ΔLP, by applying the following formula: $\Delta LP=0.3(\Delta beef+\Delta mutton) + 0.1(\Delta milk)+1.0(\Delta pork+\Delta poultry+\Delta egg)$ where Δx represents a change in final demand for livestock product x[12]. This change in demand for livestock products was then converted into a change in demand for cereals by using an appropriate feed intensity coefficient. Because almost all of the countries where final demand for livestock products decreases as a result of

[12] The total decrease in demand for milk was computed by first converting variations in demand for cream and butter into their milk equivalents.

the WHO norms are high-income countries, we used the feed intensity coefficients reported by Bouwman (1997) for developed countries[13].

The calculated decline in feed demand for cereals is large and equal to 25 million tons for the world. This decrease almost nullifies the calculated increase in human consumption of cereal of 29 million tons. Hence, the analysis demonstrates that implementation of the WHO norms would have a large negative effect on total demand for livestock products in many countries while total demand for cereals would remain relatively unaffected. A similar quantitative exercise was carried out for roots & tubers as well as oilseeds. It revealed that the 'feed effects' of the WHO norms were relatively small for these products and we therefore choose not to report them.

Consumption Impacts: Saturated Fat Concerns

In the preceding analysis of consumption impacts, our QP model's constraints related to energy, total fat, protein, sugar and alcohol. The new WHO guidelines include a specific saturated fat component, specifically that saturated fats should provide no more than 10% of total energy intake. As discussed before, the main reason for omitting an explicit saturated fat constraint has been data non-availability, specifically the unavailability of information on what individual food items in what quantities comprise FAO's aggregate food category consumption figures in each country.

Without the disaggregated data, it is impossible to ascribe saturated fat estimates for inclusion in the model. However, in recognition of the importance of the saturated fat constraint, we do an *ex-post*, informal check of approximate saturated fat composition of the reformulated diets produced by the model. We do this by matching the aggregate food category with one particular disaggregated food item belonging to that category, and using the saturated fat estimate for that disaggregated item. Obviously, the reliability of this method is far better when there are not too many items that fit under a particular aggregate category. For instance,

[13] The feed intensity coefficients reported are 3.6 for cereals, 0.6 for roots and tubers and 14 for oilseeds.

the category of eggs has limited variants, but a category such as bovine meat involves numerous constituents.

Using these proxy saturated fat numbers, we calculated the saturated fat to energy ratios for the reformulated diets of 5 countries with relative fat-intensive diets. The results were as follows: France: 9%, US: 9%, UK: 10%, Spain 8%, Germany, 10%. Thus, there is at least weak evidence available to suggest that the reformulated diets estimated by our QP models for each country do broadly meet the WHO saturated fat constraints.

Consumption Impacts: Distributional Concerns

One remaining concern is that we are using population average dietary figures to make extrapolations to changes in aggregate consumption, production and trade in countries. Where these mean figures disguise substantial variation within the population, there is scope for extrapolations from the mean to be misleading. For instance, the average household in a certain country may have a diet that already conforms to the WHO guidelines. If we extrapolate from this average household to the entire country, we would conclude that no consumption changes need take place in that country in response to WHO guidelines. However, households in lower or higher income categories (the tails of the distribution) may indeed have diets that do not conform to the guidelines. Extrapolations from the mean would miss out the needed consumption changes for these households.

This issue cannot be tackled without detailed dietary survey data for each country, broken down into various categories. This is simply not available on an international basis, and thus this concern cannot be tackled here. We did check survey results from one country for which such detailed results are indeed available: the UK. Results from the National Food Survey 2000, documents from which are archived at the UK Department of Environment, Food and Rural Affairs website, show that there is little evidence to indicate that the fat composition of diets varies by income groups in the UK. Thus, although there is little we can do about addressing these distributional issues here, they may equally not be a significant concern for many countries.

Production and Trade Impacts

The analysis of the consumption impact of the WHO/FAO norms demonstrated that these norms would, in many instances, have a profound effect on final demand for agricultural commodities. These changes in demand are bound to affect agricultural production and trade as well as farm income throughout the world and it is these effects that we now aim to quantify.

Methodology

The assessment of the production and trade impacts of the WHO guidelines is to some extent more complex than that of the consumption impacts because markets for primary agricultural commodities are, as a rule, strongly distorted. Almost all developed countries protect their agricultural producers while many developing countries, in the contrary, tax agricultural production as a way of raising revenue. This is relevant because it means that a change in food consumption in a particular country can affect producing countries in a variety of ways, depending on the policy response that this change in demand is likely to induce. Hence, both the competitive position of countries and the process by which they formulate agricultural policies should ideally be taken into account when quantifying the production and trade impacts of the WHO norms. One can illustrate this idea by considering the policy options that would be available to the EU following a sharp decline in domestic consumption of dairy products. Reducing production quotas would restore the equilibrium but that measure would harm EU producers and therefore generate political opposition. The EU could also consider increasing its export subsidies to the dairy sector, which would limit the impact of the demand change on domestic producers at the expense of non-EU producers exporting their dairy products to the world market or competing domestically with EU dairy products. The EU could even decide to administratively reduce imports of dairy products in order to adjust total supply to the depressed level of demand, which would again have a negative effect on non-EU exporters.

As our study considers a large number of countries and a large number of commodities, however, it is not realistically possible to capture accurately the endogenous nature of

agricultural policies. Simplifications are therefore necessary and our simulations are based on the following assumptions:

a. If demand for a particular agricultural commodity decreases in a net exporting country, domestic production in that country adjusts by the same amount.

b. If demand for a particular agricultural commodity declines in a net importing country, the country responds solely by reducing imports. However, if the decline in demand exceeds total imports, the difference is accounted for by a decrease in domestic production.

c. The total decrease in imports calculated from application of assumption (b) above is then allocated to exporting countries based on their shares of world exports of that particular commodity.

Assumption (a) is based on the idea that exporting countries facing a decrease in domestic demand for their products would also struggle to find new export markets given that the WHO/FAO norms would reduce global demand for the commodity considered. In importing countries, however, it is likely that a decrease in demand for a product would result in increased protectionist pressure originating from domestic producers seeing their livelihoods threatened and, ultimately, in a decline in imports achievable by the introduction of new trade barriers. This is all the more realistic that, as established in the first part of the report, a vast majority of the countries experiencing declines in food consumption as a result of the WHO norms belong to the developed world where farmers are politically powerful. Assumption (c) simply aims to take into account the competitive position of exporting countries based on their past export performances. Note, however, that this assumption is somewhat restrictive in that it implies that the trade patterns of the countries reducing their imports of a particular commodity are identical to those of countries not reducing their imports of that commodity[14]. This assumption was made because bilateral trade data were simply not available for all the commodities considered in this study[15].

[14] That is, if country A accounts for n% of world exports of a given commodity, we also assume that it accounts for n% of total exports to the subset of countries reducing their imports of that commodity.

[15] More precisely, we initially tried to use the FAO's world agricultural trade matrix in order to get an accurate representation of the bilateral trade flows of agricultural commodities. However, this data set proved grossly inconsistent with FAOSTAT data and the FAO warns that its coverage is only partial ('the detailed data

Results

Meat

Bovine Meat

World production of bovine meat was estimated at 59.8 million tons in 2000. Of this, the countries that are currently above the WHO/FAO fat consumption norm accounted for 25.07 million tons. Our results show that in these countries, consumption of bovine meat is likely to increase by 3.65% to 26 million tons. This is mainly on account of the movement away from meats like pig meat and mutton/goat meat, which, on average, have a much higher fat content. As our model predicts a marginal increase in consumption of bovine meat in the "adjusting" countries, we have not attempted a more detailed country-by-country analysis of production and trade impacts for bovine meat.

Pig meat

The impact of adjustment to WHO/FAO norms on the production of pig meat is summarised in Table-2. The table shows the impact on production of pig meat in the top 20 countries faced with the largest decline in production.

contained here include only those provided electronically by countries', see website at http://www.fao.org/es/ess/watm.asp)

Table-2: Decrease in Pig Meat Production - Top 20 Countries and World

Country	Production (000 MT)	Decline in production (000 MT)	Percentage decline in production
United States of America	8597.00	1072.31	12.47%
France	2312.00	738.88	31.96%
Spain	2912.39	608.59	20.90%
Denmark	1624.50	439.63	27.06%
Netherlands	1622.80	399.90	24.64%
Germany	3981.90	320.44	8.05%
Canada	1640.54	291.54	17.77%
Belgium	1065.40	249.13	23.38%
Serbia and Montenegro	655.40	131.19	20.02%
Hungary	640.98	109.66	17.11%
Austria	624.00	106.93	17.14%
Australia	362.86	84.65	23.33%
Switzerland	225.07	51.60	22.93%
Brazil	1887.80	49.57	2.63%
Ireland	226.40	35.06	15.49%
Finland	172.79	34.46	19.94%
Poland	1923.00	25.07	1.30%
Viet Nam	1409.02	24.08	1.71%
Norway	102.91	23.88	23.20%
Czech Republic	416.60	15.04	3.61%
World	**89534.90**	**4851.94**	**5.42%**

Total world production of pig meat in 2000 was estimated at 89.53 million tons. Implementation of the norms is likely to lead to a 5.42% (4.85 million tons) decline in total world production. The largest decreases in production are expected to occur in the United States, Canada and European countries. It must be noted that with a production of 41 million tons, China accounts for nearly 46% of total world production of pig meat, but is not a major net exporter. China is not currently above the norm for fat consumption and is, therefore, not required to reduce its consumption of pig meat. The impact of the norms on pig meat production will appear to be much higher (about 10%) if we consider world production excluding China. The top 20 countries faced with the largest production impact are likely to experience a 15% decline in production. A few countries, which are not currently above the fat consumption norm (and consequently do not have to make any adjustments in

consumption), also experience production declines on account of reduction in consumption by developed countries. These countries are Brazil, Poland and Vietnam. The decline in production in these countries is relatively small (<3%) in relation to their existing levels of production but constitutes a much larger proportion of their exports. The impact of the norms on international trade in pig meat is much larger and the trade impacts are summarised in Table-3.

Table-3: Pig Meat – Trade Impact

Exports-Top 20 Countries and World				**Imports-Top 20 Countries and World**			
Country	**Export Qty (000 MT)**	**Decline in exports (000 MT)**	**Percentage decline in exports**	**Country**	**Import Qty (000 MT)**	**Decline in imports (000 MT)**	**Percentage decline in imports**
Denmark	1223.52	378.56	30.94%	Germany	869.523	419.81	48.28%
Netherlands	879.65	250.86	28.52%	Italy	870.518	374.34	43.00%
Belgium	682.47	187.25	27.44%	United Kingdom	701.099	348.79	49.75%
Canada	595.74	169.74	28.49%	Greece	226.623	56.33	24.85%
Spain	405.54	98.02	24.17%	Sweden	57.595	38.15	66.24%
Brazil	153.28	49.57	32.34%	Portugal	112.696	35.96	31.91%
U.S.A.	580.12	46.90	8.08%	Switzerland	17.154	17.06	99.47%
Hungary	150.64	38.49	25.56%	Czech Republic	20.125	13.05	64.86%
France	552.26	32.81	5.94%	New Zealand	17.228	10.08	58.53%
Poland	117.86	25.07	21.28%	Argentina	62.79	8.40	13.37%
Ireland	115.84	24.95	21.54%	Slovakia	15.532	8.27	53.23%
Viet Nam	74.21	24.08	32.44%	Bulgaria	7.385	7.10	96.19%
Chile	17.17	4.70	27.37%	Latvia	6.869	4.27	62.14%
Belarus	20.90	4.05	19.38%	Slovenia	15.737	2.94	18.70%
Ukraine	13.17	3.59	27.28%	Serbia	5.844	1.86	31.90%
Austria	118.38	3.22	2.72%	Croatia	23.033	1.04	4.51%
Thailand	7.53	2.41	31.98%	Norway	2.423	0.37	15.23%
Swaziland	4.19	0.92	21.97%	Dominican Rep	1.27	0.33	26.23%
Australia	40.98	0.83	2.03%	Paraguay	0.278	0.28	100.00%
Zimbabwe	2.48	0.80	32.40%	Lebanon	6.857	0.12	1.75%
World	**6952.12**	**1348.59**	**19.40%**	**World**	**7016.04**	**1348.59**	**19.22%**

The implementation of the norms is likely to lead to a reduction of 19% in international trade in pig meat. The reduction of imports by countries currently above the fat consumption norm could lead to loss of export markets not only for developed countries in North America and Europe but also for a number of developing countries. Countries like Brazil, Poland, Vietnam, Chile, Belarus, Ukraine, Thailand, Swaziland and Zimbabwe stand to lose a quarter to one-third of their exports of pig meat. This illustrates the potential knock-on effects of a reduction in consumption in developing countries on the exports of developing countries.

Mutton and Goat Meat

The impact of WHO/FAO norms on the production of mutton and goat meat is summarised in Table-4.

Table-4: Decrease in Mutton and Goat Meat Production - Top 20 Countries and World

Country	Production (000 MT)	Decline in production (000 MT)	Percentage decline in production
Australia	690.575	141.08	20.43%
New Zealand	534.285	86.91	16.27%
Spain	251.132	52.60	20.94%
United Kingdom	359	48.86	13.61%
Mongolia	120	14.00	11.67%
Ireland	82.9	11.21	13.52%
Serbia and Montenegro	23.734	4.67	19.66%
Bulgaria	58.9	4.19	7.11%
Netherlands	18.6	3.91	21.00%
Uruguay	51	3.29	6.46%
Norway	23.759	3.20	13.46%
India	696.2	2.37	0.34%
Hungary	7.54	1.10	14.53%
Sudan	261	1.04	0.40%
Argentina	59.002	0.88	1.49%
Chile	16.487	0.76	4.63%
Pakistan	506	0.66	0.13%
Macedonia	4.5	0.41	9.02%
Iceland	9.735	0.27	2.73%
Ethiopia	61.56	0.23	0.38%
World	**11057.759**	**382.88**	**3.46%**

World production of mutton and goat meat was estimated at 11.05 million tons in 2000. Implementation of the norms is likely to lead to a 3.46% decline in world production. 35 countries are required to adjust consumption in order to adhere to the norms and these countries account for 27% of world production. The top 20 countries faced with the largest decline in production are likely to experience a production decline of nearly 10%. The adverse impact on production is somewhat mitigated by the fact that some of the largest producers of mutton and goat meat are countries like China, India, Iran, Pakistan and Turkey, which are not required to adjust their consumption to adhere to the recommended norms. Nevertheless, production impacts are felt by several developing countries as a result of reduction in consumption in the "adjusting" countries. These developing countries are Chile, India, Ethiopia, Macedonia, Pakistan, Sudan and Uruguay. The production impacts in these countries are not large in relation to their current levels of production. But the trade impacts for these countries are more significant. The trade impacts are summarised in Table-5.

Table-5: Trade Impact on Mutton and Goat Meat

Exports-Top 20 Countries and World				**Imports-Top 20 Countries and World**			
Country	**Export Qty (000 MT)**	**Decline in exports (000 MT)**	**Percentage decline in exports**	**Country**	**Import Qty (000 MT)**	**Decline in imports (000 MT)**	**Percentage decline in imports**
New Zealand	380.058	74.80	19.68%	France	170.432	50.09	29.39%
Australia	310.692	61.91	19.93%	U.S.A.	60.409	23.32	38.60%
Ireland	52.63	10.18	19.34%	United Kingdom	108.88	20.06	18.42%
Uruguay	16.508	3.29	19.96%	Greece	18.625	17.90	96.12%
India	11.903	2.37	19.95%	Italy	24.976	15.73	62.96%
Sudan	5.22	1.04	19.96%	Germany	40.545	15.16	37.38%
Bulgaria	5.3	1.04	19.58%	Belgium-Lux	29.079	4.05	13.94%
Netherlands	12.285	0.95	7.70%	Canada	16.278	3.85	23.65%
Spain	15.217	0.83	5.43%	Portugal	10.421	3.43	32.90%
Chile	3.944	0.76	19.37%	Switzerland	8.278	2.54	30.70%
Pakistan	3.303	0.66	19.89%	Austria	1.937	1.89	97.68%
Macedonia	2.044	0.41	19.86%	Sweden	3.562	1.09	30.64%
Iceland	1.333	0.27	19.96%	Denmark	5.304	1.01	19.12%
Ethiopia	1.162	0.23	19.96%	Norway	0.873	0.86	98.40%
Moldova	1.153	0.23	19.96%	Israel	1.082	0.41	38.19%
Turkey	1.017	0.20	19.88%	Finland	1.126	0.28	24.96%
Mongolia	0.77	0.15	19.96%	Czech Republic	0.19	0.19	100.00%
Namibia	1.796	0.14	8.01%	Argentina	1.659	0.14	8.20%
Hungary	0.526	0.08	14.65%	Lebanon	0.636	0.05	8.20%
Slovakia	0.339	0.07	19.90%	Paraguay	0.045	0.045	100.00%
World	**957.787**	**159.76**	**16.68%**		**904.993**	**159.76**	**17.65%**

Table-5 shows that international trade in mutton and goat meat is likely to decline by 17% consequent to the implementation of the norms. France, US, UK, Greece, Italy and Germany will have to make the largest cuts in their imports. Several developing countries – Uruguay, India, Sudan, Chile, Pakistan, Macedonia, Ethiopia, Moldova, Turkey and Namibia stand to lose as much as 20% of their export markets.

Poultry Meat

The production impacts on poultry meat are summarised in Table-6. World poultry meat production in 2000 was estimated at 68.3 million tons and the implementation of the norms is expected to lead to reduction of 1% in world production. The marginal impact on production of poultry meat is largely attributable to the fact that the total projected decline in consumption in the "adjusting" countries is estimated to be only 2.5%. Besides, several large poultry meat producers like Brazil, China, India, Japan, Mexico and Thailand (which collectively account for 35% of world production) are countries which are below the fat consumption norm and consequently are not required to adjust their consumption.

Table-6: Decrease in Poultry Meat Production – Top 20 Countries and World

Country	Production (000 MT)	Decline in production (000 MT)	Percentage change in production
United States of America	16415.60	312.78	1.91%
France	2219.70	139.51	6.29%
Australia	643.24	66.36	10.32%
Italy	1088.80	35.65	3.27%
Brazil	6124.75	28.68	0.47%
Netherlands	754.00	14.56	1.93%
Canada	1064.43	11.56	1.09%
Thailand	1220.19	10.45	0.86%
New Zealand	106.73	9.69	9.08%
Hungary	470.03	8.55	1.82%
Denmark	201.70	5.26	2.61%
Serbia and Montenegro	88.60	5.04	5.68%
Paraguay	58.26	2.80	4.80%
Belgium-Luxembourg	407.23	1.75	0.43%
Ireland	116.28	1.15	0.99%
Poland	626.40	0.86	0.14%
Chile	378.11	0.73	0.19%
Ecuador	148.21	0.12	0.08%
El Salvador	47.60	0.11	0.23%
Turkey	660.92	0.07	0.01%
World	**68,347.61**	**646.27**	**0.95%**

The trade impacts on poultry meat are summarised in Table-7. The impact on international trade in poultry meat is also marginal with an expected decline of 2% in world trade. The percentage decline in several of the top 20 importing countries (faced with the largest decline in imports) is quite high, but the overall impact on international trade is limited because these countries collectively account for only 18% of the world trade. The impact on the exports of developing ("non-adjusting" countries) is also very limited (<2%).

Table-7: Poultry Meat – Trade Impact

Imports-Top 20 Countries and World				**Exports-Top 20 Countries and World**			
Country	**Export Qty (000 MT)**	**Decline in exports (000 MT)**	**Percentage decline in exports**	**Country**	**Import Qty (000 MT)**	**Decline in imports (000 MT)**	**Percentage decline in imports**
United States of America	2889.33	85.74	2.97%	**United Kingdom**	405.46	52.17	12.87%
Brazil	961.13	28.68	2.98%	**Canada**	127.26	43.08	33.85%
France	797.26	19.24	2.41%	**Spain**	100.33	28.61	28.52%
Netherlands	750.92	16.71	2.23%	**Germany**	449.53	21.75	4.84%
Thailand	350.37	10.45	2.98%	**Portugal**	14.98	8.95	59.75%
Belgium-Luxembourg	326.08	5.97	1.83%	**Italy**	78.71	6.61	8.40%
Denmark	129.52	3.17	2.45%	**Greece**	47.15	6.23	13.21%
Hungary	118.16	2.91	2.46%	**Serbia and Montenegro**	5.99	5.26	87.83%
Poland	46.47	0.86	1.85%	**Dominican Republic**	2.20	1.83	83.00%
Chile	24.81	0.73	2.95%	**Slovenia**	5.53	1.61	29.13%
Australia	20.09	0.59	2.94%	**Czech Republic**	17.69	1.52	8.57%
Israel	8.51	0.25	2.98%	**Finland**	4.04	1.39	34.56%
Ireland	64.60	0.13	0.20%	**Slovakia**	9.13	1.22	13.31%
Ecuador	4.87	0.12	2.38%	**Latvia**	17.51	1.07	6.11%
El Salvador	4.55	0.11	2.37%	**Bulgaria**	23.31	1.00	4.27%
Turkey	3.75	0.07	1.83%	**Austria**	39.54	0.25	0.63%
Costa Rica	3.03	0.07	2.20%	**Paraguay**	0.28	0.24	84.15%
Croatia	3.72	0.04	1.19%	**Lebanon**	2.07	0.13	6.35%
Zimbabwe	1.12	0.03	2.86%				
New Zealand	1.02	0.02	1.66%				
World	**8609.45**	**175.90**	**2.04%**	**World**	**7499.69**	**175.90**	**2.35%**

Dairy Products, Animal Fat and Eggs

Butter & Ghee

Table-8 shows the world production impacts for butter (and ghee). The world decline amounts to 917,700 metric tons, or 12.5% of total world production. Some countries are predicted to feel the burden of this decline very sharply – New Zealand's butter production shrinks by almost 60%, while Australia and Ireland stand to see their butter production

almost halved. There are two contributory factors to this. Firstly, adherence to the new WHO norms would imply a significant reduction in current butter consumption, and therefore production, in these countries. Secondly and more importantly, three major net importers of butter, UK, France and Germany, would need to slash their imports drastically, contributing to a decline in exports and therefore production for major exporters such as New Zealand and Ireland.

Table-8: Decrease in Butter & Ghee Production - Top 20 Countries and World

Country	Reduction in Production (MT)	Percentage reduction in production
New-Zealand	201930	59
USA	176195	30
France	86763	19
Australia	80958	48
Ireland	64595	48
Germany	63494	15
Netherlands	32317	26
Belgium-Luxembourg	26467	21
Finland	24156	44
Sweden	18082	36
Ukraine	16808	12
Canada	13774	17
Spain	13596	35
Czech-Republic	11863	19
Denmark	11848	26
Switzerland	9804	26
Belarus	9313	14
Austria	9252	25
Argentina	8537	14
World	**917701**	**12.5**

Table-9 below lists the trade impacts for butter & ghee. World trade is cut by more than a third of its current level, declining in volume by 441,752 metric tons. France and Germany are major net importers and consumers of butter, and their butter consumption would significantly decline if the WHO norms were implemented. This predicted consumption reduction being in excess of their current imports, all their current imports would be slashed according to the setup of our model, along with some reductions in domestic production as well. Significant reduction in imports would also follow in the UK, Italy and North America. The major exporters, New Zealand, Australia, Ireland, Finland and Netherlands would feel

the bulk of this impact, with their exports having to decline by more than half. Some of the countries from the former USSR, such as Ukraine and Belarus would also experience major reductions in their butter exports. Argentina and Uruguay would be the major losers from among the developing nations.

Table-9: Butter & Ghee – Trade Impacts

Imports-Top 20 Countries and World			**Exports-Top 20 Countries and World**		
Country	**Import Reduction (MT)**	**Percentage reduction in imports**	**Country**	**Export Reduction (MT)**	**Percentage reduction in exports**
France	148302	100	New-Zealand	197508	55
Germany	131121	100	Ireland	63075	53
UK	66631	54	Australia	57485	50
Italy	41167	100	Finland	19513	55
USA	22160	100	Netherlands	17765	15
Canada	14477	100	Ukraine	16808	54
Switzerland	7369	100	Czech-Republic	11863	53
Austria	5845	100	Belarus	9313	55
Greece	2284	45	Denmark	9009	22
Serbia	630	100	Sweden	8968	55
Israel	603	63	Lithuania	5999	51
Nigeria	525	21	Argentina	4641	55
Bulgaria	278	25	Spain	3975	21
Syria	178	2	Belgium-Luxembourg	3401	3
Lebanon	104	1	Uruguay	2865	55
Croatia	44	6	Estonia	2108	39
Mongolia	35	100	Norway	1978	52
			Portugal	1935	25
			Slovakia	1013	46
World	**441752**	**34.3**	**World**	**441752**	**34.3**

Cream

The production impacts on the world cream market are shown in Table-10 below. World production of cream is seen to shrink significantly, by 484,988 metric tons, some 18% of current production levels. EU and Scandinavian countries are the biggest losers in this regard, although some East European countries such as Hungary and the Czech Republic are also predicted to suffer significant production declines. Germany, the UK and Canada suffer the biggest losses in terms of volumes. Some countries with relatively modestly sized cream production, such as the US, Netherlands and New Zealand are seen to completely shut down home cream production, mostly because of the shrinkage in consumption in export markets rather than at home.

Table-10: Decrease in Cream Production - Top 20 Countries and World

Country	Reduction in Production (MT)	Percentage reduction in production
Germany	198602	30
United-Kingdom	54113	72
Canada	47856	23
Spain	26661	34
Netherlands	25000	100
Sweden	23968	25
Austria	20311	35
Denmark	19628	34
Hungary	18112	21
Australia	8393	73
Finland	7409	19
Norway	6644	22
Czech-Republic	4853	27
New-Zealand	4502	100
USA	3510	100
Lithuania	3038	17
Israel	2544	10
Switzerland	2124	5
Portugal	2065	17
World	**484988**	**18**

Trade impacts are presented in Table-11. Almost a third of the world cream trade is forecast to be wiped out by international adherence to the diet norms. More than half of this effect on trade derives from the consumption reductions in only three countries: France, Italy and Belgium/Luxembourg. These three countries are large importers and consumers of cream. Adjusting to the WHO norms results in large reductions in cream consumption in these counties, which translates to a significant curtailment of their imports. The main countries affected are the largest net exporters of cream, the UK, Germany, Netherlands and Austria. Note however, that some lower income cream exporting countries such as Tunisia and Chile also face a significant shrinkage in their cream exports.

Table 11. Cream – Trade Impact

Imports-Top 20 Countries and World			Exports-Top 20 Countries and World		
Country	**Import Reduction (MT)**	**Percentage reduction in imports**	**Country**	**Export Reduction (MT)**	**Percentage reduction in exports**
France	113906	71	United-Kingdom	53869	63
Italy	46849	54	Germany	37393	34
Belgium/ Lux'bourg	18243	16	Netherlands	28073	48
Greece	4387	22	Austria	20311	61
Ireland	2631	22	Australia	8393	68
Hungary	1349	100	Denmark	6164	41
Slovenia	963	100	New-Zealand	5876	67
Slovakia	733	100	Tunisia	5861	73
Latvia	438	100	Spain	5026	21
Croatia	41	1	Sweden	4451	69
Paraguay	28	8	Czech-Republic	3435	61
Lebanon	15	1	Lithuania	3038	71
			USA	1415	18
			South-Africa	1306	72
			Switzerland	857	64
			Portugal	694	8
			Chile	603	73
			Finland	505	55
			Canada	402	46
World	**189583**	**31**	**World**	**189583**	**31**

Animal Fats

Table-12 contains the production impacts on the worldwide animal fat industry in response to the predicted consumption change. As seen from the table, the production impacts at the world level are fairly small, amounting to only 4.1% of current world production. An important reason for this is that the consumption levels of some of the very large world producers of animal fats, such as China, India and Brazil, are unaffected by the WTO norms, as seen in the consumption section of this report. Also, these countries produce mostly for their own internal consumption, playing only small roles in the international markets. Consequently, their own production levels are unaffected by import curtailments that may be happening in other countries. USA, Germany and France are most affected by the predicted changes in terms of decline in production volumes. Some lower/middle income countries such as Serbia-Montenegro and Hungary do experience significant shrinkages in their production, with production contracting by about 24% in Serbia-Montenegro and 17% in Hungary.

Table-12: Decrease in Animal Fats Production - Top 20 Countries and World

Country	Reduction in Production (MT)	Percentage reduction in production
USA	483088	7
Germany	223423	10
France	113712	9
Canada	79349	8
Australia	62588	8
Hungary	50230	17
Serbia-and-Montenegro	45104	24
Netherlands	41218	7
New-Zealand	37645	7
Austria	30988	11
Denmark	24408	6
Peru	16125	3
Argentina	14619	5
Ireland	13871	5
Sweden	12993	6
Iceland	5582	6
Czech-Republic	5548	3
Slovakia	4068	5
Finland	4020	4
World	**1283973.4**	**4.1**

Table-13 lists the world trade impacts. A similar result is seen for world trade in animal fats, with imports & exports declining by a modest 3.5% each. Again, an important reason for the small size of the effects in trade relates to the fact that major consumers of animal fat such as India, China and Brazil are mostly self-sufficient in this product. Although some importing countries, mostly in the EU, experience significant reductions in the imports (31% in Italy and 40% in Portugal), the major exporters such as the US, Australia and New Zealand experience only a 6% reduction in the volume of their exports. Two developing countries, Peru and Bolivia, are among the 20 countries experiencing the largest reductions in animal fat exports.

Table-13: Animal Fats – Trade Impact Top 20 Countries and World

Imports-Top 20 Countries and World			Exports-Top 20 Countries and World		
Country	**Import Reduction (MT)**	**Percentage reduction in imports**	**Country**	**Export Reduction (MT)**	**Percentage reduction in exports**
Italy	74961	31	USA	92260	6
United-Kingdom	64097	20	Australia	37394	6
Belgium-Lux'bourg	46400	10	New-Zealand	31895	6
Spain	33484	15	Peru	16125	6
Portugal	13626	40	Canada	12629	4
Switzerland	11510	51	Germany	12620	2
Norway	7167	3	Ireland	11876	6
Paraguay	3033	72	Argentina	8216	5
Bulgaria	2807	41	Denmark	6537	3
Latvia	2616	40	Iceland	5582	6
Dominican-Republic	1323	2	Uruguay	3981	6
Greece	1152	4	Sweden	3956	6
Mongolia	604	100	Austria	3590	4
Croatia	498	4	Ukraine	2514	6
Israel	408	8	Finland	2414	5
Syria	253	3	Netherlands	1942	0
Lebanon	44	0	Bolivia	1760	5
			Poland	1561	3
			Slovenia	1421	4
World	**263984**	**3.5**	**World**	**263984**	**3.5**

Eggs

Tables 14 and 15 present the impact of the WHO/FAO norms on the production and trade of (hen) eggs. The total production impacts are modest at around 700,000 tons that represent only 1.4% of world production in year 2000 but some countries, such as the Netherlands, Spain and Belgium, experience relative decreases in production in excess of 10%. Table-15 shows that implementation of the norms reduces trade in eggs by almost a third, but this is largely due to the fact that international trade in eggs is limited in the first place[16].

[16] The FAO reports a volume of trade of less than a million tons in year 2000 for a volume of world production of more than 50 million tons.

Table-14: Decrease in Egg Production - Top 20 Countries and World

Country	Volume MT)	Share of initial production (%)
USA	192,586	3.9
Netherlands	140,549	21.0
Spain	80,759	13.5
France	42,217	4.1
Belgium	30,092	15.5
Malaysia	26,276	6.7
Belarus	24,013	13.2
UK	23,085	3.9
Iran	18,225	3.1
Italy	15,783	2.3
Australia	12,046	8.4
Hungary	10,217	5.8
Greece	9,832	8.4
Serbia	7,227	10.0
Finland	6,449	11.0
Czech Rep.	6,257	3.3
India	4,867	0.3
Russia	4,226	0.2
El Salvador	3,971	7.5
New Zealand	3,762	8.7
World	693,120	1.4

Table-15: Eggs – Trade Impact

Decrease in Imports - Top 20 countries and world			**Decrease in Exports - Top 20 countries and world**		
Country	**Volume (MT)**	**Share of initial imports**	**Country**	**Volume (MT)**	**Share of initial exports**
Germany	85,606	39.0%	**Netherlands**	113,584	38.4%
Italy	62,821	100.0%	**USA**	28,871	44.7%
France	61,046	100.0%	**Malaysia**	26,276	47.2%
UK	32,773	100.0%	**Belarus**	24,013	47.2%
Canada	22,508	96.7%	**Belgium**	22,326	29.3%
Austria	8,951	90.9%	**Spain**	21,454	44.9%
Sweden	7,534	81.2%	**Iran**	18,225	47.0%
Denmark	7,516	37.7%	**India**	4,867	47.3%
Switzerland	4,490	19.0%	**Russia**	4,226	42.9%
Bulgaria	3,432	67.3%	**El Salvador**	3,971	41.5%
Ireland	1,205	69.4%	**Finland**	2,794	46.5%
Serbia	1,097	100.0%	**Ecuador**	2,497	42.6%
Slovenia	642	86.3%	**Thailand**	2,352	47.2%
Paraguay	216	100.0%	**Brazil**	2,007	45.3%
Croatia	130	6.6%	**Moldova**	1,690	46.7%
			Hungary	1,581	36.9%
			Saudi Arabia	1,469	19.2%
			South Africa	1,347	47.1%
			Zimbabwe	1,288	47.3%
			Viet Nam	1,131	45.2%
World	295,096	32.9%	**World**	295,096	30.8%

Vegetable Oils

Soybean Oil

Table-16: Decrease in Soybean Oil Production - Top 20 Countries and World

Country	Volume (MT)	Share of initial production (%)
USA	2,204,617	27.3
Germany	110,189	15.8
Italy	65,695	26.8
Spain	63,486	14.4
France	50,980	75.4
Canada	44,067	15.0
UK	43,607	30.4
Netherlands	36,936	4.7
Argentina	29,158	0.9
Belgium	16,479	11.0
Norway	12,773	19.1
Brazil	8,701	0.2
Serbia	8,551	32.2
Paraguay	6,014	4.3
Finland	5,942	24.0
Portugal	5,293	5.2
Switzerland	3,746	18.2
Greece	1,855	4.2
Bolivia	1,387	0.8
Malaysia	858	0.9
World	2,720,774	11.4

The potential impact of the WHO/FAO norms on production of soybean oil is presented in Table-16. Our analysis suggests that world production would decrease by more than 2.7 million tons, which represents 11.4% of world production in year 2000. Given that oil production represents the main use of soybean, this decrease would have a substantial negative effect on soybean growers around the world. Using the conversion ratio of soybeans into oil reported by the Chicago board of trade[17], one obtains an estimate of the decline in actual soybean production in the range of 15 million tons.

Table-16 further presents the decrease in production of soybean oil production for individual countries. The United States is by far the country that would be the most adversely affected

[17] The Chicago Board of Trade reports that crushing 60 pounds of soybeans produces on average 11 pounds of soybean oil, see website at http://www.cbot.com/cbot/www/cont_detail/0,1493,12+29+170+6173,00.html

with a decrease in soybean oil production in excess of 2.2 million tons, which represents more than a quarter of its 2000 production level. This result can be explained first by the fact that, according to our model, US domestic consumption of soybean oil would contract by 34% as a result of WHO/FAO fat target. Furthermore, the US is a large exporter of soybean oil and would therefore be affected by reductions in consumption of this product in importing countries, most notably within the EU. Table-17, which presents the trade impact of the norms, demonstrates that the first of these two effects is the largest since the decrease in US exports of soybean oil is marginal at less than 1% of its 2000 level.

Table-17: Soybean Oil: Trade Impact

Decrease in Imports - Top 20 countries and world			**Decrease in Exports - Top 20 countries and world**		
Country	**Volume (MT)**	**Share of initial imports**	**Country**	**Volume (MT)**	**Share of initial imports**
Dominican Republic	11,647	11.3%	**Argentina**	26,370	0.9%
Israel	7,992	100.0%	**Brazil**	8,563	0.8%
Denmark	6,464	22.1%	**USA**	4,822	0.8%
Australia	5,021	61.5%	**Germany**	3,561	0.8%
Sweden	4,183	17.8%	**Netherlands**	2,960	0.6%
Hungary	3,406	54.9%	**Spain**	1,433	0.8%
Czech Rep.	3,272	12.5%	**Bolivia**	1,365	0.9%
New Zealand	2,987	18.2%	**Paraguay**	845	0.9%
Austria	1,312	7.6%	**Malaysia**	844	0.5%
Mongolia	1,252	N.A.	**Belgium**	345	0.1%
Bulgaria	863	41.1%	**Portugal**	330	0.7%
Syria	837	3.4%	**Thailand**	242	0.9%
Slovakia	792	7.5%	**Norway**	221	0.7%
Latvia	787	24.7%	**Italy**	177	0.6%
Ireland	707	4.7%	**Serbia**	174	0.8%
Slovenia	588	5.7%	**Finland**	131	0.9%
Lebanon	531	1.4%	**Greece**	126	0.8%
Croatia	386	7.9%	**Romania**	115	0.9%
			UK	112	0.4%
			Switzerland	100	0.7%
World	53,029	0.78%		53,029	0.74%

Our results further demonstrate that production in other countries would also be significantly affected by the WHO/FAO norms (Table-16). The largest impacts are observed in EU countries and Canada, while the other large world producers of soybean oil such as Argentina and Brazil remain relatively unaffected. This is explained by the fact that the trade impacts of the norms are very small (Table-17) with a reduction in world exports amounting to less than

1% of their levels in year 2000. Consequently, most of the decrease in production takes place where consumption declines as a result of the introduction of the WHO/FAO norms. Notice, however, that our results only provide a partial view of the impact of the norms on agricultural producers because soybean oil is a processed product that can be manufactured from imported soybeans. That is in fact the case in most European countries. For instance, Germany produced 700,000 MT of soybean oil in year 2000 when its production of soybeans was a bare 1000 MT.

Rapeseed Oil

The impact of the norms on production of rapeseed oil is presented in Table-18. At a world level, the total effect is a relatively modest decline of less than one million tons representing roughly 7% of world production in year 2000. However, the impact on individual countries can be rather large and this apparent paradox is explained by the fact that production of rapeseed oil in India and China, two of the world's largest producers, would not be affected by the WHO norms. The impact on virtually all the other large producers is large. Germany tops the list of countries with a decline of almost half a million tons that represents a quarter of its national production. Large reductions in production of rapeseed oil are also observed in Canada, France, Belgium and Australia. Altogether, it is the developed countries that are affected, and particularly so within the EU, while the production impacts of the WHO norms on developing countries and the transitional economies of Eastern Europe are limited.

Table-18: Decrease in Rapeseed Oil Production - Top 20 Countries and World

Country	Volume (MT)	Share of initial production (%)
Germany	452,022	24.6
Canada	211,838	16.3
France	92,196	16.8
Belgium	61,005	19.4
Australia	60,359	35.7
Austria	19,585	27.8
Czech Republic	19,150	9.0
Finland	9,057	13.6
Denmark	4,705	4.0
Switzerland	4,109	25.6
Hungary	2,476	2.8
Malaysia	2,080	16.8
Serbia	1,543	39.8
Ukraine	1,057	4.8
Israel	915	7.6
Paraguay	661	N.A.
Romania	411	15.9
Togo	46	N.A.
Greece	25	N.A.
Uganda	25	N.A.
World	943,286	6.98

The trade impacts are much more pronounced than in the case of soybean oil, with decreases in exports accounting for more than one third of the decline in world production. This is explained by the fact that many of the countries that reduce their consumption of rapeseed oil are also net importers of this product, which, by assumption, adjust to the change by cutting imports. Table-19 shows that the largest reductions in imports of rapeseed oil take place in the high-income economies of Western Europe (UK, Sweden, Italy, Netherlands, Spain) and the US, while changes in developing and transitional economies have little impact on the pattern of world trade in rapeseed oil. The largest decreases in exports take place in the countries where production impacts are also largest, with Germany and Canada, for instance, loosing more than 20% of their export markets due to the WHO/FAO norms.

Table-19: Rapeseed Oil - Trade Impact

Decrease in Imports - Top 20 countries and world			Decrease in Exports - Top 20 countries and world		
Country	**Volume (MT)**	**Share of initial imports**	**Country**	**Volume (MT)**	**Share of initial exports**
UK	183,104	96.0%	**Germany**	164,968	21.4%
US	86,658	19.1%	**Canada**	121,888	21.4%
Sweden	35,627	69.0%	**Belgium**	44,592	16.0%
Italy	23,326	18.8%	**France**	14,408	6.0%
Netherlands	8,270	3.6%	**Australia**	9,408	23.4%
Spain	7,197	40.2%	**Finland**	3,654	15.5%
Hungary	5,610	100.0%	**Czech Rep.**	3,172	10.4%
Slovakia	5,461	15.2%	**Denmark**	2,785	5.3%
Norway	4,550	72.0%	**Malaysia**	2,080	14.5%
Latvia	3,359	15.0%	**Serbia**	1,543	25.0%
Ireland	3,275	10.2%	**Ukraine**	1,057	25.4%
Switzerland	2,230	100.0%	**Paraguay**	661	25.4%
New Zealand	1,549	10.0%	**Romania**	411	24.6%
Mongolia	407	22.0%	**Austria**	357	1.3%
Slovenia	292	1.3%	**Togo**	46	5.0%
Croatia	125	6.6%	**Greece**	25	10.4%
Israel	71	100.0%	**Uganda**	25	18.6%
Lebanon	1	1.4%	**Chile**	14	25.4%
Syria	1	0.3%	**Uruguay**	12	25.4%
			Swaziland	8	25.4%
World	371,114	14.4%	**World**	371,114	14.1%

Palm Oil

We now turn to the analysis of the impact of the WHO norms on palm oil producers. The model predicts a relatively small decrease in world production of 219,000 tons that represents only one percent of the production recorded in year 2000 (Table-20). This result is explained by the fact that, as established in the first part of the report, consumption of oils decreases primarily in developed countries as a result of the implementation of the WHO norms. However, palm oil is a product consumed mainly in developing countries, most notably India, Indonesia, India, Pakistan and Nigeria, so that its demand remains relatively unaffected by these norms. Not surprisingly, the two giants of the international palm oil market, Malaysia and Indonesia, account for the bulk of the decrease in production, with declines of 136,000 tons and 69,000 tons respectively.

Table-20: Decrease in Palm Oil Production - Top 20 Countries and World

Country	Volume (MT)	Share of initial production (%)
Malaysia	136,269	1.3
Indonesia	69,245	1.0
Papua New Guinea	5,567	1.7
Costa Rica	1,614	1.2
Colombia	1,562	0.3
Côte d'Ivoire	999	0.4
Thailand	608	0.1
Honduras	553	0.6
Solomon Islands	540	1.5
Guatemala	511	1.2
Paraguay	320	11.7
Senegal	228	4.1
Ecuador	183	0.1
Brazil	179	0.2
Ghana	136	0.1
Peru	126	0.5
Liberia	93	0.2
Cameroon	93	0.1
Gabon	81	1.3
World	219,051	1.0

Because most of the decrease in consumption takes place in temperate high-income countries while production takes place in tropical countries of the developing world, 99.8% of the decrease in production is associated with a decrease in trade. The countries reducing their imports the most are Germany, the UK as well as Australia and other EU members. Eastern European countries such as the Czech Republic and Hungary also reduce their imports of palm oil but the calculated volumes are very small. Malaysia and Indonesia reduce their exports of palm oil by the largest volumes but the calculated declines represent only a small percentage of their exports in year 2000 (Table-21).

Table-21: Palm Oil – Trade Impact

Decrease in Imports - Top 20 countries and world			Decrease in Exports - Top 20 countries and world		
Country	**Volume (MT)**	**Share of initial imports**	**Country**	**Volume (MT)**	**Share of initial exports**
Germany	66,594	12.0%	**Malaysia**	136,269	1.7%
UK	36,511	6.6%	**Indonesia**	69,245	1.7%
Australia	34,221	31.0%	**Papua New Guinea**	5,567	1.7%
Netherlands	16,177	2.3%	**Costa Rica**	1,614	1.7%
France	14,274	11.5%	**Colombia**	1,562	1.6%
Belgium	12,758	4.7%	**Côte d'Ivoire**	999	1.4%
Italy	11,896	4.6%	**Thailand**	608	1.6%
Spain	6,344	4.4%	**Honduras**	553	1.7%
Dominican Rep.	4,583	43.6%	**Solomon Islands**	540	1.7%
Switzerland	4,088	36.9%	**Guatemala**	511	1.3%
Portugal	3,842	14.6%	**Senegal**	228	0.8%
Czech Republic	3,149	12.3%	**Ecuador**	183	1.4%
Hungary	1,314	9.3%	**Brazil**	179	0.6%
Austria	1,308	9.0%	**Sweden**	144	0.6%
Israel	705	4.8%	**Ghana**	136	1.0%
Serbia	572	27.5%	**Peru**	126	1.5%
New Zealand	396	2.7%	**Liberia**	93	1.7%
			Cameroon	93	0.8%
			Gabon	81	1.3%
			Paraguay	2	1.7%
World	218,732	1.6%	**World**	218,732	1.5%

Conclusions

This study presents a quick assessment of the likely impact of WHO dietary recommendations on world food consumption, production and trade. FAO nutritional balance sheets are used to describe average food consumption for a group of 173 countries in year 2000. The analysis demonstrates that forty-nine of these countries violate the norm with regard to the maximum percentage of energy intake originating from fat. Most of these countries are either developed countries of the Western hemisphere and Oceania, or Eastern European countries. The norm on protein intake is rarely violated.

A programming approach is used to predict how diets in countries violating the WHO/FAO norms would have to adjust in order to meet these norms. The model formalises the idea that consumers would attempt to adhere to the norms by modifying their diets as little as possible.

The results demonstrate that in the countries currently violating the norms, the adjustments in food consumption necessary to adhere to the norms are substantial. The general direction of the change is a shift away from human consumption of meats, vegetable oils, eggs and dairy products towards consumption of more cereal-based products, pulses, fruits and vegetables.

The production and trade impacts differ widely across products and countries but in some cases are found to be large. It is clear that in many countries, the WHO/FAO norms have serious implications for farm income and farmers' livelihoods. The most significant effects relate to the production of oil crops (soybean, rapeseed), meats (pig meat, mutton) and dairy products. The effect of the norms on international trade is also found to be substantial and, in general, exceeds the production impact in relative terms.

Besides the effects of the WHO/FAO population nutrient goals evaluated in this report, consumer preferences for specific food products are also likely to be influenced by the references in the WHO/FAO report to the harmful effects of the intake of these products. These additional effects, however, are difficult to quantify. Yet, it is clear that these specific references to individual food items will be of great importance when countries set food-based (as opposed to nutrient-based) dietary guidelines. The potential impact of the WHO/FAO report on consumer preferences for individual food products could be large.

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Appendix-1: Share of Fat in Energy Intake, All Countries, 2000

	Country	Calories (kcal)/person/ day	Fat grams/person /day	Fat as % of kcal
1	**France**	3,596.70	167.4	41.9%
2	**Spain**	3,386.90	151.6	40.3%
3	**Switzerland**	3,435.40	150.5	39.4%
4	**Germany**	3,505.50	152.9	39.3%
5	**Netherlands**	3,336.40	144.7	39.0%
6	**Australia**	3,110.30	134.8	39.0%
7	**Belgium-Luxembourg**	3,695.40	159.8	38.9%
8	**Austria**	3,794.00	163.7	38.8%
9	**Serbia and Montenegro**	2,660.30	113.5	38.4%
10	**Italy**	3,663.00	154.7	38.0%
11	**United Kingdom**	3,311.90	139.8	38.0%
12	**Hungary**	3,551.80	147.2	37.3%
13	Bermuda	2,950.00	120.2	36.7%
14	Iceland	3,213.90	130.9	36.7%
15	**Denmark**	3,443.40	139.8	36.5%
16	**United States of America**	3,814.30	154.3	36.4%
17	Cyprus	3,282.70	132.7	36.4%
18	**Greece**	3,738.00	151	36.4%
19	French Polynesia	2,881.10	115.9	36.2%
20	**Sweden**	3,099.80	123.7	35.9%
21	**Canada**	3,178.00	126.8	35.9%
22	**Norway**	3,338.00	133	35.9%
23	**Mongolia**	2,083.50	81.6	35.2%
24	New Caledonia	2,774.70	107.3	34.8%
25	**Finland**	3,169.40	120.7	34.3%
26	**Latvia**	2,719.70	102.7	34.0%
27	**Bulgaria**	2,544.00	95.2	33.7%
28	Antigua and Barbuda	2,378.20	88.1	33.3%
29	**Ireland**	3,701.00	137	33.3%
30	**Israel**	3,509.70	129.8	33.3%
31	Fiji Islands	2,777.80	102.1	33.1%
32	**Portugal**	3,757.20	138	33.1%
33	**Czech Republic**	3,028.30	111.1	33.0%
34	**New Zealand**	3,210.50	117.1	32.8%
35	Grenada	2,757.50	100	32.6%
36	**Paraguay**	2,543.60	91.8	32.5%
37	Netherlands Antilles	2,595.30	93.6	32.5%
38	**Dominican Republic**	2,318.70	83.6	32.4%
39	Kiribati	2,910.10	104.2	32.2%
40	**Slovakia**	2,788.70	99.8	32.2%
41	Seychelles	2,436.80	87	32.1%
42	Bahamas	2,735.60	97.3	32.0%
43	**Lebanon**	3,151.20	111.5	31.8%
44	Vanuatu	2,582.70	91.1	31.7%
45	**Slovenia**	3,149.20	110.4	31.6%
46	**Syrian Arab Republic**	3,052.30	104.6	30.8%
47	**Argentina**	3,180.40	108.5	30.7%
48	**Croatia**	2,596.60	88.5	30.7%
49	Macedonia, The Fmr Yug Rp	2,695.20	90.3	30.2%

50	**Belarus**	2,895.20	96.2	29.9%
51	**Uruguay**	2,837.80	94	29.8%
52	**Poland**	3,401.00	112.6	29.8%
53	**Barbados**	2,946.20	97.5	29.8%
54	**Ecuador**	2,726.40	89.2	29.4%
55	**Chad**	2,082.50	67.7	29.3%
56	**Libyan Arab Jamahiriya**	3,324.30	107.9	29.2%
57	**Sudan**	2,272.00	73.6	29.2%
58	**United Arab Emirates**	3,333.30	107.9	29.1%
59	**Kuwait**	3,151.20	102	29.1%
60	**Saint Kitts and Nevis**	3,095.20	99.1	28.8%
61	**Malta**	3,542.70	113.2	28.8%
62	**Sao Tome and Principe**	2,484.00	78.4	28.4%
63	**Central African Republic**	1,968.10	61.1	27.9%
64	**Panama**	2,215.20	67.8	27.5%
65	**Japan**	2,752.60	83	27.1%
66	**Tunisia**	3,309.90	99.8	27.1%
67	**Gambia**	2,273.30	67.8	26.8%
68	**Jamaica**	2,685.70	80	26.8%
69	**Albania**	2,874.80	85.6	26.8%
70	**Kazakhstan**	2,385.60	70.9	26.7%
71	**Chile**	2,867.30	85.2	26.7%
72	**Cape Verde**	3,285.80	97.6	26.7%
73	**Brazil**	3,002.30	88.8	26.6%
74	**Jordan**	2,732.20	80.7	26.6%
75	**Estonia**	2,946.40	86.5	26.4%
76	**Senegal**	2,270.30	66.5	26.4%
77	**Djibouti**	2,181.50	63.3	26.1%
78	**Lithuania**	3,292.80	94.9	25.9%
79	**Mauritius**	2,988.70	85.6	25.8%
80	**Malaysia**	2,917.20	83.5	25.8%
81	**Trinidad and Tobago**	2,712.60	77.4	25.7%
82	**Dominica**	2,990.60	85.2	25.6%
83	**Saint Vincent/Grenadines**	2,641.80	74.9	25.5%
84	**China**	2,978.90	83	25.1%
85	**Brunei Darussalam**	2,758.00	76.7	25.0%
86	**Honduras**	2,394.30	66.2	24.9%
87	**Saudi Arabia**	2,836.70	78.3	24.8%
88	**Pakistan**	2,456.40	67.8	24.8%
89	**Romania**	3,329.20	91	24.6%
90	**Mexico**	3,153.90	86.1	24.6%
91	**Turkey**	3,373.50	91.9	24.5%
92	**Liberia**	2,175.50	59.2	24.5%
93	**Saint Lucia**	2,957.70	80.1	24.4%
94	**Costa Rica**	2,749.20	73.7	24.1%
95	**Russian Federation**	2,917.90	77.5	23.9%
96	**Zimbabwe**	2,104.20	54.9	23.5%
97	**Venezuela**	2,359.70	61.1	23.3%
98	**Suriname**	2,624.50	67.2	23.0%
99	**Gabon**	2,585.40	66.1	23.0%
100	**Turkmenistan**	2,715.10	69.4	23.0%
101	**Ukraine**	2,898.40	73.8	22.9%
102	**Uzbekistan**	2,285.70	57.5	22.6%
103	**Colombia**	2,576.00	64.8	22.6%

104	**South Africa**	2,907.60	73	22.6%
105	**Bosnia and Herzegovina**	2,723.40	67.8	22.4%
106	**Korea, Republic of**	3,092.60	76.7	22.3%
107	**Botswana**	2,255.60	55.1	22.0%
108	**Guinea**	2,320.40	56.1	21.8%
109	**Kenya**	2,037.20	48.9	21.6%
110	**Maldives**	2,551.90	60.9	21.5%
111	**Belize**	2,867.30	68.4	21.5%
112	**Guinea-Bissau**	2,486.30	59.1	21.4%
113	**Sierra Leone**	1,904.20	45.2	21.4%
114	**Mauritania**	2,762.30	64.8	21.1%
115	**Congo, Republic of**	2,235.50	52.4	21.1%
116	**Nigeria**	2,742.50	63.7	20.9%
117	**Algeria**	2,928.20	67	20.6%
118	**Burkina Faso**	2,438.90	55.3	20.4%
119	**El Salvador**	2,470.00	55.5	20.2%
120	**Comoros**	1,763.50	39.6	20.2%
121	**Cameroon**	2,254.00	50.6	20.2%
122	**Bolivia**	2,227.50	49.5	20.0%
123	**Armenia**	2,006.00	43.8	19.7%
124	**Guatemala**	2,147.80	46.8	19.6%
125	**India**	2,489.40	54.2	19.6%
126	**Haiti**	2,045.90	43.8	19.3%
127	**Côte d'Ivoire**	2,588.10	54.7	19.0%
128	**Nicaragua**	2,222.60	46.6	18.9%
129	**Papua New Guinea**	2,177.40	45.6	18.8%
130	**Namibia**	2,742.70	57.3	18.8%
131	**Georgia**	2,235.90	46.2	18.6%
132	**Swaziland**	2,541.00	52.5	18.6%
133	**Philippines**	2,374.80	48.9	18.5%
134	**Mali**	2,357.60	47.8	18.2%
135	**Iran, Islamic Rep of**	2,935.40	59.3	18.2%
136	**Indonesia**	2,912.90	58.8	18.2%
137	**Angola**	1,901.80	38.1	18.0%
138	**Thailand**	2,458.70	49.2	18.0%
139	**Togo**	2,281.10	45	17.8%
140	**Morocco**	2,965.60	58.5	17.8%
141	**Tajikistan**	1,716.40	33.8	17.7%
142	**Cuba**	2,614.40	51.4	17.7%
143	**Sri Lanka**	2,345.00	46	17.7%
144	**Peru**	2,599.20	50.2	17.4%
145	**Solomon Islands**	2,221.30	42.8	17.3%
146	**Guyana**	2,639.30	50.2	17.1%
147	**Benin**	2,537.00	47.3	16.8%
148	**Kyrgyzstan**	2,876.60	53.6	16.8%
149	**Yemen**	2,040.80	38	16.8%
150	**Moldova, Republic of**	2,628.20	48.9	16.7%
151	**Egypt**	3,375.70	62.5	16.7%
152	**Zambia**	1,900.80	33.1	15.7%
153	**Myanmar**	2,806.30	46.1	14.8%
154	**Niger**	2,120.60	34.7	14.7%
155	**Korea, Dem People's Rep**	2,165.40	34.7	14.4%
156	**Viet Nam**	2,498.30	39.2	14.1%
157	**Nepal**	2,446.30	37.8	13.9%

158	**Eritrea**	1,668.90	25.7	13.9%
159	**Tanzania, United Rep of**	1,958.40	30	13.8%
160	**Azerbaijan, Republic of**	2,386.80	36.4	13.7%
161	**Congo, Dem Republic of**	1,556.90	23.6	13.6%
162	**Madagascar**	2,138.40	32.3	13.6%
163	**Ghana**	2,613.00	37.7	13.0%
164	**Cambodia**	2,011.00	28.2	12.6%
165	**Lesotho**	2,304.40	32.2	12.6%
166	**Mozambique**	1,939.30	26.9	12.5%
167	**Uganda**	2,381.90	31.3	11.8%
168	**Malawi**	2,166.00	27.5	11.4%
169	**Laos**	2,302.90	29	11.3%
170	**Bangladesh**	2,158.30	26.3	11.0%
171	**Ethiopia**	1,886.90	19.5	9.3%
172	**Rwanda**	2,057.70	19.3	8.4%
173	**Burundi**	1,603.60	10.8	6.1%
	World	2,804.40	76.3	24.5%