DOCTOR OF PHILOSOPHY

Determinants of health in horticultural workers: a comparison of national and international supply chains

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Determinants of health in horticultural workers: a comparison of national and international supply chains

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by

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Supplementary declaration

Paul Cross was in receipt of an ESRC funded PhD Scholarship. This scholarship was undertaken in association with a larger project funded under the UK Research Councils Rural Economy and Land Use Programme entitled 'Comparative assessment of environmental, community and nutritional impacts of consuming fruit and vegetable produced locally and overseas' (RES-224-25-0044).

Abstract

Food miles are often the sole criteria by which agricultural sustainability is assessed. Social justice is an alternative measure. Social justice is comprised of a number of component parts of which health is but one. Little appears to be known of the health status of farm workers. This study describes the self-reported health status of farm workers in four countries employed in producing fresh vegetables for UK supermarkets. The study had five objectives:

i. To assess the health and well being of farm workers in UK vegetable production.
ii. To compare the health of UK farm workers with farm workers from other countries supplying similar products to the UK market.
iii. To explore the potential impact of pesticides on farm worker health, both at the policy and farm level.
iv. To identify major causes of poor health (where it occurs) and identify its determinants.
v. Consider the ethical implications of supplying to the UK horticulture market from production in developing countries.

Over 2500 completed questionnaires were collected from farmers and farm workers in the UK, Spain, Kenya, and Uganda between 2006 and 2007. Pesticide data was collected from a number of farms in the UK, Kenya and Uganda but not from Spain. Workers employed on Kenyan export farms scored significantly higher than both the population norm and workers from the three other participating countries. There was no relationship between the self-reported health of a worker and the environmental impact rating of pesticides used on a given farm. The farm worker health scores have important implications for policy makers as ethical purchasing decisions will need to offset the food miles of a given vegetable by the social benefits such as health that devolve from purchasing vegetables from developing countries. Ethical purchasing decisions might be shaped in the future by the concept of buying from wherever improves the health status of producers rather than wherever is nearest.

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Abbreviations and Acronyms

BP	Bodily Pain scale of the SF-36
CBA	Cost Benefit Analysis
DEFRA	Department for Rural Affairs
DFID	Department for International Development
EI	Environmental Impact
EIQ	Environmental Impact Quotient
EQ-5D	The five itemed EuroQol health questionnaire instrument
ETI	Ethical Trade Initiative
EU	European Union
EUREP-GAP	European Retailers Protocol for Good Agricultural Practice
FWI	Farm worker Impact
GDP	Gross domestic product
GH	General Health scale of the SF-36
GHG	Greenhouse gas
GWP	Global warming potential
HDI	Human Development Index
HRQL	Health Related Quality of Life
IFOAM	International Federation of Organic Agricultural Movements
LCA	Life cycle assessment
MCS	Mental Component Summary scale of the SF-36
MH	Mental Health scale of the SF-36
PCS	Physical Component Summary scale of the SF-36
PF	Physical Functioning scale of the SF-36
RE	Role Emotional scale of the SF-36
RELU	Rural Economy and Land Use
RP	Role Physical scale of the SF-36
SDHS	Short Depression Happiness Scale instrument
SF	Social Functioning scale of the SF-36
SF-36	The thirty-six itemed version of the Short Form health questionnaire instrument
VAS	Visual Analogue Scale
VI	Voluntary Initiative
VT	Vitality scale of the SF-36
WHO	World Health Organisation

Prologue

General introduction: Testing the assertion that 'local food is best': the challenges of an evidence based approach

Preamble

This thesis aims to explore issues relating to the well-being of farm workers in UK horticulture supply chains. The genesis for such a study can be traced back through the food debate of the past ten years, culminating in the food miles debate of more recent years. This thesis is part of the output of the larger parent project named 'Comparative assessment of environmental, community & nutritional impacts of consuming fruit and vegetables produced locally and overseas' funded by the Rural Economy and Land Use (RELU) programme of the UK Research Councils. The project attempted to characterise the benefits and disbenefits of vegetable horticultural production in four countries from a variety of perspectives such as soil carbon emissions, life cycle analysis, discriminant choice analysis of consumer preference. This body of this thesis attempts to characterize the supply chain through the prism of farm worker well-being. The prologue that follows provides a broad overview of the relevant evidence pertaining to the food miles debate and identifies gaps that the parent project and this thesis attempted to fill.

The prologue to this chapter was first published in 2008 in the journal *Trends in Food Science & Technology*. Edwards-Jones, G., L. Mila i Canals, N. Hounsome, M. Truninger, G. Koerber, B. Hounsome, P. Cross, E.H. York, A. Hospido, K. Plassmann, I.M. Harris, R.T. Edwards, G.A.S. Day, A.D. Tomos, S.J. Cowell, and D.L. Jones. 2008. Testing the assertion that `local food is best': the challenges of an evidence based approach. *Trends in Food Science & Technology*. 19:265-274.

1.0 Abstract

Advocates of 'local food' claim it serves to reduce food miles and greenhouse gas emissions, improve food safety and quality, strengthen local economies and enhance social capital. We critically review the philosophical and scientific rationale for this assertion, and consider whether conventional scientific approaches can help resolve the debate. We conclude that food miles are a poor indicator of the environmental and ethical impacts of food production. Only through combining spatially explicit Life Cycle Assessment with analysis of social issues can the benefits of local food be assessed. This type of analysis is currently lacking for nearly all food chains.

1.1 General introduction

Concerns about the environmental impacts of transporting food increasingly long distances prior to its consumption have focused on the notion of 'food miles' (Smith et al., 2005). This idea, popularly understood as the distance that food travels from farm gate to consumer, has generated considerable interest among environmental groups, academics, Government, the media, and the general public (Frith, 2005; Hamilton, 2006; Kelly, 2004; Smith et al., 2005). In response to these concerns there is a growing advocacy for food systems that reduce food miles, popularly termed 'local food'.

Positive claims about the environmental and social benefits of 'local food' systems are increasingly common (Morgan et al., 2006; Norberg-Hodge et al., 2002; Smith et al., 2005). However, the concept of 'local food' remains ambiguous. Some 22% of respondents in an Institute of Grocery Distribution (IGD) survey (IGD, 2006) expected local food to be produced within 30 miles of where they lived (IGD, 2006), while others extended their notion of 'local' to country limits (e.g. England, Scotland or to Britain as a whole). For the majority of respondents, though, food was considered 'local' if it was produced in the same county as it was consumed.

However, distance from source is not the only attribute that consumers associate with local food. In the IGD survey, local foods were also strongly associated with freshness, and 60% of respondents gave this as the most important reason for buying local food. Other reasons included support for local producers (29%), environmental concerns (24%) and taste (19%) (IGD, 2006). These data are consistent with other studies which report that local foods are equated with safe, pure and natural foods, whilst imported foods are more likely to carry the connotation of being impure and unsafe (Draper and Green, 2002; La Trobe, 2001; Nygard and Storstad, 1998; Weatherell et al., 2003; Winter, 2003).

Debates around local food have been given a new significance in the light of the responses of industry and Government to climate change and their desire

to calculate the carbon footprints of goods and products. The carbon footprint of a food item is the total amount of greenhouse gases (GHGs) emitted during its production, processing and retailing (the most important GHGs derived from agriculture are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O)). As these GHGs have different effects on the radiative forcing (global warming potential, GWP) of the atmosphere relative to the effect of CO_2, they are converted to CO_2 equivalents; with 1 kg of CH_4 being equivalent to 25 kg of CO_2, and 1 kg of N_2O equivalent to 298 kg CO_2 over a 100 year time horizon (IPCC, 2007). [1]

Once the carbon footprint for a food item has been estimated it is possible to use this to inform both food chain professionals and consumers about the relative impacts of different products. In the latter case a carbon label could act in a similar way to other food labels (Kaiser and Edwards-Jones, 2006), on the assumption that concerned consumers will preferentially purchase goods with the desired characteristics, here a low carbon footprint.

In summary, the argument in favour of increased localisation of food chains assumes and reinforces an association between localness, taste, naturalness, safety, nutritional value, environmental quality and local economy. Thus advocacy for 'local' food suggests that it is generally better overall to consume local food than food produced 'non-locally'. However, a priori reasoning would question the universality of such claims, as every location is local to someone, but all locations are non-local to most people. The local food argument implies that eating an English grown carrot in England is better for the environment, the consumer and society than eating a Moroccan grown carrot in England, and vice versa. But consider a hypothetical consumer, living on an island in the Atlantic Ocean equidistant between Morocco and England, who wants to buy carrots and has the choice of either English or Moroccan at the same

[1] These are the latest conversion figures given by the Intergovernmental Panel on Climate Change (IPCC). Previously IPCC. 2001. Climate Change 2001: The Scientific Basis. Cambridge University Press, Cambridge, UK. had suggested that 1 kg of CH_4 was equivalent to 23 kg of CO_2, and 1 kg of N_2O was equivalent to 296 kg CO_2, while before that IPCC. 1995. Climate Change 1995: The Science of Climate Change. Cambridge University Press, Cambridge, UK.had suggested GWP conversion factors of 21 for CH_4 and 310 kg for N_2O.

price – which should she choose? A rational scientific outlook would suggest that there must be an objective answer to this question, and that by collecting evidence, a rational decision could be made. This reasoning would be equally applicable to a London consumer faced with a choice between an Essex and a Kent grown carrot, and indeed could be extended to the general case of all consumers. That is to say, there must be a portfolio of evidence that could be collected which would indicate which food item is the 'best choice' in any given situation, where 'best' may variously be defined as the most ethical and/or that which maximises social welfare. If the evidence in this portfolio clearly showed that local food was best, then this would have profound implications for food production. However, if the opposite were true then some of the current marketing and media focus on local food may prove to be inconsequential.

This prologue discusses the portfolio of evidence that would need to be gathered in order to decide which type of food chain is 'best'. The prologue primarily focuses on evidence related to biological and physical characteristics of food chains, and does not present any analysis of issues related to economics of comparative analysis and the benefits or dis-benefits of international trade (for further information on these issues see Southgate (2007). The prologue begins by considering the contribution of local and 'non-local' food to climate change, and then proceeds to consider other environmental and social issues. There is a particular focus on the case of fruit and vegetables, as this is a sector of high public interest. While most of the issues discussed are of generic interest, there may be important differences between fruit and vegetables and other foods, and any generalisations should be made with caution[2].

[2] This prologue arises from research conducted as part of the UK Research Councils' RELU Programme in a project entitled 'Comparative assessment of environmental, community and nutritional impacts of consuming fruit and vegetable produced locally and overseas' (RES-224-25-0044). RELU is funded jointly by the Economic and Social Research Council, the Biotechnology and Biological Sciences Research Council and the Natural Environment Research Council, with additional funding from the Department for Environment, Food and Rural Affairs and the Scottish Executive Environment and Rural Affairs Department.

1.1.1 Greenhouse gas emissions from the food chain

Between 1850 and1990 worldwide changes in land use and management led to the release of an estimated 156 Pg C to the atmosphere (Houghton, 2003) (which is about half that released from the combustion of fossil fuels over the same period). Increasing public awareness of the consequences for climate change, as well as the media driven 'food miles' debate and the potential for commercial advantage, are propelling the introduction of carbon labelling in the food chain (PepsiCo *pers. comm.*). However, in the absence of an agreed framework for calculating a carbon label, there is the potential to draw the system boundary in different ways. System boundaries can be defined more or less narrowly: for example, to include only the transport element of the food chain; or slightly more widely to include on-farm activities only (cradle to farm gate); or more widely still to include on-farm activities, processing, retailing and consumption (cradle to plate); and ultimately from cradle to grave, which would also include waste disposal. Further, uncertainty arises as both different data and calculation methods may be used when incorporating data into integrative methodologies such as Life Cycle Assessment (LCA). Thus, estimates of the amount of greenhouse gases emitted from a food system will depend on both the definition of the system boundary and the carbon accounting methodology utilised (Buckwell, 2005).

1.1.2 Working with a narrowly defined system boundary: transport only

It is relatively easy to estimate GHG emissions from within a narrowly defined system which includes only transport, as the levels of relevant emissions are well known (Table 1.1). Air freight is an area of particular public concern as it has a large global warming potential per tonne km (i.e. the GHG emissions associated with moving 1 tonne of goods a distance of 1 km). Because of this, even when relatively low volumes of food are transported by air, their environmental impact may be relatively large (Marriott, 2005).

1.1.3 Widening the system boundary: Life Cycle Assessment

A wider system boundary would consider all stages of the food chain, and LCA is a commonly used methodology for integrating and analysing material and energy flowing into and out of such a system (Fig. 1.1). When considering GHG emissions, LCAs generally consider both the direct emissions from activities like transport, alongside those generated during the manufacture of the relevant inputs, e.g. fertiliser, pesticides, electricity and machinery. It is evident from LCAs published in the peer reviewed literature (Table 1.2) that for many field grown crops the manufacture of fertiliser tends to be one of the on-farm inputs with the greatest energy demand and GHG emission factor (Roelandt et al., 2005). However, in glasshouse production, direct use of electricity for heating and lighting may represent the greatest energy input (Williams et al., 2006).

When considering local food, several LCA studies report that local production can be more energy efficient than non-local production, largely because of transportation savings. For example, Stadig (1997) suggests that more energy is used in importing apples produced in New Zealand (NZ) to Sweden than in producing them in Sweden, even though apple production is more energy efficient in NZ. Interestingly while Jones (2002), who is a UK based researcher working on the LCA of apples, reports similar results for the UK situation, Saunders, Barber & Taylor (2006) who are NZ based researchers suggest the opposite. These contradictory results emphasise the need to utilise similar system boundaries and methodologies when making comparisons between different food systems. The full complexity of the apple LCA is revealed in a recent study by Milà i Canals, Cowell, Sim & Basson (2007) (Fig. 2). This study compares the apples imported to the European Union (EU) from NZ and other southern hemisphere countries. Unlike the study of Saunders *et al.* (2006), Milà i Canals *et al.* (2007) consider the full calendar year and the energy inherent in storage of apples from time of production to time of consumption. Thus, an apple produced in a UK orchard which is consumed in October, uses less energy than one produced in the

same orchard which is consumed in the following August. This difference is due to the energy used in storage between October and the following August. So while on average the consumption of EU grown apples in the EU uses less energy than consuming a NZ grown apple in the EU, the relative benefits of so doing vary with the season.

Table 1.1 Direct emissions of carbon dioxide and the global warming potential (GWP) of all gaseous emissions for different modes of transport (expressed as kg CO_2-equivalent). [a] Includes all direct emissions of CO_2 and to provide 1 tonne-km (i.e. including production and delivery of fuel and capital infrastructure). [b] Includes also radiative forcing of emissions of other greenhouse gases. # It should be noted that the Royal Commission on Environmental Pollution highlights that "the total radiative forcing due to aviation is probably some three times that due to carbon dioxide emissions alone"(RCEP, 2002). Source: Ecoinvent 1.2 database (Spielmann et al., 2004).

Transport type	kg CO_2 (direct)/t*km [a]	kg CO_2-eq (GWP)/t*km [b]
Passenger car	0.191 kg/passenger km	0.203 kg/passenger km
Van <3.5t	1.076	1.118
Truck, 16t	0.304	0.316
Truck, 32t	0.153	0.157
Plane, freight#	1.093#	1.142
Train, freight	0.037	0.038
Transoceanic freight	0.010	0.011
Transoceanic tanker	0.005	0.005

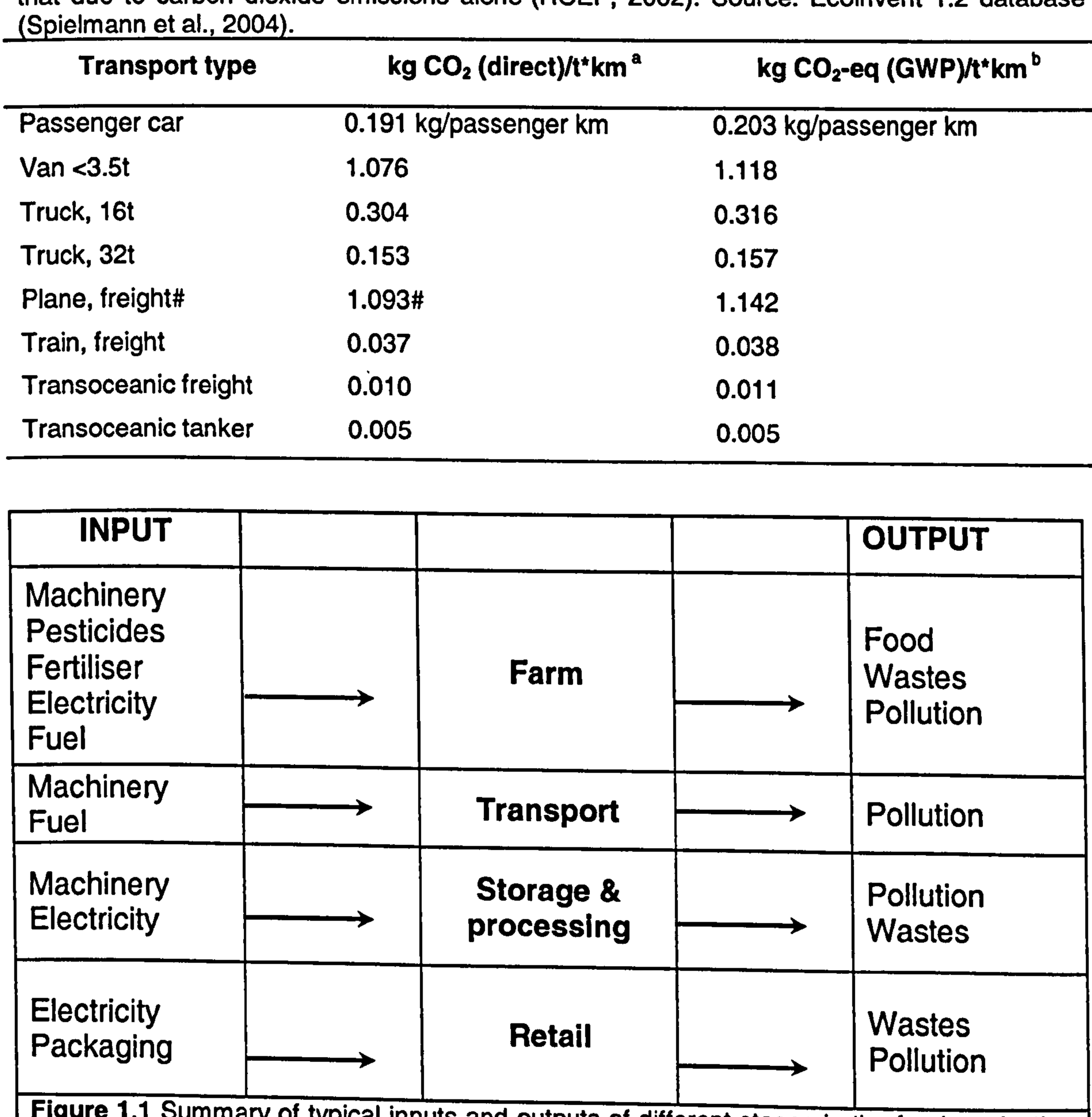

Figure 1.1 Summary of typical inputs and outputs of different stages in the food production system. Standard Life Cycle Assessment considers direct and indirect impacts of each of each of these inputs and outputs.

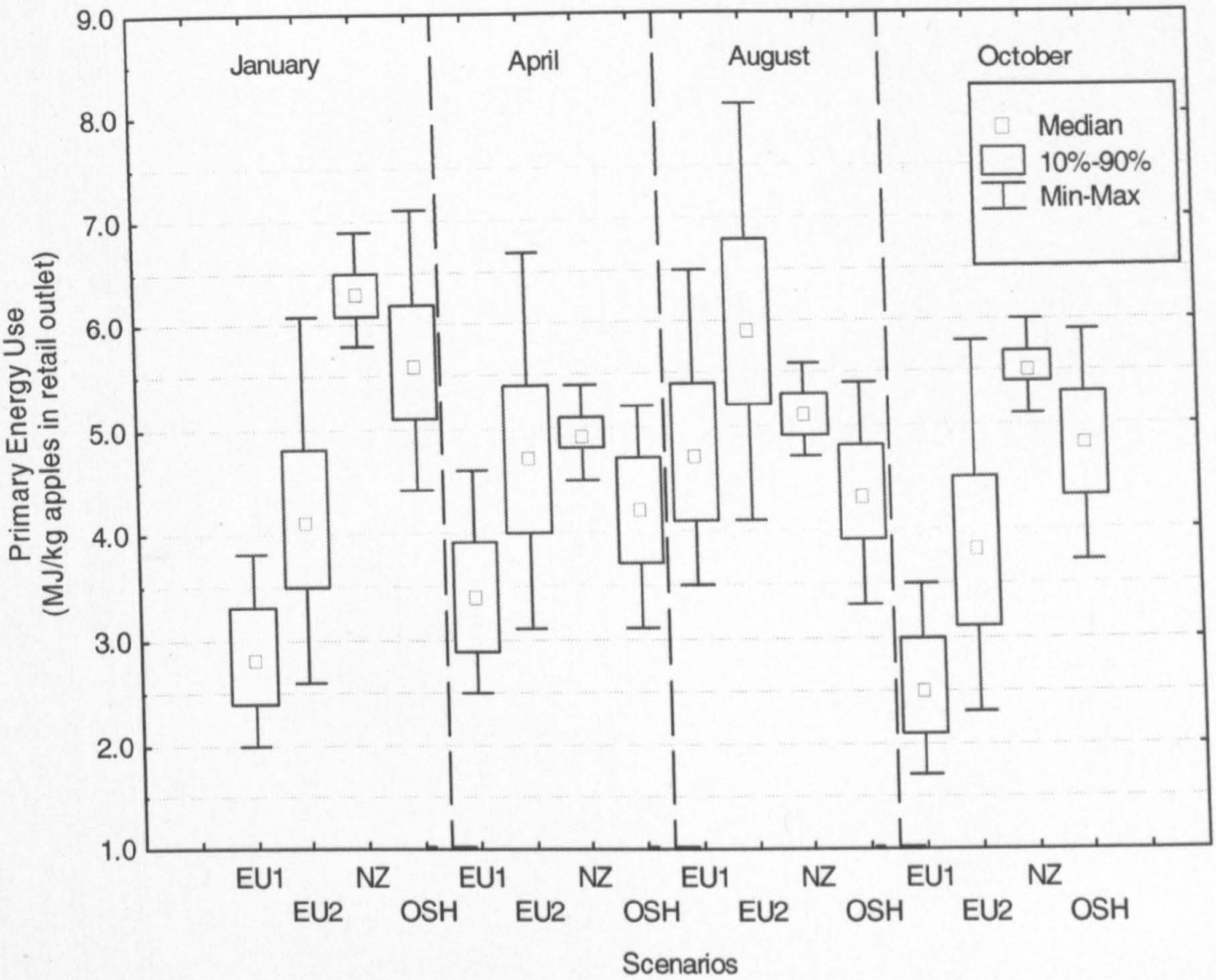

Figure 1.2 Primary energy use per kg of apples from European and southern hemisphere suppliers for the different seasons. EU1 indicates an apple produced in a country within the European Union (EU) and eaten in the same country. EU2 indicates an apple produced in a country within the EU and eaten in another EU country. NZ indicates an apple produced in New Zealand and eaten in an EU country. OSH indicates an apple produced in another country within the southern hemisphere, not NZ, and eaten in an EU country (Milà i Canals et al., 2007)

Table 1.2 Examples of life cycle assessment analyses of horticultural products which have been published in the peer reviewed literature.

Country of production	Product	Main findings	Reference
Europe, South America and New Zealand	Apples	• Primary energy requirement for production in: Europe and South America was 0.4-3.8 MJ kg-1, and in New Zealand was 0.4-0.7 MJ kg-1 • Storage for 5-9 months in Europe increases energy requirements by 8-16 % • Specific farming practices introduce significant differences in energy consumption • Season of production and consumption and storage losses affect total energy consumption	(Milà i Canals et al., 2007)
New Zealand	Apples	• Specific farming practices introduce significant differences in energy consumption (30-50 %) and other environmental impacts • Fuels, fertilisers and pesticides have an important impact on many environmental variables and careful selection of products can reduce environmental impacts • Direct energy input for field operations represent 64-71 % of total energy consumption; most environmental impacts are related to energy-related emissions • Percentage of total energy consumption for different inputs were: pesticide production (10-20 %), machinery manufacture: (7-12 %), fertiliser production (5-11 %)	(Milà i Canals et al., 2006)
UK	Apples	• Transportation accounts for a considerable percentage of total energy consumption in the life cycle of fresh apples • Transportation in most cases exceeds the energy consumed in commercial apple cultivation • Development of local production and marketing systems can help reduce transport demand	(Jones, 2002)
Switzerland	Apples	• Apple production is represented by 37.6 GJ eq. ha^{-1} for energy use, 4.7 kg Zn eq. ha^{-1} for aquatic ecotoxicity and 1.0 kg PO_4 eq. ha^{-1} for aquatic eutrophication • Potatoes, sugar beet and carrots have similar energy consumption and aquatic ecotoxicity • Aquatic eutrophication caused by apple production is much lower than all arable crops because of low P-fertiliser needs • Area-related energy use is 50 % higher for apple growing compared to arable crop rotation • The key impact categories energy use, aquatic ecotoxicity and aquatic eutrophication can be managed by keeping the inputs of machinery, pesticides and fertilisers low	(Mouron et al., 2006)
Sweden	Potatoes	• Agricultural production accounted for almost all the emissions contributing to eutrophication and acidification • Agricultural production, production of packaging materials and the household phase were the main contributors to global warming • Energy use was evenly distributed among life cycle stages	(Mattsson and Wallen, 2003)

Table 1.2 continued

Country of production	Product	Main findings	Reference
UK and Spain	Greenhouse tomatoes	• Importing tomatoes from Spain to the UK during the winter is more energy efficient than growing them in heated glasshouses in the UK	(Smith et al., 2005)
Spain	Greenhouse tomatoes	• Main negative impact derives from the waste of biomass and plastics	(Anton et al., 2005a; Anton et al., 2005b)
Spain	Greenhouse tomatoes	• Relative impacts of pest control depend on the selection of specific pesticides and crop stage development at the time of application • Both integrated pest management and chemical pest management could be improved by a careful selection of pesticides	(Anton et al., 2004)
The Netherlands	Greenhouse tomatoes	• Substrate cultivation with recirculation of the drainage water results in less environmental effects per kilogram of tomatoes than soil cultivation and free drainage • Reusing the drainage water leads to a lower emission of N and P and consequently to a much lower score for nitrification • The lower consumption of phosphate fertilizers in crops with recirculation results in much lower scores for toxicity to water and soil organisms • These conclusions are also valid for other fruit and vegetable crops grown on substrate • The energy consumption at the glasshouse holding of natural gas and electricity has a great share in the total environmental pressure	(Nienhuis and de Vreede, 1996)
UK	Sugar beet	• Mean impacts per ha were 21.4 GJ of energy consumption, emission of 1.4 t of CO_2-equivalents, 3.3 kg nitrogen leached and 15.2 kg nitrogen lost to denitrification	(Tzilivakis et al., 2005)
Switzerland	Several arable crops	• Energy use dominated by mechanization, use of mineral fertilisers and grain drying • Eutrophication is mainly caused by nitrogen compounds Field emissions are of decisive importance for many environmental impacts	(Nemecek and Erzinger, 2005)

The results of LCAs may also be influenced by different scales of production at the local/global level. Sundkvist et al., (2001) studied bread production with locally sourced flour versus bread produced in other regions of Sweden, and concluded that the smaller scale of the local mills results in reduced energy efficiency. However, when considering other impacts apart from energy use, Andersson & Ohlsson (1999) find lower emissions per kg of bread in smaller bread-making facilities compared to a large industrial bakery. Interestingly, Schlich & Fleissner (2005)suggest that the energy efficiency of global food systems is greater due to the increased size of producers (i.e. 'ecology of scale'), which counters the increased energy use for transportation. However, this study is contested by Jungbluth & Demmeler (2005), who highlight some of the critical – and controversial – decisions made during the analysis (e.g. direct energy consumption instead of primary energy requirements; non-representative data for regional production; inconsistent system boundaries for the two compared systems). Further, the production practices of producers servicing local distribution networks may differ substantially from those of more 'globalised' producers servicing large retailers, and this should also be considered in any analysis.

These studies serve to demonstrate several important issues related to LCAs. Firstly, there is inherent variation at the farm level, within a country and between seasons, which leads to different levels of environmental impact even for the same product Secondly, it is only when the system boundary of the LCA includes all phases of the food chain that accurate estimates of impact can be obtained. Thirdly, the outputs from LCAs may not give simple messages to those consumers who are seeking to make informed but uncomplicated purchasing decisions.

1.1.4 Widening the system boundary further: spatially specific emissions from agro-ecosystems

Standard LCA methodologies have been largely developed within the context of engineering and physical systems, and are not well adapted to deal with the variation inherent in biological systems. So if LCA is to contribute to the local

food debate it will be necessary to utilise spatially explicit coefficients which reflect the reality of production in different localities. While this is theoretically possible in some of the newest LCA methodologies, severe difficulties remain in practice, as discussed below.

1.1.5 Greenhouse gas emissions from on-farm activities

Emissions of CO2 from soils represent one of the major fluxes in the global carbon cycle, and through the biological and chemical processes that occur within them, agricultural soils are responsible for releasing significant amounts of GHGs into the atmosphere (Schlesinger and Andrews, 2000). Gaseous emissions from soil are not considered by consumers when making food choices, and even when they are accounted for in LCAs, the assumptions made are often incorrect. The discussion below highlights the uncertainties which surround GHG emissions from soils and the difficulties inherent in representing these emissions in integrative analyses.

The release of CO_2 from soil occurs mainly from respiring plant roots and from soil microbes decomposing organic matter in soil (Farrar et al., 2003). A second GHG, N_2O, is produced naturally in soils by microorganisms through the processes of nitrification or denitrification. Nitrification is the aerobic oxidation of ammonium to nitrate; denitrification is the anaerobic reduction of nitrate to nitrogen gas. Both processes are enhanced by the increased availability of nitrogen in the soil, such as through additions of fertilisers, faeces, slurries, manure, ploughed in leys, arable residues etc., all of which have the potential to increase N_2O emissions. As large quantities of nitrate fertiliser are added to most agricultural systems the potential for emissions is large. There are also indirect emissions of N_2O due to the volatilisation, leaching and run-off of nitrogen from managed soils. Major sources of emissions of the third main GHG, CH_4, are animal wastes and severely anaerobic soils (e.g. rice paddies), although in most agricultural systems CH_4 is much less important as a GHG than CO_2 and N_2O (Conrad, 2002).

The magnitude of GHG emissions from soil depends on an extremely diverse range of biological, chemical, physical and management variables making measurement or prediction of the net GHG budget for agricultural soils extremely difficult (Christopher and Lal, 2007; Kebreab et al., 2006). This also implies that single GHG emission values cannot be ascribed to broad agricultural system types but are moreover likely to be highly context specific and dependent upon local conditions. This contrasts strongly with the relatively fixed carbon emissions associated with subsequent food processing and transport/distribution.

One major issue which is rarely appreciated, and which fundamentally remains poorly understood, is that soils can also be major sinks for greenhouse gases. In the case of CO_2, all crop plants sequester atmospheric CO_2 in photosynthesis. Some of this is returned to the soil when roots die and at the end of the season in crop residues left behind in the fields. Both of these are important in replenishing soil organic carbon stores. In addition, soils can also act as sinks to significant quantities of both N_2O and CH_4 (Castaldi et al., 2007; Chapuis-Lardy et al., 2007; Suwanwaree and Robertson, 2005).

The net release of GHGs from agricultural soils is therefore a delicate balance of CO_2, N_2O and CH_4 gains and losses across an entire growing season. Consequently, it is important to measure all three of these gases simultaneously to reliably estimate GHG emissions. Further, it can be expected that over a cropping cycle an agricultural field will fluctuate from being a source to a sink for these gases. Studies have demonstrated that these net fluxes can change dramatically within a day depending upon the prevailing weather conditions and management regime (WagnerRiddle et al., 1996). Therefore, accurate estimates of GHG emissions from food production systems require measurements to be made over long time periods (ideally a full calendar year) on a continuous, or very regular, basis (e.g. hourly). This intensity of measurement poses severe practical challenges and is rarely undertaken. Even if it were undertaken for a whole calendar year, variation in

weather between years may render the results from a single cropping cycle unrepresentative of long-term GHG emissions.

The IPCC approach to this problem was to undertake a meta-analysis of all the available experimental data and to produce standard emission factors, which describe, for example, the proportion of nitrogen fertiliser that is emitted as N2O from crop production (Bouwman and Taylor, 1996). This emission factor approach is based on a limited number of data points and is applied worldwide for agricultural soils regardless of variations in soil characteristics, land management or climate (Roelandt et al., 2005). This is obviously a crude approach that can have little relevance to local conditions (Smith et al., 2002). To address this issue, many researchers have developed mathematical modelling approaches that attempt to simulate net GHG emissions from soil at a range of temporal (days to decades) and spatial scales (field to continental level) (Levy et al., 2007; Vuichard et al., 2007). Ultimately, however, these models are only as good as the knowledge that underpins them (Tonitto et al., 2007). Although scientific knowledge of carbon and nitrogen dynamics is far from complete for many agro-ecosystems, simulation models of GHG emissions from soil such as DNDC (Li. et al., 1992) and soil carbon stocks CENTURY (Sanford et al., 1991) have been widely accepted and partially validated. However, in many situations there may be poor agreement between modelled outputs and actual measured emissions, and further refinement of these modelling approaches is required before they can be used to make informed judgements pertinent to the local food debate.

1.1.6 Conclusion on LCA and GHG emissions from local food production

It is clear from the above discussion that in order to quantify the GHG emissions from local and non-local food it is necessary to conduct spatially explicit LCAs which include emissions from agricultural systems alongside those emanating from food processing, transport and retailing. Unfortunately, due to the many different definitions of the phrase 'local' it remains difficult to identify the precise scale of analysis which would best inform consumers and/or policy-makers. Given the paucity of studies published at any scale

which analyse emissions from across the entire food chain it is currently impossible to state categorically whether or not local food systems emit fewer GHGs than non-local food systems.

1.1.7 Other environmental hazards in the food chain

The impact of food production on climate change is not the only environmental issue that needs to be considered when comparing 'local' and 'non-local' food. For example, in some locations horticulture can have aesthetic impacts on the landscape through the use of glasshouses, poly-tunnels, field scale mulches and fleeces, particularly when there is a clustering of horticultural farms in one area. Buying food from such areas may support these production methods, and thereby perpetuate the visual impact.

Another potentially polluting practice relates to the use of pesticides, and again the hazard arising from pesticides may vary with location. The types and amounts of pesticide used on a given crop relate to the pest and disease pressure which vary between growing regions (BCPC, 2007). Different pesticides have their own toxicological profiles, and therefore pose different levels of hazard. In general, herbicides tend to pose low hazards to human health, while insecticides demonstrate higher hazards (Cross and Edwards-Jones, 2006). For these reasons the actual hazard posed to the environment and society from the use of pesticides varies with location.

In addition, there are a range of other potential environmental hazards posed by agriculture whose severity may also vary with location. These include gaseous emissions eg. ammonia (Havlikova and Kroeze, 2006), pollution of surface and ground water (eg. nitrate leaching, phosphate pollution (Almasri and Kaluarachchi, 2007; Powers, 2007)), soil erosion (Van Oost et al., 2006) and impacts on biodiversity (Butler et al., 2007). These hazards are not discussed in detail here, but they do serve to highlight that growing the same crop in different places will pose different environmental hazards, which may result in different levels of impact. Further, the importance of these impacts can only be assessed in the context of the locality in which the impact occurs.

There is currently no study which has quantified and mapped the full range of environmental impacts arising from fruit and vegetable production at a local, national or global level. To do so would be a mammoth task, and while such a dataset may have some value to Governments it is unclear how consumers and producers would react to such a mass of information.

1.1.8 Local food, quality and nutritional value of fruit and vegetables: Determinants of quality

The commercial and nutritional quality of fruit and vegetables is determined by a range of characteristics, attributes and properties (Schröder, 2003). Commercial quality standards include cleanliness, firmness, lack of damage, freedom from disease, colour, size and shape, freshness, appearance, texture, aroma, consistency, origin and use-by-date (UNECE, 2007). Nutritional quality relates to essential nutrients (carbohydrates, amino and fatty acids) and biologically active compounds (vitamins, dietary fibre, flavonoids, carotenoids, phytosterols, phenolic acids and glucosinolates). Both of these aspects of quality may be affected by the various activities that occur along the supply chain. For example, fresh vegetables can experience deterioration in their marketing quality during transportation due to mechanical damage caused by handling and transit vibrations (Hinsch et al., 1993). Storage can also reduce vegetable quality due to microbial spoilage and nutritional losses, with the most susceptible nutrient compounds being ascorbic acid, niacin, folic acid, phenolics, carotenoids and flavonoids (Goldberg, 2003).

Preservation methods such as refrigeration, gas and controlled modified atmosphere, chlorination, electrolyzed water treatments, ionizing radiation, application of film packaging and surface coating aim to reduce the nutritional losses and to increase the shelf-life of fresh vegetables (Alzamora et al., 2000). While consumer knowledge of these processes may be limited, preservation by freezing is familiar to most Western consumers. The application of quick freezing technologies combined with blanching, a thermal treatment, can minimise both nutritional losses and physical damage of frozen

vegetables. Unfortunately though, freezing is not suitable for all vegetables and cannot be used effectively to preserve salad items such as endives, cucumbers and radish. However, although frozen vegetables retain most of their nutrients and vitamins (including ascorbic acid, folic acid and thiamine), the freezing process does not guarantee retention of the full nutritional quality of the produce. The major risk of nutrient loss for frozen vegetables occurs during blanching prior to freezing (Puuponen-Pimia et al., 2003). Nevertheless, blanching is a necessary activity as it deactivates the enzymes responsible for undesirable changes in odour, flavour and colour during defrosting and reduces the microbial activity and oxidation processes that cause spoilage.

If consumers collected produce from a farm within a few hours of its harvest, then it could be expected that its nutritional quality would be high. However, if quality was only related to time since harvest, then given that produce grown in Kenya can be available for sale in some parts of northern Europe 24-30 hours after harvest, this produce too may be of high nutritional quality. For these reasons it is not possible to state categorically that locally produced fruit and vegetables will always be of higher nutritional quality than non-local produce. Rather their quality will depend on time since harvest and the type of processing to which they are subjected. Thus the characteristics of the supply chain are probably more important in determining quality of fruit and vegetables than is the distance between producer and consumer.

1.1.9 Assessing impacts on health

Scientific evidence of quality differences between local and non-local food could be derived by measuring the chemical constituency of food from different supply chains throughout the year. If the health status of consumers who ate food from the different supply chains were also assessed, then any changes in their health status could, in theory, be related to the chemical constituency of their food. However, such an approach faces several challenges. Firstly, a large amount of analytical effort would be needed in order to chemically characterise all food items from the different supply

chains. Secondly, despite a large amount of information being available on this topic, the nutritional quality of all fruit and vegetables has not yet been defined. To date, around 50,000 chemical compounds have been elucidated in plants (Fiehn, 2002), most of which have unknown function in humans. Thirdly, the actual health impact on individuals who choose to consume either local or non-local produce could only be assessed in relation to the rest of their diet. So any nutritional advantage gained by eating one type of produce could be enhanced or counteracted by the quality and quantity of other elements of the diet. Finally, the relevance of this type of chemical information to consumers is unclear. While some consumers seem to value the claimed health benefits associated with certain food products, sociological research suggests that consumers normally have a multidimensional concept of quality which goes beyond chemical and physical variables, and may include a range of social factors relating to the traditions and experiences of people in the food chain (see Parrott et al., (2002)).

1.1.10 Overall discussion and the role for interdisciplinarity in the local food debate

The previous discussion has largely taken a natural science perspective to the impacts of purchasing local and non-local food. However, there are also a range of social and economic factors which have not been discussed in detail here. For example, an issue of concern to some consumers is the impact that their purchasing decisions will have on individual farmers, and also on the local and regional economies in which the farmer is located (witness the growth of Fairtrade produce). Whilst many consumers may have the desire to use their purchasing decisions to help poorer regions and nations, others may explicitly decide not to buy produce from some countries for political reasons (e.g. movements to boycott South African goods in the 1980s as a protest against apartheid). So when a consumer decides to preferentially purchase local food, they may explicitly be making a decision to benefit local farmers, the local economy and the local political status quo. However, simultaneously they are implicitly deciding not to support farmers, regions and political systems beyond their locality. The cumulative impact of these decisions may

have implications for the wealth of producers and the development of regions, which may in turn have wider environmental and political impacts.

The interaction of the impacts of consumer choice on natural and socio-economic systems highlights the inherent interdisciplinarity of food chain analysis. If research is to contribute to understanding the advantages and disadvantages of alternative food supply chains, then social and natural scientists must work closely together. However, both sets of scientists need to recognise each other's perspective.

For example, natural scientists may argue that it would be almost impossible to develop a scientific dataset which would enable formal testing of the hypothesis that local food is better than non-local food. The difficulties associated with this task relate firstly to difficulties in defining each locality in a spatially explicit manner – which is a necessary step if relevant environmental data are to be collected – and secondly to the large volume of data needed to enable all locality-locality comparisons to be made for all relevant variables. However, social scientists may not be surprised that reductionist natural science cannot resolve the local food debate, as for many consumers the attractions of local food do not relate to measurable differences in its embodied energy or nutrient status, but rather they relate to sense of place, trust and experience.

The role of natural science in the local food debate will probably focus around informing the wider societal debate about technical issues (e.g. energy use of different technologies) and in highlighting emerging issues (e.g. GHG emissions from soil). Social science will also play a role in knowledge discovery in fields such as risk perception, consumer behaviour and social attitudes. In addition social scientists will have an important role in understanding how decision-makers, be they consumers, the media, food chain professionals or politicians, can best use the emerging knowledge to guide their actions. This does not mean that there is no role for natural scientists in communicating knowledge, but rather that by working together,

the inherent synergies in natural and social science approaches can help bring about real change in food supply chains – be they local or otherwise.

Chapter 1

Introduction

1.2 Introduction

Food culture anxieties of contemporary Western societies are finding increasing resonance in the old French proverb 'Dites-moi ce que vous mangez et je vous dirais qui vous êtes' (tell me what you eat and I'll tell you who you are). Many of these anxieties are a product of science and technological advances coupled with industrialisation and urbanisation (Raoult-Wack and Bricas, 2002). Significant shifts in our social psyche have taken place during the last 30 years. We appear to no longer fear nature but fear what we are doing to it. Diseases such as Bovine Spongiform Encephalopathy (BSE) Creutzfeldt-Jakob Disease (CJD) variant Creutzfeldt-Jakob Disease (vCJD) and ethical issues such as Genetically Modified Organisms (GMO) have provided a pertinent perspective in the public's mind of the gap between 'natural' Man and modern Man.

At the same time, an increasing geographical and temporal separation between where and when food is grown and where it is consumed has meant that the consumer has become progressively dissociated with nature and the process of cultivation. This is further exacerbated by the growing tendency of supermarkets to import fresh, out of season vegetable produce from all over the world. The consumer is presented with an extensive choice of foods that would normally be either out of season in the UK or exotic to the UK. However, an important counterpoint to this expanded choice is the homogenization of foods which render the origin, history and cultural identity of the foodstuff obsolescent (Fischler, 1988). Consumers appear to be increasingly confronted by the omnivore's paradox (Fischler, 1988) whereby nutritional/health advantages can be gained through trying new foods but at the risk of eating something harmful. The paradox is cogently expressed as the "tension between the two poles of neophobia (prudence, fear of the unknown, resistance to change) and neophilia (the tendency to explore, the need for change, novelty, variety)" (Fischler, 1988). The contention is that rather than attenuating anxiety, contemporary society functions in such a way as to exaggerate it. When pesticides (a creation of science) are wedded to overseas production (a creation of a new globalised industrialisation) then

consumer anxieties can become acute. If 'we are what we eat' and we don't know what we are eating then we no longer know who we are (Fischler, 1988). Consequently, there appears to be a deep-seated need for people to reappropriate food (Raoult-Wack and Bricas, 2002). Part of the process of reappropiration involves expressing concerns *vis á vis* overseas food production and possibly mitigating individual angst by purchasing either local and/or organic produce. How rational this decision is depends upon how comparatively harmful overseas production processes such as pesticide practices or employment conditions are to both the consumer and the supplier compared to UK processes.

1.3 Vegetable production

1.3.1 European imports

Fresh vegetable imports from developing countries play an important role in meeting European food needs particularly in the supply of peas and beans, sweet maize and baby corn. Extra-European imports of fresh fruit and vegetables have been increasing since 2000. The volume of vegetable imports increased by 12% between 2000 and 2002 from 900 000 tonnes to 1.1 million tonnes whilst the value of extra-European vegetable imports increased from €900 million in 2000 to €1.2 billion in 2002. The major European importers are Germany (2.5 million tonnes), the UK (1.5 million tonnes) and France (1.4 billion tonnes) (Fig. 1.3)(CBI, 2004).

1.3.2 UK imports

Important changes have occurred in the UK fresh vegetable retail sector since 1991. Home production volumes have decreased by 12% whilst imports have increased by a substantial 46%. At current rates home grown production will be surpassed by imports in 2011 and could completely disappear by 2070 (Fig 1.4) (DEFRA, 2005).

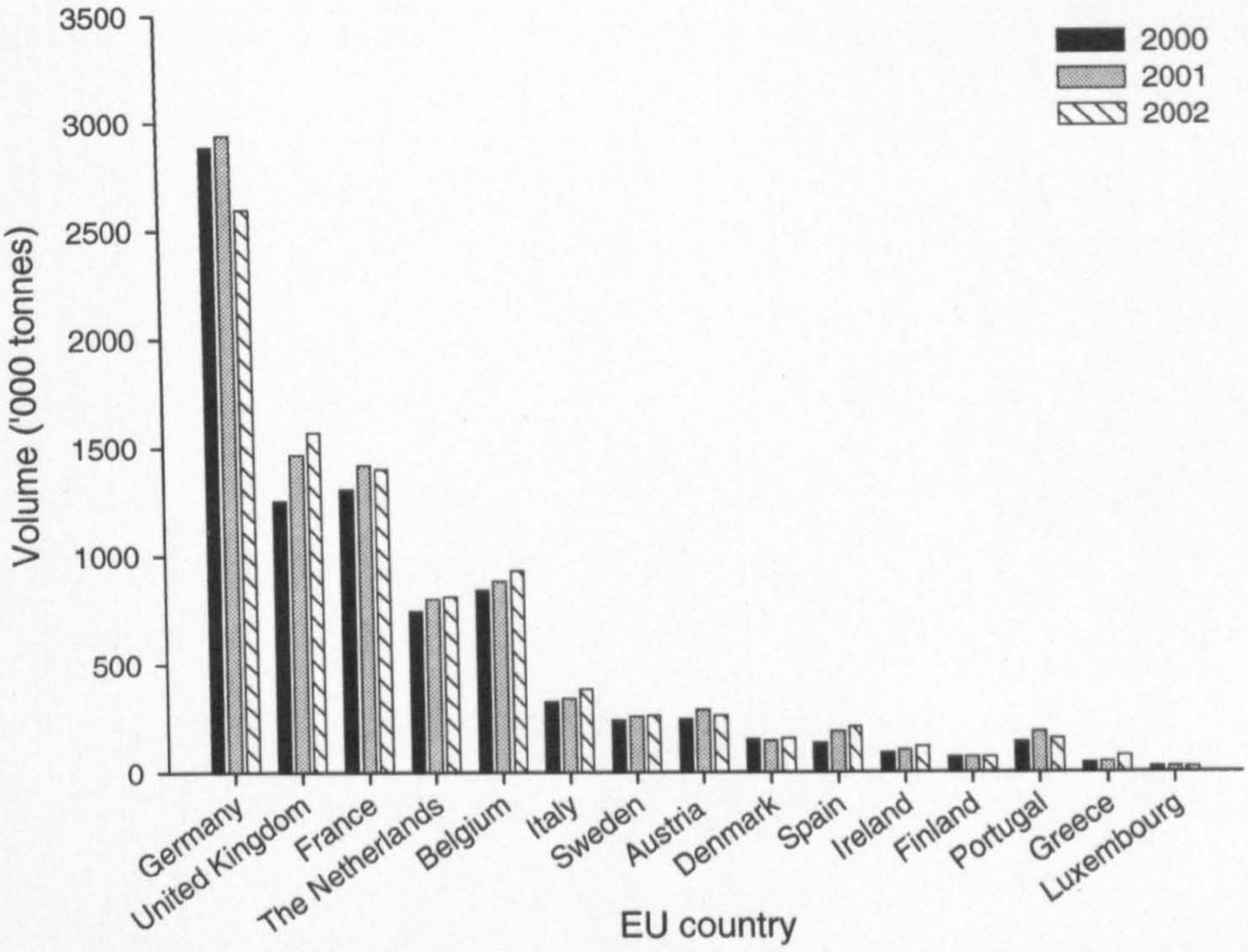

Figure 1.3 Imports of fresh vegetables by EU member countries, 2000-2002. *Source:* adapted from Eurostat data cited in (CBI, 2004)

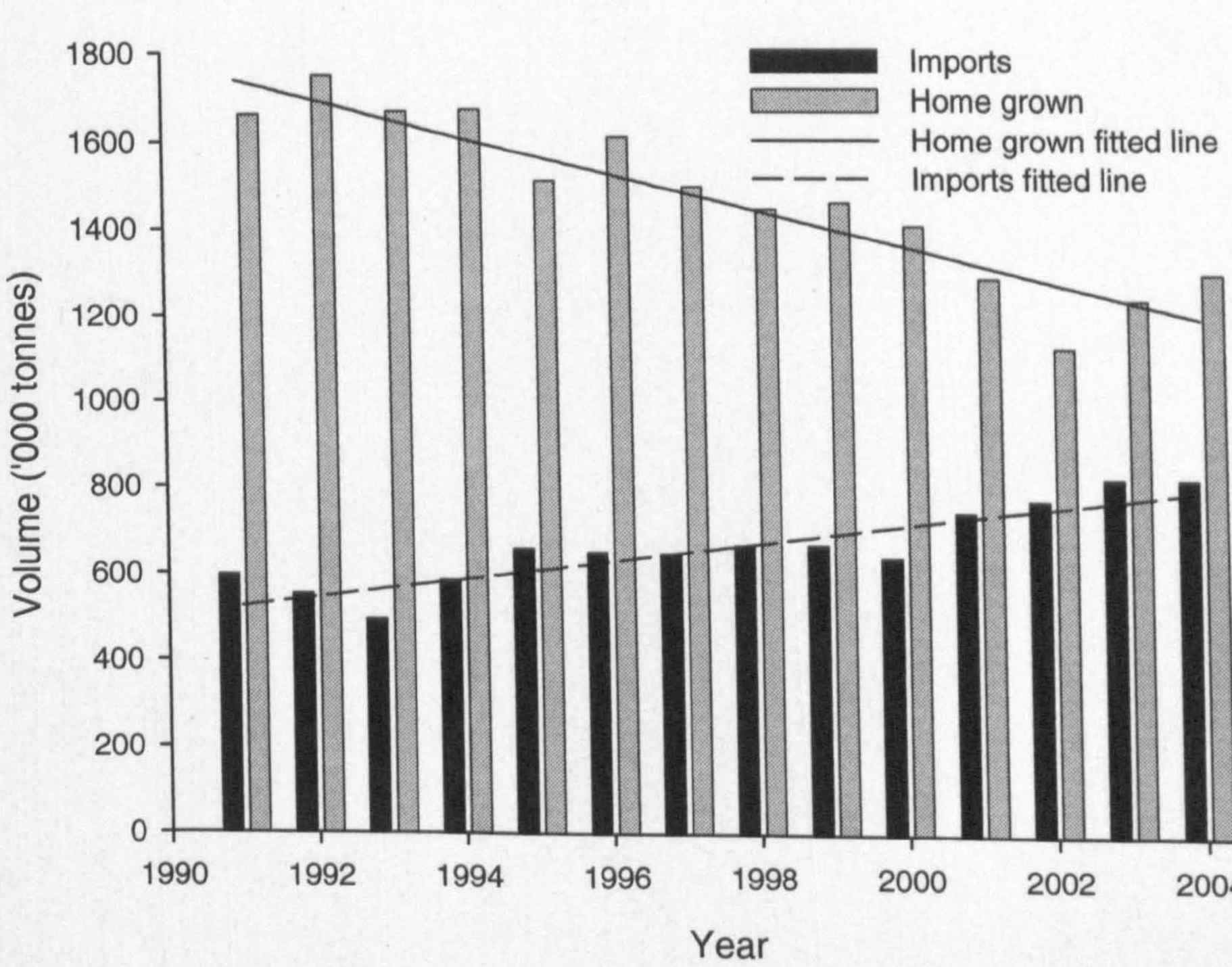

Figure 1.4 Quantity of home grown and imported study vegetables to the UK 1991-2004. *Source*: Adapted from DEFRA Basic horticultural statistics. Fitted linear lines: Home grown $y = -41.837x + 1787.3$, $r^2 = 0.864$ Imports $y = 20.528x + 510.54$, $r^2 = 0.8103$

1.3.3 Kenyan exports

The Kenyan export horticulture industry has been widely celebrated as an African economic success story (Jaffee, 2003; Minot and Ngigi, 2004; Whitaker and Kolavalli, 2004). It is an industry that has generated foreign income valued at US$ 155 million in 1999 (Minot and Ngigi, 2004) rising to US$ 350 million in 2003 (World Bank, 2004) placing horticulture as the third largest foreign income generating sector in the economy (Minot and Ngigi, 2004), and created thousands of jobs, 50,000 of which are attributed to floriculture alone. Horticulture has proven to be more reliable than other sectors such as cotton, tea or coffee, as the world vegetable market has maintained price and supply stability. Cotton, tea and coffee have been subject to wildly fluctuating prices, which has seriously impacted income security. Furthermore export horticultural production has created employment income opportunities as it is a labour intensive sector of the economy (Dijkstra, 1997) (p.51). According to Minot & Ngigi (2004) the potential for poverty alleviation in the lives of smallholders is considerable. For instance, the potential for significant returns per hectare can be made on crops such as French beans which can produce gross margins more than ten times that of maize-bean intercropping. Indeed, intercropping of tea and coffee with maize and bananas can lead to drastic reductions in yields (Dijkstra, 1997) (p.51). It is not only the rural poor who have benefited from export horticulture success. Many landless, unmarried women from low income households, who would otherwise be unemployed, have been given work in pack houses in urban areas (McCulloch and Ota, 2002) (p.29)

The apparent unmitigated success of Kenyan export horticulture is not without a number of caveats. In the mid-1980s there were an estimated 15, 000 smallholders involved in the export horticulture trade. By the early 1990s approximately 75% of export vegetables were produced by smallholders (Humphrey et al., 2004). By 1998 this had reduced to only 18% (Dolan et al., 1999) with 40% of the produce grown on farms owned and managed by the exporters. By 2001 exporter grown produce was thought to account for 60% of export vegetable production (Humphrey et al., 2004). However, Humphrey et

al. (2001) contend that this shift from smallholder production to own farm production does not necessarily detract from the goal of overall reductions in poverty as many previously poor or unemployable people have gained both employment and a degree of income security in the export horticulture sector. Whilst mean income of households growing export vegetables is several times greater than those of non-export farm households, the export vegetable growers tended to possess land and have greater access to water and were thus possibly better-off than non-export growers' to begin with, suggesting that poverty causality is problematic in relation to export horticulture (World Bank, 2004). The initial entry requirements to supplying produce to the export market are governed to extent by the relative resource richness of the smallholder. The problems of entry exclusion are then further compounded by the access to credit and extension services made available by the exporter to its smallholder suppliers which allows reinvestment in the smallholding but further marginalises those unable to enter in the first place (Dinham, 2003; Mannon, 2005; McCulloch and Ota, 2002). As exporters have attempted to respond to the increased demands placed upon them by UK supermarkets, which in turn are governed to an extent under the aegis of European law, particularly in regard to pesticide residues, so those smallholders at the base of the production pyramid have been increasingly excluded from the production process.

1.3.4 The role of UK supermarkets in Kenyan production

UK food retailers are reputedly the world's most sophisticated in terms of efficiency and innovation (Fearne and Hughes, 1998). Supermarkets driven by acute competition during the 1980s and 1990s were able to increase their market share through location and price competitiveness taking business away from small retailers. In the early 2000s the market had become relatively stagnant and growth strategies were primarily based on product differentiation with own label products the centerpiece of this strategy (Fearne and Hughes, 1998). Own label products are not price sensitive but aimed at the quality sensitive consumer. Fresh fruit and vegetables are one of the few categories of supermarket produce for which consumers will switch store. Consequently,

the vegetable section in supermarkets moved to a prime position at the front of the store (Fearne and Hughes, 1998). Furthermore, for ease of display and to guarantee quality much of the produce is now pre-packaged, the responsibility for which rests with the supplier (Fearne and Hughes, 1998). There is an added burden for suppliers to provide product variety, packaging and processing management in order to retain contracts with the large supermarkets and to bear the costs incurred (Dolan and Humphrey, 2000).

As well as meeting the logistical demands of their own marketing strategies, supermarkets are under regulatory pressure following acts such as the 1990 Food Safety Act to demonstrate 'due diligence' in the production process from field to shop shelf. Consequently, produce is now traceable along the entire supply chain placing significant extra burdens on the export farms. To meet the information needs of a 21st century European supermarket chain requires considerable investment in both trained labour and information management systems which inevitably excludes the capital poor sections of the horticultural sector in developing countries (Dolan and Humphrey, 2000; Freidberg, 2003).

Whilst supermarkets are obliged to conform to the various acts and initiatives of both the UK government and the EU they are also under consumer pressure to provide produce that is ethically acceptable. Issues of workers rights, living conditions, child labour and environmentally acceptable production systems are as much a product for marketing as the vegetable itself. Supermarkets now readily display their ethical credentials (fair-trade, organic) and have signed up to umbrella associations such as the Ethical Trade Initiative (ETI) and the International Federation of Organic Agricultural Movements (IFOAM).

Increased volumes of high quality vegetable produce has been achieved with relatively little extra expense to supermarkets who have needed to *'rationalise' their Kenyan fresh vegetable supply chain in favour of a small number of large, well-capitalized and predominately white-run export firms...* resulting in an homogenised supply chain that deals preferentially with suppliers who share the same language and corporate perspective on business (Freidberg,

2003). Thus, what began as a political expression of concern about international food production has been assimilated into the corporate supermarket's portfolio and fetishised as another product for sale. The supermarket need to protect its 'clean image' of ethical trade has obligated farmers to bear most of the costs whilst, according to Freidberg (2003), small farmers have foregone all the opportunities that such trade has brought to Kenya. Some of the costs that a farmer or farm workers must bear relate to the long documented hazards associated with pesticide use.

1.4 Health impacts of pesticide exposure in agricultural contexts

1.4.1 Post World War II pesticide externalities

According to Maroni et al., (2000) pesticides in horticulture exist to aid society in an ongoing struggle to subvert nature to its will, by killing organisms that can have negative impacts on food production and public health (Maroni et al., 2000).

Prior to World War Two (WWII) pesticides were relatively few, highly toxic and broad spectrum in target. Following the development of chemicals designed for use in warfare, the chemical nature of pesticides changed and became primarily synthetic organic compounds. Research on nerve gas during WWII spawned development of organophosphates such as Malathion and Parathion. DDT, HCH, dieldrin and aldrin were developed during the 1940's and 1950's and coupled with organophosphate and organochlorine compounds undesired side-effects began to be reported for both humans and wildlife (Merrington et al., 2002; Pretty and Hine, 2005; van Emden and Peakall, 1996). Increasing evidence suggesting a link between human health and harm to wildlife were crystallised in the 1960's following Rachel Carson's polemic *Silent Spring* which took the pesticide industry to task over the apparent misuse and overuse of chemicals in the environment (van Emden and Peakall, 1996). Whilst the findings of *Silent Spring* still stir controversy, its publication in 1962 appeared to mark a watershed in the pesticide debate and the ebbing away of public confidence in both science and agriculture.

Subsequent research has repeatedly reported negative affects on human health (Sandborn et al., 2004). A large number of the effects of pesticide intoxication are acute, short-term and relatively benign whilst others can be fatal and/or long-term (Pretty and Hine, 2005; Wilson and Tisdell, 2001). In spite of the growing number of scientific reports describing pesticide related adverse health effects there is continued and increasingly polarised debate regarding the precise causal origin of poisonings. Many pesticides are used in conjunction with other compounds and delimiting the extent to which an ingredient provokes any given health symptom has been problematic (Kishi, 2005). Furthermore, there is a time differential between the moment of intoxication and the manifestation of symptoms. The problem is exacerbated in developing countries as the toxic effects of pesticides can be aggravated due to climatic conditions, the lower baseline health of populations and the differing exposure profiles of those potentially exposed to pesticide contamination such as mothers and children working in the fields (Kishi, 2005).

A number of studies have focused on those members of society whose pesticide exposure profile is considered high, namely adult males working in occupational sectors that are heavily reliant upon pesticides such as farmers, horticulturalists and spray applicators. The majority of these studies focus on workers in developed countries (Kishi, 2005; Sandborn et al., 2004). Pesticide related fatalities are relatively rare occurrence in the United States and the United Kingdom, with one incident a decade is reported in the UK and eight a decade in the US (Pretty and Waibel, 2005). Based upon the low rate of pesticide induced fatality, the extent of public and scientific concern appears disproportionate. However, western concerns relate to the potentially insidious, long-term effects of pesticides. Several studies have found significant relationships between pesticide exposure and a variety of cancers including lip cancer (Acuavella et al., 1998), lung cancer (Alavanja et al., 2004) leukaemia (Lee et al., 2004a; Lee et al., 2004b) and breast cancer (Mills and Yang, 2005). A number of other studies on the neurological effects of pesticides have identified correlations with pesticide use and a range of

psychological disorders (Amr et al., 1997; Baldi et al., 2001; Farahat et al., 2003; Stallones and Beseler, 2002). These illnesses are purportedly the result of the cumulative effects of pesticides and therefore are unlikely to be reported in annual pesticide poisoning reports.

People working in the horticultural sector in developing countries are subject to more acute risks associated with pesticide use than their western counterparts. A combination of low literacy rates of spray applicators, lax government regulations with regard to pesticide monitoring, use of highly toxic out of patent pesticides and the difficulty of working in atmospheric conditions that are uncomfortable when wearing protective clothing have resulted in relatively high poisoning rates (Gomes et al., 1999; Williamson, 2003).

1.4.2 Pesticide poisoning

Human pesticide poisoning events are broadly divided into two types, namely acute and chronic. Acute toxicity is by far the most reported of the two as its symptoms are immediate and relatively easy to diagnose (BMA, 1992; Wesseling et al., 1997)

1.4.3 Acute toxicity

Global figures for pesticide poisonings are primarily derived from estimates. In 1973 WHO reported up to 500,000 acute pesticide intoxications based on hospital admissions (Jeyaratnam, 1990). In some regions of the world pesticide poisonings outstrip many acute infectious health problems more habitually associated with the area (Murray et al., 2002). A study in Sri Lanka in 1982 found that hospitals annually admitted 10 000 acute pesticide poisoning incidents of which 1000 were fatal. The fatality figure was twice as high as for malaria, whooping-cough, poliomyelitis, diphtheria and tetanus. Approximately 65% of these were due to suicides. WHO estimates that approximately three million single and short-term poisoning events occur annually and of these 220, 000 prove to be fatal (Jeyaratnam, 1990).

These figures may underestimate global poisonings as they are founded uniquely upon hospital admissions data. Based upon surveys in four Asian countries, (Jeyaratnam, 1990) suggests that 3% or 25 million workers in developing countries may suffer an occupational poisoning event each year. However, individual country rates are often above 3%. A study in Bolivia found between 2% and 10% of agricultural workers from different localities had previously experienced a poisoning event (Wesseling et al., 1997), whilst a study of Indonesian farmers found that 9% had suffered a poisoning event in the past year (Kishi et al., 1995).

These figures may still under-represent the actual rate of pesticide poisoning for several reasons. Many pesticide poisonings are neither reported or diagnosed (Reeves et al., 1999). Farmers might not make the connection between poisoning symptoms and the use of pesticides. In tropical countries the cause of pesticide poisoning symptoms can easily be dismissed by an individual who might associate symptoms such as nausea, vomiting and headaches with illnesses such as malaria or a strong bout of flu. Even where strong emphasis is placed on reporting targeted illnesses, underreporting can be substantial (Crespi et al., 2005; Keifer et al., 1996). Poisoning incidents go unreported because many epidemiological studies in developing countries concentrate solely on male pesticide applicators even though many of the women who work in the fields are equally at risk (Garcia, 2003; London et al., 2002). A number of households in developing countries are without men to carry out the spraying tasks as they may have died from AIDS or moved to towns to seek employment. The burden of farm maintenance and the associated pesticide risks of such tasks are now undertaken by women (Harari et al., 1998; Murphy et al., 1999).

1.4.4 Chronic Toxicity

Chronic toxicity generally refers to longer-term exposure and public and scientific concern centres particularly upon five health categories;

1. reproductive (reproductive toxicity refers to alterations in sexual behaviour, decreases in fertility, or loss of the foetus during pregnancy)
2. teratogenicity (the capability of producing foetal malformation)
3. mutagenicity (refers to the capacity of a chemical or physical agent to cause permanent genetic alterations)
4. carcinogenic (causing cancer or contributing to the causation of cancer).
5. neurological (neurological disorders affect the central nervous system (brain, brainstem and cerebellum), the peripheral nervous system (peripheral nerves - cranial nerves), or the autonomic nervous system (parts of which are located in both central and peripheral nervous system)

Reproductive

There is increasing evidence that pesticides may be linked to a variety of reproductive dysfunctions or illnesses in men and women in both the developed and developing world (Sharpe and Irvine, 2004). Sperm counts of Western men have been decreasing for a number of years with environmental chemicals thought to be the principal causal agent. Between 1973 and 1999 the number of sperm per milliliter of semen has dropped from 120 ($\times 10^6$/ml) to 60 ($\times 10^6$/ml) for adult males in the US whilst the decrease has been even sharper in Europe 170 ($\times 10^6$/ml) to 60 ($\times 10^6$/ml) (Sharpe and Irvine, 2004). More consequential events involve the development of outright sterility. A number of men working in a DBCP (1,2-dibromo-3-chloropropane) factory in California in the 1970's suffered similar symptoms (Whorton et al., 1977). In the same decade, nearly 1500 workers on banana plantations in Costa Rica were exposed to nematicide called DBCP. The workers subsequently suffered differing degrees of sterility (Thrupp, 1991).

Further concern has been expressed concerning the relationship between exposure to certain pesticides and testicular dysgenesis syndrome (TDS) of which sterility is but one aspect (Skakkebaek et al., 2001). Clinical cases of testicular cancer have increased over the past four decades in industrialised

nations rising from approximately three cases per 10 000 in 1973 to 5.5 cases per 10 000 in 1999 (Sharpe and Irvine, 2004). The degree of incidence varies considerably between nations and causality is complex as it is thought that exposure of mothers to substances that are endocrine disruptors may result in their sons developing testicular cancer irrespective of their sons being directly exposed. Nonetheless, attention is increasingly focussing on possible links between testicular cancer and endocrine disruptors (Huyghe et al., 2003).

Women are equally likely to develop deleterious symptoms following exposure to particular chemicals as are their offspring if exposed during pregnancy. Time to pregnancy of daughters who were exposed to p,p'-DDT and its metabolite p,p-DDE at the foetal stage was affected as was the likelihood of becoming pregnant (Cohn et al., 2003). A significant proportion of children born to Colombian floriculture workers had birth defects, specifically birthmarks (Restrepo et al., 1990).

Oncogenicity

There are established links between pesticide exposure and cancer (Alavanja, 2003; Dich et al., 1997; Sandborn et al., 2004). However causality has proven more difficult to determine as many studies have assessed pesticides generically rather than focusing on a specific substance (Dich et al., 1997). There are a number of possible confounding factors which either prohibit or preclude determination of causality. Variables may include diet, toxic non-pesticide chemicals or mixtures of active ingredients (RCEP, 2005).

A number of studies have found links between pesticide exposure and specific cancers such as soft tissue sarcoma (Wiklund et al., 1988) and non-Hodgkin's lymphoma (Kato et al., 2004). Farmers in a study by (Acuavella et al., 1998) had a significantly higher incidence of lip cancer compared to workers in urban settings but (Kishi, 2005) suggests that this may have been due to higher ultra-violet exposure rates rather than any effect caused by pesticides. A number of other cancers have been linked to pesticide exposure such as cancer of the prostate (van der Gulden and

Vogelzang, 1996; van Maele-Fabry and Willems, 2003), pancreas (Fryzek et al., 1997; Ji et al., 2001), lungs (Alavanja et al., 2004; Lee et al., 2004a), and breast cancer (Engel et al., 2005; Lopez-Carrillo L, 1997; Mendonça et al., 1999; Olaya-Contreras et al., 1998; Romieu et al., 2000).

1.4.5 Kenyan pesticide poisoning

Despite official bans of organochlorines in Kenya in 1985, alachlor, alpha and gamma-BHC and endosulfan are still widely used and the Kenyan Ministry of Agriculture remains the principal importer of pesticides (Wandiga, 2001). Whilst pesticide intoxication data for Kenya is incomplete there is reason to suspect that the significance of poisoning events has increased. Kimani and Mwanthi (1995) suggested that in the 1990s 350,000 people in agriculture were victim of a pesticide related poisoning each year whilst the Kenyan Ministry estimated that 700 deaths per year were as a direct result of pesticides (Karlsson, 2004). Of increasing concern are the links made between pesticide use and the inhibition of acetylcholinesterase activity which were detected in a study of Kenyan agricultural workers discovered prevalence ratios were significantly >1 for respiratory, eye and central nervous system symptoms (Ohayo-Mitoko et al., 2000).

The same can not be said for the developing world where the number of occupational and accidental exposure events is disproportionate to the number of people working in agriculture (Dinham, 2005; Karlsson, 2004). Pesticides are the preferred *modus operandi* for suicide in developing countries. Approximately 60% of suicides in Asia can be attributed to pesticides (Joseph et al., 2003) and the highest rates of self-harm in rural areas are through pesticide abuse (Eddleston et al., 2002; Konradsen et al., 2003). Chemical substance induced death in Kenya is common and approximately 52% are due to pesticides with the majority of resultant fatalities due to poor work practices (Wandiga, 2001). Spray applicators in developing countries often work in climatic conditions that render the wearing of protective clothing uncomfortable. In Cameroon 85% of spray applicators were reported as rarely wearing protective clothing and never wearing gloves

even when mixing substances (Matthews et al., 2003). The findings in Cameroon appear to apply to agricultural workers in most developing nations where workers are often barefoot, without gloves, breathing masks or overalls and may be illiterate or unable to understand the language in which the instructions on the packet are written (Gomes et al., 1999; Kishi, 2005; Wesseling et al., 1997). The issue of safe storage and disposal generally remains unaddressed. Furthermore, approximately 77% of agricultural interviewees in a study of agrochemical exposure in Kenya reported that pesticides were stored in parents' bedrooms or in food stores, with the majority of substances being handled by women and children (Kimani and Mwanthi, 1995).

Where causal links have been made between acute toxicity and human health those pesticides have been removed from circulation, for example the European Union Pesticides Directive 91/414 (EU, 2002) requires Member States to prohibit the use of pesticides not included in Annexe 1 of the Directive. This is considerably lower than the number of people who die each year from work related accidents in farming, forestry and agriculture (Table 1.3) (HSE, 2005; HSE, 2006a).

Table 1.3. Six year comparison of work related accidental fatalities in Great Britain 1999-2006

	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Employed	13	13	20	15	6	17	13
Self-employed	23	33	19	20	38[1]	27	23
Non-employed	8	7	2	3	7	3	9
A Total adults	40	49	39	37	49	47	39
B Total children (<16)	4	4	2	1	2	0	6
Total **A + B**	44	53	41	38	51	47	45

Source: Adapted from HSE annual report (HSE, 2005; HSE, 2006a)

1.4.6 Farmer health

In addition to the potential for pesticide ill-health, agriculture has the highest fatality rate of any industry Great Britain with an average of nearly fifty deaths per year. In addition to the risks of accident there is growing debate with

respect to farmer general health and in the UK particularly the issue of mental health status (Gerrard, 1998; Hounsome et al., 2006; Simkin et al., 1998).

The extent of morbidity within a farming population can be dependant upon employment status. For instance, hired farm workers are subjected to increased exposure histories and greater degrees of occupational risk (Villarejo, 2003). In Great Britain during 2004/05 there were broadly estimated to be 420,000 and 611,000 temporary workers employed to harvest and process fresh produce of which between 235,000 and 345,000 were thought to be UK migrants. These figures are difficult to determine as a number of workers are undocumented (HSE, 2006b).

Seasonal workers and particularly seasonal non-national migrant workers are particularly susceptible to increased mental health stress due to insecure employment status (Benavides et al., 2000; Virtanen et al., 2005). They are also vulnerable to problems relating to language, health care access, violence and bullying (FAO-ILO-IUF, 2005; Villarejo, 2003). In spite of the increased health hazards that this occupational group are exposed to, recording illness poses a number of problems as many seasonal migrants report health symptoms upon return to their country (Villarejo, 2003). Consequently, although many workers in UK horticulture supply chains are both temporary migrants and work in environments where potentially harmful substances are an integral part of their everyday working lives, very little is known of their general health status.

1.5 Thesis structure

The principal objective of this thesis is to compare the health, well-being and ethical implications of farm workers working on farms in different countries who supply to the UK market.

The specific research aims are:

i. To assess the health and well being of farm workers in UK vegetable production.
ii. To compare the health of UK farm workers with farm workers from other countries supplying similar products to the UK market.
iii. To explore the potential impact of pesticides on farm worker health, both at the policy and farm level.
iv. To identify major causes of poor health (where it occurs) and identify its determinants.
v. Consider the ethical implications of supplying to the UK horticulture market from production in developing countries.

This thesis is written as a series of distinct scientific or ethical papers and is summarized in the thesis schematic (Figure 1.5). The scientific papers are self-contained and comprise an introduction, methods, results and discussion. To avoid overlap and repetition for the health based chapters the methods sections of chapters 6-10 have been compiled into a single methodological chapter (Chapter 5).

The thesis is divided into a total of eleven chapters. Chapter two investigates the first research question by describing the UK pesticide hazard environment in UK vegetable horticulture. The UK pesticide hazard is evaluated by using the Environmental Impact Quotient model. Chapter three uses the same model and evaluates the hazard posed by arable pesticide hazard ratings as a comparator with vegetable production. The principal objective is to determine

the change in pesticide environmental impact if horticulture shifted production to arable crops.

Chapter four presents theoretical evaluation of the ethical issues related to exporting pesticide hazards to countries such as Kenya. Three ethical paradigms (utilitarian, deontological and Rawls' Theory of Justice) are used to compare the ethical merits of pesticide use in developing countries supplying food to the UK

Chapter five describes the methodology employed to measure farm worker health. Chapter six studied the effects of farming system on farm worker health scores. Farm workers employed on conventional and organic farms were surveyed during the summer of 2006. Four distinct health survey instruments were used to assess the health status of workers: the 36 item SF-36, the five dimensions EuroQol (EQ-5D), the Visual Analogue Scale (VAS) and the Short Depression Happiness Scale (SDHS).

The results of Chapter six are further explored in Chapter seven. The purpose of this study was to ascertain the extent to which UK farms impact farm worker health. Three health survey instruments (SF-36, SDHS and VAS) were supplied in three languages (Lithuanian, Polish and Russian) in a shortened version of the original questionnaire used in Chapter six.

Chapter eight describes the health status of Kenyan export, non-export and Ugandan farm workers. The focus of the study was to determine the contribution of export horticulture in Kenya to farm worker well-being. Data collection used the same health instruments of the original UK based study.

Chapter nine draws together the findings of Chapters six and eight and presents supplementary results for Spain. The farm worker scores for the UK, Spain, Kenya and Uganda are compared and tentative conclusions drawn concerning the relative merits of each locality to worker health.

Chapter ten draws on the evidence of chapters two, six, eight and nine and investigates the relationship between mean farm worker health scores for the UK, Kenya and Uganda and the corresponding on farm pesticide hazard rating.

Chapter eleven includes a general discussion of the thesis. Strengths and weaknesses are discussed and conclusions drawn. Finally, implications for policy and recommendations for future research are identified.

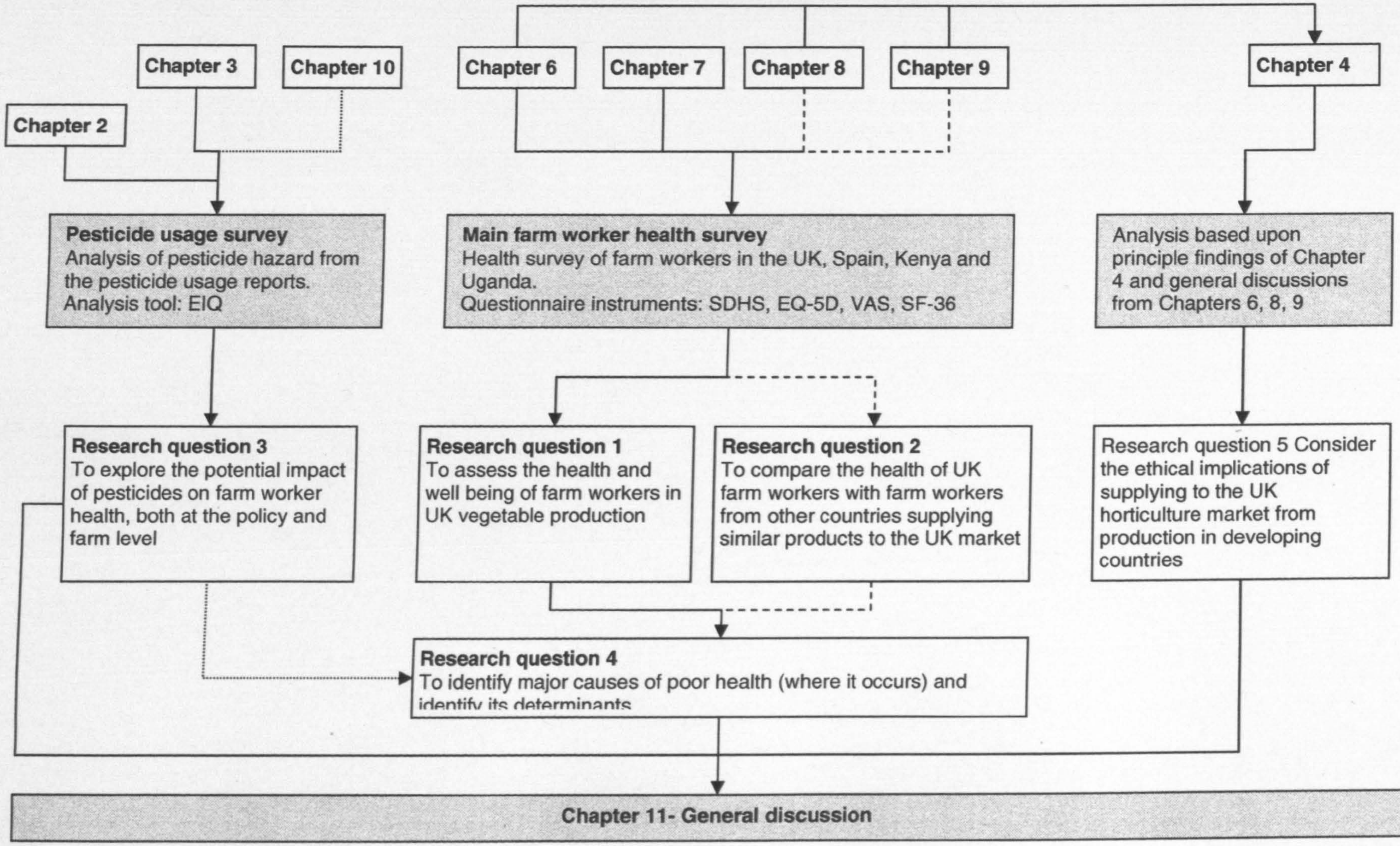

Figure 1.5 Thesis schematic

Chapter 2

Variation in pesticide hazard from vegetable production in Great Britain from 1991 to 2003[1]

[1] This chapter was published in 2006 in the journal *Pest Management Science*. Cross, P., and G. Edwards-Jones. 2006. Variation in pesticide hazard from vegetable production in Great Britain from 1991 to 2003. *Pest Management Science*. 62:1058-1064.

Chapter 3

Variation in pesticide hazard from arable crop production in Great Britain from 1992 to 2002: pesticide risk indices and policy analysis[1]

[1] This chapter was published in 2006 in the journal *Crop Protection*. Cross, P., and G. Edwards-Jones. 2006. Variation in pesticide hazard from arable crop production in Great Britain from 1992 to 2002: Pesticide risk indices and policy analysis. *Crop Protection*. 25:1101-1108

Chapter 4

Ethical considerations for farm worker well-being in Kenyan export horticulture

4.1 Introduction

In early 2006 the Independent newspaper in the UK reported a growing food crisis in Northern Kenya where 2.5 million people were at risk of starvation (Willis, 2006). This estimate increased to 3.5 million in February and to 4.5 million by the end of February (IRIN, 2006). The Kenyan government declared a national disaster and requested £90m ($155m) to be jointly raised by Kenya and the international community. At this time Kenya was a major exporter of fresh horticultural products; arguably providing part of the solution to countering the societal issue of obesity in the United Kingdom.

The provision of food to the UK from a developing country such as Kenya raises a number of ethical issues one of which relates to health. This chapter considers ethical issues arising out of Kenyan export vegetable production. It begins by evaluating the specific issue of the health risks posed by pesticide use before moving to more general concerns regarding worker's employment conditions. The ethical consequences of the opportunity cost of growing vegetables for export are then discussed.

The ethical import of these issues is evaluated through the perspective of three theories that have dominated ethical debate in the 20th century and continue to do so today. The first is utilitarian and draws on Cooley's (2002) formulation, which circumvents the more subjective aspects of risk-based utilitarianism. The second is the deontological approach which determines the ethical value of an action based upon predetermined precepts. The third is the contractual approach based upon Rawls' 'Theory of Justice' (Rawls, 1999) which employs concepts such as the difference and efficiency principles. These ethical frameworks were chosen as they each possess qualities that are exclusive to themselves. Combined, they cover much of the moral terrain of an 'ethical matrix' for assessing food ethics (Mepham, 2000).

The utilitarian or consequentialist approach emphasises the right or wrong of an action based upon derived outcomes. Antipathetic to this perspective is the deontological approach whereby ethical principles, derived from abstract

analytical thought, hold the same for everyone and are not incumbent upon the outcome of any particular action. Such principles require respect for the rights and autonomy of other people making impermissible those decisions that treat anyone as a means to an end irrespective of the resultant benefits. Deontological principles, once formulated, are inclined to become prescriptive and absolute as embodied in Kant's concept of the categorical imperative (Kant, 1998). In common with the deontological approach, Rawls's theory of justice holds that an individual possesses an inviolable dignity. Commonality is also found between Rawlsian and utilitarian theory in as much that choices are evaluated based upon expected outcomes, although with the proviso for Rawls (1999) that any action must ensure that the well-being of the least-advantaged in society must improve irrespective of the gains obtained by other members of the society.

4.1.1 Externalities and ethical impacts of export horticulture

Since 1991 important changes have occurred in the UK fresh vegetable retail sector. There has been a 12% decrease in home production volumes and a 46% increase in imports. At current rates home grown production may be outstripped by imports by 2011 and could, theoretically, disappear by 2070 (DEFRA, 2005). By contrast horticultural export production in Kenya is claimed as an African success story (Jaffee, 2003; Minot and Ngigi, 2004; Shah, 2004; Stevens and Kennan, 2000; Whitaker and Kolavalli, 2004). Benefits include the creation of thousands of employment opportunities, poverty alleviation for the rural poor (Minot and Ngigi, 2004), jobs for previously unemployable unmarried women in pack houses located in urban areas (McCulloch and Ota, 2002) and foreign income generation (World Bank, 2004). A substantial proportion of the reported 135,000 workers involved in Kenyan horticulture are tangible beneficiaries of the export market.

A shift in vegetable production from the UK to overseas would be accompanied by a corresponding shift in work related hazards (e.g. pesticides) from the UK to overseas (Cross and Edwards-Jones, 2006). The potential increase in overseas pesticide hazard, due to increased production,

raises some ethical issues with regard to the health of horticultural workers and pesticide exposure.

4.1.2 Pesticide related ill-health in developing countries

There are several contributing factors that help explain the higher rates of pesticide poisoning in developing countries (Dinham, 2005). Firstly, spray applicators in these countries often work in hot conditions which make the wearing of protective clothing uncomfortable. A number of studies have shown that many horticultural workers perform their tasks barefoot, gloveless, without protective masks or overalls and are often illiterate or unable to understand the language in which the pesticide safety instructions are written (Gomes et al., 1999; Kishi, 2005; Matthews et al., 2003; Wesseling et al., 1997). Even on farms that subscribe to a number of ethical labour codes and where 'best practice' is common practice, there are persistent concerns relating to the effective and safe use of pesticides. For instance, in the cut flower industry, female flower pickers have been reported working on one side in a greenhouse whilst spray applicators worked on the other (Hale and Opondo, 2005). The storage and disposal of pesticides is a further cause for concern. in a study of agrochemical exposure in Kenya, approximately 77% of agricultural interviewees reported that pesticides were stored in parents' bedrooms or in food stores, with the majority of substances being handled by women and children (Kimani and Mwanthi, 1995).

Compounding the hazards of poor work practice, some pesticides in developing countries are reported to be WHO hazard classification class 1a and 1b substances (Mbakaya et al., 1994) (Table 4.1). In industrialised countries, pesticides proven to be harmful to human health have consistently had their registration revoked or the manufacturer has decided not to resubmit new toxicological data and consequently the product has been prohibited from sale within the country or trading block. Whilst Europe revoked the registrations of 320 substances in 2003 (EU, 2002), permission remains for the production of unregistered substances and companies may export to countries where product registration procedures can be more relaxed, such as

some developing countries. Poor farmers in these countries rarely possess the financial means to switch from the cheaper more toxic pesticides to more expensive but less toxic alternatives (Dinham, 2005).

Table 4.1. The WHO classification of pesticides

Class	LD_{50} for rat (mg/kg body weight)	Oral		Dermal	
		Solids	Liquids	Solids	Liquids
Ia	Extremely hazardous	≤5	≤20	≤10	≤40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	200-2000	100-1000	400-4000
III	Slightly hazardous	>500	>2000	>1000	>4000

Pesticide toxicity classes are primarily based on rat LD_{50} oral values *Source:* (IPCS, 2005)

Acute toxicity hazards are known, recorded and often ascribable to a specified substance which is why safety guidelines must accompany the sale of any pesticide that presents a hazard. The safe use of a chemical is dependant upon three factors. Firstly, that the user is literate in the language in which the safety guidelines are written, or has been informed of the hazard and how to mitigate its effects. Secondly, users should undertake the necessary precautions to protect themselves from exposure, and thirdly, that all possible secondary exposure to workers in the field or pack houses is avoided unless informed consent is obtained.

4.1.3 Pesticide poisonings: is defining "acceptable" risk

Human pesticide poisoning events are classified in to two groups, namely acute and chronic. Acute toxicity is the most reported of the two classes as symptoms are immediate and easier to diagnose and link causally (BMA, 1992; Wesseling et al., 1997). According to the World Health Organisation (WHO) approximately three million poisoning events occur annually and 335,000 are fatal (WHO, 2006). It is possible that these figures underplay the total number of acute poisoning events worldwide as they are based solely upon hospital admission records. Surveys of farmers in countries such as Bolivia, Indonesia, and Costa Rica suggest that poisonings affect between 2% and 10% of the farming population (Kishi et al., 1995; Wesseling et al., 1993; Wesseling et al., 1997). Based on only a 3% poisoning level at a global rate it

is possible that as many as 25 million people are affected annually (Jeyaratnam, 1990)

Deciding what constitutes an acceptable risk and the extent to which one can permissibly impose risk on others is ethically complex. The acceptability of an action is ultimately dependant upon subjective opinion as "a risk becomes acceptable to whatever degree people decide to accept it: acceptability is not something a risk has but something a risk gets" (Rescher (1983) in (Cooley, 2002)).

Medical research is explicit in the Declaration of Helsinki in delineating what is acceptable in terms of risk.

> 'Physicians should abstain from engaging in research projects involving human subjects unless they are satisfied that the hazards involved are believed to be predictable. Physicians should cease any investigation if the hazards are found to outweigh the potential benefits' (World Medical Organization, 1996).

As a further caveat the Chairman of the World Medical Association suggests that medical research should not be undertaken in developing countries based uniquely upon cost savings or a country's comparatively relaxed laws. The same ethical rules for medical research should apply irrespective of location (Christie, 2000).

The European Union considers the risk of consumer poisoning due to pesticide residues sufficiently important to introduce a form of the precautionary principle for acceptable residue limits in its legislation. This is in spite of little or no published work establishing causality between residue levels and illness. In so doing the EU has shifted the onus of proof to one where no risk or limited risk needs to be demonstrated. In setting residue levels based upon scientific testing of laboratory animals the EU is implicitly

stating that pesticide residues found above the recommended limits constitute an unreasonable risk.

Whilst the risk from residues is as yet undetermined in the EU, there is tangible, catalogued evidence of the risk to Kenyans of direct acute poisoning, where the number of victims of annual pesticide poisoning events has official recognition (350,000 poisonings and 700 fatalities annually) (Karlsson, 2004; Kimani and Mwanthi, 1995). By most standards and particularly when compared to those of the UK (one death in the past decade (Pretty and Waibel, 2005)) the scale of Kenyan poisonings and fatalities should qualify as a significant risk even if that risk is through misadventure. Based upon Kenyan estimates, several hundred people may die in 2008 as they did each year during the 1990s, although how many of these deaths will be related to vegetable export production is difficult to determine[1]. To facilitate the determination of whether an action is right or wrong it is important to employ ethical theories that can be generalised so that everyone is treated the same.

4.1.4 Utilitarian views on acceptable risk

Founded upon the idea that human beings are rational agents and that when furnished with the relevant information will make rational decisions, a utilitarian would attempt to evaluate the most beneficial means to resolving a particular dilemma by weighing the pros and cons of an action and estimating to what degree the benefits of such an action negate the costs. On this basis a course of action is ethical if it increases overall utility (the greatest good for the greatest number). Utilitarian decisions making can resemble a cost-benefit analysis (CBA). Unfortunately, when human health is placed at risk from technology then CBA is an unsatisfactory framework for assessing the ethical probity of using such technology as decisions are reduced to issues of

[1] In both UK and Kenyan horticulture the risks are not predictable in any strict sense, as people's tolerance of chemicals varies widely. Confounding variables such as historical exposure to other harmful substances renders causality extremely problematic, particularly for chronic toxicity.

assigning value (often financial) to competing actions. This can produce unjust outcomes as people may be prepared to pay a higher price for safeguarding their own health than the health of others. Thus the value ascribed to an action would be subject to considerable bias in favour of those assigning value to an action, namely the decision makers. In an attempt to obviate this type of inherent bias in utilitarianism Cooley (2002) proposes Resher's (1983) formulation of a modified utilitarianism whereby:

1. Acceptance of risk increases with the [perceived] benefits to be derived from an activity...
2. For any given level of benefit, people tolerate a greater level of risk for voluntary activities than for involuntary activities.
3. The rate of death from natural causes is something of an upper limit in determining the acceptability of life-threatening activities. Involuntary activities whose resultant fatality rate exceeds that of ordinary life... would be unacceptable (Rescher, 1983).

Even within these guidelines people are still likely to evaluate the acceptability of risk differently as individuals will differ in the value they attribute to particular benefits. A further rejoinder is thus proposed which invokes the precautionary principle whereby the onus of proof is placed on the safety of a product rather than on proving its potential to cause harm.

Concerning the first and second points, that reasonable people will tolerate a greater degree of risk for voluntary activities than for involuntarily activities, would require that workers in export horticulture are informed of the risks and aware that alternatives exist (thus rendering them voluntary). The harm that befalls an individual would therefore be more acceptable to others if that individual were aware of the risk and had full access to the information used to evaluate such a risk.

With respect to the third point, the approximate number of recorded annual pesticide-related fatalities in horticulture in both the UK and Kenya is known. However, the number of these fatalities which are as a direct consequence of

producing vegetables for the UK either through Kenyan export or UK home grown is probably zero as UK farms are under strict regulation by the Health & Safety Executive (HSE) and some large Kenyan export farms are subject to almost thirty monthly audits by organisations such as EurepGAP. However, Kenyan deaths attributed to pesticide use and abuse each year are substantially greater than the upper limit proposed in point three. It might therefore be argued that for many of the workers on Kenyan non-export farms their activities may be involuntary as they may be unaware of the hazards to which they are exposed, and consent, which is a prerequisite of any voluntary activity, is not obtained when information concerning risk is withheld or inaccessible. If non-export farms serve as outgrowers to the larger farms then the larger farms would appear to have an ethical duty of care to workers employed on outgrower farms.

A recurrent difficulty in employing a utilitarian approach relates to the ascribing of value to actions. If the criterion of weighted average is used to derive relative utility to different individuals or groups then it is possible that those same weightings may favour those who allocate value to an action whilst undervaluing the utility of others. Weightings and assigned values tend to be arbitrary, prohibiting a more just and equitable assessment of a situation (Chu and Liu, 2001).

Decisions based uniquely on the expected outcome of an action and the differential value assigned to individuals of such an outcome is deemed unethical by non-utilitarians because:

> 'No human can see the future reliably enough to perform acts that would only be justified from the perspective of an ideal observer, a 'God's eye' point of view. To place others at risk under such circumstances is to use them in a pernicious way, to disrespect others' right to make their own rational choices. One respects other persons when one obtains their consent before exposing them to risk. As such, human beings have a responsibility to respect and facilitate others' freedom and their capacity for acting

on the basis of their own values, even when doing so appears to lead inexorably to suboptimal outcomes' (Thompson, 2001).

4.1.5 Deontological views on acceptable risk

The need to respect and facilitate the freedom of others (which equates to the deontological notion of respect for the autonomy of others) is understood here to indicate the capacity of an individual to evaluate a situation, make rational decisions and assess potential consequences of an action. Violation of an individual's autonomy always renders an action unethical from a deontological perspective. Thus using an individual as a means to an end (even if the benefit of that end is deemed advantageous to all but the individual concerned) is unacceptable because an action that is partly wrong is entirely wrong.

The inviolable dignity of an individual is also a pre-condition of Rawls' (1999) Theory of Justice as expressed in the first principle: 'Each person is to have an equal right to the most extensive total system of equal basic liberties compatible with a similar system of liberty for all'. An action that involves risk would be required by both deontological and Rawlsian principles to obtain consent from those exposed to the risk.

4.1.6 Consent and exit

Risk in itself is not unethical for either consequentialists or deontologists. It is the subjecting of human beings to risk without their prior, informed consent that renders an action unethical. Consent gained through a rigorous appraisal of the risks associated with a particular employment is not in itself sufficient to satisfy the deontological criteria of acceptability as consent can only be given when an equivalent viable alternative is available that permits an exit strategy. Thompson (2001) contends that exit must be central to a food system founded on consent. Kenyan horticulture therefore, might fulfil these conditions only by ensuring that all workers who come into contact with pesticides, whether via a spray applicator working in the fields harvesting or planting vegetables or

working in the pack house, are informed of the associated health hazards. Furthermore, the opportunity for exit should ideally be present in terms other than unemployment and poverty although this may be a very testing requirement for any individual farm. The extent to which the provision of exit (in the form of alternative employment) as a requirement of ethical sustainability is feasible in any country at any given time appears to be an abstract proposition rather than a realisable possibility. Applying the logic of the argument for exit could entail that only the wealthier countries should grow vegetables for the UK as in theory workers in those countries have alternative employment opportunities.

Workers on UK farms appear to have viable exit options such as alternative employment and a social welfare system that support periods of unemployment. By contrast workers on Kenyan farms do not have equivalent possibilities to exit, as alternative sources of employment or income generation are either non-existent, or more precarious than remaining in waged-horticulture (McCulloch and Ota, 2002).

4.1.7 Working conditions

The Declaration of Helsinki requires that any medical study performed on a population must in some way be beneficial to the participants. Applied to a horticultural context, those individuals employed on a permanent basis appear to benefit in terms of income security, free schooling for workers' children, sick pay, health facilities (often in the form of an on farm clinic) and maternity leave.

However, in many cases these fringe benefits do not apply to those workers who are employed on a casual or seasonal basis for less than 90 consecutive days in a given year. The majority of workers on Kenyan farms are employed on such a basis and are subject to considerable job insecurity. Work that is seasonal, temporary or casual is frequently performed by women who account for 63% of the flexible labour force whilst men occupy over 60% of permanent posts (Dolan and Sorby, 2003; Dolan and Sutherland, 2002). Women are

rarely eligible for paid maternity leave and once in the advanced stages of their pregnancy are either asked to leave or are unable to renew their contracts (Barrientos et al., 2001; Smith et al., 2004). As a consequence, the abortion rate is reported to be high in on cut flower farms in Kenya (Hale and Opondo, 2005). Such discrimination would appear to contravene most ethical employment codes and yet apparently remains a widespread practice in Kenya.

4.1.8 Meeting the deontological criterion

From a deontological perspective there is no place for qualification in judging the food production system as ethical or unethical. An action or process that is not universilisable or able to obtain the consent of participants or does not provide exit remains unethical. Whilst specific actions, processes or choices within the production process may indeed attain the highest ethical standards we may not be able to ascribe the label 'ethical' to either Kenyan export or UK horticulture based solely upon the occasions where ethical standards are met. The exceptions to the rule, especially when these rules are routinely broken, may determine the ethical status of a system.

4.1.9 Export horticulture, Rawls and the Theory of Justice

Poor employment conditions would also be unacceptable from a Rawlsian perspective as such conditions would fail to meet the requirements of the efficiency and difference principles. According to Rawls' first principle of liberty it is reasonable that "each person is to have an equal right to the most extensive total system of equal basic liberties compatible with a similar system of liberty for all". The second principle deals with uneven distribution of wealth which is admissible only if inequalities are arranged in such a fashion that they are simultaneously:

a) to the greatest benefit of the least advantaged, consistent with the just savings principle, and

b) attached to offices and positions open to all under conditions of fair equality of opportunity.

This 'difference principle' permits only those inequalities in wealth and opportunity that improve the conditions of everyone; otherwise an equitable distribution should be preferred. A further caveat requires that differences are only permissible where efficiency criteria (pareto-optimality) are met, whereby any improvement for some people does not entail a worsening of conditions for others. In other words we as consumers are prohibited in a moral sense from exercising a particular liberty, such as consuming cheap imported vegetables, if it entails the exploitation of farm workers in ways already cited above. What we do if similar worker conditions prevail in UK farms is less clear.

4.1.10 Is Kenya meeting its basic needs?

The revenue generated by Kenya from growing export vegetables is advanced as a compelling argument for directing efforts towards increasing market growth in order to alleviate poverty. Proponents of this approach accept that problems persist with regard to issues such as gender rights, working conditions and health and safety, but argue that the means to address these problems is already extant within the system and that with better monitoring and targeted inputs as well as awareness raising in the UK, the welfare of Kenyan horticultural workers should improve (Jaffee, 2003; Minot and Ngigi, 2004; Shah, 2004; Stevens and Kennan, 2000; Whitaker and Kolavalli, 2004).

This presupposes that the market will be able and willing to accommodate improved social well-being if sufficient regulatory and monitoring resources exist. What appears to have been overlooked in the debate is the possibility that Kenyans could produce food for themselves rather than for the UK [2].

[2] An added economic and ethical advantage of feeding the Kenyan poor is that research suggests that "where inequality is persistently low, the poor will tend to obtain a relatively

Failure to consider this as an option raises questions as to the extent to which it is morally responsible for UK supermarkets to source produce from food-poor countries?

In Northern Kenya the lack of food and the means to pay for it, is testimony to the country's inability or willingness to meet its citizens' basic nutritional requirements. Pro-poor food distribution requirements are apparently not being met by trickle-down wealth distribution and are unlikely to do so in the near future.

It would appear reasonable to suggest that the most deprived life is preferable to no life at all and that a life that satisfies the most basic criteria of the WHO definition of good health is better than one that does not, irrespective of the practicalities involved in attaining such a condition. In addition, if we can agree that we have an ethical responsibility to alleviate suffering where possible then we might also agree that the marginal utility to be gained from sustaining life and substantially increasing life-expectancy in developing countries is more urgent than more minor increases of life expectancy for UK citizens.

There may be several reasons why food is in short supply in certain areas and not others, but the argument being made here proposes that suffering could be tempered and possibly alleviated if an alternative conception of what is ethically right were adopted. The efficiency principle requires that social and economic inequalities are to the greatest benefit of the least advantaged and no system can be called efficient where an alternative exists that improves conditions for some with no worsening of conditions for others. This entails in other words assessing viable alternative scenarios and determining which of these could produce the most beneficial outcome for the most disadvantaged without negatively impacting other members of a society.

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higher share of the gains from growth" Ravallion, M., and G. Datt. 1999. When is Growth Pro-Poor? Evidence from the Diverse Experience of India's States. *In* Policy Research Paper. World Bank..

4.2 Conclusion

As described above some of the ethical issues are complex that arise in relation to concepts of risk and working conditions in export horticulture. Different ethical paradigms produce different outcomes. For instance, utilitarians may be more accepting than either deontologists or Rawlsians of the risks that are imposed upon farm workers for two reasons. Firstly, risk is only ever acceptable to the extent that citizens are accepting of it and in the case of export horticulture UK consumers' acceptance of risk is implicit in their purchasing patterns. Secondly, if the benefits such as employment for the rural poor in Kenya and cheaper food for UK consumers outweighs the disbenefits of pesticide exposure and possible subsequent ill-health for farm workers then utilitarians would be consenting to the production system.

By contrast, deontological ethical approval could only be given if farm workers on export farms were fully consenting. Consent could only be sought if the workers had previously been fully informed of the risks associated with pesticide exposure. Ideally, conditions of exit would also need to be made available. This could take place on the farm by offering work that removes the worker from situations where exposure is likely to occur. Alternatively, work opportunities outside of the farm need to be available although this might have the unpleasant consequence of requiring businesses to locate to areas of pre-existing high employment.

The more general concerns relating to working conditions, particularly gender inequality and sexual abuse, in Kenya would likely evoke similar responses from all three ethical theories. For instance, cases of sexual abuse from male supervisors towards their female colleagues are widely reported (Hale and Opondo, 2005). Utilitarians would find this unacceptable as any benefits to the individual supervisor would appear to be outweighed by the disbenefits to the victim as well as any subsequent loss in production for the farm. The company would not necessarily be at fault as responsibility for the supervisor's actions would be dependant upon the degree of unsupervised power that the farm management permitted the supervisor to wield, as well as the extent to which

the farm was aware of wrongdoing. And even then, in a classical utilitarian world, sexual abuse could still be theoretically tolerated as the benefits might outweigh the disbenefits.

Deontologists may draw similar conclusions to utilitarians but for very different reasons. Firstly, the act itself between the perpetrator and the victim is unethical because the supervisor fails to respect the autonomy of the victim. Consequently his actions are not universal as he would not be able to achieve his goal without infringing the freedom of others to pursue their own. The extent to which the company is acting unethically once again depends upon the extent of knowledge of the wrongdoing by the farm management. A deviant individual within an organisation is ultimately responsible for their own actions and only an inability by the farm management to act when aware of the wrongdoing would appear to render them ethically liable.

Rawlsian ethicists may contend that the supervisor's actions are unethical for two reasons. Firstly, they fail to respect the principles drawn from Rawl's original position such as the duty not to be cruel; the duty not to injure and the duty not to harm the innocent (Rawls, 1999). Secondly, any improvement for one person does not entail a worsening for another which in this case it patently does.

From a legal perspective the farm company may have been vicariously liable through the legal doctrine of *respondeat superior* which holds that "the head (master) is liable for illegal or wrongful acts of his servants. From this has emerged the doctrine holding the corporation responsible for the actions of its employees" (Stevens, 1994). However, the legal contention requires that "an employer is not liable for the unauthorised acts of an employee unless they are so connected with acts which he has authorised that they may rightly be regarded as modes —although improper modes— of doing them" (Buckley, 1997). Establishing the liability of a company is dependant upon the extent to which the company is cognisant of any continuing misconduct. Permitting serious misconduct to continue in a company is to condone the perpetrators actions. In this instance it could probably be contended that if the horticultural

company was aware of continuing misconduct then it was probably culpable from a legal and ethical perspective (utilitarian, deontological and Rawlsian) as it knowingly failed to prevent harm.

Evaluating the relative ethical merits of the horticultural production both in the UK and overseas is very complex. The consumer does not appear to be equipped to make these types of decision and it may fall to policy makers at a governmental level to make evidence based decisions relating to ethical issues in the food production process.

Chapter 5

Health survey methodology

5.1 Introduction

5.1.1 Why measure health related quality of life?

It is now understood that a full description of an individual's health status can not be achieved solely through measures of disease. Account must also be taken of other factors such as pain, anxiety and physical functioning (Muldoon et al., 1998). The medical findings of many common and rarer health complaints are well known. For instance, the link between hypertensive blood pressure, cholesterol levels and heart attack are well documented and have been exhaustively tested in clinical trials (Smith et al., 2001). Much is also known of less prevalent illnesses such as multiple sclerosis (Fisk et al., 2005) or ankylosing spondylitis but empirical knowledge of the subjective health status of sufferers can be scarce (Dagfinrud et al., 2004). Conventional medical practices such as blood tests for cholesterol levels and monitoring blood pressure to identify hypertensive disorders are commonplace. These and other physiological measures such as VO_2 max (the maximal capacity for oxygen consumption by the body during maximal exertion) can inform clinicians about specific aspects of an individuals physiological functioning, but unfortunately afford little or no indication regarding the patient's functional capacity (Guyatt et al., 1993).

Health-related quality of life (HRQL) offers a complementary perspective on the value that an individual assigns to his or her health status. It focuses on the degree of morbidity that the respondent describes as opposed to external attempts to quantify the stage or degree of illness (Draper and Thompson, 2001; Muldoon et al., 1998).

Health is generally understood to include an individual's awareness of his or her social, physical and mental functioning as well as well-being (WHO, 2008). Limitations in any of these aspects of health can impact on an individual's life style. For example reduced physical functioning following a hip replacement operation for instance, is likely to influence an individual's ability to remain in employment (Dagfinrud et al., 2004) however, this unlikely to be

detected by more formal, traditional medical practices. Furthermore, the relative ability of patients to cope with the stress of events such as hospitalisation can also influence outcome measures of their well-being. For instance, two patients both recuperating from "successful" hip replacements may have very different mental coping strategies. Equally, their physical and emotional roles in their social milieu may be affected to differing degrees and thus reduced physical and emotional capacity will impact differently upon their lives (Guyatt et al., 1993). Such differences may remain undetected in conventional medicine, but should become apparent in many self-reported health questionnaires. Thus, HRQL assessment gives a broader and more encompassing assessment of an individual's well-being.

In their most fundamental incarnation, HRQL questionnaires can comprise just one question asking the respondent to describe their general health as "excellent, very good, good, fair or poor". Whilst such a question has proven surprisingly useful for predicting future mortality rates (Bowling, 2005a; Burstrom and Fredlund, 2001; Deeg and Bath, 2003; Idler and Benyamini, 1997; Ringback Weitoft and Rosen, 2005; Schoenfeld et al., 1994; Singh-Manoux et al., 2007), it generally provides limited information about an individual (Guyatt et al., 1993).

In general, HRQL questionnaires (commonly referred to as health instruments) comprise a number of dimensions or scales which measure different aspects or attributes of human health such as mobility, physical functioning, happiness and mental health. An individual's or group's scores for these attributes can frequently be compared to a published population norm or a sub-group of the population (gender, age-group, socio-economic class etc). Such generic instruments are designed to measure the health status in any given population irrespective of the disease burden of that population (Guyatt et al., 1993; Muldoon et al., 1998).

This chapter will describe the sample size, the methods employed to recruit farms to the study, the collection of field data and a description of the health instruments.

5.1.2 Difficulties involved in obtaining a representative sample in a multi-national context.

This study was confronted with substantial difficulties in obtaining a representative sample of farm workers in a multinational context. In an ideal experimental design a comparative analysis of health scores between individuals in different countries would require that gender and age be evenly distributed throughout the survey sample. In reality, age groups and gender differed between countries although they did tend to be homogenous within countries.

Farms recruited to the project did so at their own volition. It is possible that their willingness to participate reflects self-selection bias as only those farms who felt they had no serious problems with working conditions may have been willing to participate. For example, one farm in the UK refused to participate in the study because the owner admitted having "trouble" with approximately ninety Polish workers. One other very large farm was also reticent about participating and subsequently became bankrupt following revelations of underpaying migrant workers. To assess the well-being of workers on farms requires a broad cross-section of farm types. The dynamic environmental and social interaction between farm workers, their working environment and their relationship with their employer may differ between farms. Locating a sufficient quantity (assuming that a representative quantity could be predetermined) of smaller farms is problematic and cost ineffective as a far greater number need to be identified and contacted in order to obtain a sample size that reasonably reflects the variation between farms.

Replicating the selection process over four countries also proved difficult to do as different contexts require different recruiting methods. Thus, in the UK, farm recruitment was undertaken primarily through telephone contact. In Uganda, recruitment was managed by Makerere University through a network of contacts and extension officers. Kenyan farms were recruited through both contacts made with holding companies in the UK and following a parent project scoping visit in 2006.

5.1.3 Sample size

The farm worker sample size obtained for each country is given below (Table 5.1).

Table 5.1 Number of farms and respondents in each of the survey countries.

Study country	Farms	Respondents
UK 2006	10	605
UK 2007	3	207
Spain	3	472
Kenya	2	893
Uganda	62	573

The SF-36 health instrument was the principal measurement tool in this study and consequently sample size was determined by the requirements of the SF-36 to detect smaller points differences between two groups. The required sample size estimates for comparisons between two experimental groups for post-intervention SF-36 physical and mental component summary scores vary depending upon the required statistical power (Table 5.2).

Table 5.2 Sample size estimates for the SF-36 health instrument needed to detect differences between two experimental groups, post-intervention scores only. As the number of points required to detect a difference between two groups decreases the sample size increases at a commensurate rate.

	Number of points difference				
	1	2	5	10	20
Physical Component Summary	801	201	33	9	5
Mental Component Summary	801	201	33	9	5

Adapted from Ware (2001)

An increase in the power to detect ever smaller differences between two groups is dependant upon increasing sample size. For example, approximately 25 times as many respondents are required to detect a one point difference in scores between two groups compared with a five point difference.

5.1.4 Sample recruitment

UK and Spain

This work was part of a larger multi-disciplinary study[1] of vegetable production, and the types of farms and range of crops available to be studied in the UK were determined by the aims of the parent project. The parent project focused on large commercial horticultural businesses. These businesses typically employ hundreds of workers, with some employing more than a thousand.

The initial sampling frame included large vegetable producing farms in the UK which produced at least one of the following crops: brassicas, peas, beans, onions, leeks, lettuce and endives. Where possible this farm selection criterion was applied to all participating farms in all countries. The sample businesses in UK and the Spain were identified through a combination of personal knowledge, telephone listings and web sites. They were contacted by phone or e-mail in a non-systematic manner, and successful initial contacts were followed up with meetings with farmers and/or managers as appropriate. Having first recruited a series of large businesses to the study, several smaller horticultural farms were invited in order to provide some contrast.

Due to the potential sensitivity of the research topic it was agreed with participating businesses that absolute confidentiality would be maintained about their identity. For this reason minimal descriptive data on the sample farms are presented here. On completion of the research work each participating farm received a report summarising the findings of the research overall, which compared the results from their business with the whole sample.

[1] The parent project was 'Comparative assessment of environmental, community & nutritional impacts of consuming fruit and vegetables produced locally and overseas' funded by the Rural Economy and Land Use (RELU) programme of the UK Research Councils.

Kenya and Uganda

Contact details for the principal Kenyan export farms were obtained through searches on the internet. Subsequent contact was initially by e-mail and at a later date through telephone and arranged meetings between the author and representatives from the participating farms.

Kenyan non-export farm workers were recruited during November 2007 in an area that shared the same climate as that of the export farms but was distant enough from the export farms as to be beyond the socio-economic influence of those farms. Farm workers were visually located working in fields the length of a valley on the northern flanks of Mount Kenya. Field researchers then approached the farm owner to seek his or her permission to interview farm workers.

Ugandan farms were identified by research members of staff at Makerere University. Extension workers were then allocated to the research team to act as guides to the sample areas. Permission from farm owners was sought by the extension workers who then coordinated the subsequent sample.

5.1.5 Data collection

UK and Spain

Fieldworkers were defined as those members of staff, whether seasonal or permanent, who spent the majority of their day working in the field. These included all workers who planted, harvested, weeded or sprayed crops as well as those who supervised the workers or drove tractors in the field. Packhouse workers were defined as all those employed in the packhouse and undertaking tasks that involved grading, packing, tray-lining, stacking, washing or tractor work within the packhouse or warehouse. Most field and packhouse workers were employed on a seasonal basis.

Questionnaires in the UK and Spain were distributed through the farm owner (on small farms) or the human resources department on larger farms. A researcher was present at the distribution stage on all but two farms in the UK but absent in the Spanish survey. Collection was undertaken by inviting respondents to either place their completed questionnaires into a centrally located collection box or by placing it in a sealed envelope and handing it to their line manager who then returned the questionnaires to the researcher. All questionnaires were completed outside of work time and away from managerial supervision. The questionnaire was self-administered and the participants were adults of working age of both sexes. Ethical approval was obtained through the University of Wales, School of Agricultural and Forest Science ethics committee.

Kenya and Uganda

In both Kenya and Uganda questionnaires were completed using face to face interviews between research assistants whose mother tongue was the target language in the study sample. Research assistants in both countries received a minimum of two days training and continuous monitoring during the data collection stage. Uganda data was collected during February and March 2007. Workers were invited to participate in the survey through the coordination of extension workers.

In Uganda farms and farm workers were located through the participation of agricultural extension workers in Kasese, Luwero, Mukono and Wakiso districts.

Chapters 6 to 10 utilise self-reported questionnaires to assess farm worker health status. The questionnaires differ slightly between studies and the methodology utilised in their employment is here described.

5.1.6 Instrument description

The principal survey questionnaire comprised three parts. Firstly, a general demographic section which included the respondent's age, gender, nationality, residents status, marital status, educational attainment and whether they had in the past or currently smoked. Secondly, information was gathered relating to the respondents' employment conditions (employment status, job description, equipment provision, facilities and fringe benefits such as housing provision or subsidised lunch, and rates of pay) and their living conditions (changes in household income, number of children, housing conditions and what types and quantity of valuables they possessed). The objective of collecting socio-economic data was to gain insights into the relative vulnerability of the different workforces. This section was omitted from the longitudinal survey of 2007. Thirdly, the remainder of the questionnaire comprised an array of health questionnaire instruments which are described in detail below.

5.1.7 Health Scale Description

A wide range of health instruments have been developed since the mid 1970s as indicators of illness have tended to move away from clinical and laboratory indicators and increasingly have attempted to incorporate the patients' opinion (Bowling, 1997; Hunt, 1997; Wood-Dauphinee, 1999). Their use can afford valuable insights into the economic validity of health interventions as well as the quality of life of individuals and groups (Hounsome et al., 2006). In this study four different health related instruments were utilised, three of these have been widely used in health research: the SF-36 (Dubernard et al., 2008; Forger et al., 2005; Picavet and Hoeymans, 2004), EuroQol EQ-5D (Ankri et al., 2003; Burström et al., 2004; Wolfs et al., 2007), and Visual Analogue Scale (VAS) (Dolan et al., 1999; Kim et al., 2005; Sach et al., 2006). The fourth, the Short Depression Happiness Scale (SDHS), is a relatively new instrument which has not been widely used in other studies yet. A brief description of each of these instruments is given below.

SF-36

The SF-36 was the primary health instrument used in the study. It is a multi-purpose health instrument that enables comparisons within and between populations of the health burden of specific diseases, health outcomes of a variety of medical interventions and the health effects of differing lifestyles and work related illnesses. It has been translated for use in over 50 countries and its results have been reported in over 4000 publications (Ware, 2000). The SF-36 has been used in both clinical settings to measure the impact on functional life for medical complaints as diverse as rheumatoid arthritis sufferers (Talamo et al., 1997), post hip fracture recovery rates (Peterson et al., 2002), AIDS (Anderson et al., 1998), Sickle cell disease (Anie et al., 2002) as well as for use in more general population studies (Alonso et al., 2004; Eisen et al., 2005; Lahelma et al., 2005; Yamazaki et al., 2006). It has been judged to be the most widely evaluated of all generic health questionnaires, which strongly recommended its use in this study (Stansfeld et al., 1997; Ware and Gandek, 1998; Ware, 2000).

The SF-36 is composed of 36 items which together measure eight different aspects of health (termed scales): Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional and Mental Health.

- physical functioning (10 items)
- social functioning (2 items)
- role limitations due to physical problems (4 items)
- role limitations due to emotional problems (3 items)
- mental health (5 items)
- energy/vitality (4 items)
- pain (2 items)
- general health perception (5 items).

Physical Functioning (PF)

The importance to both the clinician and patient of evaluating the many aspects of physical functioning is reflected in the number of items (questions) that comprise this scale (Table 5.1) and the 21 possible response levels. Low scores indicate considerable limitations in performing physical activities such as bathing and dressing due to ill health. High scores indicate no limitations in even the most vigorous activities.

Role-Physical (RP)

An individual's level of physical functioning will be reflected in the relative limitations in their physical role. For instance, severely limited physical functioning is likely to restrict the type of work that can be undertaken, reduce the amount of time spent at work and/or reduce the scope of more general activities that can be performed. Low scores indicate problems with work or other daily activities owing to physical health. High scores indicate no problems with work or other daily activities owing to physical health.

Bodily Pain (BP)

This scale asks the respondent to assess the extent of bodily pain they have suffered in the previous month by indicating one of the following answers: none, very mild, mild, moderate, severe, very severe. A follow up question inquiries as to the extent that any bodily pain interfered with work both at home and in the work place. Low scores indicate severe restrictions in work or daily activities due to physical pain. High scores indicate no limitations due to pain.

General Health (GH)

This scale comprises five items and 21 response levels. The scale has been shown to be useful for predicting of medical care expenditure and general health outcomes (Ware, 2000). Low scores indicate that personal health

considered poor and likely to deteriorate. High scores evaluate personal health as excellent.

Vitality (VT)

The vitality scale has been shown to be sensitive to the impacts of diseases such as hypertension, prostate disease and differing severities of AIDS (cited in Ware, 2000). Low scores indicate that the individual continuously feels tired and worn out. High scores by contrast are indicative of an individual who feels full of energy and vigour all of the time.

Social-Functioning (SF)

This scale moves beyond the concepts of physical and mental well-being and attempts to capture the quantity and quality of social activities involving the respondent. The scale asks how either physical or mental health has interfered with normal social activities such as visiting friends or family. Low scores indicate the individuals normal social activities are disrupted due to physical and emotional health.

Role-Emotional (RE)

An individual's level of mental functioning will be reflected in the relative limitations in their emotional role. For instance, limited emotional functioning is likely to restrict the amount of time spent at work or doing other activities. It may lead to under performance at work or careless accomplishment of work activities. Low scores indicate problems at work or other daily activities due to emotional problems. High scores by contrast are indicative of no problems with work or daily activities.

Mental Health (MH)

This scale provides a composite score from each of the four principal mental health dimensions: anxiety, depression, loss of behavioural/emotional control

and psychological well-being. Low scores reflect an individual's continuous sense of nervousness and depression whereas high scores are indicative of serenity, calm and happiness.

Component Scores

Low scores indicate limitations in self-care, physical, social, and role activities, severe bodily pain, frequent tiredness and health is rated as "poor". High scores indicate no physical limitations, disabilities, or decrements in well-being, high energy levels and health are rated as "excellent".

Respondents' scores are transformed according to a standard protocol and range from 0-100 where a score of 100 for any given scale indicates no limitations for that particular health attribute (Picavet and Hoeymans, 2004; Shadbolt et al., 1997). Two further scales summarise the aggregate scores of relevant scales. The Physical Component Summary (PCS) aggregates scores for Physical Functioning, Role Physical, Bodily Pain and General Health whilst the Mental Component Summary (MCS) aggregates scores for Vitality, Social Functioning, Role Emotional and Mental Health (Table. 5.3).

One of the advantages of using the more established survey instruments such as the SF-36, EQ-5D and VAS is that established population norms are available for these instruments. Published population norms exist for the eight health scales and two component summary scores for the SF-36. Population norms are baseline data sets for the general population. They are generally derived from large population samples (the SF-36 is based upon a sample size of 1982 respondents). Norm based scores allow comparisons to be made between the scores of an individual or survey group and a population benchmark. They also allow researchers and clinicians to place an individual's or group's scores within gender or age specific contexts (Ware, 2000).

Table 5.3 The SF-36 measurement model and the relationship between questionnaire items health scales and summary scales

Question number	Items	Scales	Summary scales
3a	Vigorous activities	Physical Functioning	Physical Health
3b	Moderate activities		
3c	Lift, carry shopping		
3d	Climb several flights		
3e	Climb one flight		
3f	Bend, Kneel		
3g	Walk a mile		
3h	Walk half a mile		
3i	Walk 100 yards		
3j	Bathe, dress		
4a	Cut down time	Role Physical	
4b	Accomplished less		
4c	Limited in kind		
4d	Had difficulty		
7	Pain magnitude	Bodily Pain	
8	Pain interferences		
1	EVGFP rating	General Health	
11a	Sick easier		
11b	As healthy		
11c	Health to get worse		
11d	Health Excellent		
9a	Full of life	Vitality	Mental Health
9e	Energy		
9g	Worn out		
9i	Tired		
6	Social-Extent	Social Functioning	
10	Social-Time		
5a	Cut down time	Role Emotional	
5b	Accomplished less		
5c	Not careful		
9b	Nervous	Mental Health	
9c	Down in the dumps		
9d	Peaceful		
9f	Downhearted/low		
9h	Happy		

Adapted from http://www.sf-36.org/tools/SF36.shtml#VERS2

Scores are transformed and normalised to facilitate comparison of individual or group aggregate scores with published national norms (Ware and Kosinski, 2001; Ware and Gandek, 1998; Ware, 2000). However the use of national norms is problematic for the UK vegetable horticultural workforce, as this workforce is multinational. Suitable norms do not exist for all nationalities

represented in the horticultural workforce. Given that the workers are working in the UK, it would normally be acceptable to compare their health to UK norms. Unfortunately though, the UK norms for this instrument are not yet sufficiently robust for such a purpose (Bowling et al., 1999). Consequently, the 1998 US national norms were used as the comparator for this instrument (http://www.SF-36.org/).

EuroQol EQ-5D

The EQ-5D is a generic health instrument comprising five questions designed to measure aspects of an individual's self-appraised physical and mental well-being (Brooks and EuroQol Group, 1996; EuroQoL Group, 1990; Schrag et al., 2000). It has been widely validated and proven to be sensitive, reliable and internally consistent when used to measure population and group health (Brooks and EuroQol Group, 1996; Dorman et al., 1997; EuroQoL Group, 1990; Hurst et al., 1994; Nowels et al., 2005; Schrag et al., 2000). As with the SF-36, the EQ-5D has been used in both clinical settings to measure the impact on functional life for a diversity of medical complaints such as myocardial infarction (Nowels et al., 2005), major depressive disorder (Sapin et al., 2004), lung transplant patients (Anyanwu et al., 2001) type 2 diabetes (Redekop et al., 2002) and in more general population health contexts (Burstrom and Fredlund, 2001; Burström et al., 2004; Greiner et al., 2005; Kind et al., 1998; Parry et al., 2007).

A respondent's health status is described by five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression (Fig. 5.1) with three possible scores for each dimension indicating whether the respondent has no problem, some problems or severe problems. Scores from the five dimensions are converted using an index to give 243 possible unique health states ranging from zero to one, where one indicates a perfect health state and zero the poorest. United Kingdom population norms exist for this instrument (Kind et al., 1998; Sapin et al., 2004).

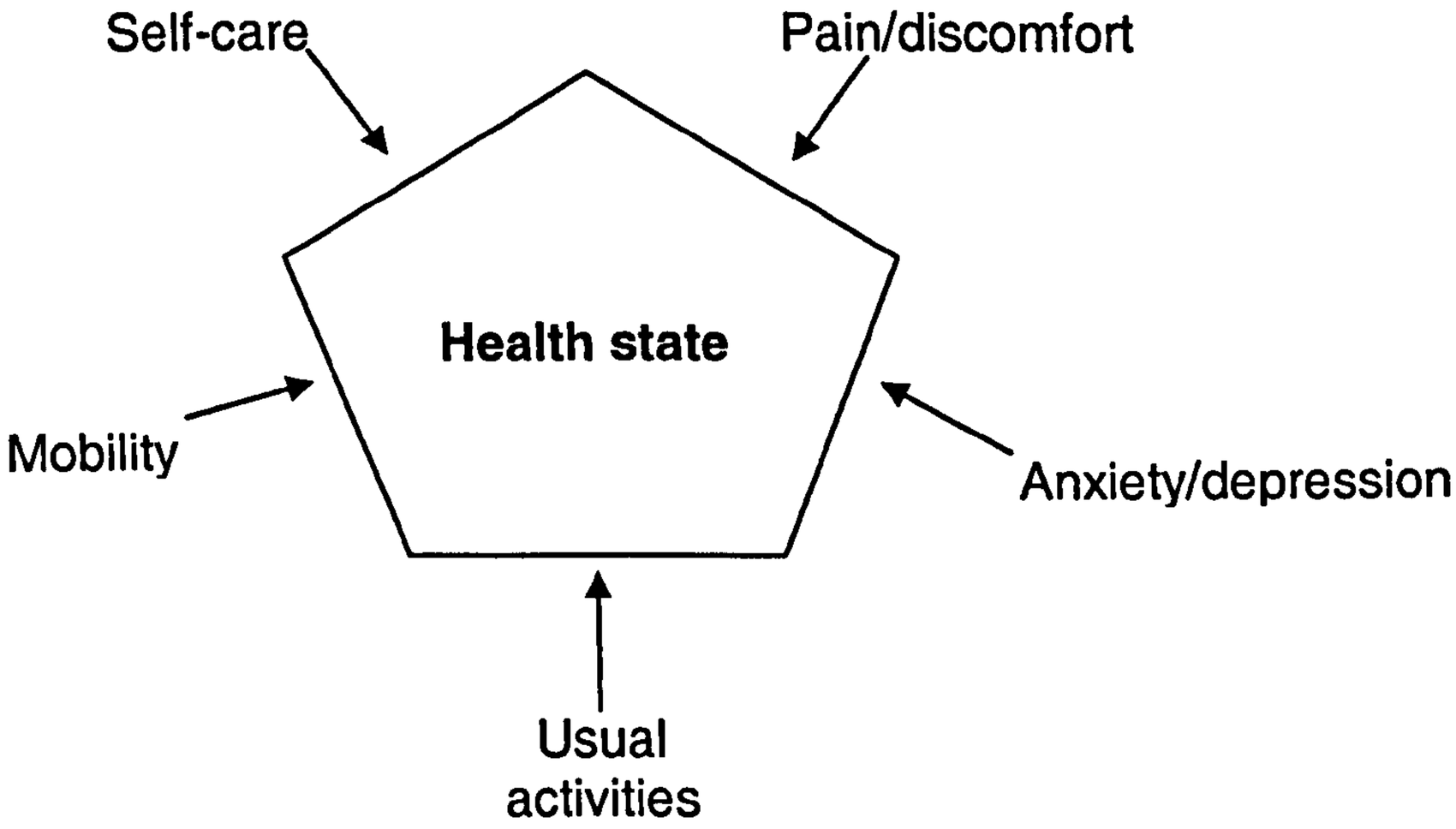


Figure 5.1 A unique health state for an individual is defined by combining one level from each of the 5 dimensions. Adapted from EuroQoL Group, 1990.

The EQ-5D was used in the survey to compliment the SF-36. It covers some of the same areas of the SF-36 but requires only five questions to do so. It's utility was particularly present when assessing the validity of responses from respondents using translated versions. For instance, the bodily pain component of both the SF-36 and the EQ-5D should theoretically correlate with each other quite closely as they are asking a very similar question.

Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) is a conceptually simple health instrument comprising a vertical line with equally spaced gradations from 0-100 much like a thermometer (Fig. 5.2). Respondents indicate their present health status by drawing a line on the scale with the understanding that zero represented their worst possible health status and 100 their best. As with the preceding two instruments the VAS has been widely used in clinical settings to assess the impacts of a broad range of illnesses and conditions such as strokes (Price et al., 1999), depression (Kindler et al., 2000) and is commonly used in studies of pain (Aubrun et al., 2003; Gallagher et al., 2001; Kelly, 2001). The VAS is also frequently utilised in broader population health studies (Brazier et al., 1996; Gudex et al., 1996). Population norms for the UK exist for this instrument (Kind et al., 1998).

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your health state is today.

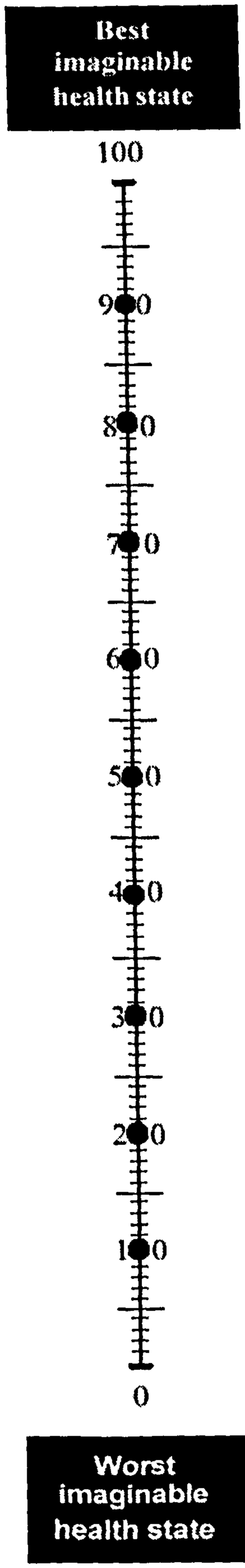


Figure 5.2 Visual Analogue Scale "thermometer".

Short Depression Happiness Scale (SDHS)

The Short Depression Happiness Scale allows measurements of depression and happiness across sample populations (Joseph et al., 2004). The SDHS consists of six questions three of which are reverse scored (Table 5.4). There are four possible responses available for each question. The four responses are scored from zero to three giving eighteen possible health states. High scores indicate greater levels of happiness and conversely low scores indicate greater levels of depression. It is a relatively untried instrument, but was included in this study as it had potential to provide information that may have been missed by the other general health instruments. Whilst no population norms exist for this instrument, a score of 9 or below has been suggested as a threshold level indicating mild clinical depression (Joseph et al., 2004).

Table 5.4 The Short Depression Happiness Scale (SDHS). The numbers in the shaded boxes were not included in the survey questionnaire and are here reported as an example of the reversed scoring system used for this particular instrument.

Happiness **Please tick.** In the past 7 days …	Never	Rarely	Some-times	Often
a. I felt dissatisfied with my life	3	2	1	0
b. I felt happy	0	1	2	3
c. I felt cheerless	3	2	1	0
d. I felt pleased with the way I am	0	1	2	3
e. I felt that life was enjoyable	0	1	2	3
f. I felt that life was meaningless	3	2	1	0

The EQ-5D and the SF-36 were both included in the study as they have been shown to give comparable results for elderly patients (Brazier et al., 1996) and the general population (Brazier et al., 1993). Both the EQ-5D and the SF-36 have also shown surprisingly good correlations with the VAS (Myers and Wilks, 1999). The SDHS was useful because it offered a more sensitive measure of the concepts of happiness and depression than either the EQ-5D

(which records depression but not happiness) or the SF-36 (which is less precise for recording the transition from depression to happiness (Joseph et al., 2004)).

The four instruments are complimentary at a temporal scale. For instance, the EQ-5D and VAS ask respondents to assess their health "today", whilst the SDHS measures aspects of mental health during the preceding week and the SF-36 over the previous four weeks. Consequently, the four instruments measure slightly different but overlapping aspects of human health at different time scales. Utilising all four instruments simultaneously was consequently expected to provide a more comprehensive profile of farm worker health.

5.1.8 Translation of instruments

Health questionnaires are complex instruments that can not be assumed to be culturally invariant. So prior to use on an internationally diverse population formal, validated translations need to be obtained (Bullinger et al., 1998; Gandek and WareJr., 1998). Validated, formally translated versions of the SF-36, EQ-5D and VAS were made available to respondents in five languages English, Latvian, Lithuanian, Polish and Russian. No formally translated versions of the SDHS were available and therefore recognised, professional translators who were native speakers of the target language translated from English into Latvian, Lithuanian, Polish and Russian. The Spanish sample required translations into French, Arabic, Polish and Spanish. Two translated questionnaires from English into Lugandan and Lhukonzo were made available for Ugandan respondents, whilst the Kenyan survey used a Kiswahili translation. No backward translation was undertaken due to resource constraints. It should also be noted that the SF-36 version 1 was preferred to version 2 as a Kiswahili translation existed for the former which was the target language used in the study in Kenya. A copy of the original English questionnaire can be found in Appendix 1.

5.1.9 Study design for 2007

The study questionnaire used in 2007 (Chapter 7: The impact on migrant farm worker health of being employed in UK horticulture) differed in content from the principal questionnaire used in the main body of the study. As this study was a repeated measure sample (three sampling points over three months), and primarily focussed upon assessing the extent to which conditions on farms in the UK determined the farm worker health scores, the questionnaire omitted all socio-economic sections and retained only three of the original four health instruments (Visual Analogue Scale, Short Depression-Happiness Scale and the SF-36). Demographic data included age, gender, nationality, residency, marital status (single, married/partnered, divorced, and widowed), education (primary, secondary, college, university) and whether or not the respondent was a smoker, ex-smoker or non-smoker. A supplementary set of statements grouped under three categories (integration, lifestyle and job satisfaction) were added to the final questionnaire in the study in an attempt to determine to what extent factors beyond an individual farms control were responsible for farm worker health. Farm workers were invited to respond to twenty statements relating to their work, cultural changes and facilities provided by the farm. Five possible responses were provided for each statement (strongly agree, slightly agree, don't know, slightly disagree and strongly disagree). A copy of the original questionnaire can be found in Appendix 2.

The questionnaire used for the 2007 longitudinal study was distributed to all field and pack house workers who could read Lithuanian, Polish or Russian and whose induction date was on or after the 30th April 2007. Participation was optional and only those who completed and returned the initial questionnaire were considered to have consented.

5.1.10 Data Analysis

The distribution of data sets was tested for normality using the Kolmogorov-Smirnov test. Normally distributed data sets were analysed to detect

differences between group mean scores using t-tests and analysis of variance (ANOVA). Where data was not normally distributed and was unresponsive to transformation operations, differences between groups were analysed using non-parametric Mann-Whitney *U*, Kruskal-Wallis and t-tests. Where appropriate, associations between mean scale scores were explored using Spearman's rank and Pearson's correlations.

Multiple regression

Where appropriate, multiple regression analysis was used to examine the relationship between self-reported health status and a range of demographic and socio-economic variables in all four countries. Multiicollinearity can be problematic when including a large number of variables as it tends to increase parameter variance and increases the r^2 value which can mislead researchers into committing a type II error (Mela and Kopalle, 2002). Multicollinearity was tested by ensuring that the tolerance value did not exceed 0.2 and the Variance Inflation Factor (VIF) remained well below 5.

5.2 Conclusion

The results obtained from using the above instruments are reported and broadly discussed in Chapters 6-10. All four of the health instruments (in English, Latvian, Lithuanian, Polish and Russian) were used in the study of UK farm worker health, the scores for which are reported in Chapter 6. The longitudinal study of farm workers in the UK during 2007 (described in Chapter 7) utilised the SF-36, VAS and SDHS instruments, omitting the EQ-5D. The Kenyan and Ugandan data was collected using three translations. A Kiswahili version was used for Kenya and Lugandan and Lhukonzo for Uganda. The health scores are reported in Chapter 8. Chapter 9 combines the findings of Chapters 6, 7 & 8 and also reports on the Spanish survey where Arabic, French, Polish and Spanish translations were used. Chapter 10 combines the findings of Chapters 2 and 3 and discusses them within the context of the SF-36 results from Chapters 6 and 8.

Chapter 6

Comparative assessment of migrant farm worker health in conventional and organic horticultural systems in the United Kingdom[1]

[1] This chapter was published in 2008 in the journal *Science of the Total Environment*. Cross, P., R.T. Edwards, B. Hounsome, and G. Edwards-Jones. 2008. Comparative assessment of migrant farm worker health in conventional and organic horticultural systems in the United Kingdom. *Science of The Total Environment*. 391:55-65

Chapter 7

The impact on migrant farm worker health of employment within UK horticulture

7.0 Abstract

Continuing concerns exist relating to the health status of UK migrant horticultural workers in the UK. Horticultural migrants are a vulnerable sub-sector of seasonal workers. Migrant farm workers' self-reported health scores are substantially lower than those expected for the general population. The extent to which farms and farming practice in UK horticulture affects farm worker health status remains unclear. This study explored the relationship between self-reported health for migrant farm workers in UK horticulture and assessed the extent to which farm practices are responsible for changes in health scores. A self-administered questionnaire recorded the demographics, self-reported health status and potential farm and UK cultural causal pathways. The farm worker health scores at induction for the 2007 cohort were significantly higher than population norms. There was a significant decrease in scores for three of the SF-36 scales between induction and the one month sampling periods. As expected, health scale scores for workers employed mid-season 2006 were highly significantly lower than scores for workers at induction in 2007. Non-response bias is thought to have affected the results. The findings of this study were inconclusive but nonetheless suggest that workers health declines during their service in UK horticulture based upon the mid-season 2006 mean health scores and those from the induction sample in 2007.

7.1 Introduction

As concern for diet-related morbidity, such as child obesity, has increased, organisations such as the United Kingdom Government Department of Health and the World Health Organization are encouraging people to eat more fruit and vegetables in an attempt to combat declining population health (Department of Health, 2007; WHO, 1990). At the same time, growing societal concerns for the external costs of vegetable production are increasingly voiced through agro-social organizations such as the organic movement and the Fair Trade organization. Awareness of the importance of the social benefits of food production has also grown to such an extent that farm worker well-being, is now enshrined in declarations of intent such as the International Federation of Organic Movements' Principle of Health (IFOAM, 2006).

Over the last decade research into farmer health has tended to focus on mental health related issues such as farmer stress (Simkin et al., 1998), depression and psychiatric morbidity (Hounsome et al., 2006; Sanne et al., 2004; Thomas et al., 2003) and suicide prevalence (Gregoire, 2002). A recent study found that the self-reported physical and mental health scores of farm workers were significantly lower than published population norms after controlling for both age and gender (Cross et al., 2008).

One possible explanation for the below average health scores of UK farm workers may be owing to the risks typically associated with farming such as pesticide exposure, occupational accidents and psychiatric morbidity such as stress and depression which can be particularly acute for migrant workers (Das et al., 2001; Villarejo, 2003). The health hazards associated with farming may be further compounded for migrant workers as precarious employment conditions are known to be positively correlated with ailments such as fatigue, backache and muscular pain (Benavides et al., 2000). Furthermore, temporary employees are frequently relatively inexperienced and lack of knowledge of workplace hazards are strongly associated with both fatal and non-fatal occupational injuries (Benavides et al., 2006; Hope et al., 1999). These problems are further compounded for migrant workers who are also

confronted with language problems, violence and inadequate access to health care facilities (FAO-ILO-IUF, 2005; Villarejo, 2003). Work-related variables such as low job control and passive work are strongly associated with absenteeism and may be a causal variable in low mental health scores of farm workers (Benach et al., 2002; Benach and Muntaner, 2007; Gimeno et al., 2004; Silla et al., 2005; Virtanen et al., 2005).

An alternative explanation for the low health scores of UK farm workers may be that migrant workers arrive in the UK already exhibiting poor health. For instance, the level of self-reported health in Russia is thought to be considerably lower than in western countries with up to 80% of Russian women reporting their health as being less than good (Bobak et al., 1998). It may therefore be the case that farm workers arrive in the UK with pre-determined low health scores. If such is the case then it may be that farm worker health scores begin to improve upon arrival in the UK.

Cultural issues such as language and assimilation into the local community may further influence health status. The degree to which the farm can be expected to influence such variables remains unclear. Cultural and social isolation is known to be deleterious to mental health and is a causal variable in a number of psychosomatic problems such as stress related ulcers, headaches, anxiety attacks, dermatitis and sleeping disorders all of which can inhibit successful social, cultural and occupational integration which in turn may compound feelings of isolation (Carballo et al., 1998).

In light of the apparent vulnerability of migrant farm workers and their recorded poor health status, this study aimed to evaluate the extent to which the UK farming process, rather than factors outside the control of farms, is responsible for the poor self-rated health scores.

7.2 Methods

(See chapter 5 Health survey methodology)

7.3 Results

A total of four businesses agreed to participate in the work. Of these, one was entirely conventional, one was entirely organic and two were composite businesses which included both conventional and organic units. These units were self contained, geographically separated and did not exchange staff. The organic farm withdrew from the survey due to a forced redeployment of staff to other farms following heavy flooding.

Questionnaires were distributed to all farmworkers whose induction day fell between the 30th April 2007 and the 9th May 2007. Of the 252 questionnaires distributed to farm and pack house workers 207 were completed and returned, giving a response rate of 82%. Those respondents who completed the first questionnaire were given the same questionnaire one month later. Of these, only 92 completed the questionnaire, giving a response rate of 44%. The final questionnaire was distributed three months after induction and 65 responded, giving a response rate of 31.5%.

There were six nationalities in the sample population, the composition of which was as follows: Lithuanian (55), Polish (42), Russian (19), Ukrainian (67), Belarusian (6) and Latvian (9). The sample population comprised 128 males and 68 females, 182 of whom were aged 18-34 and the remaining 13 were between 35-44 years of age.

7.3.1 Health scores

As 93% of the sample population were aged 18-34, for simplicity the following analysis refers solely to this age group. From the initial 182 farm workers aged 18-34, only 81 (44.5%) completed the second questionnaire one month after induction and 56 (30.8%) completed the final survey. When mean health scores for the various scales were compared between the three sampling times, there were significant differences for role physical (RP), bodily pain

(BP) and role emotional (RE) (Table 7.1).

Table 7.1 Mean health scale scores for three sampling periods. Reported scales include the Short Depression Happiness Scale (SDHS), Visual Analogue Scale (VAS) and the SF-36 scales Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social-Functioning (SF), Role-Emotional (RE), Mental Health (MH), Physical Component Summary (PCS), Mental Component Summary (MCS). [a] Significance at the <0.05 level, [b] Significance at the <0.01 level

	Induction			One month			Three months				
	Mean	n	sd	Mean	n	sd	Mean	n	sd	df	*p*
SDHS	14.32	130	2.57	14.00	63	3.11	15.00	35	2.70	2	0.149
VAS	86.22	174	13.18	86.84	80	14.72	89.30	57	11.68	2	0.105
PF	54.47	182	7.67	55.17	81	2.74	54.86	56	6.19	2	0.593
RP	53.05	182	7.34	51.88	81	7.21	54.60	56	4.04	2	0.019[a]
BP	54.82	182	8.87	52.21	81	9.29	55.82	56	7.90	2	0.038[a]
GH	51.85	180	8.06	51.14	81	8.01	52.34	55	7.69	2	0.736
VT	56.88	180	8.06	54.93	81	10.28	58.22	56	6.89	2	0.241
SF	51.74	182	7.41	49.30	81	9.97	51.90	56	6.63	2	0.403
RE	52.62	182	7.79	50.14	81	8.01	52.14	56	8.01	2	0.004[b]
MH	51.40	180	8.76	50.59	80	8.97	51.62	56	7.43	2	0.465
PCS	54.68	179	4.83	53.91	80	4.98	55.71	55	5.18	2	0.153
MCS	51.97	179	7.77	49.81	80	9.37	51.88	55	7.02	2	0.128

There were significant differences in the mean scale scores between the induction and one month sample times. Mean health scores were significantly lower in the one month sample for role physical (RP), bodily pain (BP) role emotional (RE) and the mental component summary scale (MCS) (Table 7.2). Mean scores for the final survey sample were not significantly different to the induction sample but were significantly higher than the one month sample for role physical (RP), bodily pain (BP).

Table 7.2 Significance values for tests between mean scale scores for three independent sampling periods. [a] *p* value significant at the 0.05 level.

	Induction & 1 month		Induction & 3 months		1 month & 3 months	
	n	*p*	n	*p*	n	*p*
SDHS	191	0.451	163	0.171	36	0.114
VAS	252	0.738	229	0.117	70	0.296
PF	261	0.425	236	0.729	57	0.776
RP	261	0.231	236	0.132	61	0.012[a]
BP	261	0.031[a]	236	0.450	63	0.019
GH	259	0.510	233	0.690	61	0.385
VT	259	0.099	234	0.263	64	0.038[a]
SF	261	0.028[a]	236	0.885	64	0.090
RE	261	0.019[a]	236	0.689	62	0.153
MH	258	0.495	234	0.865	63	0.481
PCS	257	0.241	232	0.175	58	0.044[a]
MCS	257	0.054	232	0.939	62	0.166

7.3.2 Broken contacts

The high rate of workers who broke their contractual agreements with the various farms was analysed to explore the relationship between induction health scores and demographic classification.

There were no significant differences in the mean health induction scores for workers who broke contract and those that completed their contractual service, with the exception of the Visual Analogue Scale (VAS) (Table 7.3).

Table 7.3 Mean health scale scores for non-contract breakers and contract breakers

	Unbroken			Broken			
	Mean	n	sd	Mean	n	sd	*p*
SDHS	14.44	104	2.45	13.91	33	2.77	0.28
VAS	84.82	140	14.09	88.95	59	12.64	0.01
PF	55.07	148	3.81	52.56	59	12.22	0.44
RP	53.15	148	6.33	52.62	59	9.02	0.99
BP	55.14	148	8.51	54.36	59	9.61	0.74
GH	51.59	147	8.27	50.62	58	7.5	0.36
VT	56.93	148	7.78	57.17	57	8.35	0.87
SF	51.48	148	7.3	52.33	59	7.19	0.40
RE	52.74	148	6.45	52.09	59	10.02	0.83
MH	51.5	148	7.96	51.24	57	10.81	0.67
PCS	54.67	147	4.9	54.05	57	4.52	0.21
MCS	51.86	147	7.29	52.43	57	8.64	0.29

When analysed by nationality, Russian workers had the highest rate of broken contracts (47%) and Ukrainians the lowest (10%) (Table 7.4). There were no significant differences in the number of individuals who broke contract when analysed by gender (n= 196, p=0.35). Thirty-six males broke contract (28%) and fifteen females (22%). A nearly significant number of married workers (9 out of 30) broke contract than single workers (10 out of 78) (n=117, p= 0.085).

Table 7.4 Percentage of total population who broke contracts by nationality

	Broke contract	Population total	% broke contract
Lithuaian	17	55	30.91
Polish	17	42	40.48
Russian	8	17	47.06
Ukranian	7	67	10.45
Belarussian	1	6	16.67
Latvian	1	9	11.11

7.3.3 Comparison between 2007 and 2006

Individuals employed during 2006 were not necessarily the same individuals working in 2007 and consequently the following results should be considered as referring to independent samples of a population rather than a longitudinal study.

There were significant differences between farm worker scores for the SDHS, VAS and all SF-36 scales with the exception of physical functioning (PF) and general health (GH) (Table 7.5)

Table 7.5 Comparison of mean scores of four survey groups.

	2006			Before			During			After			
	mean	n	sd	mean	n	sd	mean	n	sd	mean	n	sd	*p*
SDHS	12.28	269	3.56	14.31	137	2.53	13.97	65	3.07	15.57	28	2.17	0.001[c]
VAS	78.19	400	17.75	86.05	199	13.78	86.61	94	14.15	89.33	58	10.81	0.001[c]
PF	54.03	407	7.82	54.39	207	7.34	55.05	96	2.82	54.76	58	5.96	0.522
RP	50.26	407	8.58	53.03	207	7.20	51.45	96	7.78	54.41	58	4.50	0.001[c]
BP	48.48	407	10.54	54.93	207	8.84	52.35	96	9.38	55.97	58	6.98	0.001[c]
GH	49.26	407	8.94	51.32	205	8.04	50.71	96	7.74	51.20	58	7.70	0.053
VT	51.35	407	9.67	56.98	205	7.92	55.36	96	9.88	58.68	58	6.63	0.001[c]
SF	46.81	407	10.34	51.74	207	7.29	49.73	96	9.52	52.27	58	6.65	0.001[c]
RE	50.00	407	9.30	52.59	207	7.62	50.07	96	8.37	51.53	58	8.30	0.001[c]
MH	46.25	407	10.56	51.43	205	8.81	50.30	95	9.16	51.93	58	7.59	0.001[c]
PCS	52.02	407	6.78	54.50	204	4.80	53.71	95	5.16	55.28	58	4.88	0.001[c]
MCS	46.84	407	9.98	52.02	204	7.67	49.91	95	8.96	52.02	58	7.18	0.001[c]

All SDHS, VAS and SF-36 scale and component summary scores (with the exception of physical functioning (PF)) were significantly higher for farm workers at induction for the 2007 cohort than those recorded for workers mid-season in 2006 (Table 7.6).

Table 7.6 Comparison of UK farm worker health scores at induction in 2007 and mid-season 2006 Reported scales include the Short Depression Happiness Scale (SDHS), Visual Analogue Scale (VAS) and the SF-36 scales Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social-Functioning (SF), Role-Emotional (RE), Mental Health (MH), Physical Component Summary (PCS), and Mental Component Summary (MCS). [a] Significance at the <0.05 level, [b] Significance at the <0.01 level, [c] Significance at the <0.001 level

	2006/before		2006/during		2006/after		before/during		before/after		during/after	
	n	*p*	n	*p*	n	*p*	n	*p*	n	*p*	n	*p*
SDHS	406	<0.001[c]	334	<0.001[c]	297	<0.001[c]	202	0.622	165	0.012[a]	93	0.018[a]
VAS	599	<0.001[c]	494	<0.001[c]	458	<0.001[c]	293	0.598	257	0.118	152	0.308
PF	614	0.355	503	0.199	465	0.964	303	0.521	265	0.540	154	0.311
RP	614	<0.001[c]	503	0.244	465	<0.001[c]	303	0.024[a]	265	0.251	154	0.009[b]
BP	614	<0.001[c]	503	0.001[b]	465	<0.001[c]	303	0.023[a]	265	0.685	154	0.024[a]
GH	612	0.010[b]	503	0.226	465	0.171	301	0.431	263	0.773	154	0.792
VT	612	<0.001[c]	503	<0.001[c]	465	<0.001[c]	301	0.220	263	0.258	154	0.061
SF	614	<0.001[c]	503	0.005[b]	465	<0.001[c]	303	0.215	265	0.631	154	0.182
RE	614	<0.001[c]	503	0.697	465	0.205	303	0.001[b]	265	0.280	154	0.163
MH	612	<0.001[c]	502	0.001[c]	465	<0.001[c]	300	0.223	263	0.971	153	0.344
PCS	611	<0.001[c]	502	0.045[a]	465	<0.001[c]	299	0.182	262	0.424	153	0.068
MCS	611	<0.001[c]	502	0.005[b]	465	<0.001[c]	299	0.045[a]	262	0.782	153	0.202

The induction cohort SF-36 mean scores were significantly higher than the US population norms for physical functioning (df 543, p=0.010), bodily pain (p<0.001), vitality (p<0.001), social functioning (p=0.035), role emotional (p<0.001), mental health (p=0.0011) and mental component summary scale (p<0.001) (Fig. 7.1).

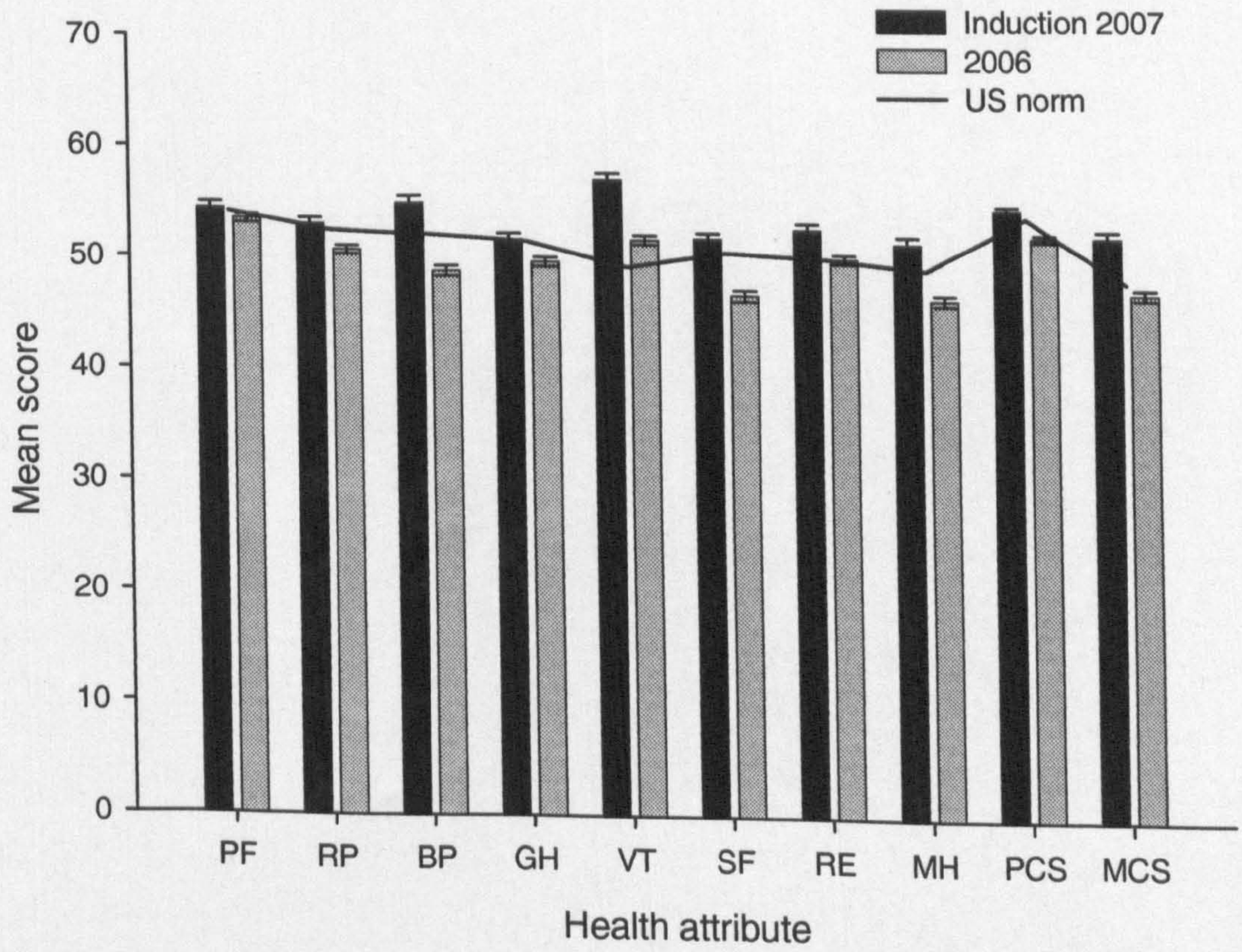


Figure 7.1 Comparison of SF-36 2007 induction scores with 2006 scores and US norms

7.3.4 *Integration, lifestyle and job satisfaction*

There were significant correlations between the four principal health measures (SDHS, VAS, PCS and MCS) and twelve of the twenty supplementary questions. Interestingly, the mental component summary (MCS) correlated strongly with ten of the twenty questions and is explored further here as mental health was an important determinant of health scores in the 2006 survey (Table 7).

In answer to the statement '*it is easy to remain in contact with family and friends?'* 90% either strongly agreed and/or slightly agreed. The correlation coefficient between this question and the MCS was (n=62, r^2=-0.27, p=0.04), suggesting that as the respondent found it increasingly difficult to maintain contact with family and friends so their MCS scores decreased. Almost 70% of respondents disagreed with the statement *'It is difficult to communicate and get on with others on the farm?'* (n=63, r^2=0.28, p=0.027). Cultural adaptation was not thought to pose a problem as 82% of respondents either strongly or slightly agreed with the statement *'it was easy to adapt to the new culture in England (shopping, greetings etc)'* (n=61, r^2=-0.37, p=0.004). There was a strong correlation between answers to the statement *'There are few facilities for leisure time activities',* and MCS scores. As respondents tended to agree with this statement so their MCS scores decreased (n=61, r^2=0.34, p=0.004).

The greatest number of significant correlations between health scale scores occurred with statements relating to work place practise. Responses to the statement *'I feel that I am valued by this company'* were significantly correlated with respondents MCS scores (n=62, r^2=0.29, p=0.022). The perception that adequate training was not given was significantly correlated with low MCS scores (n=62, r^2=0.30, p=0.019). Workers' satisfaction with their income was positively correlated with their mental health score (n=61, r^2=0.35, p=0.005), Respondents affirmative responses to the statement *'this job demands too much (physically, emotionally, mentally)'* were negatively correlated with their MCS scores (n=61, r^2=0.33, p=0.008). There were significant and similar correlations between MCS scores and responses to

both of the following statements *'The work I do is interesting'* (n=62, r^2=0.36, p=0.004) and *'This job adds significant pressure and anxiety to my life'* (n=63, r^2=0.36, p=0.003).

Table 7.7 Pearson correlation coefficients for health scales and measures of integration. Columns **a** to **t** refer to the questions **a** to **t** at the foot of the table. [a] Significance at the <0.05 level, [b] Significance at the <0.01 level, [c] Significance at the <0.001 level

Health scale	**a** family	**b** meeting	**c** welcome	**d** communication	**e** homesick	**f** culture	**g** housing	**h** doctor	**i** leisure	**j** religion
SDHS	-0.28	0.30	0.04	0.51[b]	-0.27	0.05	0.20	-0.24	0.05	-0.17
VAS	0.01	0.30[a]	-0.20	0.25[a]	-0.14	-0.12	0.02	-0.11	0.07	-0.06
PF	-0.35[b]	-0.01	0.06	-0.06	-0.16	-0.02	-0.17	-0.11	0.08	-0.21
RP	-0.15	0.17	0.14	0.05	0.07	0.02	0.00	-0.12	0.26[a]	-0.01
BP	-0.25[a]	0.12	-0.29[a]	0.15	-0.25	-0.50[c]	0.06	-0.04	0.23	-0.02
GH	-0.27[a]	0.17	-0.18	0.26[a]	-0.25	-0.11	-0.12	-0.05	0.14	-0.18
VT	-0.27[a]	0.18	-0.13	0.38[b]	-0.18	-0.26[a]	0.17	-0.27[a]	0.24	-0.17
SF	-0.52[c]	0.10	-0.02	0.02	-0.03	-0.21	0.08	-0.10	0.40[b]	-0.13
RE	-0.20	0.00	0.16	0.10	-0.16	-0.03	-0.16	-0.19	0.22	-0.09
MH	-0.16	0.33[b]	-0.03	0.29[a]	-0.11	-0.04	0.17	-0.12	0.25[a]	-0.09
PCS	-0.32[a]	0.08	-0.16	0.05	-0.18	-0.17	-0.16	0.01	0.12	-0.15
MCS	-0.27[a]	0.21	0.04	0.28[a]	-0.13	-0.37[b]	0.10	-0.21	0.34[a]	-0.12
	k transport	**l** free time	**m** valued	**n** work training	**o** income	**p** job demands	**q** job interest	**r** job worry	**s** benefits	**t** job support
SDHS	0.35[a]	0.08	-0.27	0.08	-0.34[a]	0.31	-0.58[c]	0.53[b]	-0.33	0.19
VAS	0.14	0.05	-0.26[a]	0.21	-0.22	-0.02	-0.24	0.33[b]	-0.10	-0.07
PF	0.30[a]	-0.06	-0.26[a]	-0.16	-0.19	-0.03	0.05	0.00	-0.04	0.16
RP	0.24	0.08	-0.12	0.05	-0.32[a]	-0.03	0.05	0.20	-0.14	0.18
BP	0.28[a]	0.23	-0.38[b]	0.26[a]	-0.34[b]	0.08	-0.23	0.31[a]	-0.16	0.09
GH	0.17	0.05	-0.26[a]	0.08	-0.35[b]	0.14	-0.37[b]	0.33[b]	-0.22	-0.12
VT	0.24	0.29[a]	-0.44[c]	0.25[a]	-0.36	0.18	-0.43[c]	0.22	-0.13	0.15
SF	0.27[a]	0.19	-0.34[b]	0.11	-0.37[b]	0.33[b]	-0.30[a]	0.27[a]	-0.24	0.17
RE	0.15	0.03	-0.12	0.19	-0.24	0.18	0.01	0.26[a]	-0.12	0.14
MH	0.24	0.25[a]	-0.29[a]	0.23	-0.32[a]	0.24	-0.41[b]	0.33[b]	-0.22	0.18
PCS	0.26[a]	0.04	-0.31[a]	-0.05	-0.31[a]	-0.06	-0.09	0.17	-0.12	0.03
MCS	0.22	0.24	-0.29[a]	0.30[a]	-0.35[b]	0.33[b]	-0.36[b]	0.36[b]	-0.23	0.18

a. It is easy to remain in contact with family and friends, **b.** There are few opportunities to meet other people **c.** English people are friendly and welcoming towards me, **d.** It is difficult to communicate and get on with others on the farm, **e.** I never feel homesick, **f.** It was easy to adapt to the new culture in England (shopping, greetings etc), **g.** The quality of my accommodation is poor, **h.** It is easy to see a doctor or nurse if I needed to, **i.** There are few facilities for leisure time activities, **j.** There is good access to cultural and religious organisations, **k.** Transport to the shops was difficult, **l.** I don't have enough leisure time to do what I want, **m.** I feel that I am valued by this company, **n.** I receive poor training for my job, **o.** I am satisfied with my income, **p.**

7.4 Discussion

The farm worker health scores at induction for the 2007 cohort were significantly higher than population norms. There was a significant decrease in scores for three of the SF-36 scales between induction and one month. There was no significant difference in scores for the induction cohort and those who responded to the three month survey, although there was a substantial increase in the number of non-responses. As expected health scale scores for workers employed mid-season 2006 were highly significantly lower than scores for workers at induction in 2007.

This study suffers from two principal weaknesses. Firstly, the sample size was small. Detection of a two-point difference between the group mean and the corresponding population norm for the PCS or MCS would require a sample size of 197. This was almost achieved for the induction period but not for subsequent sampling times. Secondly, the low response rate to both the one and three month follow up questionnaires posses serious problems of validity to this study. Low response rates raise issues of analysis validity particularly because smaller sample sizes are problematic for detecting significant differences in health scores between groups.

High non-response rates have been shown to underestimate a number of negative health variables. Non-respondents' tend to have higher prevalence rates for health risk factors such as smoking, blood pressure and physical inactivity (Hill et al., 1997). They tend to be associated with lower socioeconomic status, higher rates of hospitalisation, a generally poorer overall health profile and a higher mortality rate than respondents (Drivsholm et al., 2006). In this study, the response rate for the one month period was 44% and only 31.5% at the three month period compared to 82% at induction and 56% for the study in 2006 (Cross et al., 2008). A possible explanation for farm worker health not falling to the low levels recorded in 2006 is that those workers predisposed to suffer mental and physical fatigue would be disinclined to complete subsequent questionnaires as they may be more likely to suffer from survey fatigue. Their self-removal from the survey would

effectively increase the group mean score, particularly as only the more pro-active and optimistic workers remain in the sample. Just over 25% of the total number of workers sampled returned home earlier than stipulated in their contracts. These workers physical and mental health may have been partly causal in their decision to return to their home country. If such were the case then the three month sample scores may have been lower if the returning workers had completed their questionnaires prior to departure.

In spite of these weaknesses, the induction sample mean scores should be considered relatively reliable as the response rate was very high (82%). The sample size was close to the estimated size required to detect a two point difference between groups allowing valid comparisons between the 2007 induction mean scores and those of 2006.

7.5 Conclusion

The findings of this study were inconclusive but nonetheless give an indication that workers health declines during their service in UK horticulture based upon the mid-season 2006 mean health scores and those from the induction sample in 2007. Future research should attempt to maximise response rates, either by face to face interviews or by personal distribution of the questionnaire by the investigator in an attempt to control as much of the distribution and collection process as possible.

Chapter 8

Potential health consequences to overseas workers of buying local

8.0 Abstract

Proponents of the 'local food' movement argue that high food miles render some farming systems unsustainable. Food miles are but one of a number of indicators that can be used. Health is a possible alternative which can give insights into the ethical viability of reducing imported fresh produce. This study compared the self-reported health status of Kenyan export, non-export and Ugandan non-export farm workers. The health status of export farm workers aged 18-34 was significantly higher than both non-export farm workers and the US population norm. Ugandan farm worker scores were similar to non-export Kenyans. Export horticulture has the potential to improve the health of workers in the sector by redistributing wealth from the developed to the developing world.

8.1 Introduction

Since the turn of the 21st century poverty eradication has become a central international policy driver for governments in both developed and developing countries (FAO-IFAD-WFP, 2005; UNDP, 2003). Three quarters of the world's poor and hungry live in rural areas in developing countries. Consequently, one of the strategic elements considered fundamental to meeting Millennium Development Goal No. 1 (MDG1) objective to eradicate poverty and hunger is to 'focus policies and investments on rural areas and agriculture' tied to support for a 'dynamic growth process' (FAO-IFAD-WFP, 2005).

Agriculture is central to efforts by the United Kingdom Department for International Development (DFID) to reduce global poverty and meet the goals of MDG1 (DFID, 2005). This commitment to agricultural development is premised on the belief that the benefits of increased agricultural productivity extend beyond the direct effects of increasing farmer income. Greater agricultural productivity is linked to increased food security which enhances nutrition which in turn improves health. For instance Irz (2001), found that increasing yields by 1% would increase the Human Development Index (HDI) by 0.12%. The resulting improved population health is thought to be a critical determinant of economic growth (Mayer, 2001) and a functioning agricultural system which generates income tends to be linked to improving health standards (Hawkes and Ruel, 2006). An individual's health status is strongly predicated upon income (Diener et al., 1995; Ecob and Davey Smith, 1999; Lynch et al., 2000), which in turn can affect morbidity and mortality rates (Fuchs, 2004; Mackenbach et al., 2005; Raphael et al., 2005). The relationship between health and income is thought to be curvilinear, implying that health improvements are more marked per unit increase in income for members of the lowest income groups and less marked for higher income groups (Mackenbach et al., 2005; Stronks et al., 1997; van Doorslaer et al., 1997). Consequently, the health of the most impoverished citizens in developing countries might be expected to show the greatest improvement per dollar than any other social group in the world.

The link between export horticulture and poverty reduction in countries such

as Kenya has been proposed as a viable pro-poor economic model (Jaffee, 2003; Minot and Ngigi, 2004). Kenyan export horticulture is considered an important factor in poverty reduction as it is labour intensive and can generate up to four times as much employment as arable crops (Weinberger and Lumpkin, 2007). As an industry it is thought to provide upwards of half a million jobs and benefit both the urban and rural poor (Dijkstra, 1997; Whitaker and Kolavalli, 2004). A number of the tasks, particularly in the packhouse (such as chopping cleaning and labeling) provide jobs for women who previously would have been considered unemployable (McCulloch and Ota, 2002).

Contrary to these apparent successes there is growing concern that the transportation of year round produce to the UK from distant countries such as Kenya may be unsustainable (Smith et al., 2005). Organisations such as the Soil Association and Sustain have spearheaded media campaigns that actively promote local food through initiatives such as the 'Eat organic, buy local' (Soil Association, 2008; Sustain, 2008). The rationale driving such campaigns emanates from the belief that 'sustainable food is an economically and technically viable choice, which provides many benefits for food quality, health and the environment' (Sustain, 2008). Therefore in an attempt to tackle the issue of food miles, the possible withdrawal of accreditation is being considered for organic farmers whose produce is air freighted a large distance (Soil Association, 2007).

There appears to be a tension between proponents of 'local food' and DFID in that the former appears to welcome a reduction in imported food whilst the latter is committed to international agreements that promote growth in all agricultural sectors in developing countries, including export horticulture (see Freidburg, 2004). However, a reduction in vegetable produce from developing countries may be problematic for both organic movements and DFID for the following reasons. Firstly, the underlying principles of the organic movement include a commitment to social justice and rights as well as human health and well-being (IFOAM, 2006; Soil Association, 2007). The environmental benefits of reducing air-freighted miles may or may not compensate the social,

health and economic impacts on farm workers employed in export horticulture in developing countries and the communities within which they live. Secondly, the restricting or banning of vegetable imports from developing countries may run counter to the principles and development objectives of DFID.

In light of the increased interest generated by the 'food miles' debate, the UK government's Department for Rural Affairs (DEFRA) commissioned a report assessing the development of a food miles indicator. The report suggested that policies targeting food transport should also consider the impacts in other areas such as trade, international development and agriculture (Smith et al., 2005). These findings were echoed in a more recent study which concluded that food miles were a poor indicator of the environmental and ethical impacts of food production (Edwards-Jones et al., 2008).

A coherent policy intervention would require assessments of competing agricultural systems based upon notions other than just food miles. For instance, income has been used as a tool to assess the benefits of Kenyan export horticulture and it was shown that farmers who participated in horticultural production tended to earn higher incomes than their neighbours who did not (McCulloch and Ota, 2002). More recently, self-reported farm worker health measures have been used to differentiate between competing productive systems (Cross et al., 2008). Baseline health data is required for policy makers to form effective policy and consumers to make ethically appropriate purchasing decisions based upon farm worker health.

This study compares the self-reported health and well-being of farm workers in different horticulture production systems in Kenya (export horticulture, outgrowers and non-export workers) and Uganda (non-export). Export horticulture in Uganda is considered a future growth sector of the economy (Achterbosch et al., 2005; Pender et al., 2004; Sonko et al., 2005). The inclusion of Uganda allows comparisons to be made between worker health status in a country considering the development of export horticulture and a country where exports now have an established profile (Kenya).

8.2 Methodology

(See chapter 5 Health survey methodology)

8.3 Results

8.3.1 Kenyan and Ugandan sample description

A total of 1453 questionnaires were administered to individual farmers and farm workers in Kenya (883) and Uganda (571) through personal interviews. The sample Kenyan population comprised 484 males and 399 females (mean age 29.87) and 282 males and 289 females for Uganda (mean age 37.69 and 36.63 respectively). The Kenyan sample consisted of 495 employees working in export vegetable horticulture, 92 out-grower employees (supplying the export farms) and 296 workers employed on non-export farms (supplying to the local market). The marital status category of the questionnaire allowed four possible responses; single (Kenyan 40%, Ugandan 16%), married/partnered (Kenyan 50%, Ugandan 66%), divorced (Kenyan 9%, Ugandan 8%) and widowed (Kenyan 1%, Ugandan 10%). Seventy four percent of Kenyans and eighty-five percent of Ugandans said they had children and of these, approximately 50% had at least one child less than five years of age. The average number of children per Kenyan was 2 and 3.5 for each Ugandan. Three responses were possible for the 'do you smoke' question; smoker (Kenyan 18%, Ugandan 7%), ex-smokers (Kenyan 9%, Ugandan 4%) and never smoked (Kenyan 71%, Ugandan 89%). Malaria was the only serious illness explicitly mentioned by respondents and was exclusive to Uganda where 37% of respondents claimed to have experienced an episode in the three months preceding the survey.

8.3.2 Export versus non-export in Kenya

All scales of the SF-36, EQ-5D, VAS and the SDHS were highly significantly correlated ($p<0.001$) (Table 8.1).

Gender

Kenyan males scored significantly higher than females for the physical

component summary (PCS) of the SF-36 whilst females scored higher mental component summary (MCS) (Table 8.2). Males employed in export horticulture scored significantly higher than their non-export counterparts for four of the five health scales and lower for none (EQ-5D, VAS, PCS and MCS). Female export workers scored significantly higher than non-export females for four of the five health scales (EQ-5D, VAS, PCS and MCS) (Table 8.2).

Table 8.1. Pearson correlation of health scores for all Kenyan and Ugandan farm workers. All correlations were significant to the <0.001 level (n=1423).

Health scale	SDHS	EQ5D	VAS	PF	RP	BP	GH	VT	SF	RE	MH	PCS
EQ5D	0.44											
VAS	0.38	0.55										
PF	0.31	0.56	0.47									
RP	0.42	0.51	0.42	0.52								
BP	0.48	0.66	0.55	0.62	0.72							
GH	0.47	0.65	0.65	0.57	0.57	0.69						
VT	0.60	0.48	0.37	0.40	0.55	0.58	0.57					
SF	0.38	0.44	0.42	0.53	0.52	0.67	0.56	0.50				
RE	0.44	0.43	0.34	0.45	0.63	0.52	0.46	0.48	0.45			
MH	0.65	0.47	0.44	0.40	0.49	0.56	0.55	0.76	0.53	0.49		
PCS	0.36	0.66	0.57	0.75	0.80	0.85	0.78	0.49	0.59	0.35	0.37	
MCS	0.63	0.44	0.39	0.37	0.53	0.55	0.54	0.78	0.62	0.81	0.86	0.31

Table 8.2 Mean health scores for SDHS, EQ-5D, VAS, PCS and MCS disaggregated by gender for export and non-export farm workers

Gender	Males		Females			
	mean	n	mean	n	*p*	n
SDHS	12.46	454	12.92	397	0.074	851
EQ-5D	0.93	452	0.90	396	0.051	848
VAS	77.35	454	77.22	397	0.913	851
PCS	57.02	452	55.88	392	0.034	844
MCS	47.10	452	48.60	392	0.028	844
Males	Export		Non-export			
SDHS	12.35	229	12.31	171	0.906	400
EQ-5D	0.99	228	0.86	171	<0.001	399
VAS	83.89	229	69.18	171	<0.001	400
PCS	59.39	227	54.81	171	<0.001	398
MCS	47.79	227	46.24	171	0.028	398
Females	Export		Non-export			
SDHS	12.88	234	12.14	125	0.070	359
EQ-5D	0.96	234	0.78	124	<0.001	358
VAS	84.82	234	66.64	125	<0.001	359
PCS	57.66	229	52.51	125	<0.001	354
MCS	50.60	229	45.04	125	<0.001	354

Except where stated the following reports refer solely to the SF-36 results. Self-reported SF-36 scores across all age groups and genders were

significantly higher for those employed in export horticulture compared to non-export horticulture for all scales and component summaries except Vitality (VT) (Table 8.3). Non-export workers scored significantly higher than Ugandan workers for all but three of the health scales. As more than a third of Ugandan respondents professed to having suffered a bout of malaria in the three months preceding the survey, the health scores for these workers were removed from the sample to facilitate comparisons with Kenyan non-export workers. Kenyan non-export scores were significantly higher for the Physical Component Summary (PCS) (df=751 p=<0.001) and significantly lower for the Mental Component Summary (MCS) (df=751 p=0.006) when compared with malaria free Ugandans (Fig. 8.1, Table 8.3).

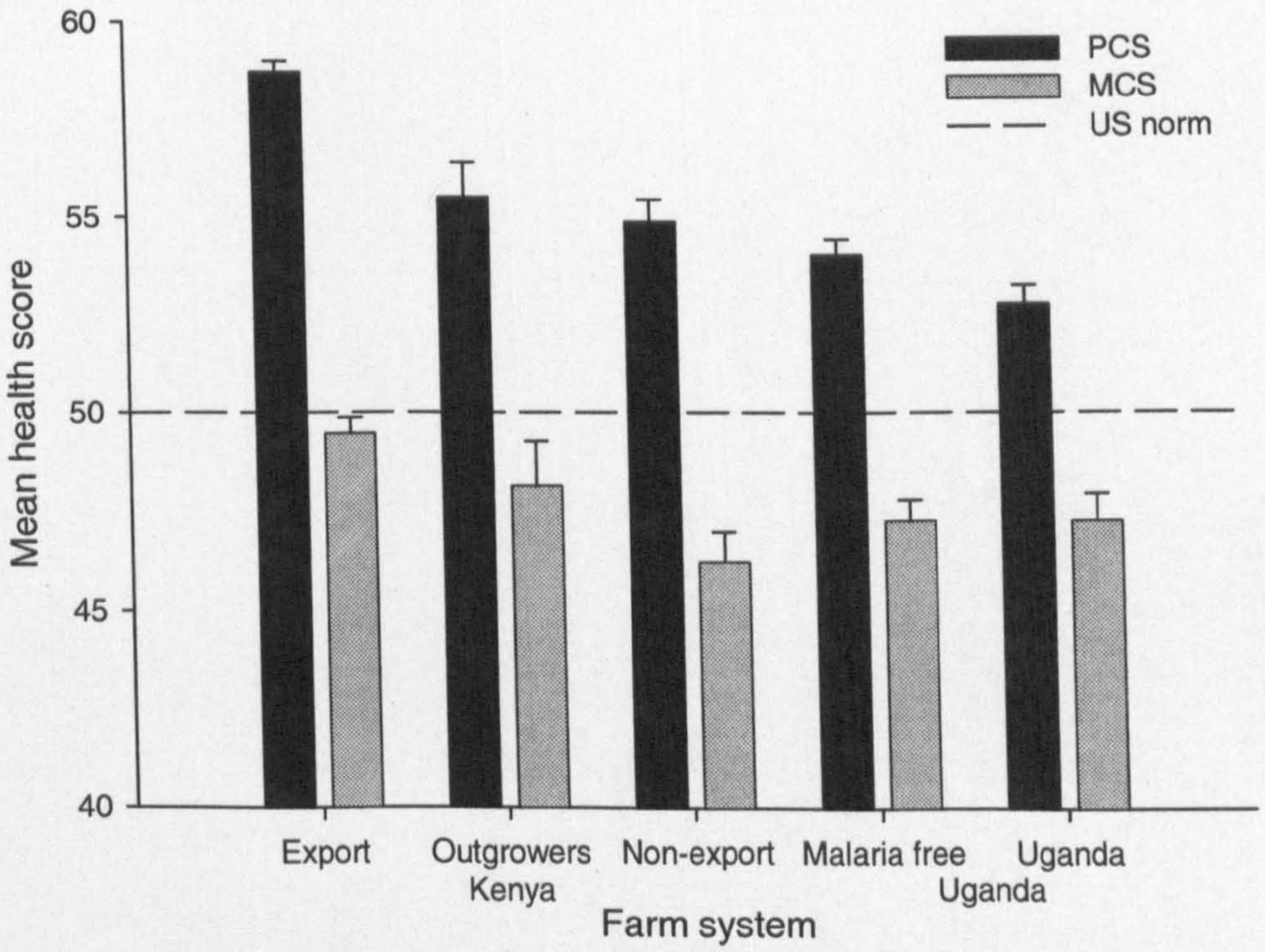


Figure 8.1 SF-36 Physical and mental component summary scores (PCS & MCS) for all age groups disaggregated by farming sector and malaria sufferers., 'Malaria free' refers to Ugandan mean scores once those who professed to having suffered malaria in the three months preceding the survey in Uganda were removed from the analysis. The US norm for both the PCS and MCS is 50 with a standard deviation of 10.

8.3.3 Age group

Health scores for farm workers aged 18-34, employed on export horticulture farms in Kenya were significantly higher than non-export workers for all scales except Vitality (VT) (Fig. 8.2, Table 8.3). Kenyan non-export workers had

significantly higher health scores than Ugandan farm workers for Role Physical (RP), Vitality (VT) and the Physical Component Summary (PCS). There was no difference in the mean scores for the Mental Component Summary (MCS). When scores for malaria sufferers were removed Kenyan non export workers only scored significantly higher than Ugandan workers for VT and PCS and they scored significantly lower for Mental Health (MH) (Fig.

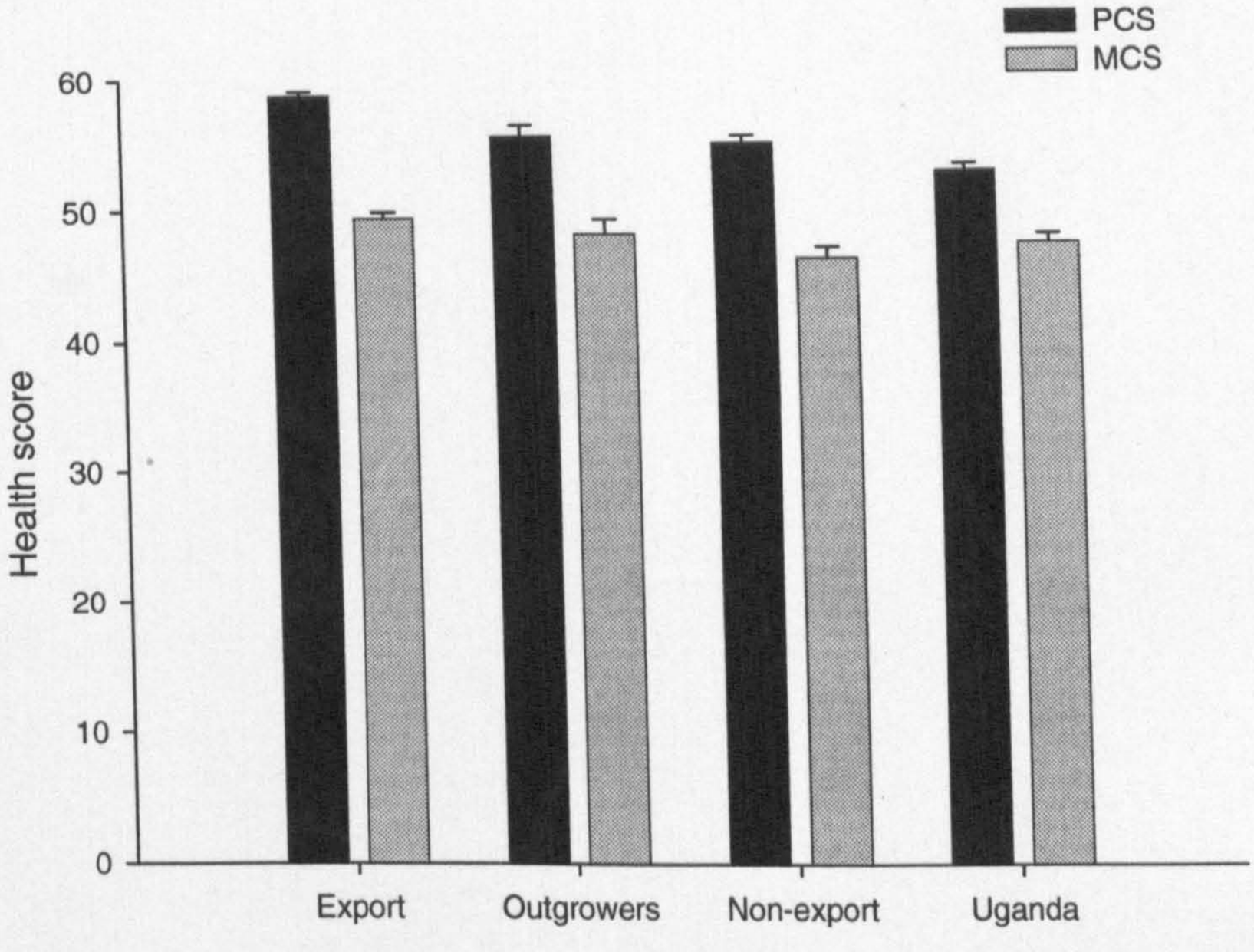


Figure 8.2 Physical and mental component summary scores (PCS & MCS) for the 18-34 age group disaggregated by farming sector.

8.2, Table 8.3).

8.3.4 Comparison of Kenyan and Ugandan scores with US norms

Export farm worker scores, when adjusted for the 18-34 age group, were higher than the published US norms for physical functioning (PF) bodily pain (BP), general health (GH), vitality (VT) and social functioning (SF) (Table 8.4). Non-export farm worker scores were significantly higher then the norms for bodily pain (BP) and vitality (VT) and significantly lower for role physical (RP), role emotional (RE), mental health and the mental component summary (MCS). Ugandan workers scored significantly higher for vitality (VT) and lower for role physical (RP), role emotional (RE) and the physical component summary (PCS). The Ugandan sample of malaria non-sufferers scored

significantly higher than the US norms for bodily pain (BP), general health (GH) and vitality (VT). They scored significantly lower for role physical (RP) and role emotional (RE) but there were no significant differences for the physical and mental component summaries (Table 8.4).

Table 8.3 Comparison of the Kenyan and Ugandan scores for the SF-36 scales Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social-Functioning (SF), Role-Emotional (RE), Mental Health (MH), Physical Component Summary (PCS), Mental Component Summary (MCS)

Sample group	Test	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
All age groups combined	Export	55.66	51.88	58.64	58.43	55.34	52.99	49.17	49.92	58.52	49.20
	Non-export	53.12	48.10	52.81	51.10	53.71	49.19	44.63	46.21	53.82	45.71
	df	759	759	755	755	754	755	759	753	750	750
	p	<0.001[a]	<0.001[a]	<0.001[a]	<0.001[a]	0.1	<0.001[a]	<0.001[a]	0.003[a]	<0.001[a]	<0.003[a]
All age groups combined	Non-export	53.12	48.10	52.81	51.10	53.71	49.19	44.63	46.21	53.82	45.71
	Uganda	52.83	44.99	50.42	49.87	49.99	50.06	45.53	47.89	50.92	47.13
	df	868	868	867	865	865	867	868	865	862	862
	p	<0.001[b]	<0.001[b]	0.004[b]	<0.001[b]	<0.001[b]	0.061	0.714	0.051	<0.001[b]	0.046[b]
All age groups combined	Non-export	53.12	48.10	52.81	51.10	53.71	49.19	44.63	46.21	53.82	45.71
	Uganda malaria free	52.62	45.30	50.60	50.05	50.63	50.47	46.19	48.52	50.85	47.88
	df	754	754	753	751	752	752	754	752	751	751
	p	<0.001[c]	<0.001[c]	0.017[c]	<0.001[c]	<0.001[c]	0.012[d]	0.311	0.009[d]	<0.001[c]	0.006[d]
18-34 age group	Export	55.72	51.86	58.90	58.67	55.41	53.30	49.28	50.16	58.71	49.43
	Non-export	54.08	48.64	53.83	52.35	54.63	50.06	44.96	46.89	54.86	46.23
	df	592	592	588	589	588	588	592	588	586	586
	p	<0.005[e]	<0.001[e]	<0.001[e]	<0.001[e]	0.323	<0.001[e]	<0.001[e]	<0.001[e]	<0.001[e]	0.022[e]
18-34 age group	Non-export	54.08	48.64	53.83	52.35	54.63	50.06	44.96	46.89	54.86	46.23
	Uganda	54.19	46.28	52.05	51.70	51.08	50.57	45.69	48.76	52.74	47.26
	df	485	485	485	484	484	485	485	483	483	483
	p	0.856	0.032[f]	0.061	0.523	<0.001[f]	0.543	0.573	0.067	0.004[f]	0.314
18-34 age group	Non-export	54.08	48.64	53.83	52.35	54.63	50.06	44.96	46.89	54.86	46.23
	Uganda malaria free	54.39	47.29	52.79	52.32	52.22	51.21	47.24	49.53	53.08	48.44
	df	425	425	425	425	425	425	425	425	425	425
	p	0.61	0.246	0.3	0.978	0.017[h]	0.186	0.092	0.014[k]	0.023[h]	0.093

35-44 age group	Export	55.64	51.38	57.93	57.48	55.06	51.98	48.38	49.06	57.79	48.19
	Non-export	51.39	47.70	51.08	48.69	49.90	46.91	43.53	43.22	52.57	42.93
	df	108	108	108	107	107	108	108	106	105	105
	p	0.016[a]	0.124	<0.001[a]	0.002[a]	0.092	0.009[a]	0.113	0.057	0.030[a]	0.065
35-44 age group	Non-export	51.39	47.70	51.08	48.69	49.90	46.91	43.53	43.22	52.57	42.93
	Uganda	53.00	46.39	51.97	51.20	50.48	51.49	47.14	47.81	52.08	47.99
	df	170	170	169	169	169	169	170	169	168	168
	p	0.374	0.634	0.667	0.907	0.973	0.002[d]	0.255	0.031[d]	0.240	0.034[d]
35-44 age group	Non-export	51.39	47.70	51.08	48.69	49.90	46.91	43.53	43.22	52.57	42.93
	Uganda malaria free	52.91	46.45	51.86	51.26	50.67	51.73	47.07	48.40	51.93	48.19
	df	142	142	142	141	141	141	142	141	141	141
	p	0.281	0.609	0.725	0.282	0.707	0.009[d]	0.198	0.032[d]	0.732	0.022[d]

([a]) Export farm worker scale scores were significantly higher than Non-export ([b]) Non-export farm worker scale scores were significantly higher than Ugandan scale scores ([c]) Non-export farm worker scale scores were significantly higher than Ugandan scale scores after controlling for malaria in Uganda ([d]) Non-export farm worker scale scores were significantly lower than Ugandan scale scores after controlling for malaria in Uganda. ([e]) Export farm worker scale scores were significantly higher than Non-export in the 18-34 age group. ([f]) Non-export farm worker scale scores were significantly higher than Ugandan scale scores for the 18-34 age group ([g]) Non-export farm worker scale scores were significantly lower than Ugandan scale scores for the 18-34 age group ([h]) Non-export farm worker scale scores were significantly higher than Ugandan scale scores after controlling for malaria in Uganda for the 18-34 age group ([k]) Non-export farm worker scale scores were significantly higher than Ugandan scale scores after controlling for malaria in Uganda for the 18-34 age group.

Table 8.4 Comparison with US population norms of SF-36 scale scores for Kenyan and Ugandan farm workers aged 18-34, disaggregated by both farming sector and malaria incidence

		Kenya			Uganda	
		Export (df=730)	Non-export (df=586)	Outgrowers (df=438)	Uganda (df=627)	Malaria free (df=552)
	US norm	Mean *p*	Mean *p*	Mean *p*	Mean *p*	Mean *p*
PF	54.07	55.72 <0.001[a]	54.08 0.290[a]	54.88 0.811[c]	54.19 0.745[c]	54.60 0.232[c]
RP	52.45	51.86 0.396[a]	48.64 <0.001[b]	46.48 <0.001[b]	46.28 <0.001[b]	48.06 <0.001[b]
BP	52.05	58.90 <0.001[a]	53.83 0.029[a]	56.75 <0.001[a]	52.05 1.000[c]	53.65 0.018[a]
GH	51.36	58.67 <0.001[a]	52.35 0.274[a]	56.00 <0.001[a]	51.70 0.566[c]	53.06 0.008[a]
VT	49.14	55.41 <0.001[a]	54.63 <0.001[a]	54.09 <0.001[a]	51.08 0.002[a]	52.80 <0.001[a]
SF	50.45	53.30 <0.001[a]	50.06 0.614[a]	52.35 0.093[c]	50.57 0.830[c]	51.40 0.146[c]
RE	50.02	49.28 0.360[a]	44.96 <0.001[b]	47.05 0.023[b]	45.69 <0.001[b]	47.85 <0.001[b]
MH	49.05	50.16 0.089[a]	46.89 0.014[b]	48.45 0.621[c]	48.76 0.590[c]	50.24 0.103[c]
PCS	53.76	58.71 <0.001[a]	54.86 0.089[a]	55.50 0.057[c]	52.74 0.007[b]	53.64 0.755[c]
MCS	48.00	49.43 0.029[a]	46.23 0.043[b]	48.13 0.918[c]	47.26 0.166[c]	49.00 0.160[c]

([a]) Farm worker scale scores were significantly higher than US population norm. ([b]) Farm worker scale scores were significantly lower than the US population norm. Malaria free = scores were removed from the analysis of those workers who self-diagnosed as having suffered a bout of malaria during the three months preceding the survey

8.3.5 Regression analysis

Two components of the SF-36 instrument each serve to aggregate scores from four of the eight scales. These are the Physical Component Summary score (which aggregates Physical Functioning, Role-physical, Bodily Pain and General Health) and the Mental Component Summary score (which aggregates Vitality, Social Functioning, Role-Emotional and Mental Health).

In an attempt to better understand the relative contribution of different socio-demographic and occupational factors to health the PCS and MCS scores were utilised as dependent variables in a multiple linear regression model. Independent variables entered into the first model were number of children per respondent, the employment status of the employee (permanent, temporary, part time, temporary seasonal) whether the respondent smoked or had smoked in the past, distance travelled to work, annual income, level of education, farm type (export, outgrower and non-export), marital status

(single, married, divorced, widowed) gender and age. Stepwise backwards regression was used to remove the variables with the entry criteria being set at 0.05 probability of *F* and removal set at 0.1 probability of *F*. Multicollinearity did not appear to be an issue, as tolerance statistics were above 0.2 and the Variance Inflation Factor (VIF) statistics were below 5.

A significant model emerged for the PCS ($F_{,5,775}$=28.08 p=<0.001, adjusted r^2=0.126), with the significant variables being children (β=-0.133 p=<0.001), annual income (β=0.124 p=<0.001), marital status (β=-0.138 p=<0.001) and farm type (β=-0.239 p=<0.001). A significant model also emerged for the MCS ($F_{,5,774}$= 5.916 p=<0.001, adjusted r^2=0.031). Significant variables were children (β=-0.088 p=<0.014), annual income (β=0.079, p=0.027), education (β=0.089 p=0.013), gender (β= -0.079 p =0.027) and farm type (β=-0.089 p =<0.013). The two explanatory variables 'annual income' and farm type were significant in explaining respondents' scores for all five instrument measures. The mean annual income was significantly higher for export workers ($US 958) than for non-export farm workers ($US 608, df=739 p=<0.001)

Further analysis was undertaken to explore the relationship between annual income (expressed in US dollars) and PCS and MCS scores within the context of farming type (export, outgrower, non-export and Ugandan farm worker). Regressions were significant for both the physical component summary (PCS) (F=96.03, p=<0.001) and the mental component summary (MCS) (F=30.49, p=<0.001) (Figs. 8.3 & 8.4). There is a positive relationship between annual income and both physical and mental health such that as income increases so health status improves. Scores for farm workers employed in both non-export and Uganda were towards the y axis indicating lower income and poorer health than their export and outgrower counterparts who were located further from the axis.

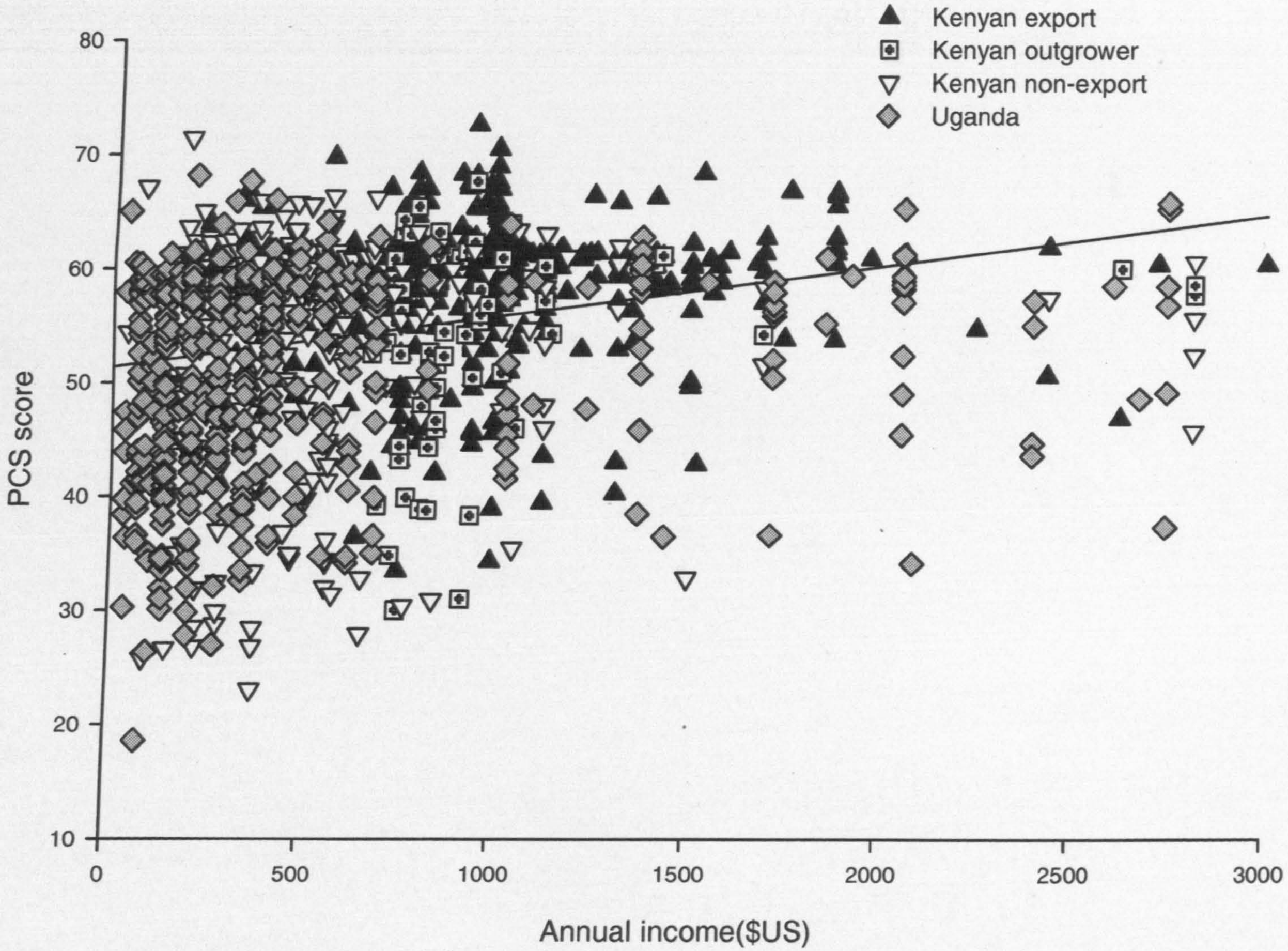


Figure 8.3 Regression analysis of annual income against physical component summary score (PCS) for all workers surveyed (Kenyan export and non-export farmworkers and all Ugandan farmworkers earning below $3000 per annum). Approximately 1% of all reported income data above $3000 was suspected of being an outlier. Data points above this amount were removed. Regression was significant ($F=96.03$, $p=<0.001$), $y = 0.0045x + 51.399$, $r^2= 0.0693$. The majority of non-export worker data points are obscured by the Ugandan points located near the y axis.

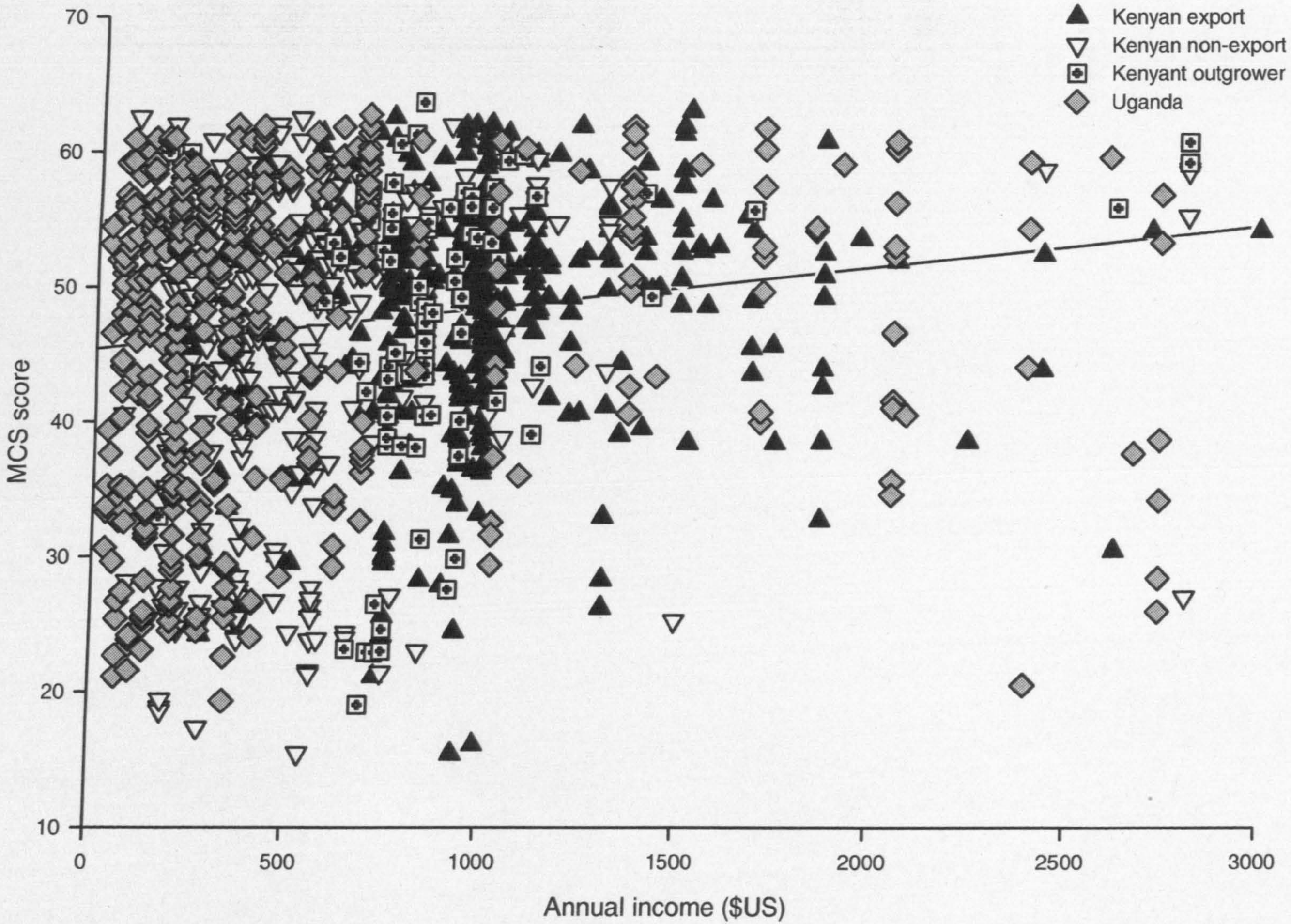


Figure 8.4 Regression analysis of annual income against mental component summary score (MCS) for all Kenyan export and non-export farmworkers and all Ugandan farmworkers earning below $3000 per annum. Regression was significant (F=30.49, p=<0.001), y=0.0031x + 45.439, r^2 = 0.0228. The majority of non-export worker data points are obscured by the Ugandan points located near the y axis.

8.4 Discussion

8.4.1 Strengths and weaknesses

Some limitations to this study are worth considering when interpreting the results. Firstly, the high scores of survey respondents compared to US norms may reflect social desirability bias whereby morbidity rates are underreported in face to face interviews as health problems are perceived as an undesirable social characteristic (Bowling et al., 1999). For instance a study in Australia reported that respondents tended to have higher scores for emotional health and well-being when interviewed compared to completing the questionnaire on their own (Perkins and Sanson-Fisher, 1998). Wagner et al., (1999) suggest a similar explanation as to why Tanzanian respondents had unexpectedly higher mean scale scores than the US and other European countries. Secondly, Ugandan respondents reporting an attack of malaria prior to or during the survey were not specifically asked if malaria had been diagnosed by a qualified member of the health care community. Consequently, it is possible that those respondents may have been suffering from a variety of other illnesses. However, the reported malaria prevalence rate in this study of approximately 25% corresponds to a Uganda prevalence rate for adults of generally below 30% for adults (CDC, 2004), which gives some confidence that the respondents were answering accurately.

8.4.2 Gender differences

A degree of confidence can be taken in the translation validity as differences in mean scores by gender and age-group appear to follow accepted patterns whereby men score higher than women and the young are healthier than the older workers. The differences in mean scale scores between males and females in Kenya were less marked than between males and females in Uganda. Kenyan males had better physical well-being and females better mental well-being. Ugandan males scored higher than females for all scales including the component summary scales. Export horticulture employment conditions appear to have blurred many of the socio-economic gender

differences. These findings are supported by previous studies in several countries (Cross et al., 2008; Jenkinson et al., 1993; Jenkinson et al., 1999; Ware and Kosinski, 2001; Wyss et al., 1999). In an a sub-Saharan context a study by Wyss et al., (1999) in Tanzania also found that males scored higher than females for all scales. Men working on export farms scored higher for all physically related scales (PF, RP, BP, GH and PCS) whilst women scored higher for all emotional scales (VT, SF, RE, MH and MCS). By contrast non-export males scored higher than non-export females for all scales.

8.4.3 Export v non-export

There appears to be a marked health advantage of working on export farms as workers scored significantly higher than non-export workers for all SF-36 scales. When controlled by age the 18-34 age group scored significantly higher for all scales and component summaries except for the vitality scale (VT) where there were no significant differences. The mean SF-36 scale scores for export farm employees aged 18-34 were higher than the published US population norms for seven out of the ten scales including the PCS and MCS. These results compare favourably with those of the Tanzanian survey of urban dwellers where scores were similar to those of the US general population aged 25-34 for all scales except GH, VT and MH (Wyss et al., 1999). By contrast non-export workers had higher scores for only two scales and lower for four. Similarly, Ugandans aged 18-34 scored significantly higher than the US norms for only one scale and lower for three. However, when malaria was accounted for, scores were significantly higher for three scales and lower for only one.

There are a number of advantages of working on export instead of non-export farms. Some or all of the following may have contributed towards the higher health scores, guaranteed minimum wage plus bonuses; frequent and formally paid overtime opportunities; subsidised lunches; health clinic check ups; transport to and from work; education for employees children; controlled use of hazardous substance.

8.4.4 Income and poverty

This study appears to support the assertion of Benzeval and Judge (2001) that there is a causal relationship between low income and poor health. In this study, mean income levels were more than 50% higher for export farm workers' than their non-export counterparts. The disparity in income levels between workers employed in export and non-export horticulture in Kenya has previously been reported. McCulloch and Ota (2002), found that households of non-pack house workers had incomes approximately 26% lower than households of pack house workers.

Income inequality has generally been associated with differences in health, although the evidence at country level is mixed (Lynch et al., 2000). A number of studies at the community level have revealed associations between income inequality and both morbidity and mortality`(Fiscella and Franks, 1997 ; Kobetz et al., 2003) with mean income being linked to mortality rates (Stanistreet et al., 1999). Multiple regression identified income as one of the stronger explanatory variables of both PCS and MCS health scores when aggregated across both countries. Income explained 7% of the variation in PCS scores and just 2.3% of the variation in MCS scores. When the data was disaggregated by country, income explained 11% of the Kenyan PCS scores and 6% of MCS scores, compared to 23% of Ugandan PCS scores and 8% of MCS scores. The mean Ugandan PCS, MCS and SDHS scores were significantly different when compared by annual income class (Fig. 8.5). Generally as respondent's annual income increases so does their physical and mental health status. However, the respondents in this study occupied the lowest income classes. A broader range of income categories might indicate that marginal health utility decreases as income increases as suggested in a study by Backlund et al., (1996).

8.4.5 Income and malaria in Uganda

Both income and malaria were strong explanatory variables in Uganda for the PCS (income β=0.23 p=<0.001; malaria β=-0.119 p=0.004) and MCS scores

(income β=0.084, p=<0.05; malaria β=-0.204 p=<0.001). This is not surprising as a number of studies suggest that there are important financial costs at the individual level (Cho-Min-Naing and Gatton, 2004) and to households following malarial illness (Chuma et al., 2006; Laxminarayan, 2004; Onwujekwe et al., 2000). In some cases causality appears to be bidirectional with income levels correlated with malarial infection rates and malarial incidence impacting income (Sachs and Malaney, 2002). A possible partial explanation of the relationship between malaria and individual and household income is that the poorest households are more disinclined to seek preventative and treatment measures due to cost inhibitions (Worrall et al., 2005).

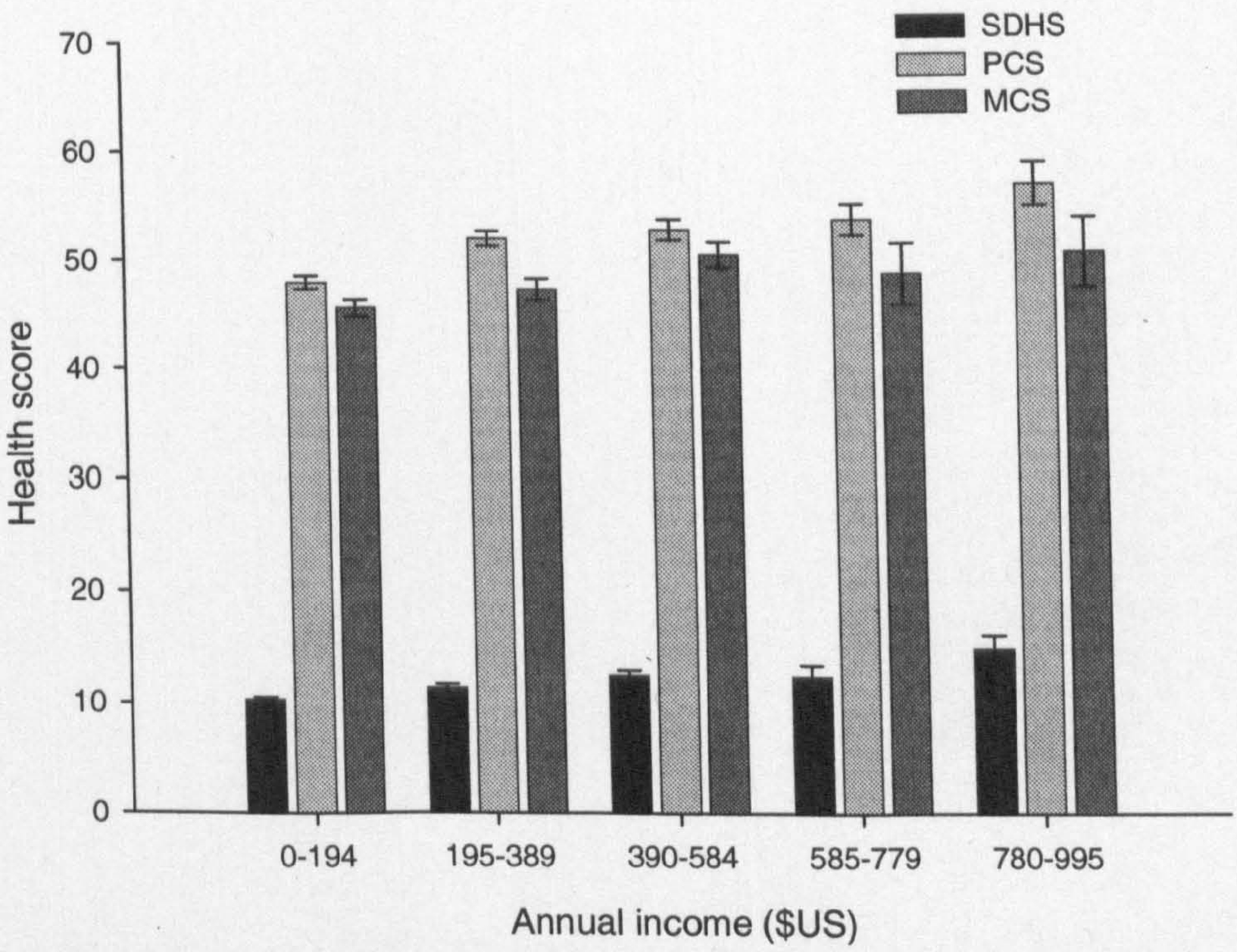


Figure 8.5 Ugandan farm workers mean health scale scores by annual income for the SDHS, PCS and MCS

Malaria prevalence on the western flanks of Mount Kenya is considered negligible, particularly among the adult population (Afrane et al., 2007; Chen et al., 2006) whilst in Uganda it is mesoendemic or endemic throughout the sample area (Okello et al., 2006). Income generation in Uganda through export horticulture development may be an effective means of attenuating the worst effects of malaria as there are established links of below the poverty line income and malaria incidence (Sharma, 2003).

If UK horticultural production were to relocate to Uganda then wealth would flow from a developed to a developing nation (Edwards-Jones et al., 2008). Based upon the income increases experienced by farm workers in Kenya, Ugandan farm workers may expect similar changes in their earnings. If the relationship holds between income and health then improvements in population health would also be expected as a consequence of export horticulture. Conversely, a reduction or removal of income as a result of consumers purchasing UK grown 'local' produce would be expected to cause a greater negative impact on health (Benzeval and Judge, 2001).

8.4.6 Principles and the local food movement

According to the Soil Association a primary justification for encouraging UK consumers to buy locally produced food is that it benefits local communities by allowing links to be made between people in urban and rural settings (Soil Association, 2007). However, if vegetable imports from countries such as Kenya decline as a result of pro-local consumer choice, to what extent will the benefits that accrue to local UK communities outweigh the income and health disbenefits that will devolve to Kenyan export farm workers? The consequences of appeals to consumers by the Soil Association to purchase locally grown rather than imported produce would appear to run contrary to the IFOAM principle of fairness whereby:

> 'those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties - farmers, workers, processors, distributors, traders and consumers. Organic agriculture should provide everyone involved with a good quality of life, and contribute to food sovereignty and reduction of poverty' (IFOAM, 2006).

There appears to be an incompatibility between on the one hand a commitment to the principle of social justice through the reduction of poverty and on the other supporting UK based buy local initiatives that would effectively undermine worker livelihoods in developing countries. This

'unreflexive' localism of local food movements has been considered by some as an undemocratic and defensive particularism (whereby a small unrepresentative group strives to convert others to their world view) (DuPuis and Goodman, 2005; Hinrichs and Kremer, 2002; Hinrichs, 2000; Hinrichs, 2003; Winter, 2003). The membership of these groups generally comprises the white middle-class that can become "elitist and reactionary" (Hinrichs, 2000). Local and organic food movements have attempted to connect the spatial, social and ethical aspects of food production and consumption. By linking the spatial with the ethical, local and organic food movements have been accused of conflating the local with the ethical (Freidberg, 2004; Hinrichs, 2000).

8.4.7 Policy implications

There is an increasing risk that UK based local food initiatives will undermine DFID's development policy, particularly with regard to the targets of the Millennium Development Goal 1 to eradicate poverty. A major policy implication which we would support is that export horticulture should be developed and expanded as a vehicle for the redistribution of wealth from rich developed nations to much poorer developing nations like Kenya and Uganda.

Local food appears to have gained popularity as a movement more through 'intuition' rather than in the face of scientific findings. Only recently have evidence based studies begun to provide insight into some of the issues relating to local versus overseas food policy. For DFID to achieve its development objectives may require that UK consumers are adequately informed of the ethical trade-off between buying 'local' and foregoing produce from developing countries.

The health of farm workers has recently gained importance as a measure by which the ethical viability of competing production systems is measured. This study suggests that employment on export farms in Kenya improves worker health to the extent that it surpasses the IFOAM principle whereby health is 'not simply the absence of illness, but the maintenance of physical, mental,

social and ecological well-being' (IFOAM, 2006).

This study proposes that income and health are causally related variables in Kenyan vegetable horticulture production. To decrease or stop export food production in developing countries would ultimately harm the health of citizens in those countries. This in turn would undermine DFID's international obligations to the MDG 1, as well as being counterproductive to some of the local food organisations fundamental principles of social justice and health. Future studies might compare the health trade-offs for those employed in export horticulture in countries such as the UK, Kenya and a European supplier country such as Spain. Research could also attempt to determine what the trade-offs are in competing production systems between social variables such as consumer and farm worker health and environmental variables such as carbon emissions.

Chapter 9

A comparison of the health impacts to farm workers of buying vegetables from four different countries

9.0 Abstract

The use of food miles as a unique indicator of sustainability is increasingly regarded as an insufficient tool for informing policy makers. A measure of social justice is considered important for the formulation of good policy. There is growing recognition that health is a component part of social justice and recognised by the organic and local food movements as important to the development of rounded sustainable agricultural practices. This study compared the self-reported health status of farm workers in the UK, Spain, Kenya and Uganda. Farm workers on Kenyan export horticulture farms reported significantly higher levels of physical health compared to Kenyan non-export farm workers, workers in the other study countries and US population norms. Mean health levels for UK farm workers were significantly lower than the age-adjusted population norms. These findings have important implications for policy makers and consumers. Future ethical purchasing decisions could be guided by the concept of buying from wherever positively affects health rather than wherever is nearest.

9.1 Introduction

In recent years increasing tensions have appeared in the debate regarding agricultural sustainability and food production (Campbell, 2004). One of these tensions relates to the increasing distances travelled by fresh vegetable produce from farm to supermarket, commonly referred to as 'food miles' (Edwards-Jones et al., 2008; Pretty et al., 2005; Wangler, 2006). Alternative food groups (pro-organic and local food groups in particular) have adopted the food miles concept as a means of encouraging consumers to change their purchasing behaviour (MacGregor and Vorley, 2006).

Part of the appeal of the local food movement is that it has tended to posit itself as antithetical to the apparent faceless and harmful character of the industrialised global food system (Hinrichs, 2000; 2003). Many local food initiatives self-define in terms of their opposition to the global and share political commonalities such as a desire to (re)create a food system that is economically, environmentally and socially ethical (Allen et al., 2003). However, there is increasing concern with the assumption that local contains inherent qualities of good (Weatherell et al., 2003; Winter, 2003). A number of authors have suggested that there is nothing inherently good or bad about scale (local scale in this case) (Born and Purcell, 2006; Christopher Brown and Purcell, 2005) and consequently linking social ethics/justice with local confounds the two (Freidberg, 2004). Born & Purcell (2006) contend that 'localizing food systems, therefore, does not lead inherently to greater sustainability or to any other goal. It leads wherever those it empowers want it to lead'.

Changes in consumer purchasing decisions resulting from either the food miles or buy local debate could have far reaching consequences on communities across the world (MacGregor and Vorley, 2006). Changes at the local scale may have varying degrees of impact on the livelihoods of a number of local and non-local stakeholders. Coping with negative impacts may be particularly problematic for stakeholders in developing rather than developed countries (Bellows and Hamm, 2001). For example, Kenya exports 70% of its

total green bean production to the UK whilst the UK imports 58% of its total green bean needs from Kenya (Jones, 2006). There have been a number of socio-economic achievements attributed to the trade in export horticulture from Kenya which includes the employment of half a million workers employed either directly or indirectly by the industry (Dijkstra, 1997; Gabre-Madhin and Haggblade, 2004; Jaffee, 2003); increased household incomes for export horticulture workers compared to non-export workers and employment opportunities to uneducated and consequently previously unemployable rural and urban women (McCulloch and Ota, 2002).

A valid indicator is needed that goes beyond food miles and geographical scale as a measure of sustainability. Such an indicator needs to capture the impacts of changes that may result from a shift towards local as a production scale. A more appropriate indicator for assessing impacts on production stakeholders relates to the idea of social justice (Allen et al., 2003; Edwards-Jones et al., 2008). Social justice refers to the fair and equitable treatment of people, although the means to this end are strongly contested (Ruger, 2006). Health is considered an attribute of social justice and good health a necessary precondition of an individual's capability to live a flourishing life (Ruger, 2003; Ruger, 2004). Sen's (1985) capability approach as outlined by Anand (2005a) suggests that the multi-dimensionality of human health incorporates variables such as longevity, life expectancy, mobility and pain. It is argued that health status, much like income, is a measure of an individual or group's capability to lead a fulfilling life (Anand, 2005a). An advantage of preferring health over income as a measure is that it better captures the emphasis of the capability approach by focusing not on the presence of resources but the possibility of using them (Verkerk et al., 2001).

The principle of farm worker health and well-being as a measure of the ethical viability of a food system is implicitly embedded in organisations such as the International Federation of Organic Agricultural Movements (IFOAM), the Soil Association, the Fairtrade organisation and the Ethical Trade Initiative. They respond to a belief held by some consumers that purchasing decisions will impact producers both locally and globally. Consumers who consciously

purchase local produce are making two purchasing decisions. Firstly, they are acting proactively towards locally grown produce and secondly, they are withdrawing support by not purchasing from producers and their associated local economy in other regions.

Consumers wishing to make ethical purchasing decisions with respect to the different food systems require access to relevant and comparable information. In the context of health the use of self-reported questionnaires is considered a valid partial measure of an individual's or group's capability to live a flourishing life (Anand, 2005b; Cookson, 2005; Verkerk et al., 2001). A quantitative comparative assessment of farm worker health in producer countries, which includes the UK, could facilitate the consumer decision making process by providing a partial evaluation of social justice.

This study compared the self-reported health of farm workers in vegetable horticulture in the UK, Spain, Kenya and Uganda and attempted to evaluate the potential impact of UK consumer purchasing decisions on worker health in each of the respective countries. Whilst this study is restricted to just four of the many countries that supply the UK supermarkets with fresh vegetables, it is hoped that the findings may help to evaluate the degree to which international development from the perspective of export horticulture helps those in poverty (MacGregor and Vorley, 2006).

9.2 Methods

A description of the data collection methods and health survey instruments used in this chapter are described chapter 5 'Health survey methodology'.

9.3 Results

9.3.1 Sample description

A total of 2545 completed questionnaires were collected from individual farmers and farm workers in the UK (605), Spain (472), Kenya (893) and Uganda (573) during 2006 and 2007. Questionnaires were self completed in the UK and Spain and completed through personal interviews with interviewers in Kenya and Uganda. The combined workforce of these four countries comprised twenty five nationalities[1], twenty three of whom worked in the UK and Spain. Farm workers in the United Kingdom were significantly younger (24.27) than workers in Spain (36.78), Uganda (37.69) and Kenya (29.88) (df=3, p=<0.001) (Fig. 9.1).

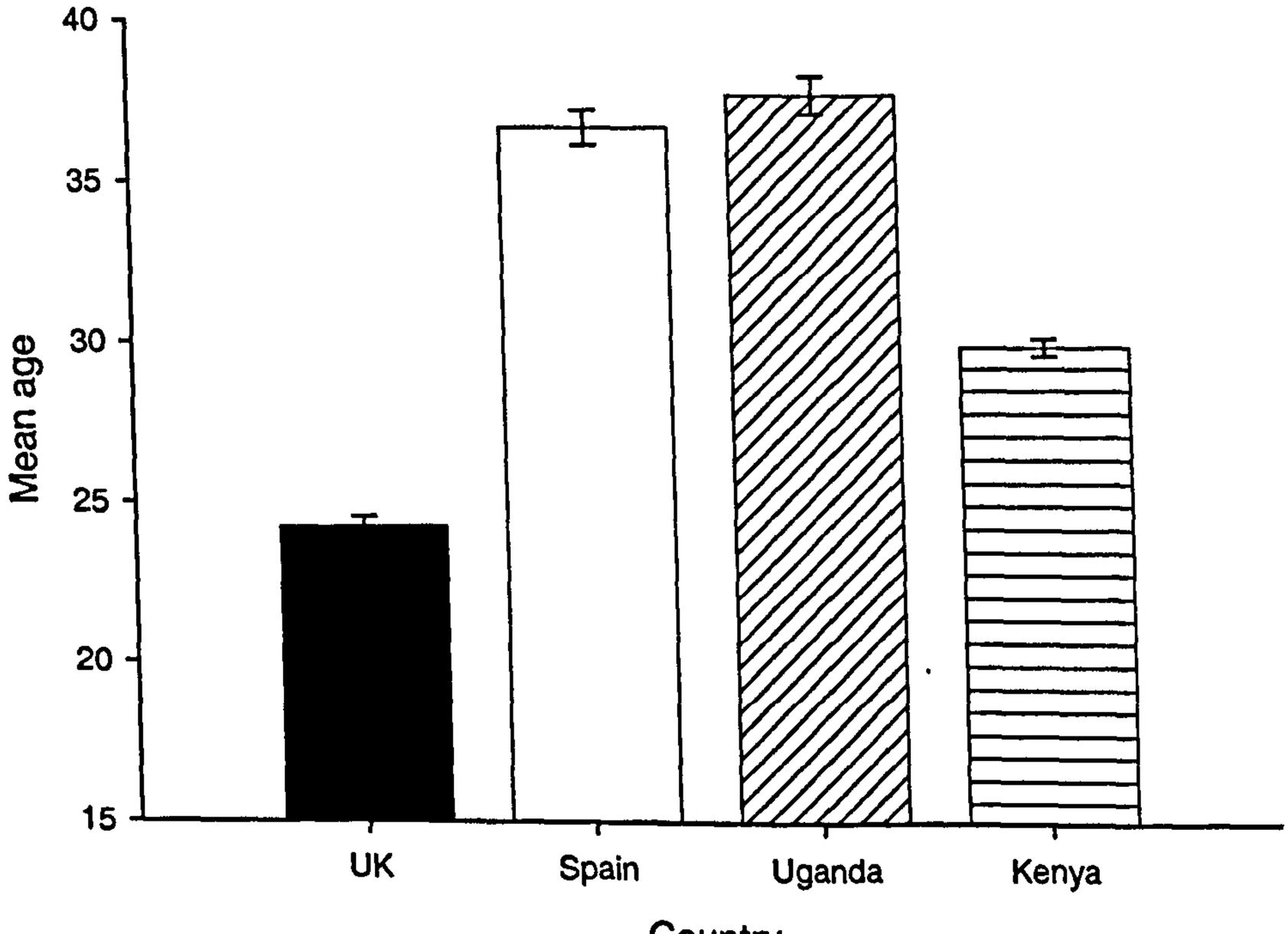


Figure 9.1 Mean age of farm workers by country.

[1] The nationalities included Byelorussian, Bolivian, Brazilian, British, Bulgarian, Colombian, Dutch, Ecuadorian, Estonian, French, Indian, Iranian, Kenyan, Latvian, Lithuanian, Moldovan, Moroccan, Nigerian, Polish, Romania, Russian, Slovakia, South African, Spanish, Ugandan, Ukrainian, Zimbabwean.

9.3.2 Health scale correlations

All scales of the SF-36, EQ-5D, VAS and the SDHS were highly significantly correlated with each other ($p<0.0001$) (Table 9.1). Correlations between scales were stronger than those found in the UK study which gives some degree of confidence concerning the translations.

Table 9.1 Pearson correlation of health scores for farm workers pooled across all four countries. All correlations were significant to the <0.001 level (minimum n=2227 maximum n=2543)

Health scale	SDHS	EQ5D	VAS	PF	RP	BP	GH	VT	SF	RE	MH	PCS
EQ5D	0.42											
VAS	0.38	0.53										
PF	0.21	0.31	0.29									
RP	0.36	0.41	0.32	0.60								
BP	0.39	0.61	0.50	0.45	0.56							
GH	0.42	0.59	0.58	0.45	0.45	0.65						
VT	0.56	0.47	0.42	0.26	0.45	0.57	0.54					
SF	0.37	0.41	0.39	0.37	0.45	0.62	0.52	0.47				
RE	0.40	0.34	0.27	0.56	0.72	0.38	0.34	0.41	0.39			
MH	0.63	0.46	0.46	0.27	0.40	0.51	0.51	0.72	0.53	0.43		
PCS	0.27	0.58	0.50	0.74	0.69	0.81	0.73	0.44	0.51	0.24	0.31	
MCS	0.62	0.44	0.41	0.17	0.47	0.46	0.47	0.76	0.64	0.75	0.86	0.19

9.3.3 Between country comparisons

Kenyan farm worker physical component summary (PCS) scores from the SF-36 instrument were significantly higher compared to farm workers employed in the UK, Spain and Uganda (df=3, p=<0.001).

Kenyan export horticulture farm workers' SF-36 scores were significantly higher than both Kenyan non-export workers and outgrowers (Fig. 9.2). Spanish farm workers scored highest on the mental component summary and significantly higher than the UK (df=942, p=<0.001), Kenyan non-export (df=717, p=<0.001) and Uganda (df=987, p=<0.001) (Fig. 9.2). The physical and mental component summary scores are known to be age dependant (Ware and Kosinski, 2001; Ware et al., 1994). Increasingly lower physical component summary scores and increasingly higher mental component summary scores normally being attributed to older age groups. It is therefore more useful to analyse physical and mental health by controlling the age of

respondents. The 18-34 age group was the only age demographic that contained sufficient numbers of respondents across all countries. The following reports health scores for this age group and then compares them with published norms.

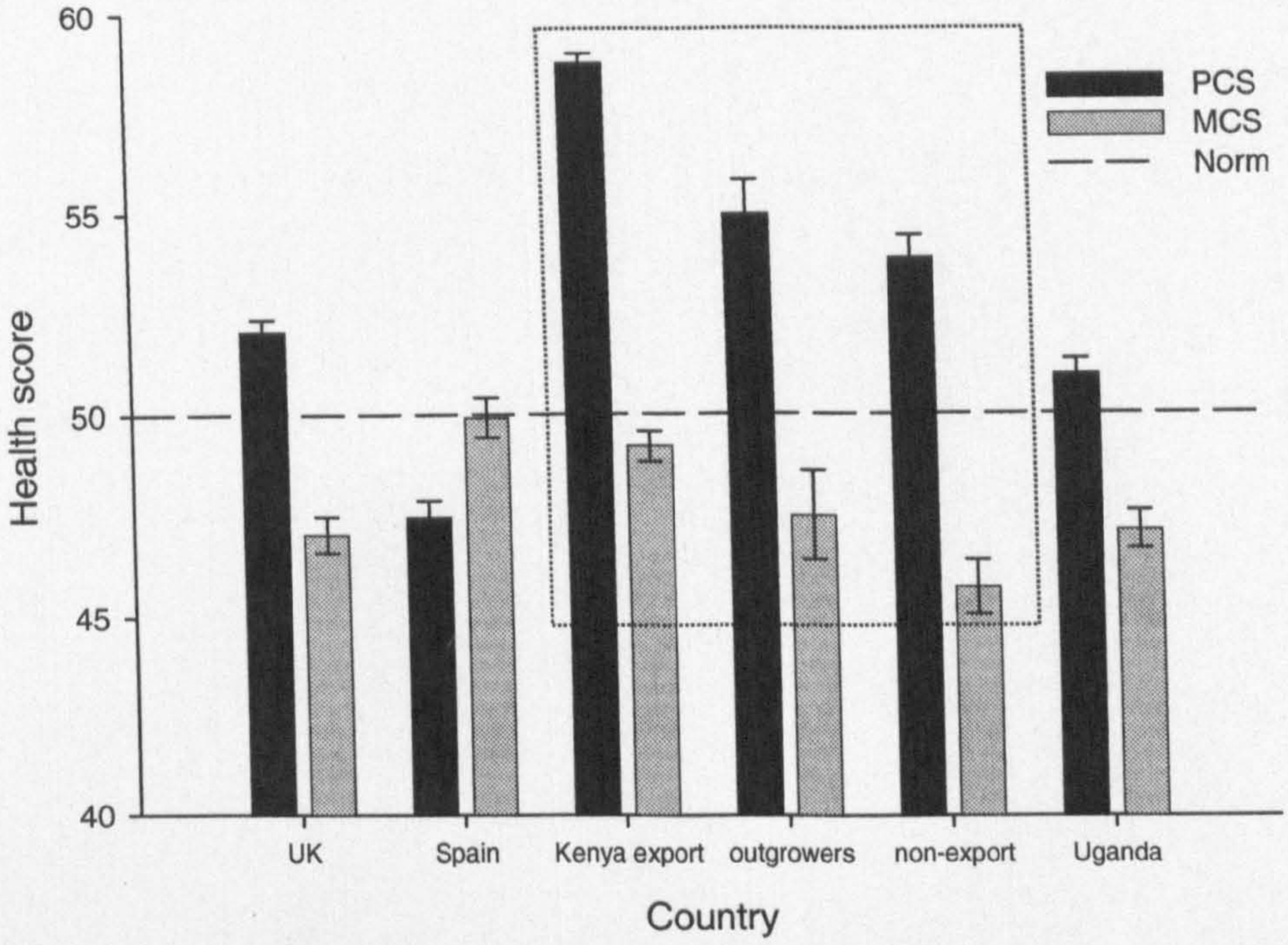


Figure 9.2 Mean physical component summary (PCS) and Mental Component Summary (MCS) scores by country and Kenyan farming system across all age classes. Population norm relates to the US standardised norm for independent of age or gender. The norm is set at 50 and one standard deviation is set to 10 (Ware and Kosinski, 2001).

9.3.4 Age group

Kenyan farm worker physical component summary (PCS) scores were significantly higher compared to farm workers employed in the UK, Spain and Uganda for the 18-34 age group (df=3, p=<0.001). Kenyan export horticulture farm workers scored significantly higher than both Kenyan non-export workers and outgrowers (Fig. 9.3). Spanish farm workers scored highest on the mental component summary (MCS) for this age group and significantly higher than the UK (df=673, p=<0.001), Kenyan non-export (df=407, p=<0.001) and Uganda (df=448, p=<0.018) (Fig. 9.3).

9.3.5 Norm based comparisons

Scores for UK respondents for the SF-36 health scales and component summaries were significantly lower than the US population norm for the 18-34 age group for role physical (RP), bodily pain (BP), general health (GH), social functioning (SF), mental health (MH) and both physical and mental component summaries PCS & MCS). Scores were only significantly higher for the vitality scale (VT) (Table 9.2). The Spanish respondents scored significantly lower than the norm for the same scales as UK workers with the exception of the mental component summary scale where the Spanish scored significantly higher. Kenyan export farm workers scored significantly higher for all scales with the exception of role physical (RP) and role emotional (Table 9.2).

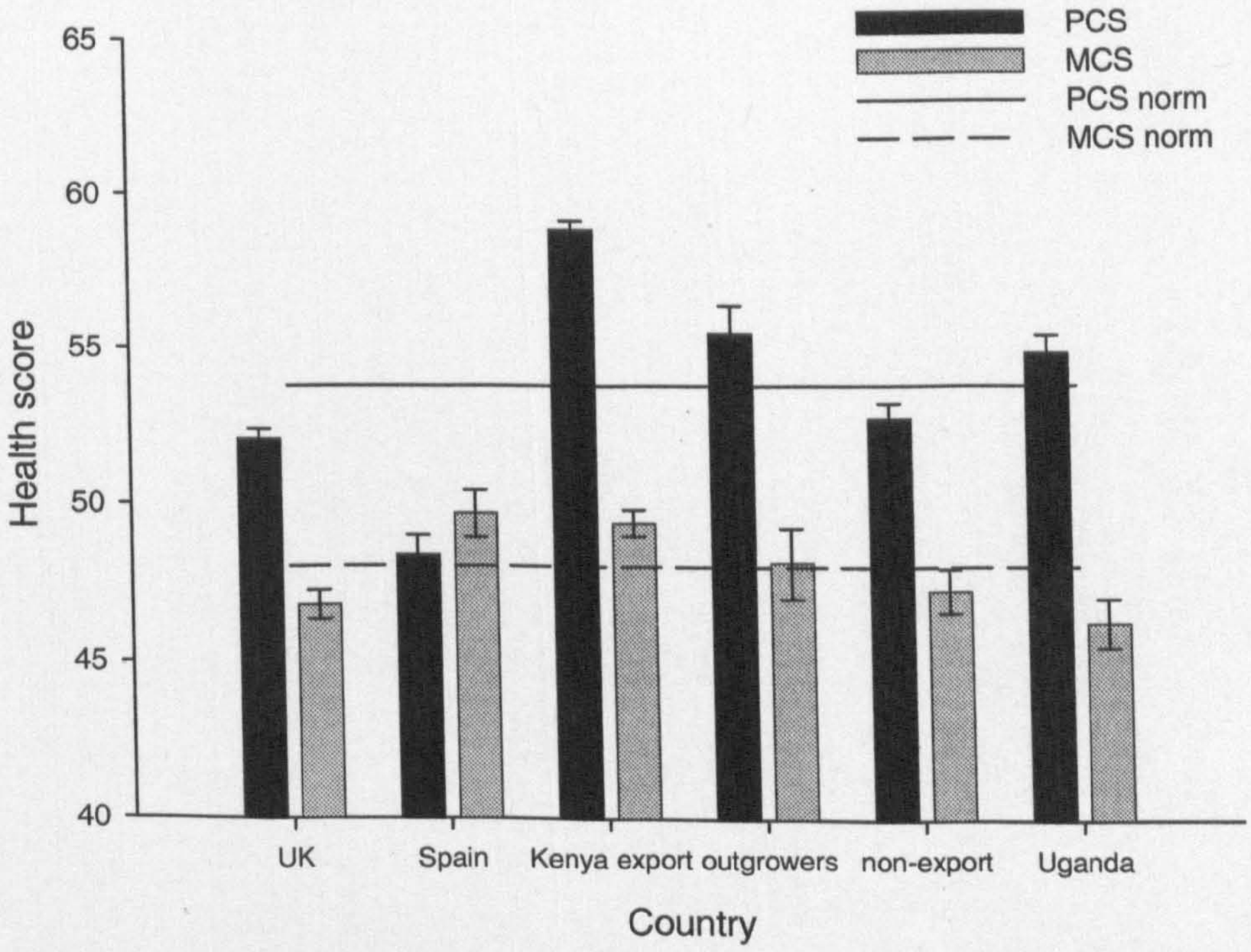


Figure 9.3 Mean physical component summary (PCS) and mental component summary (MCS) scores by country and Kenyan farming system for the 18-34 age group.

Scores from the three other health scales included in the survey (SDHS, EQ-5D and VAS) generally concord with the results for the SF-36. Kenyan export workers scored higher than the UK, Spanish and Ugandan workers on the three instruments for males and the 18-34 age group. Kenyan female export workers' SDHS scores were slightly lower than the Spanish (Table 9.3). None of these differences in scores were significant with the exception of Spanish scores which were significantly higher than for Uganda. The percentage of

males recording a score of nine or less was lowest for Kenyan export farm workers (16.87%) and highest for non-export and Uganda workers (27.27% and 26.43% respectively). The percentage of females scoring nine or less was lowest for Spanish farm workers (12.50%) and highest for Ugandan and non-export workers (27.42% and 25.56% respectively). The percentage of workers aged 18-34 recording a score of nine or less for this instrument was lowest for Kenyan export farm workers (15.68%) and highest for non-export and UK workers (27.03% and 21.53% respectively) (Table 9.3). All countries with the exception of Kenyan export farm workers scored significantly lower than the UK norm for both the EQ-5D and VAS when controlled for by age and gender. Kenyan export workers scored significantly higher for the EQ-5D and significantly lower for the VAS (Table 9.3).

Table 9.2 Comparison with US population norms for mean SF-36 scores for all farm workers aged 18-34 disaggregated by country

	UK			Spain			Export			Non-export			Uganda		
	Mean	df	*p*	Mean	df	*p*	Mean	df	*p*	Mean	df	*p*	Mean	df	*p*
PF	53.28	852	0.055	48.16	551	<0.001	56.23	832	<0.001[a]	54.26	627	0.601	54.11	586	0.927
RP	50.53	852	<0.001[b]	49.21	551	<0.001[b]	51.54	832	<0.063	46.32	627	<0.001[b]	48.66	586	<0.001[b]
BP	48.86	852	<0.001[b]	48.13	551	<0.001[b]	58.74	832	<0.001[a]	52.14	627	0.882	53.85	586	0.005[a]
GH	49.66	852	<0.001[b]	47.95	551	<0.001[b]	58.37	832	<0.001[a]	51.73	627	0.504	52.34	586	0.170
VT	51.37	852	<0.001[a]	53.20	551	<0.001[a]	55.33	832	<0.001[a]	51.11	627	0.001[a]	54.62	586	<0.001[a]
SF	46.55	852	<0.001[b]	46.48	551	<0.001[b]	53.38	832	<0.001[a]	50.74	627	0.601	50.07	586	0.430
RE	49.92	852	0.844	51.28	551	0.061	49.24	832	0.159	45.77	627	<0.001[b]	45.00	586	<0.001[b]
MH	46.17	852	<0.001[b]	47.07	551	<0.001[b]	49.92	832	0.031[a]	48.76	627	0.588	46.89	586	<0.001[b]
PCS	52.06	852	<0.001[b]	48.36	551	<0.001[b]	58.34	832	<0.001[a]	52.74	627	0.007[b]	54.86	586	0.031[a]
MCS	46.80	852	0.020[b]	49.68	551	0.019[a]	49.19	832	0.004[a]	47.26	627	0.165	46.23	586	0.001[b]

([a]) Farm worker scale scores were significantly higher than US norm. ([b]) Farm worker scale scores were significantly lower than the US norm.

Table 9.3 Comparison with UK population norms for mean EQ-5D, VAS and SDHS* scores for all farm workers aged 18-34 disaggregated by country

		UK			Spain			Export			Non-export			Uganda		
		Mean	df	*p* or %	Mean	df	*p* or %	Mean	df	*p* or %	Mean	df	*p* or %	Mean	df	*p* or %
Males	SDHS	12.41		22.05	11.99		24.47	12.66		16.87	12.41		27.27	12.15		26.43
	EQ5D	0.85	687	<0.001	0.92	402	0.075	0.97	576	<0.001	0.88	460	<0.001	0.85	468	<0.001
	VAS	80.23	686	<0.001	79.34	417	<0.001	82.44	577	<0.001	69.64	460	<0.001	80.43	464	<0.001
Females	SDHS	12.14		20.57	13.50		12.50	13.29		14.35	12.57		25.56	11.04		27.42
	EQ5D	0.85	609	<0.001	0.84	519	<0.001	0.97	644	<0.001	0.81	511	<0.001	0.77	546	<0.001
	VAS	75.66	603	<0.001	76.99	524	<0.001	83.48	644	<0.001	69.06	511	<0.001	70.30	545	<0.001
Total	SDHS	12.32		21.53	12.75		18.42	12.96		15.68	12.47		27.03	11.63		26.89
	EQ5D	0.85	1298	<0.001	0.87	923	<0.001	0.97	1222	<0.001	0.85	973	<0.001	0.81	1016	<0.001
	VAS	78.69	1291	<0.001	78.08	943	<0.001	82.93	1223	<0.001	69.41	973	<0.001	75.60	1011	<0.001

* At present there are no published SDHS norms. However a score of 9 or below has been proposed as a threshold level indicating mild clinical depression (Joseph et al., 2004). The figures reported in this table refer to the proportion of the population that scored 9 or less and are consequently classed as suffering from at least mild clinical depression

9.3.6 Regression analysis of worker reported annual income and health

Regression analysis was undertaken to explore the relationship between annual income (expressed as an index of US dollars) and physical and mental component summary scores within the context of country and farming type (UK, Spain, Kenya, Kenya export, Kenyan non-export and Uganda). Physical component summary (PCS) regressions were significant for the UK ($F=11.24$, $p=<0.001$), Kenya export ($F=4.55$, $p=0.033$), and Uganda ($F=52.4$, $p=<0.001$). Mental component summary (MCS) regressions ($F=30.49$, $p=<0.001$) were significant for Kenyan export ($F=4.39$, $p=<0.037$), Kenyan non-export ($F=6.10$, $p=<0.014$) and Uganda ($F=14.99$, $p=<0.001$) (Figs. 9.4 & 9.5). Although the relationship is weak there is nonetheless a positive relationship between annual income and both physical and mental health such that as income increases so health status improves.

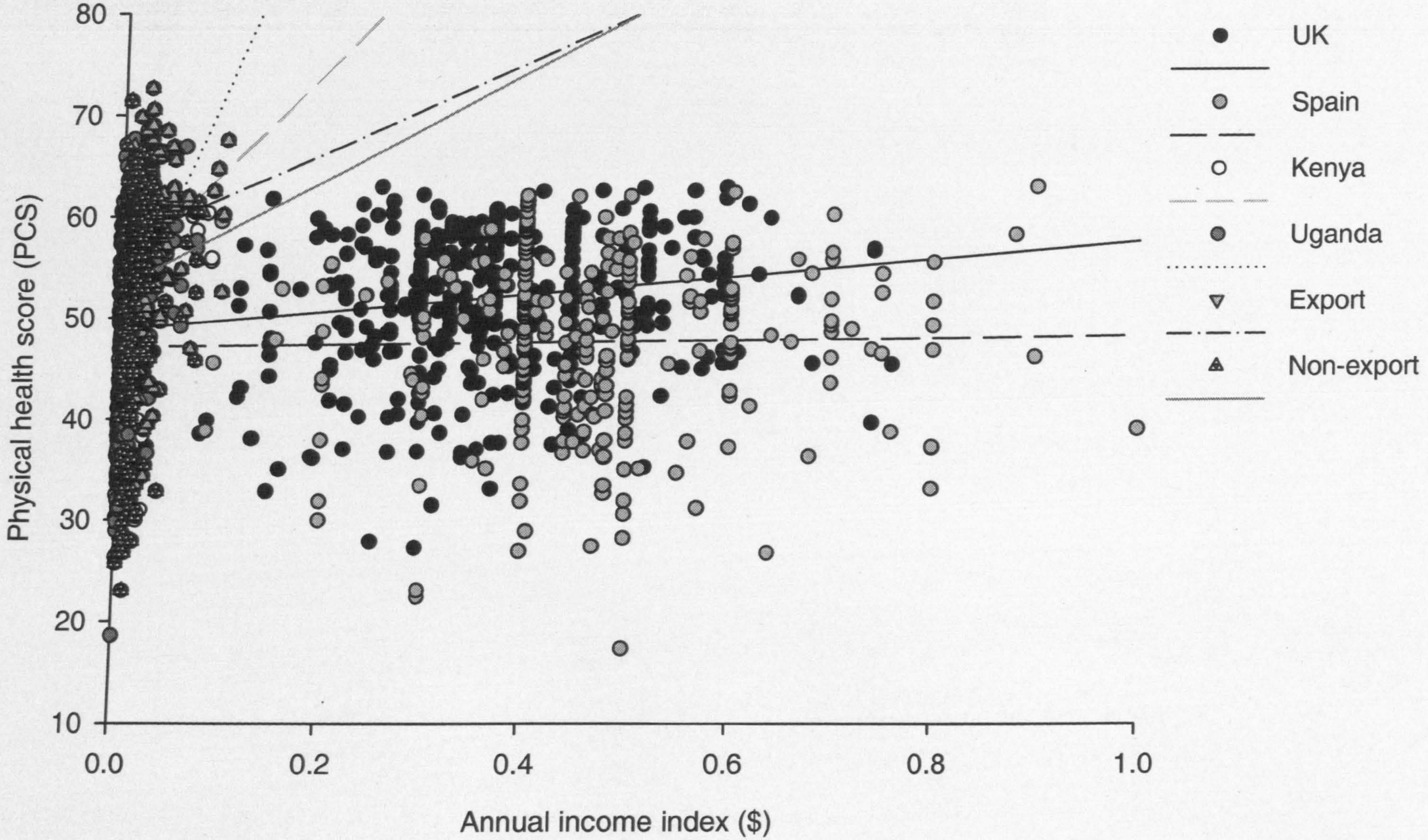


Figure 9.4 Mean PCS score and annual income regression analysis. The top 1% was removed as they were deemed to be outliers. UK y=8.837x + 48.857, $r^2 = 0.0271$; Spain y= 1.153x + 47.152, $r^2 = 0.0004$; Kenya y = 101.997x + 54.184, $r^2 = 0.0337$; Uganda y = 237.638x + 48.553, $r^2 = 0.0892$; Kenya export y = 45.033x + 57.372, $r^2 = 0.0097$; Non-export y = 53.748x + 52.937, $r^2 =0.0044$

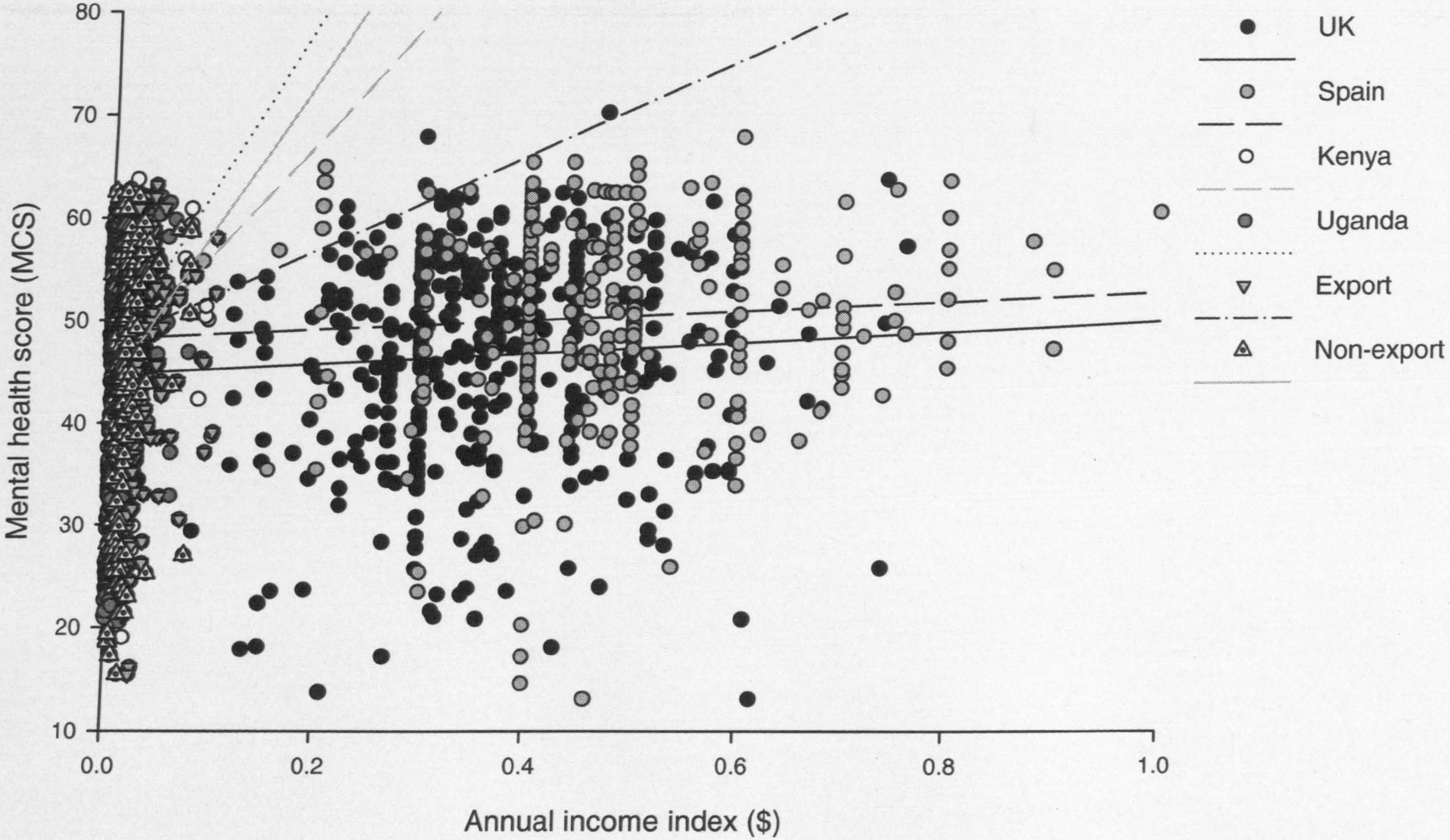


Figure 9.5 Mean MCS score and annual income regression analysis. The top 1% was removed as they were deemed to be outliers. UK y=5.148x + 44.716, $r^2 = 0.0039$; Spain y= 4.517x + 48.184, $r^2 = 0.0048$; Kenya y = 114.545x + 45.066, $r^2 = 0.0265$; Uganda y = 172.281x + 45.895, $r^2 = 0.0309$; Kenya export y = 46.275x + 47.750, $r^2 = 0.0050$; Non-export y = 155.832x + 43.311, $r^2 = 0.0243$

9.4 Discussion

9.4.1 Strengths and weaknesses

This study attempted to characterize the health impact of working on vegetable horticulture farms in four countries. One important weakness in this study was that the health data collection methodology for the UK and Spain differed from that used for the Kenya and Uganda. Respondents in the UK and Spain self-completed the questionnaires whereas in Kenya and Uganda face to face interviews were undertaken due to problems of literacy. A constant concern with face to face interviews is that actual morbidity rates are under-reported because of social desirability bias. Social desirability bias is the tendency of survey respondents to provide socially desirable answers that present themselves in a more positive frame (Hebert et al., 1995). A number of studies have found positive health status and health related quality of life tend to be inflated whilst negative social behaviour such as smoking are tends to be underestimated (Bowling et al., 1999; Brambilla and McKinlay, 1987; Lyons et al., 1999; Perkins and Sanson-Fisher, 1998). However, some studies found no evidence to suggest that survey administration affects results (Durant and Carey, 2000; Fowler et al., 1999; Kaplan et al., 2001; Wu et al., 1997).

Self-administered surveys are thought to have higher non-response rates than surveys using interviews (Bowling, 2005b). The extent to which this may affect the results is unclear although a study by Vink et al., (2004) found that non-responders generally exhibited poorer health through increased levels of anxiety, depression and neuroticism. They were also more likely to smoke and less likely to participate in physical activity such as cycling. The implications for the present study are that whilst face to face interviews in Kenya and Uganda may exaggerate the health status of respondents, the higher non-response rates in the UK and Spain (and the associated poorer health of non-responders) may have served to inflate the sample population mean health scores.

9.4.2 Health scores and population norms

Kenyan export farm workers reported the highest health status of all survey respondents and scored higher than the SF-36 US population norm for eight out of ten scales including the physical and mental component summaries (PCS & MCS). These findings concord with a study in Tanzania that found urban dwellers in Dar es Salaam scored higher than the US population (Wyss et al., 1999). Wagner et al (1999) suggested social desirability bias as an explanation for the higher than US norm scores of the Tanzanians. This does not appear to work as an explanation for the Kenyan results as non-export workers (which represent the majority of farm workers in Kenya) scored significantly lower than the US norm for the physical component summary (PCS) and the same as the US norm for the mental component summary.

If the health status of Kenyan non-export and export farm workers are directly compared then export horticulture appears to significantly improve the health status of its workers. Workers employed on export farms that are regularly audited by a number of organisations and UK supermarkets have access to benefits above increased income. Benefits can include the provision of schooling for employees children, subsidized lunch, housing allowance, health care, subsidized medicine and free transport to and from work.

By contrast the health scores of UK workers aged 18-34 were approximately equivalent to the mean scores of non-export Kenyans (PCS df=749, p=0.12, MCS df=749, p=0.47). They were also lower than the US norms for seven of the ten SF-36 scales including the physical and mental component summaries (PCS & MCS). Mean VAS scores for the UK 18-34 age group were equivalent to those of the 55-64 age group for men and the 65-74 age group for women. Mean scores for the EQ-5D were equivalent to the 45-54 age group for both men and women.

9.4.3 Income and health status

There is an established relationship between poverty levels and income whereby income generally drives health status. Income criteria have an important impact on health status, for instance, persistent poverty is more harmful than periodic episodes; and both income level and reductions in income are significantly related to health (Benzeval and Judge, 2001).

Multiple regression analysis identified income as a potential explanatory variable of health. The relationship between income and physical component summary scores was absent for Spanish workers, weakly positive for Kenyan export and UK workers, but stronger for workers in Uganda. The relationship between income and mental component summary scores was absent for the Spanish and UK workers, weak for Kenyan export and non-export workers and strongest for Ugandan workers. It is interesting to note that the Spanish and UK health scores appear to be independent of income. This implies that any attempt to improve worker health by augmenting income levels for these workers is likely to have a limited effect. By contrast Kenyan and particularly Ugandan workers' health appears to be more sensitive to income. A possible implication being that for every dollar invested in horticulture in Kenya or Uganda will result in a greater increase in health than for a similar investment in the UK or Spain.

The potential for export horticulture to improve the health of workers in Uganda may be even greater than that for Kenya. A partial explanation for the low Ugandan scores can be attributed to the debilitating effects of malaria which, unlike Kenya, was endemic or mesoendemic throughout the survey area. Both income and malaria were important explanatory variables for the physical component ($F_{5,504}$=18.86 p=<0.001, adjusted r^2=0.149) and mental component summary mean scores ($F_{5,504}$=10.633 p=<0.001, adjusted r^2 =0.086). After removing the scores for those Ugandan workers who had experienced a bout of malaria in the three months prior to the survey, physical health scores increased from significantly lower than the US norm (52.74, p=0.007) to almost equivalent to the norm (53.64, p=0.755).

9.4.4 Life expectancy

Improving the health of the rural poor, if only marginally may have long term affects on life expectancy. For instance, self-reported health is increasingly used as a predictor of future mortality rates (Bowling, 2005a; Burstrom and Fredlund, 2001; Idler and Benyamini, 1997; Ringback Weitoft and Rosen, 2005). Many self-reported health questionnaires and surveys include a question that asks respondents to rate their health as very good, good, fair, poor or very poor (the equivalent in the SF-36 is excellent, very good, good, fair and poor). Follow up studies have found that those answering poor or very poor had a subsequent increased risk of mortality compared to those answering good or very good (Singh-Manoux et al., 2007; Wannamethee and Shaper, 1991). In the study by Singh-Manoux et al., (2007) the follow up mortality rate was almost four times higher for the 3.7% of respondents who had described their health as poor or very poor in the initial survey. In a study by Wannamethee and Shaper (1991) there was a more than eight fold increase in the mortality rate at 45 per thousand compared to 5.5 per thousand for those describing their health as good or very good.

In this study Kenyan export workers aged 18-34 rated their general health significantly higher than the UK, Spanish, Kenyan non-export or Ugandan farm workers (df=5, p=<0.001). Of more concern however, is the proportion of respondents describing their health as fair or poor (this equates to poor or very poor on other questionnaires). The proportion of UK, Spanish, Kenyan non-export and Ugandan respondents describing their health as fair or poor ranged between 15 and 18% compared to only 4% for Kenyan export respondents (Fig. 9.6). A potential consequence of a consumer purchasing shift to the local may determine future mortality rates for both those already employed in export horticulture and those who could have entered the market if consumers had purchased from developing countries such as Uganda.

9.4.5 Ethical implications of going local

The comparative advantages of more locally conceived food production systems have been investigated in a number of studies. Reported benefits beyond the food miles issue include social benefits such as increased autonomy and control for various actors within the chain (Morgan and Murdoch, 2000), increased social interaction (O'Hara and Stagl, 2001; Seyfang, 2006; Wells et al., 1999) and claims of improved health for some organic producers (Ellis et al., 2006). Local and local organic food movements appear to be confronted with an ethical dilemma. Promoting local food in terms of increased economic, environmental and social ethics needs to offset the economic, environmental and social benefits in pre-existing producer countries.

9.4.6 Local food and migrant workers

Agriculture is one of the most hazardous industries in the world (Reeves et al., 1999; Shreck et al., 2006; Villarejo and Baron, 1999). Farm worker populations in the UK as in California are dominated by migrant foreign workers (Cross et al., 2008; Shreck et al., 2006). This occupational sub-group are confronted with a number of added difficulties such as language barriers, adequate health care, reduced workers' rights, (Villarejo, 2003). The cost of improving these aspects of social welfare can be prohibitive for small farms. For instance, findings from a survey of organic farmers in California suggested that support for social certification from certified organic farmers was weak and for many financially unviable for both the farmer and farm workers (Shreck et al., 2006).

In this study farm worker self-reported health scores in the UK have been shown to be significantly lower when compared to Kenya export workers and Ugandan scores. The UK scores were also significantly lower than the 1998 US population norms. If these low scores are due to the working conditions in the UK then the degree to which this is ethically permissible needs to be addressed at a policy level. There is an ethical case to be made for the

alternative to local horticultural production which involves exporting UK production to developing countries such as Kenya where the potential is accentuated to improve the day to day health and ultimately increase the life expectancy of workers in these systems.

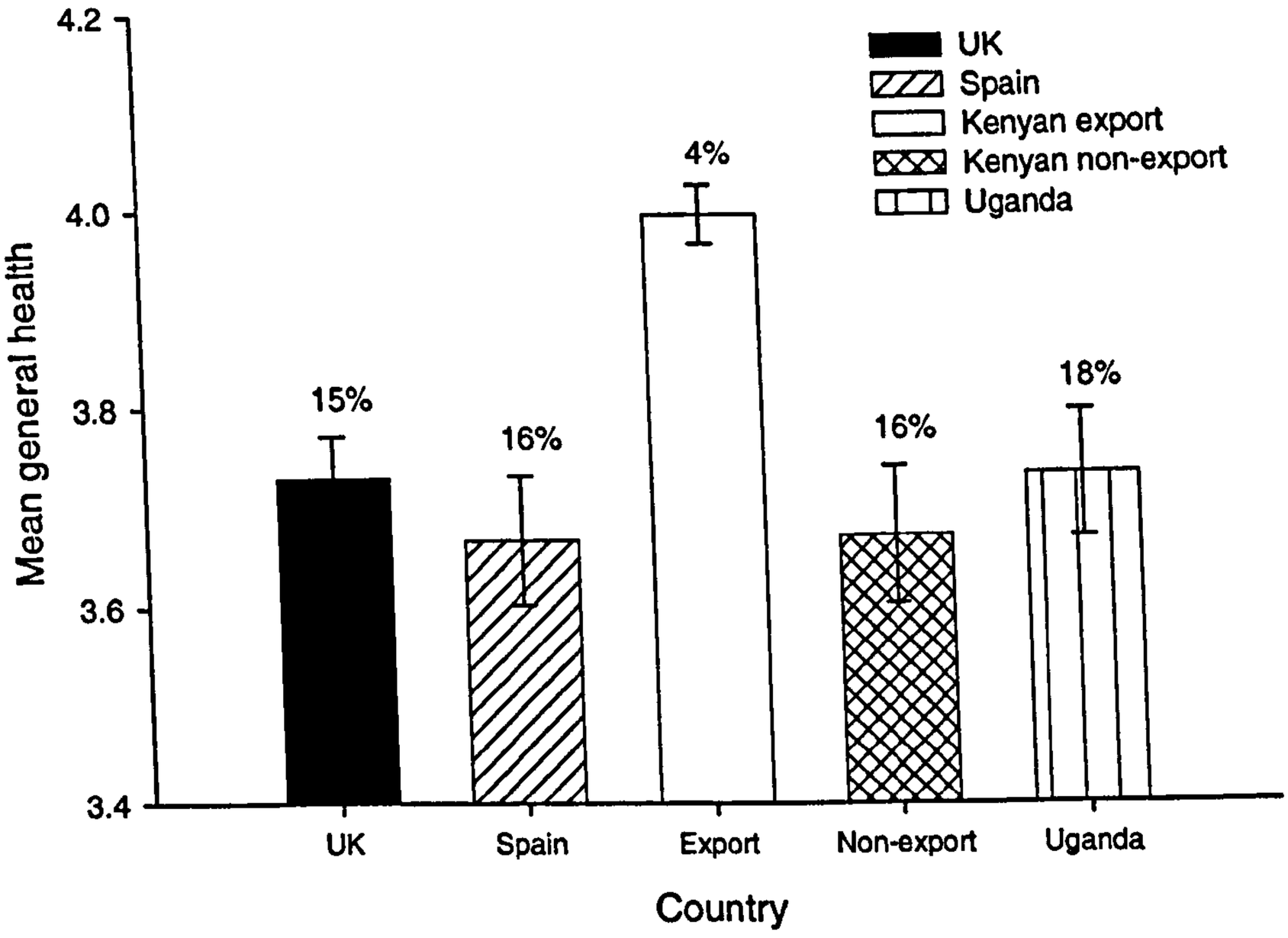


Figure 9.6 Mean general health score for the 18-34 age group by country. Percentages refer to proportion of respondents rating their health as fair or poor

9.5 Conclusion

The sustainability of competing food production systems has tended to focus on the narrow and possibly misleading notion of food miles. More recently, the focus has begun to turn towards the multi-faceted concept of social justice. Health is widely regarded as a component of social justice. This study has attempted to assess the degree of harm befalling workers in spatially separate horticultural production systems. The health consequences for Kenyan workers of a movement in consumer purchasing decisions towards more local produce were evaluated by comparing the health status of export workers with non-export workers. Export workers had highly significant better health than their non-export colleagues. This in turn has allowed the quantification of a tangible aspect of development and has demonstrated that export horticulture benefits those living in poverty. Poverty here is understood as a 'failure to reach some absolute level of capability' (Sen, 1983). Consumers and policy

makers confronted with the decision of sourcing vegetable produce might be advised to buy from wherever is poorest rather than wherever is nearest.

Chapter 10

Pesticide hazard and farm worker health

10.0 Abstract

Changing trends in vegetable production in the UK have resulted in increasing levels of vegetable imports. As the trend in production shifts from the UK to overseas producers there may be a corresponding change in pesticide hazard in supplier countries. If pesticide hazard increases in producing countries then the workers on those farms may be subjected to increased hazard. This study describes the relationship between the self-reported health scores and relative pesticide hazard of farm workers in the UK, Kenya and Uganda. Pesticide hazard ratings for both the farm worker and consumer were lower for Kenyan export farms than UK farms. There was no significant relationship between farm worker health and farm pesticide hazard in any of the four countries. Increased pesticide hazard in Uganda was significantly correlated with farm worker health scores. Subsequent analysis revealed that the pesticide hazard rating acted as a proxy for annual income. Wealthier farmers owned larger farms which in turn grew more crops requiring pesticides. Increased income is related to increased health scores. Relative pesticide hazard ratings for both the farm worker and the consumer category in this study suggest that policy makers should consider exporting pesticide hazard from the UK to Kenya.

10.1 Introduction

Increasingly, consumers, food movements and the society at large are seeking the reduction of pesticides in food production (Beaumont, 1993; Freidberg, 2003; Pretty and Hine, 2005). In recent years the trend in UK grown horticultural vegetable production volumes has declined at an approximately corresponding rate to which vegetable imports have increased (DEFRA, 2005). If this trend continues then the overall UK pesticide related hazard will also decrease because if overseas vegetable production continues to increase then it can be expected that there will be a corresponding increase in overseas pesticide hazard. The UK will have effectively exported their pesticide hazard. If the pesticide hazard increases in exporting countries then the impact on farm worker health may also increase.

The majority of the effects of pesticide intoxication are acute, short-term and relatively benign whilst others can be fatal and/or long-term (Pretty and Hine, 2005; Wilson and Tisdell, 2001). The acute effects on human health of pesticides such as organophosphates have been well documented (Farahat et al., 2003; Fiedler et al., 1997; Stephens et al., 1995; Tahmaz et al., 2003). By contrast the long-term, chronic effects of pesticide poisonings are more difficult to determine (Sandborn et al., 2004).

There are a number of methodological issues relating to data collection in pesticide studies that render poisoning causality problematic. For instance, a number of pesticides are used in conjunction with other substances. Determining which of the substances was responsible for subsequent poisonings has tended to be intractable (Kishi, 2005). Poisoning causality can also be difficult to determine as a result of the study methodology employed (Sandborn et al., 2004). For example, whilst cohort studies benefit from the large number of participants that can be typically included in a study they also suffer from a number of limitations. Firstly, large samples are inherently difficult to obtain details of exposure histories. To circumvent this problem a number of proxies have been used such as crop type grown or on farm pesticide expenditure. Unfortunately in a large number of studies covariate

information such as smoking, family medical history and ethnicity are frequently missing. Secondly, the healthy worker effect is also thought to influence results. Workers suffering illness are both less likely to remain in employment and more likely to be absent during employment and are consequently absent from studi es that use general population data as a control (Atis et al., 2005; Li and Sung, 1999; van Maele-Fabry and Willems, 2003). Thirdly, farmers are known to be healthier than other workers in a population irrespective of their pesticide exposure because they lead healthier lifestyles and areexposed to less air pollution (Sandborn et al., 2004; van Maele-Fabry and Willems, 2003). An alternative to conventional methods for assessing poisoning symptoms in study populations might be to measure the quality of life of workers and place it within the context of their environmental pesticide hazard.

Pesticide related fatalities are a very rare occurrence in both the US and UK with one or less fatalities occurring per decade (Pretty and Waibel, 2005). This is far less than the number of people who die each year from work related accidents in farming, forestry and agriculture (HSE, 2005). By contrast pesticide poisonings and related fatalities are much more widespread in developing countries (Jeyaratnam, 1990) and is disproportionate to the number of people working in agriculture (Dinham, 2005; Karlsson, 2004). In Kenya for example it has been estimated that during the 1990's approximately 350,000 people in agriculture suffered a pesticide related poisoning and approximately 700 died annually (Karlsson, 2004; Kimani and Mwanthi, 1995). Possible links have also been made between pesticide use and inhibition of acetyl-cholinesterase activity (Ohayo-Mitoko et al., 1999; 2000).

The high rate of poisonings in developing countries can be attributed to a number of causes. Firstly, pesticide intoxication is the commonest method of both self-harm and suicide, accounting for approximately 60% of all suicides in Asia (Eddleston et al., 2002; Joseph et al., 2003; Konradsen et al., 2003). Secondly, spray applicators in developing countries often work in hot conditions making the wearing of protective clothing uncomfortable. In a study in Cameroon, 85% of pesticide sprayers rarely or never wore protective

clothing and this appears to be a common practise in other developing countries (Matthews et al., 2003). Thirdly, workers often have low levels of literacy and are unable to read the instructions on pesticide packets (Wesseling et al., 1997). Finally, pesticides are often stored in parents' bedrooms or food stores and frequently handled by both women and children (Kimani and Mwanthi, 1995).

Whilst much is known about the acute and chronic effects of pesticides, little is known regarding the impact that such chemicals have upon farm workers' quality of life. It is unknown to what extent healthier lifestyles might compensate for increased pesticide hazard and whether farm workers report differing levels of health based upon the pesticide toxicity environment within which they work. This study investigated the relationship between the environmental impact of pesticide use and farm worker health status at both the farm and country level.

10.2 Methods

See chapters 2 & 3 for the methodology concerning the environmental impact of pesticide use, and chapter 5 for the methodology for farm worker health data collection in each of the study countries.

Supplementary data relating to acute pesticide poisoning events was collected from questions included in the original questionnaire. Respondents were asked if they had suffered any of the following symptoms in the seven previous days: headaches, nausea, vomiting, fatigue, aching joints, blurred vision, flu-like symptoms. Respondents were provided with four possible responses for each of the symptoms: never, rarely, sometimes and often. The subsequent data from both the self-reported health section and the pesticide symptoms section were explored using correlation analysis.

The mean EIQ scores from the 2003 survey of the UK were used as a baseline comparator for all participating farms and countries in the study (see Chapter 2).

10.3 Results

10.3.1Sample description

Health data were compiled from a total of 2073 completed questionnaires collected from individual farmers and farm workers in the UK (607), Kenya (893) and Uganda (573) during 2006 and 2007. The corresponding pesticide data was supplied by either individual farmers or the pesticide department of the large farms in the survey. No Spanish farms supplied pesticide data. Pesticide usage data was obtained from three large farms in the UK, one large farm in Kenya and sixty-two small farms in Uganda.

10.3.2 Mean EIQ and EI/ha^{-1} by country

The mean EIQ score for UK 2006 survey farms was 1.26% lower than the baseline UK national mean of 2003 (the UK 2003 pesticide usage results are here used as a baseline against which subsequent results can be compared) (Fig. 10.1). The Kenyan data was 17% greater than baseline whilst Uganda was almost 70% greater than baseline. The UK, Kenyan and Ugandan mean farm worker and consumer component EIQ scores were lower than the 2003

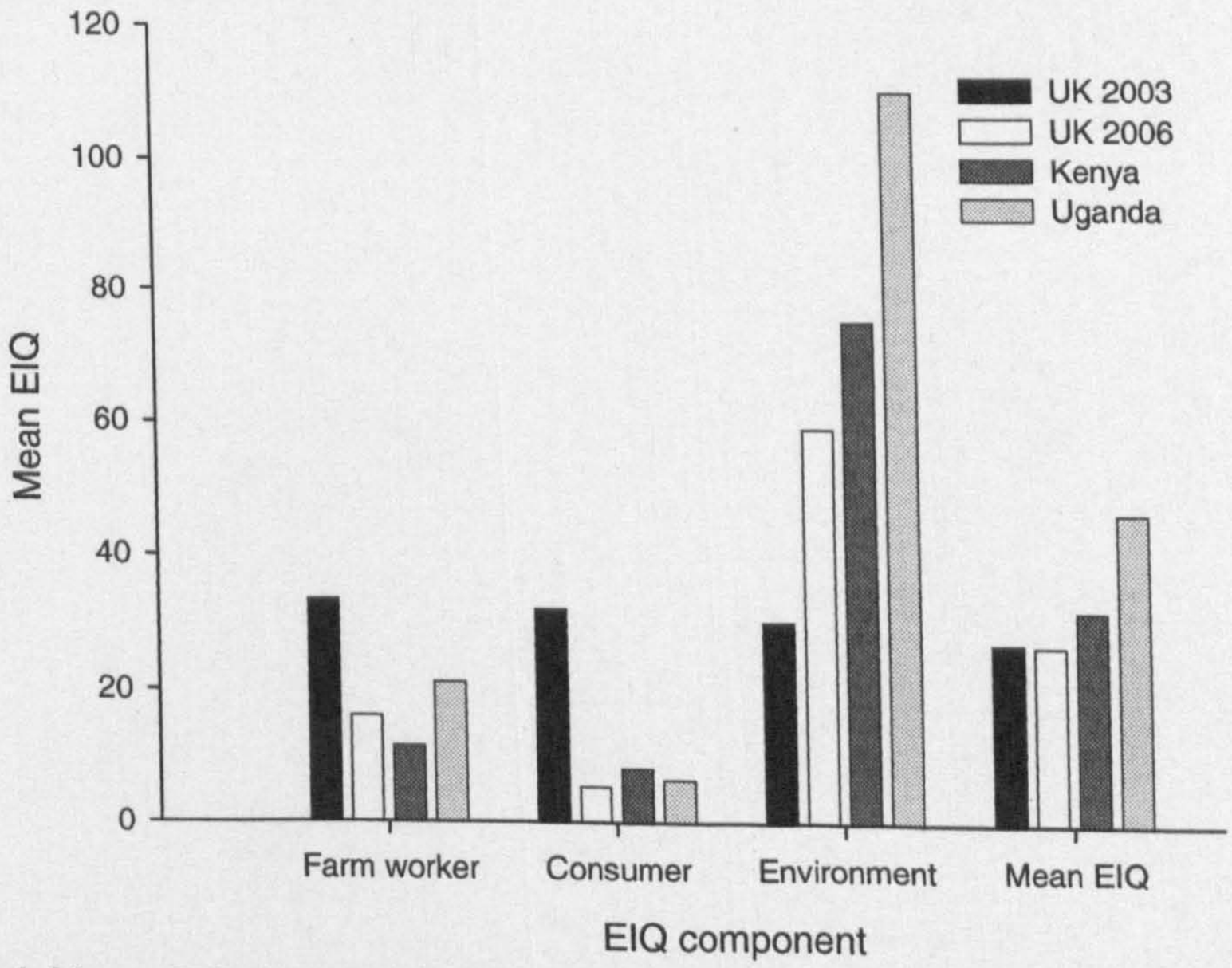


Figure. 10.1 Mean EIQ scores for the UK, Kenya and Uganda. The 2003 baseline data refers to the UK pesticide usage survey and is calculated by dividing the total environmental impact score by the total spray area .

baseline.

However, the environmental component EIQ scores for the UK, Kenya and Uganda were greater than baseline by 96%, 150% and 267% respectively.

The mean environmental impact per hectare for UK 2006 survey farms was 53% greater than the 2003 baseline (Fig.10.2). The Kenyan and Ugandan data were 24% and 28% greater than baseline respectively. The UK, and Ugandan mean farm worker scores were almost 60% higher than baseline whilst Kenyan scores were approximately 22% lower. The environmental component scores for the UK, Kenya and Uganda were greater than baseline by 55%, 121% and 147% respectively.

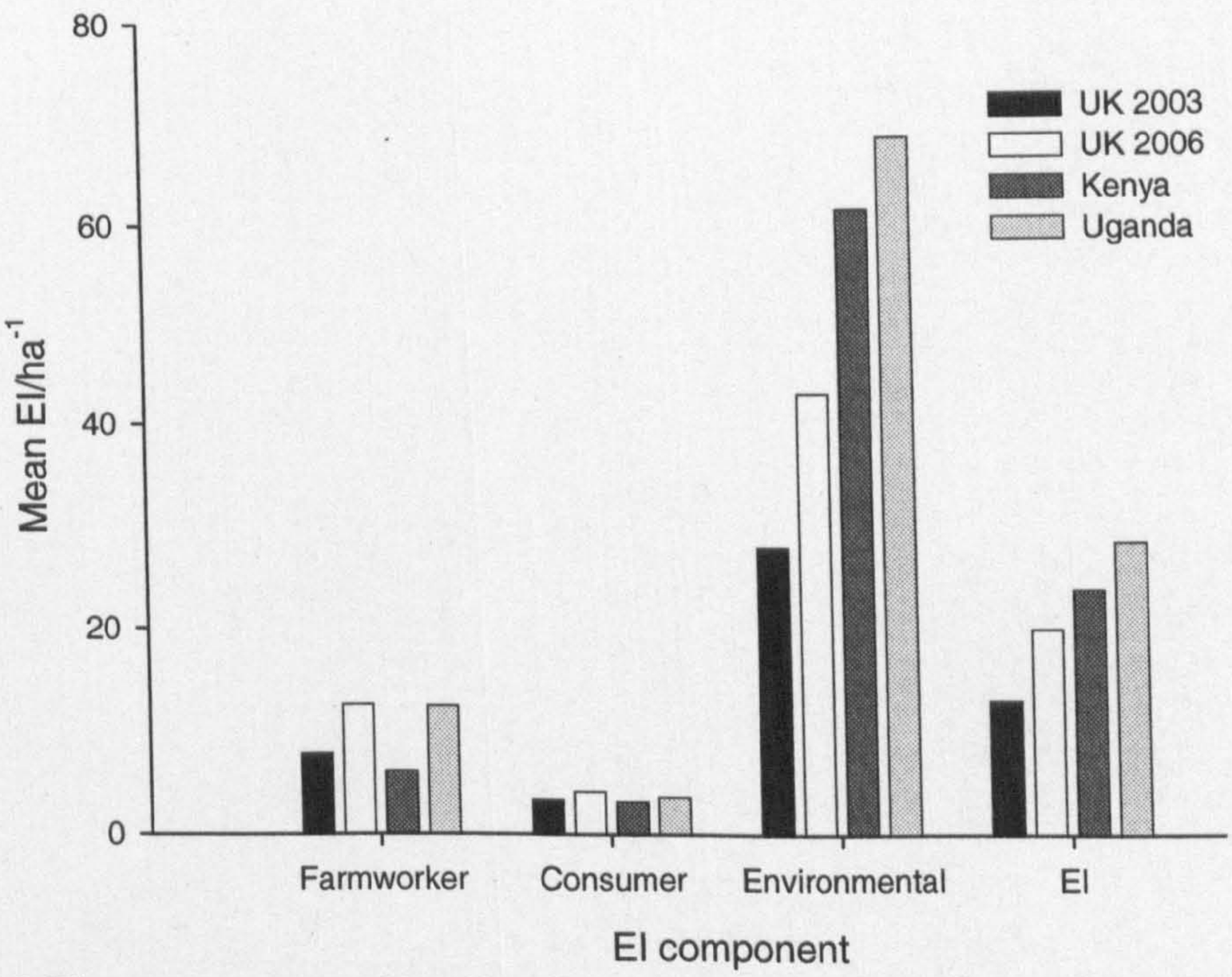


Figure. 10.2 The mean environmental impact per hectare for surveyed farms in the UK, Kenya and Uganda

10.3.3 Correlations between self-reported health and pesticide environmental impact

Uganda provided the greatest number of individual farm pesticide details. No such data was collected on Kenyan non-export farms. The consumer component toxicity rating was significantly positively correlated with the occurrence of both headaches and fatigue in farm workers (Table 10.1). However, with 40 correlations at least two would be expected to be significant

due to random chance. There were significant correlations between three of the pesticide toxicity ratings and physical component scale scores (physical functioning (PF), bodily pain (BP), general health (GH) and the physical component summary (PCS)) (Table 10.2).

Table 10.1 Pearson correlation coefficients for Ugandan environmental impact components, age and annual income and a range of symptoms associated with pesticide poisonings

	headaches	rash	nausea	vomiting	fatigue	joints	vision	flu
age	0.07	0.13	0.05	0.19	0.20	-0.08	-0.33**	0.16
income	0.22	0.01	0.03	0.06	0.34**	0.18	0.22	0.34**
worker	0.24	0.14	0.03	0.12	0.22	0.07	<0.01	0.23
consumer	0.26*	0.15	-0.02	0.14	0.27*	0.12	0.16	0.25*
environment	0.21	0.14	0.01	0.14	0.20	0.11	0.16	0.21
EI	0.22	0.15	0.01	0.14	0.21	0.11	0.13	0.22

*p=<0.05 n=60-62, ** p=<0.01

Table 10.2 Pearson correlation coefficients for Ugandan environmental impact components, age, income and respondents' SF-36 scale mean scores

	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
age	-0.10	0.04*	0.04	-0.07	-0.03	0.10	-0.08	0.02	0.01	-0.02
income	0.23	0.31*	0.33**	0.41**	0.32*	0.20	0.19	0.27*	0.36**	0.25
worker	0.22	0.04	0.17	0.22	0.17	0.14	0.06	0.14	0.16	0.12
consumer	0.22	0.12	0.23	0.34**	0.24	0.18	0.14	0.20	0.22	0.20
environment	0.29*	0.17	0.26*	0.32**	0.21	0.21	0.16	0.22	0.26*	0.20
EI	0.28*	0.15	0.25*	0.31*	0.21	0.21	0.14	0.21	0.25	0.19

*p=<0.05 n=60-62, ** p=<0.01

The relationship between these variables was further explored to assess the degree to which the self-reported health of Ugandan pesticide applicators differed from that of the general farm worker population. There were no significant differences in SF-36 mean health scale scores between sprayers and non-sprayers with the exception of the social functioning scale (SF) (Table 10.3).

Table 10.3 Comparison of SF-36 mean scale scores for Ugandan sprayers and non-sprayers (Mann-Whitney U test)

	Sprayers	n	sd	Non-sprayers	n	sd	*p*
Age	43.45	62	10.22	36.89	504	14.32	<0.001
PF	53.60	62	4.93	52.80	504	6.62	0.613
RP	45.16	62	12.55	45.12	504	12.31	0.825
BP	52.99	62	9.61	50.22	504	11.92	0.143
GH	52.17	62	9.27	49.68	504	10.91	0.133
VT	49.60	62	8.65	50.13	504	10.60	0.441
SF	54.74	62	5.85	49.69	504	9.77	<0.001
RE	47.83	62	13.13	45.46	504	13.81	0.136
MH	48.10	62	10.20	48.00	504	11.70	0.786
PCS	52.12	62	8.10	50.79	504	9.01	0.295
MCS	48.77	62	8.92	46.95	504	11.35	0.547

As the majority of sprayers were male and Ugandan male health scores were significantly higher than Ugandan females, the analysis was repeated but controlled for gender. There were no significant differences in age between either male sprayers and non-sprayers or female sprayers and non-sprayers (Table 10.4). There were no significant differences between male sprayers and non-sprayers or female sprayers and non-sprayers for any of the pesticide symptoms or mean SF-36 scale scores.

Table 10.4 Comparison of pesticide symptoms for Ugandan farm workers

	Males							Females						
	Sprayer			Non-sprayer				Sprayer			Non-sprayer			
	Mean	n	sd	Mean	n	sd	*p*	Mean	n	sd	Mean	n	sd	*p*
Age	36.11	190	13.12	37.86	83	16.20	0.713	38.24	79	11.30	38.72	206	15.07	0.689
Headaches	1.96	189	1.06	1.86	83	1.11	0.383	2.19	78	1.16	2.35	205	1.24	0.363
Skin rash	1.16	187	0.58	1.17	82	0.56	0.657	1.23	78	0.62	1.14	206	0.46	0.218
Nausea	1.25	186	0.65	1.32	82	1.20	0.789	1.44	75	0.76	1.37	206	0.78	0.247
Vomiting	1.09	187	0.36	1.06	83	0.33	0.448	1.13	77	0.41	1.10	205	0.42	0.161
Fatigue	2.67	189	1.17	2.61	83	1.14	0.635	3.00	77	1.12	2.98	201	1.14	0.853
Allergy	1.30	189	0.72	1.25	81	0.62	0.792	1.53	77	0.84	1.40	206	0.86	0.057
Sore joints	1.94	188	1.14	1.85	82	1.07	0.702	2.19	78	1.17	2.44	206	1.25	0.123
Vision*	1.39	189	0.87	1.48	82	0.97	0.713	1.96	78	1.21	1.76	206	1.12	0.224
Flu**	1.77	185	1.07	1.70	82	1.05	0.506	2.00	75	1.25	2.16	206	1.21	0.318
SDHS	12.23	190	4.00	12.11	82	3.82	0.752	10.79	78	3.56	10.50	206	3.50	0.522
EQ5D	0.85	190	0.17	0.81	83	0.24	0.620	0.75	79	0.23	0.70	206	0.28	0.515
VAS	78.21	188	16.60	76.33	80	19.47	0.674	65.96	79	17.06	67.83	206	17.75	0.437
PF	54.69	190	5.12	54.11	83	4.41	0.101	50.23	79	9.41	51.66	206	6.40	0.463
RP	48.18	190	11.29	48.56	83	11.51	0.762	41.38	79	12.04	42.03	206	12.64	0.731
BP	54.19	190	9.82	53.34	83	11.46	0.893	47.24	79	11.45	47.06	206	12.27	0.944
GH	53.36	190	9.28	52.74	83	9.24	0.550	47.69	79	9.82	46.49	206	11.77	0.714
VT	51.86	190	9.89	52.40	83	9.58	0.643	49.34	79	8.83	47.67	206	11.22	0.216
SF	52.20	190	8.59	51.30	83	8.70	0.219	48.67	79	9.41	48.59	206	10.40	0.752
RE	47.21	190	13.22	47.56	83	13.06	0.832	44.64	79	13.65	43.85	206	14.42	0.782
MH	49.66	190	11.72	51.65	83	10.73	0.235	46.99	79	10.14	45.44	206	11.73	0.331
PCS	54.19	190	7.17	53.16	83	8.16	0.248	47.31	79	9.30	48.23	206	9.29	0.557
MCS	48.34	190	11.05	49.53	83	10.74	0.379	47.02	79	9.36	45.14	206	11.71	0.380

* Respondents were asked if they experienced blurred vision. Four possible answers were available (never (1), rarely (2), sometimes (3) and often (4)) with never being coded as 1 and often coded as 4. ** Respondents were asked if they experienced flu-like symptoms

The positive correlations between pesticide hazard ratings and health scale scores (Table 10.2) did not appear to be explicable in terms of differing pesticide exposure categories (Table 10.3, 10.4). Further regression analysis revealed that total environmental impact (EI) pesticide hazard ratings and annual income (expressed in US dollars) were positively and highly significantly related (r^2=0.5458, F=35.462, p=<0.001). A quadratic regression line was fitted to the data using the equation $y=0.00000799x^2 + 0.0359x + 45.8025$ (Fig. 10.3).

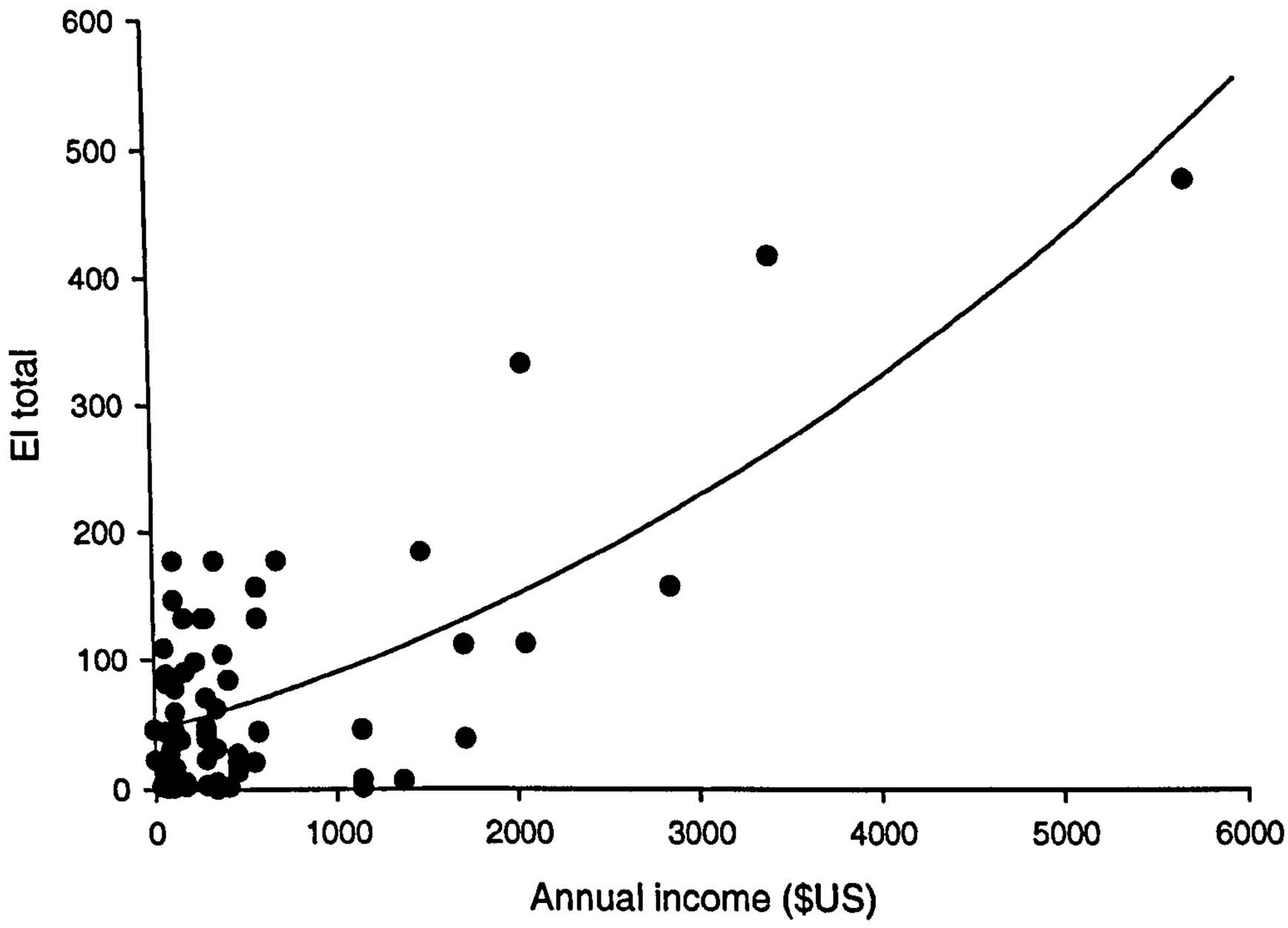


Figure 10.3 Ugandan farmer's individual income and the total environmental impact (r^2= 0.5458, Anova F=35.462, p=<0.001). A quadratic line was fitted to the data $y=0.00000799x^2 + 0.0359x + 45.8025$

The mean pesticide environmental impact rating for each of the survey farms was plotted against both the farm workers mean physical and mental component summary score (PCS & MCS) (Fig. 10.4 & 10.5). Regression analysis revealed no significant relationship between either the PCS (F=1.687, p=0.199) or the MCS (F=0.509, p=0.478) and farm mean pesticide environmental impact.

To evaluate the effects on farm workers the mean field worker impact rating for each of the farms was similarly plotted against both the mean physical and mental component summary scores (PCS & MCS) (Fig. 10.6 & 10.7). Regression analysis revealed no significant relationship between either the PCS (F=1.174, p=0.283) or the MCS (F=0.447, p=0.506) and farm mean pesticide environmental impact.

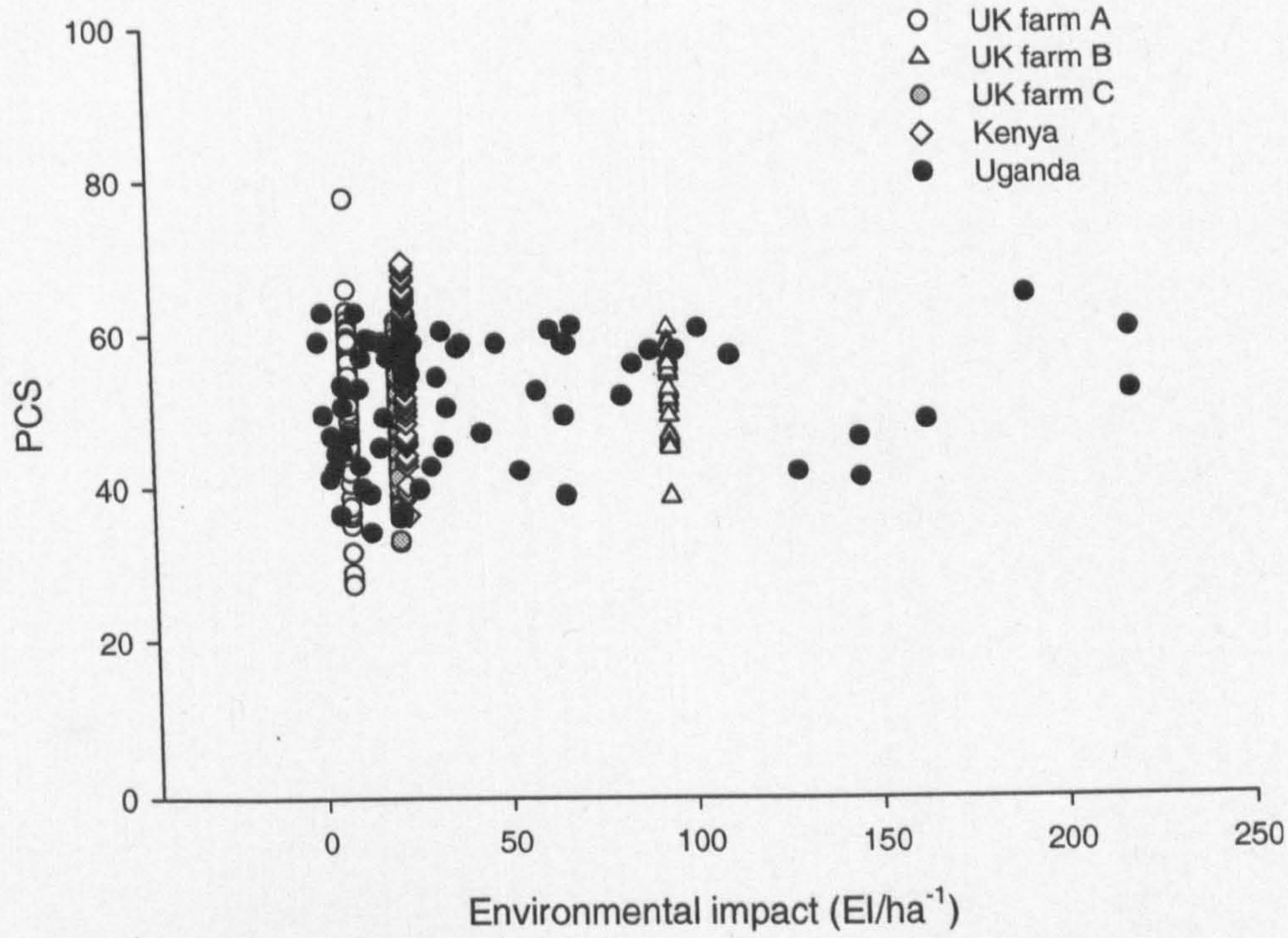


Figure 10.4 Environmental impact per hectare (EI/ha^{-1}) of on farm pesticide use and Ugandan farm worker's self-reported physical health score (PCS) (Anova F=1.687, p=0.199)

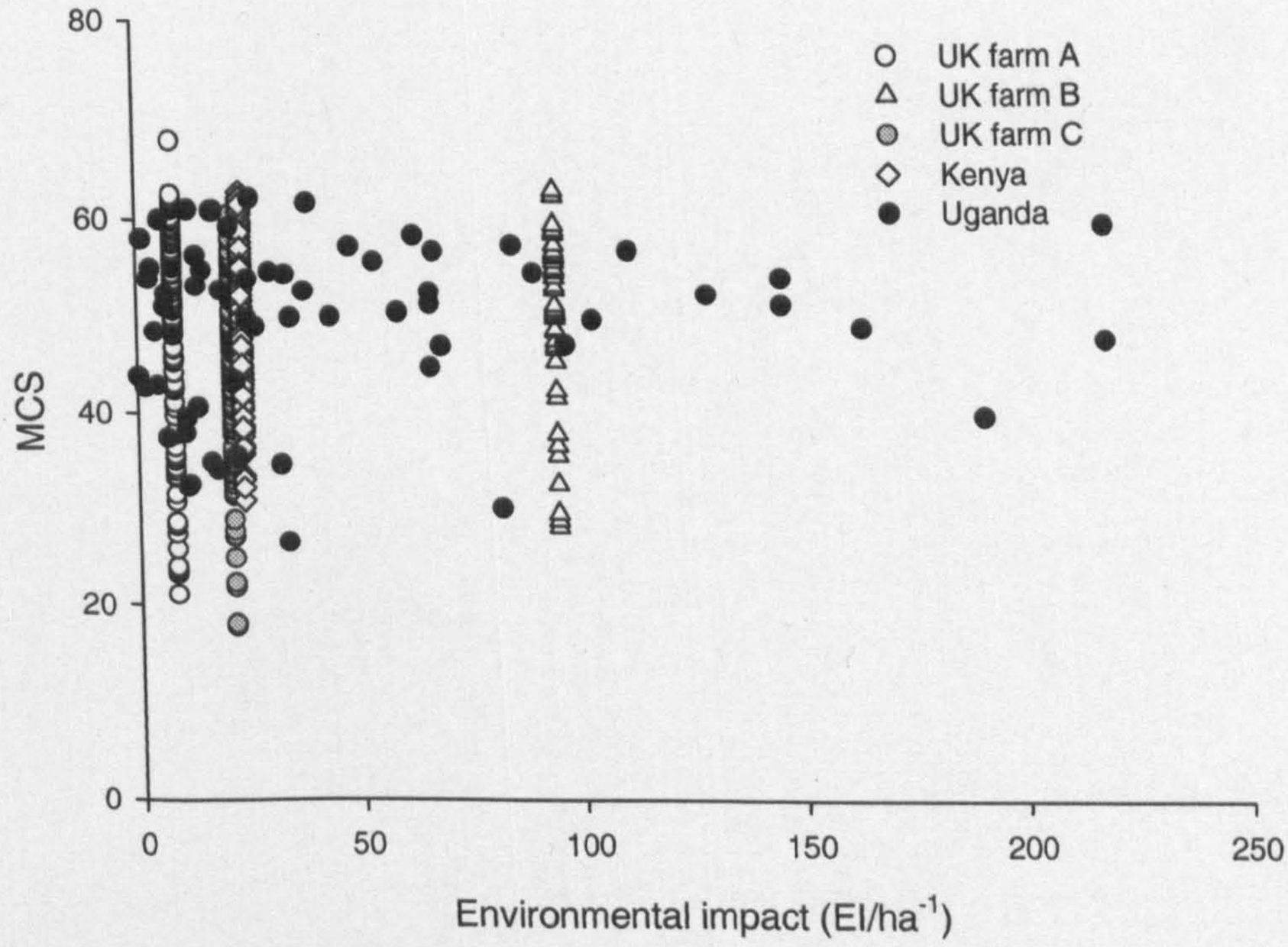


Figure 10.5 The environmental impact per hectare (EI/ha^{-1}) of on farm pesticide use and Ugandan farm worker's self-reported mental health score (MCS) (Anova F=0.509, p=0.478)

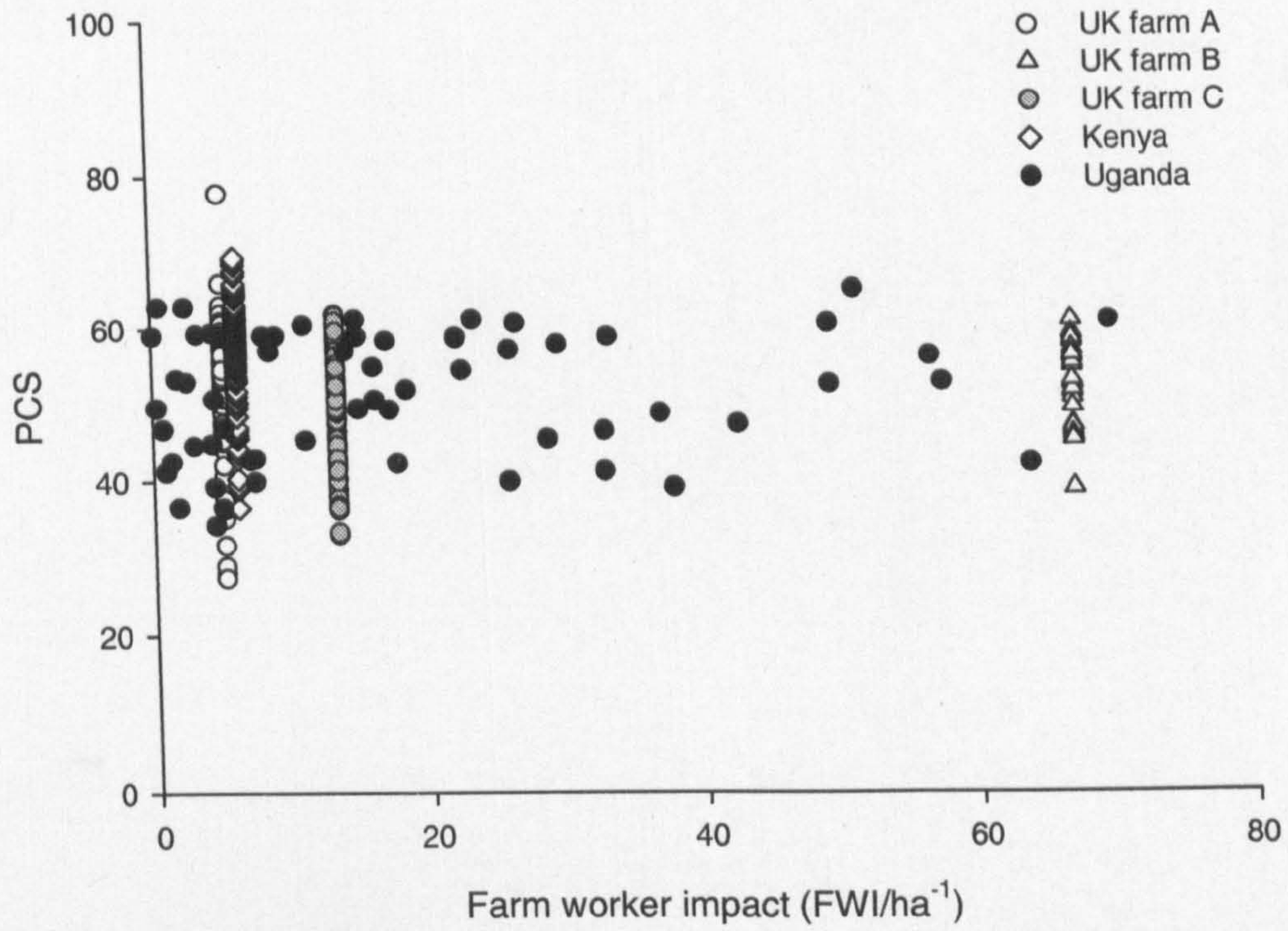


Figure 10.6 Farm worker rating per hectare (FWI/ha^{-1}) of on farm pesticide use and farmers' self-reported physical health score (PCS) (Anova F=1.174, p=0.283)

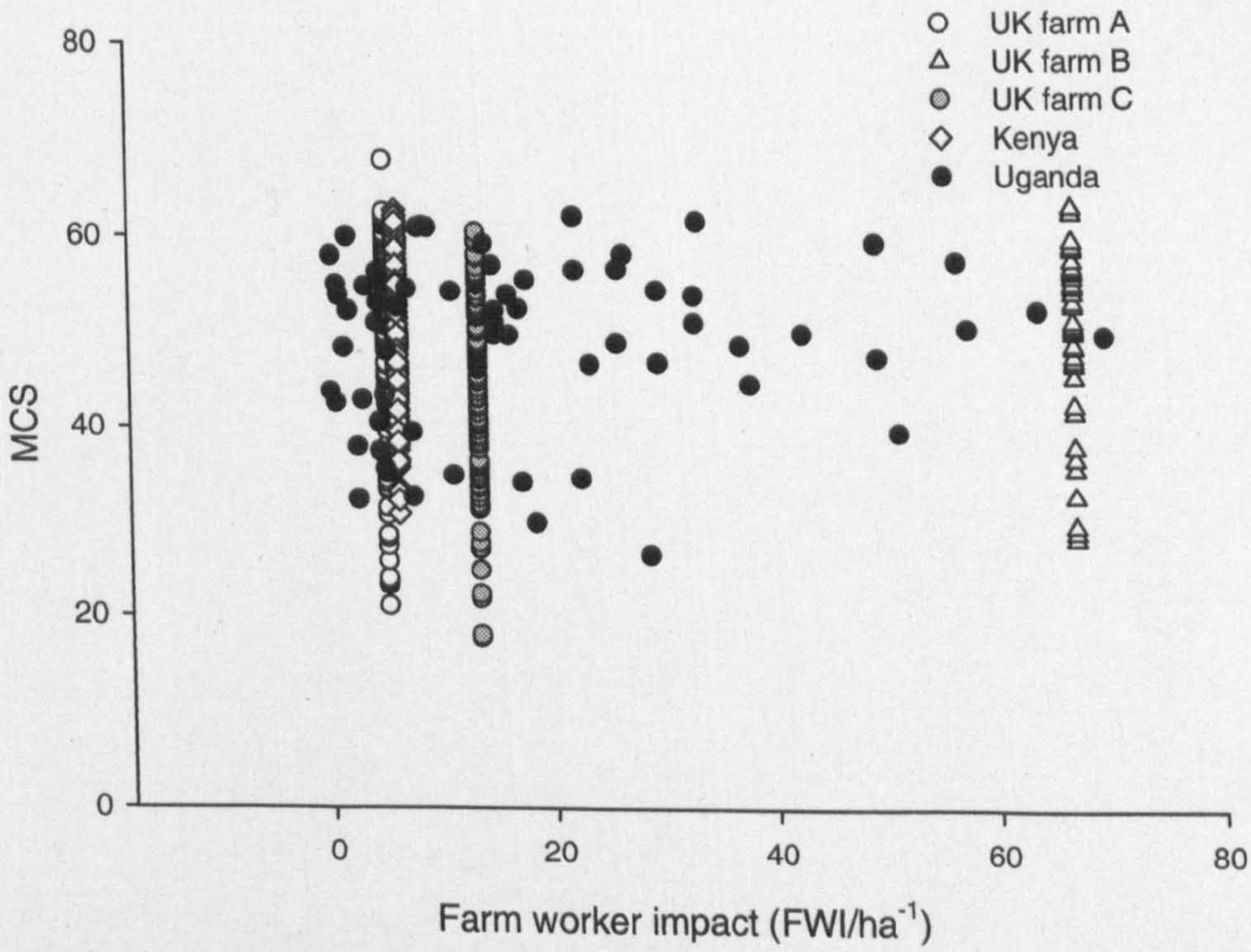


Figure 10.7 Farm worker rating per hectare (FWI/ha^{-1}) of on farm pesticide use and farmers' self-reported mental health score (MCS) (Anova F=0.447, p=0.506)

10.4 Discussion

10.4.1 Methodological issues

Data collection

This study suffers from a number of practical and conceptual weaknesses. Firstly, pesticide usage data collection was dependant upon the relative benevolence of participating farms. Large farms in all participating countries demonstrated varying degrees of reticence when asked to provide records of pesticide usage. This was particularly the case in Spain where pesticide issues appeared to provoke wariness in farm managers, possibly as a result of findings from studies related to organochlorines (Botella et al., 2004; Carreno et al., 2007). It is therefore possible that farm managers provided data only if they perceived their pesticide usage as commensurate with good practice.

Between farm and between country comparisons of farm pesticide usage data were problematic as farms and countries did not always grow the same crops. For instance, a Kenyan farm growing French beans may have a different pesticide usage profile compared to a UK farm may growing lettuce. The pesticide requirements for these two crops differ and consequently so does the pesticide hazard rating, although this does not affect the relationship to health.

The use of the environmental impact per hectare (EI/ha^{-1}) may suffer from a conceptual problem in its calculation. Annual vegetable volume was not readily available for each and every farm. As a consequence the environmental impact per hectare was not calculated as in the studies by Cross and Edwards-Jones (2006a; 2006b) which divided the total environmental impact rating by the total area grown of crops. Rather it was necessary to divide the total environmental impact rating by the total spray area. Total spray area includes repeat spraying and will underplay the environmental impact. For example, if two farmers both cultivate a hectare of vegetables each and farmer A applies 1kg of a pesticide on five occasions with an EIQ rating of 25 and farmer B applies 1kg twice then their respective

EI/ha^{-1} will be as follows:

$$\text{Farmer A} = (1\text{kg}*5 \text{ applications}*25)/5\text{ha}^{-1} = 25$$
$$\text{Farmer B} = (1\text{kg}*2 \text{ applications}*25)/2\text{ha}^{-1} = 25$$

Thus, whilst farmer A has applied five times the quantity of pesticide of farmer B, both farmers have the same environmental impact.

In this study pesticide related acute ill-health was implicitly explored by collecting information describing a number of pesticide poisoning symptoms. Individual data was complete only for Uganda. Results suggest there were no significant differences between sprayers and non-sprayers in Uganda. However, a number of pesticide poisoning symptoms are typical of a range of other prevalent illnesses in Uganda. For instance, early symptoms of malaria could include all of the following headaches, nausea, vomiting, fatigue, aching joints, blurred vision, flu-like symptoms. Malaria had affected 37% of the sample population in Uganda and consequently would tend to mask pesticide poisoning symptoms.

Equivalent data in the UK, Spain and Kenya was available only as aggregated farm data based upon two categories of job description (field worker or pack house worker). As a consequence explicit farm worker exposure histories were not recorded. The lack of significant difference between sprayers and non-sprayers supports similar findings in a study by Cross et al (2008) that used the same questionnaire to compare the health status of farm workers on conventional and organic farms in the UK.

At first glance the positive correlation coefficients and their statistical significance reported in Table 10.2 appear to be counterintuitive. With increasing ratings for pesticide hazard (increased quantities of pesticide) there was a corresponding increase in the farmers' health scores (indicating improving health). However, further investigation revealed no statistically significant differences between sprayers and non-sprayers even after controlling for gender. Pesticide hazard ratings (of which area sprayed is a

function) were strongly related to farmer annual income and appeared to be a surrogate for income. Ugandan health scores are strongly dependant upon annual income (see chapter 8) and annual income appears to be related to farm size. In turn, the larger the farm the greater the quantity of crops that can be grown. More crops require more pesticides and increased pesticide use on a farm will increase the farm hazard rating which is positively correlated with annual income as demonstrated in Table 10.2.

This study found no relationship between a farm's total environmental impact and either the farmer/farm workers' self-reported health score or the incidence of pesticide symptoms. To detect a relationship between possible pesticide symptoms and pesticide hazard ratings required more sensitive and detailed data collection. Sufficiently detailed exposure history was not obtained by aggregating respondents into two exposure groups (field and pack house worker).

Pesticide usage presents an explicit and acute hazard to workers' daily lives that is absent or diffuse for the remainder of the population. The mean farm worker hazard rating per spray hectare was lowest for Kenya but approximately double for the UK and Uganda (Fig. 10.2). A shift in production away from the UK to Kenya might be expected to decrease the level of hazard by half. If we assume that the current Ugandan pesticide hazard is similar to non-export farms in Kenya (data is missing for the latter) then adopting the Kenyan export model, a shift in production from the UK to Uganda could simultaneously reduce the hazard level in both the UK and Uganda.

The different pesticide hazard scenarios that might result from consumer driven changes in vegetable supply chains raise some complex policy and ethical issues. For instance, academic research has tended to focus on the hazard posed to workers in developing countries as the number of pesticide intoxications in developing countries is much higher than in developed countries (Karlsson, 2004). However, given the relative pesticide hazard ratings reported in this study it may be beneficial to both the farm worker and the consumer to export pesticide hazard from the UK to Kenya and ultimately

Uganda. Kenyan farm worker hazard ratings were 51% lower than the UK whilst Kenyan consumer hazard ratings were 24% lower. Whilst the corresponding Kenyan environmental hazard ratings are much higher than the UK the direct health benefits to farm workers of decreased pesticide hazard need to be evaluated within the context of the indirect dis-benefits that would accrue to all humans as a result of increased environmental hazard.

Kenyan export farms are regularly audited by the UK supermarkets they supply, the Fair Trade Organisation, the Soil Association (if the farm grows organic produce and wishes to be accredited as an organic grower) and umbrella organisations such as EUREP-GAP (European Retailers Protocol for Good Agricultural Practice). The potential for acute poisoning incidents to occur on export oriented farms should be diminished when compared to smaller non-export farms that are not subjected to such stringent controls.

Chronic pesticide poisoning may still pose a threat to farmer health and long-term sustainability. However, research has shown that there is tangible compensation in the form of healthier lifestyles and reduced air pollution (compared to urban dwellers) (Sandborn et al., 2004; van Maele-Fabry and Willems, 2003. Evaluating the extent to which improvements in farm worker health status, due to export horticulture, compensates any changes in pesticide hazard may be problematic. Ethical issues with respect to pesticide risk may need to be addressed. Consumers wishing to make ethical purchases may need to consider the pesticide environment and harm to which farm workers are subjected as a consequence of consumer purchasing decisions. Policy makers may be required to determine the degree to which the UK is responsible for any pesticide related harm that befalls workers employed on farms producing for the UK.

Chapter 11

General discussion

11.0 General Discussion

This thesis has explored the importance of a variety of aspects that are thought to influence farm worker well-being. The overriding objective of the investigation was to compare the health, well-being and ethical implications FOR farm workers working on farms in different countries who supply to the UK market. This was achieved through the collection of farm worker data in four study countries using self-reported health questionnaires. Pesticide use data was also collected for two purposes. Firstly, to facilitate a description of the ambient pesticide toxicity within which employment takes place and secondly, to assess the relationship of a given environmental toxicity setting to the workers' self-reported health status. This study offers an original set of measured on-farm evidence and is unique in its methodology of evaluating the health status of farm workers by asking the workers themselves to indicate how they felt.

This study had five principle objectives:

i. To assess the health and well being of farm workers in UK vegetable production.
ii. To compare the health of UK farmers with farmers from other countries supplying similar products to the UK market.
iii. To explore the potential impact of pesticides on farm worker health, both at the policy and farm level.
iv. To identify major causes of poor health (where it occurs) and identify its determinants.
v. Consider the ethical implications of supplying to the UK horticulture market from production in developing countries.

The first objective was accomplished and described in Chapter 6. The second objective was met and described in Chapters 8 and 9. Objective three comprises two components, the policy level and farm level. The policy level data for the environmental impact of pesticide use in the UK is described for vegetable production in Chapter 2 and for arable production in Chapter 3.

Chapter 10 then explored the impact of pesticide use on farm workers in the UK, Kenya and Uganda. The fourth objective to identify causes of poor health is intrinsic to the discussion sections of Chapters 6 and 7 for the UK and Chapter 8 for Kenya. Finally, the ethical implications of export horticulture for developing countries were explored in Chapter 4.

The various food debates can often be reduced to concerns about human health. A recurring concern in the public domain relates to the effects of pesticide use on human health. By focussing on sustainability solely in terms of presence or absence of pesticides as the organic movement has done, oversimplifies a complex debate. The debate needs to take account of other factors that influence human health (particularly farm worker health) such as employment stability and income.

11.1.1 Pesticides

Starting with the issue of pesticide hazard, Chapter 2 demonstrated that the UK pesticide hazard rating had marginally declined between 1991 and 2003 and consequently the environment should be a better place for both farm workers and consumers. A shift in production from vegetable to arable as discussed in Chapter 3 might further improve the pesticide hazard rating.

However, the frequency of acute pesticide related ill-health is a rare occurrence in the UK. Fatalities from acute poisoning occur approximately once a decade in the UK and the US. More people are reported to die annually in the US from hot air balloon accidents (4) than die in a decade from acute pesticide poisoning (Cowl et al., 1998). Consequently, acute hazards from pesticides might be classified as negligible.

This is important because the ethical implications of exporting pesticide hazards overseas (research question iii, partially discussed in Chapter 4) appear to be diminished for three reasons. Firstly, export farms are managed under strict health and safety guidelines that are audited monthly by various members of EurepGap. Consequently, the mechanisms by which any

significant malpractice would be detected are strengthened and the penalties for exporting farms a sufficient deterrent in terms of lost business. The larger export farms in the Kenyan survey also employed hundreds of extension workers to help small outgrowing farmers manage their pesticides and fertilisers safely and efficiently thus improving the working environment for outgrowers. Secondly, the farm worker component of the pesticide hazard rating was lowest on Kenyan export farms, suggesting that concerns relating to the UK hazard export no longer hold. Finally, pesticide related hazards are only one component contributing to a farm worker's well-being profile. The benefits of employment, increased income and social welfare in the form of subsidized housing and medical care appear to substantially outweigh any disbenefits that might accompany pesticide hazards. The difficulties of establishing causal routes are known (Chapter 4 & 10), particularly in terms of the potential impact on life expectancy. Claims of insidious intoxication for pesticides currently in use in the UK and Kenya through either long-term low or high level exposure are unproven.

Policy makers appear to be faced with the difficulty of prioritising perceived threats in society in such a way that they both address public concerns and are supported by scientific evidence. Once again an analogy may be useful in order to gain perspective on the relative scale of the potential long-term chronic poisoning fatalities that may result from pesticide use. In 2006 almost 260,000 people were injured in vehicle accidents on UK roads. Of these 31,000 were seriously injured or killed (DoT, 2007). What is interesting about these figures is not so much the scale but that further research showed that 10% of people involved in accidents demonstrated post traumatic stress disorder (PTSD) symptoms up to five years after the accident and irrespective of injury severity (Mayou et al., 1997). PTSD symptoms include depression and anxiety, both of which have been linked to increased suicide and mortality rates (Martikainen et al., 2003; Ringback Weitoft and Rosen, 2005). Thus, tangible hazards with equivalent symptoms to the acute and chronic symptoms allegedly associated with pesticides already pertain to travel in the UK. The hazards posed to farm workers in export horticulture appear inconsequential by comparison. Based upon the findings for pesticide use in

this study, policy makers might consider advising consumers to buy fresh vegetable produce from the poorest in the global village. Export farms in these countries are obliged to meet Eurepgap compliance criteria with regard to pesticide good practice policy and this should entail a reduction in harm to one of the least protected groups of workers in the world.

11.1.2 UK farm worker health

Many variables other than pesticides can affect a farm worker's health. For instance, the relationship between annual income, health status and life expectancy has repeatedly been demonstrated (Chapters 8 & 9). Health can also depend upon a range of more apparently trivial criteria such as task number performed at work (see UK results in Chapter 6) or social provision by the farm in the form of schooling for employees' children, subsidized lunch, housing allowance and health care (see Kenyan findings in Chapter 9).

The comparatively very low health status of farm workers on both conventional and organic farms in the UK is a cause for concern. Part or much of the explanation may lie in the fact that workers were almost entirely East European, under 30 years of age, university educated and possibly susceptible to all the fears and insecurities that accompany young displaced migrant workers. The sustainability of importing a substantial proportion of the horticultural workforce to the UK requires further investigation, particularly as these workers returned to their home country after three months with a health status equivalent to that of the 70+ age group for the population (Chapter 6). The longitudinal study (Chapter 7) indicates that worker health may decline during their stay in the UK although this remains inconclusive.

The factoring in of the costs of poor health to the farm worker and society as a whole needs to be considered by policy makers for both the short and long-term. Long-term health costs may be difficult to detect, particularly for those workers who return to their home country and receive medical care at a later date. Costs may be incurred by the donor country and the extent to which this would be morally acceptable remains unexplored. At a European level the

cost of palliative care in one country may be compensated for by the health benefits derived from increased vegetable consumption in another country. For instance, if a Polish worker experiences a decrease in health status of one unit for every ten thousand lettuces that he or she harvests, the consumer's health status may need to increase by an equivalent amount to negate the health costs. However, such a scenario would remain Pareto-inefficient as one person's improvement in health involves a decrease in another's, rendering one of the stakeholders worse-off than before. If a Kenyan or Ugandan farm worker cuts the same number of lettuce as the Polish worker but experiences a one unit increase in his or her health status policy makers may want to encourage consumers to buy non-British produce.

11.1.3 Poverty and health

There is a more powerful argument for purchasing vegetables from developing countries such as Kenya and Uganda which relates to the far reaching direct health benefits that accrue to workers in these systems. There are a range of embedded benefits in vegetables grown overseas for the UK market. For instance, increased income in Uganda strongly mitigates against the more debilitating effects of malaria sickness, as it increases an individual's ability to prevent, cope and recover faster from malaria sickness.

Export horticulture in developing countries has the potential to improve the health status of the poorest through increased household income. Increased income may engender even greater long-term embedded benefits for workers in developing countries than in the UK and Spain. For instance, to better understand the dynamic of increasing national revenue for a developing country from export horticulture and the longer term implications for life expectancy it is useful to consider Figure 1. Here an increase of 0.1 points (from 0.43-0.53) on the per capita GDP index would be expected to produce approximately a 0.13 point increase in life expectancy (0.49 to 0.62) for Ugandans, whilst a corresponding increase in Polish GDP (from 0.76-0.86) would result in a modest 0.05 point increase from approximately 0.79 to 0.84.

Thus, for the same financial investment, life expectancy increases by 0.8 points more for Ugandans than for Poles.

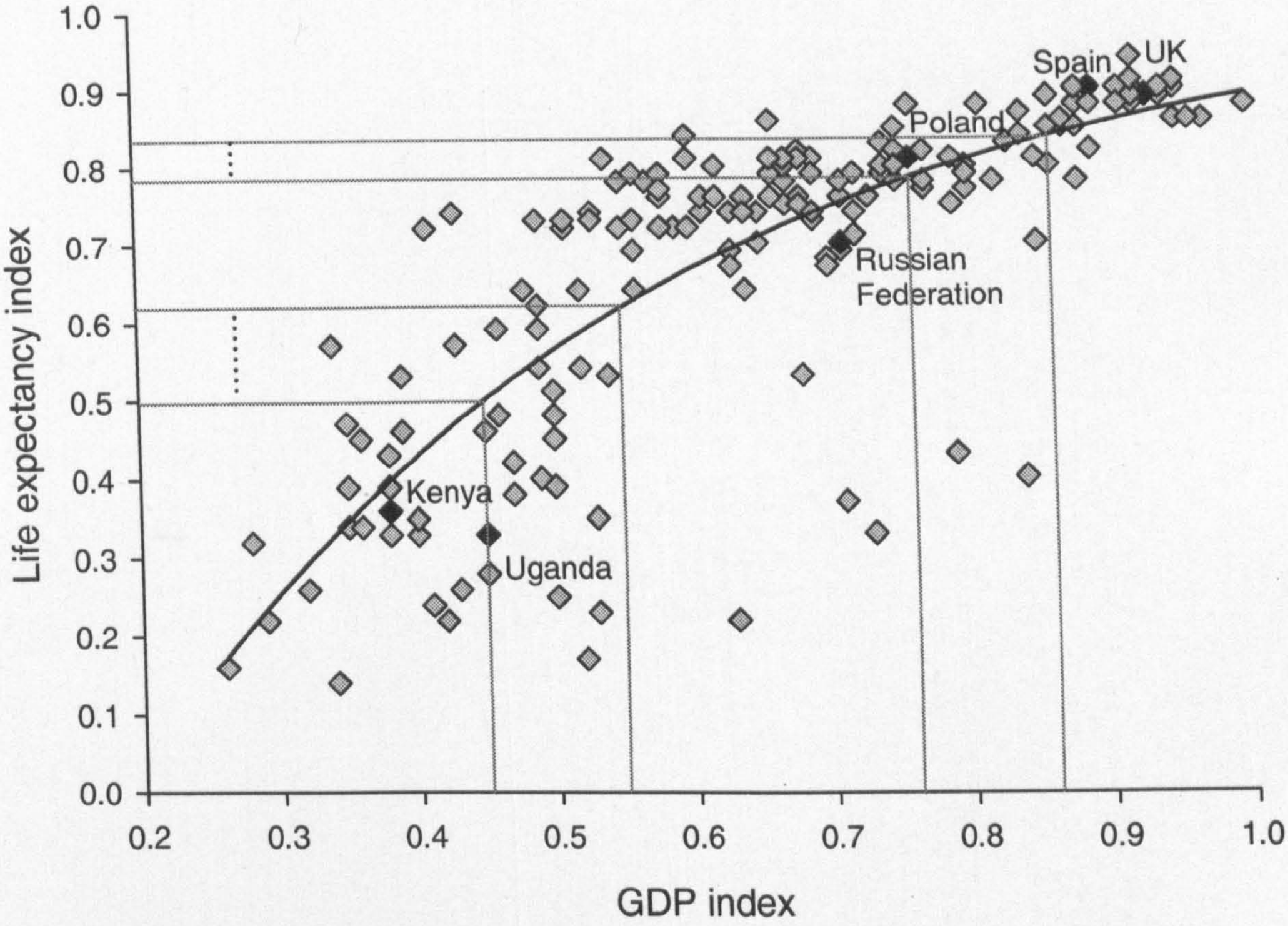


Figure 1. Life expectancy and per capita GDP. A 10% increase in the GDP index could engender a thirteen point increase in Ugandan life expectancy (49-62) whilst a similar increase in Polish GDP would only increase life expectancy by five points (79-84). Source: United Nations Development Programme, 2005 http://hdr.undp.org/reports/global/2005/

Marginal increases in life expectancy are generally highest for low income countries and lowest for the high income countries. Thus, consumers presented with a choice between buying a kilogramme of green beans from Kenya and a kilogramme from the UK should, all other things being equal, purchase the Kenyan beans for two reasons. Firstly, by not buying UK beans the consumer is causing no further harm to UK farm workers whose health has been shown to decline (Chapter 7). Secondly, by buying Kenyan beans the consumer is directly contributing revenue to the export farm that pays the farm worker the wages that are an important vector for improving the health status of Kenyan export workers.

This becomes more than abstraction when we consider the links between self-reported health and subsequent mortality rates, as discussed in Chapter 9.

Answering the simple question "in general, how would you describe your health: Excellent, very good, good, fair, poor" has been shown to indicate future mortality rates. In some studies those rates can be eight times greater for those who answer 'poor' or very poor'. Thus low self-reported health scores for workers on UK farms in 2006 may engender increased mortality rates in worker donor countries in the future. Once again this should inform policy makers to advise consumers to 'buy fresh vegetables from the poorest in the global village'.

11.1.4 Organic and local

Arising out of public concerns about the potential harm to health of pesticides, organic produce has undergone a meteoric rise in popularity during the past twenty years (Raynolds, 2004). The shift in consumer preferences to organically grown vegetables has been largely overseen by the Soil Association. As demand has outstripped supply during the past ten years, the Soil Association has been under increasing pressure from UK supermarkets and large farms to reduce the accreditation criteria. The entry of large farms to the organic market has allowed supermarkets on the one hand to meet increased demand for organic fresh vegetable products, whilst on the other undermining the organic movement's ethos by allowing industrial scales of production to dominate the market. In an attempt to increase the value-added difference between itself and industrial producers, a section of the organic movement has increasingly begun to coalesce with the local food movement as embodied in the Soil Association's campaign to encourage consumers to "Eat organic, buy local". This has had the effect of encouraging consumers to buy home grown produce rather than produce from overseas and possibly leading consumers to confuse local with organic.

Coincidentally, countries supplying much of the overseas fresh vegetable produce are also developing countries. In these countries, export horticulture is one of the few sectors that can benefit the rural poor directly (through increased income and job security) and indirectly (through employment in associated service industries) (MacGregor and Vorley, 2006). That this may

be foregone as part of the pro-local campaign would appear to be unethical and misinformed, as there is no obvious ontological reason to assume that "sustainable consumption demands localisation and re-embedding the economy within social networks" (Seyfang, 2006). The pro-local movement has dogmatically adopted the tautology that local must be good because it is local, whereas:

> geographic scale is conceptualized as socially constructed rather than ontologically pre-given, and that the geographic scales constructed are themselves implicated in the constitution of social, economic and political processes (Delaney and Leitner, 1997).

The sustainability of a local farming system that imports its workforce from Eastern Europe is questionable. For local food production to succeed in terms of meeting a large proportion of the UK's food needs may engender the re-pauperisation of a large number of workers in developing nations. This raises significant questions as to the ethicality of such a course of action and what would be the demographic of the beneficiaries following a significant shift to local food?

11.1.5 Policy implications

Some of this study's implications for policy makers have already been adumbrated in Chapters 6, 8 and 9.

If the UK government were ethically bound to encourage consumers to purchase from poorer countries then it is possible that pre-existing international development policy commitments such as the Millennium Development Goal No.1 to which the UK government is a signatory and has promised to aim to eradicate poverty and hunger may be facilitated (DFID, 2005; FAO-IFAD-WFP, 2005). Income and health appear to be positively associated, and the relationship becomes more acute and exacerbated over prolonged periods (Benzeval and Judge, 2001; Mackenbach et al., 2005; Martikainen et al., 2003). Relocating horticultural production to developing

countries such as Kenya and Uganda could engender an increase in workers' income (assuming that the market is efficient and allows revenue to flow back to the producers) in effect redistributing wealth away from middle income nations to poorer low income countries (Edwards-Jones et al., 2008). If farm worker health is the measure by which the Pareto-optimality of competing scenarios is evaluated, then exporting horticulture production to Africa may benefit African workers in terms of increased income, as evidenced by several studies showing rising income levels engendering health improvements (Mackenbach et al., 2005; Stronks et al., 1997; vanDoorslaer et al., 1997).

The UK organic and local food production debates have been driven primarily by disparate non-governmental organisations such as the Soil Association, the local food network, the slow food movement, sustain and Fairtrade. An important proportion of the debate has been based upon a belief of what appears to be intuitively "right" but lacks any factual scientific underpinning. Dogma driven and led by prominent food celebrities (whose status has in effect been elevated to the level of chief scientific food policy advisor) the debate appears to have careered from one crisis to another with little or no concern for the consequences to overseas producers. However, policy needs to be coherently formulated and sympathetic to human needs along the entire supply chain. A single measure of sustainability is unlikely to produce good policy and in the medium term it may prove more efficient, as MacGregor and Vorley (2006) suggest, to concentrate on the impacts of the home production system rather than pulling up the drawbridge on Africa.

11.1.6 Strengths & weaknesses of the methodology

A number of the strengths and weaknesses applying to this study have been covered under the relevant chapter heading. For instance, Chapter 6 covered some of the problems relating to the lack of sensitivity and ceiling effects for some of the health instruments such as the EQ-5D and VAS. Issues relating to the multi-lingual sample group and multiple translations were also discussed. In light of the high scores of Kenyan farm workers Chapters 8 and 9 discussed the possibility that scores were higher in Kenya owing to

differences in the sampling technique. Farm workers were interviewed in Uganda and Kenya as opposed to the UK and Spain where self-completion methods were used. This may have had the effect of inflating the scores in the African samples as social desirability bias could have influenced the scores. However, this may be countered by the high non-response rate in the UK which according to Vink et al., (2004) can indicate poorer health. A recent study suggests that mental health scores and the willingness to participate in activities are related (Hounsome, 2006).

Other weaknesses include the self-selection of both farm workers and participating farms although this is probably common to many surveys of this type. It is possible that only those farm workers whose mental and physical health were robust enough to permit them to work were present for the survey in all four countries.

11.1.7 Future research

As the food miles debate evolves so too does our understanding of the complexities involved in defining a sustainable food production system. If we evaluate competing food supply chains using measures such as carbon footprinting, life cycle analysis, consumer preferences, governmental development policy or socio-economic outcomes for communities connected to the food chain then we are likely to experience an array of conflicting material. For instance, whilst it may be ethically preferable to locate vegetable production in a developing country it might be environmentally preferable to grow them elsewhere. Assessing how one criterion such as farm worker health is traded off or discounted against another criterion such as nitrous oxide gas emissions is problematic. Future research might wish to consider possible policy frameworks that might inform how such trade offs might be accomplished.

The longitudinal study of Chapter 7 inconclusively described the changing health status of UK farm workers during their service. A problem of such repeated measure studies is the high non-response rate at subsequent

measurement intervals. The more ill or depressed a worker becomes the less likely they are to complete follow up surveys. Reaching these people in a survey is important from a purely academic perspective as the inclusion of their health scores would provide a more accurate overview of the true state of farm worker health in the UK. More importantly however, is the need from an ethical stance, to identify those who find it hardest to cope with both UK working conditions and separation from their home country. Identifying these people might then allow farms and policy makers to provide mitigation strategies. A more comprehensive longitudinal study of farm workers in the UK might consider combining self-reported health questionnaires with conventional health measures such as blood tests, blood pressure, cardiovascular changes, weight, mental health and nutritional measures such as calorific intake.

Very little is known of the sequelae to UK farm workers who developed low health scores whilst working in the UK. Any subsequent chronic illness would be more likely to occur only once workers return to their home country. Furthermore, any latent health benefits accruing to farm workers as a consequence of UK horticulture derived increases in wealth may offset the short-term seasonal declines in health. Follow up health surveys in the donor country would offer the opportunity of assessing the impacts of UK horticulture on both the long-term health condition and the socio-economic impacts on farm workers and their communities.

Potentially, important studies remain to be undertaken in Kenyan export horticulture. For instance, Kenyan export farm workers reported the highest levels of health in this study but it remains unclear which factors are causal in improving worker health status and to what extent those factors, once identified, are influential. For instance, workers enjoyed a number of fringe benefits such as free transport to and from work, subsidized lunches, regular employment, but how these and a range of other variables interact to improve self-perceived health is unknown. Identifying the most important health determinants could have important policy implications particularly if they are common to all countries.

Identifying commonalities to improved well-being in vegetable horticulture might ultimately be extended to the meat production industry. For example, the benefits to farm workers in the Thai export chicken industry might be compared with those of UK workers. The impacts of a variety of scenarios including the exporting of production from the UK to Thailand could be compared, and an assessment of the ethical implications for both farm workers and animal welfare which would ultimately inform policy.

11.1.8 Conclusion

This study has shown that understanding the comparative benefits that accrue to different actors in the food supply chain can influence our perceptions of sustainability. The food miles debate has rarely included the direct impacts to human-beings and has tended instead to concentrate on the long-term indirect impacts on humans of climate change. Hopefully, this thesis has managed to redress some of this imbalance.

References

Achterbosch, T., A. Allbritton, D.V. Quang, A. de Jager, E. Njue, R. Sonko, M. Stallen, S. Wertheim-Heck, and S. van Wijk. 2005. Pro-poor horticulture in East Africa & South East Asia. DFID, University of Wageningen.

Acuavella, J., G. Olson, P. Cole, B. Ireland, J. Kaneene, S. Schuman, and L. Holden. 1998. Cancer among farmers: a meta-analysis,. *Ann. Epidemiol.* 8:64-74.

Afrane, Y.A., G. Zhou, B.W. Lawson, A.K. Githeko, and G. Yan. 2007. Life-Table Analysis of Anopheles arabiensis in Western Kenya Highlands: Effects of Land Covers on Larval and Adult Survivorship. *Am J Trop Med Hyg.* 77:660-666.

Alavanja, M.C.R., M. Dosemeci, C. Samanic, J. Lubin, C.F. Lynch, C. Knott, J. Barker, J.A. Hoppin, D.P. Sandler, J. Coble, K. Thomas, and A. Blair. 2004. Use of agricultural pesticides and lung cancer risk in the agricultural health study cohort. *Epidemiology.* 15:178-179.

Alavanja, M.C.R., Samanic, C., Dosemeci, M., Lubin, J., Tarone, R., Lynch, C. F., Knott, C., Thomas, K., Hoppin, J. A., Barker, J., Coble, J., Sandler, D. P. & Blair, A. 2003. Use of agricultural pesticides and prostate cancer risk in the Agricultural Health Study cohort. *Am. J. Epidemiol.* 157:800-814.

Allen, P., M. FitzSimmons, M. Goodman, and K. Warner. 2003. Shifting plates in the agrifood landscape: the tectonics of alternative agrifood initiatives in California. *Journal of Rural Studies.* 19:61-75.

Almasri, M.N., and J.J. Kaluarachchi. 2007. Modeling nitrate contamination of groundwater in agricultural watersheds. *Journal of Hydrology.* 343:211-229.

Alzamora, S.M., M.S. Tapia, and A. Lopez-Malo. 2000. Minimally processed fruits and vegetables: Fundamental aspects and applications. Aspen Publishers, Inc., Gaithersburg, MD, USA.

Amr, M.M., Z.S. Halim, and S.S. Moussa. 1997. Psychiatric disorders among Egyptian pesticide applicators and formulators. *Environmental Research.* 73:193-199.

Anand, P. 2005a. Capabilities and health. *J Med Ethics.* 31:299-303.

Anand, P. 2005b. QALYs and capabilities: a comment on Cookson. *Health Economics.* 14:1283-1286.

Anderson, J.P., R.M. Kaplan, S.J. Coons, and L.J. Schneiderman. 1998. Comparison of the Quality of Well-Being Scale and the SF-36 Results Among Two Samples of Ill Adults: AIDS and Other Illnesses. *Journal of Clinical Epidemiology.* 51:755-762.

Andersson, K., and T. Ohlsson. 1999. Life Cycle Assessment of Bread Produced on Different Scales. *International Journal of Life Cycle Asssssment.* 4:25-39.

Anie, K.A., A. Steptoe, and D.H. Bevan. 2002. Sickle cell disease: Pain, coping and quality of life in a study of adults in the UK. *British Journal of Health Psychology.* 7:331-344.

Ankri, J., B. Beaufils, J.L. Novella, I. Morrone, F. Guillemin, D. Jolly, L. Ploton, and F. Blanchard. 2003. Use of the EQ-5D among patients suffering from dementia. *Journal of Clinical Epidemiology.* 56:1055-1063.

Anon. 2005. Prohibited Pesticides. Vol. 2005. http://www2.marksandspencer.com/thecompany/ourcommitmenttosociety/environment/info/food/chemicals/articles/pesticides.shtml.

Anton, A., F. Castells, J.I. Montero, and M. Huijbregts. 2004. Comparison of toxicological impacts of integrated and chemical pest management in Mediterranean greenhouses. *Chemosphere*. 54:1225-1235.

Anton, A., J.I. Montero, P. Munoz, and F. Castells. 2005a. LCA and tomato production in Mediterranean greenhouses. *International Journal of Agricultural Resources, Governance and Ecology*. 4:102-112.

Anton, A., P. Munoz, F. Castells, J.I. Montero, and M. Soliva. 2005b. Improving waste management in protected horticulture. *Agronomy for Sustainable Development*. 25:447-453.

Anyanwu, A.C., A. McGuire, C.A. Rogers, and A.J. Murday. 2001. Assessment of quality of life in lung transplantation using a simple generic tool. *Thorax*. 56:218-222.

Atis, S., B. Tutluoglu, E. Levent, C. Ozturk, A. Tunaci, K. Sahin, A. Saral, I. Oktay, A. Kanik, and B. Nemery. 2005. The respiratory effects of occupational polypropylene flock exposure. *Eur Respir J*. 25:110-117.

Aubrun, F., O. Langeron, C. Quesnel, P. Coriat, and B. Riou. 2003. Relationships between measurement of pain using visual analog score and morphine requirements during postoperative intravenous morphine titration. *Anesthesiology*. 98:1415-1421.

Backlund, E., P.D. Sorlie, and N.J. Johnson. 1996. The shape of the relationship between income and mortality in the United States: Evidence from the National Longitudinal Mortality Study. *Annals of Epidemiology*. 6:12-20.

Baldi, I., L. Filleul, B. Mohammed-Brahim, C. Fabrigoule, J.F. Dartigues, S. Schwall, J.P. Drevet, R. Salamon, and P. Brochard. 2001. Neuropsychologic effects of long-term exposure to pesticides: results from the French Phytoner study. *Environ Health Perspect*. 109:839-44.

Baldwin, C.M., I.R. Bell, M.K. Rourke, and M.D. Lebowitz. 1997. The association of respiratory problems in a community sample with self-reported chemical intolerance. *European Journal of Epidemiology*. 13:547-552.

Barrientos, S., C. Dolan, and A. Tallontire. 2001. Gender and ethical trade: A mapping of the issues in African horticulture. Natural Resources Institute, Chatham Maritime.

BCPC. 2007. The UK Pesticide Guide (2007). BCPC, CABI, Wallingford, UK.

Beach, J.R., A. Spurgeon, R. Stephens, T. Heafield, I.A. Calvert, L.S. Levy, and J.M. Harrington. 1996. Abnormalities on neurological examination among sheep farmers exposed to organophosphorous pesticides. *Occupational Environmental Medicine*. 53:520-525.

Beaumont, P. 1993. Pesticides, Policies and People. Pesticides Trust, London.

Bellows, A., and M. Hamm. 2001. Local autonomy and sustainable development: Testing import substitution in more localized food systems. *Agriculture and Human Values*. 18:271-284.

Benach, J., M. Amable, C. Muntaner, and F.G. Benavides. 2002. The consequences of flexible work for health: are we looking at the right place? *J Epidemiol Community Health*. 56:405-406.

Benach, J., and C. Muntaner. 2007. Precarious employment and health: developing a research agenda. *J Epidemiol Community Health*. 61:276-277.

Benavides, F.G., J. Benach, A.V. Diez-Roux, and C. Roman. 2000. How do types of employment relate to health indicators? Findings from the Second European Survey on Working Conditions. *J Epidemiol Community Health*. 54:494-501.

Benavides, F.G., J. Benach, C. Muntaner, G.L. Delclos, N. Catot, and M. Amable. 2006. Associations between temporary employment and occupational injury: what are the mechanisms? *Occup Environ Med*. 63:416-421.

Benzeval, M., and K. Judge. 2001. Income and health: the time dimension. *Social Science & Medicine*. 52:1371-1390.

BMA. 1992. The BMA Guide to Pesticides, Chemicals and Health. Report of the Board of Science and Education. Edwin Arnold, London.

Bobak, M., H. Pikhart, C. Hertzman, R. Rose, and M. Marmot. 1998. Socioeconomic factors, perceived control and self-reported health in Russia. A cross-sectional survey. *Social Science & Medicine*. 47:269-279.

Born, B., and M. Purcell. 2006. Avoiding the Local Trap: Scale and Food Systems in Planning Research. *Journal of Planning Education and Research*. 26:195-207.

Botella, B., J. Crespo, A. Rivas, I. Cerrillo, M.F. Olea-Serrano, and N. Olea. 2004. Exposure of women to organochlorine pesticides in Southern Spain. *Environmental Research*. 96:34-40.

Bouwman, A.F., and J.A. Taylor. 1996. Testing high-resolution nitrous oxide emission estimates against observations using an atmospheric transport model. *Global Biogeochemical Cycles*. 10:307-318.

Bowen, H.M., L.A. Thomas, and J.P. Snowden. 1992. Pesticide usage in Scotland: vegetables for human consumption 1991. Scottish Office Agriculture and Fisheries Department, Edinburgh.

Bowling, A. 1997. Measuring health: a review of quality of life measurement scales. Open University Press, Buckingham and Philadelphia.

Bowling, A. 2005a. Just one question: If one question works, why ask several? *J Epidemiol Community Health*. 59:342-345.

Bowling, A. 2005b. Mode of questionnaire administration can have serious effects on data quality. *J Public Health*. 27:281-291.

Bowling, A., M. Bond, C. Jenkinson, and D. Lamping. 1999. Short Form 36 (SF-36) Health Survey questionnaire: which normative data should be used? Comparisons between the norms provided by the Omnibus Survey in Britain, the Health Survey for England and the Oxford Healthy Life Survey. *Journal of Public Health Medicine*. 21:255-270.

Brambilla, D.J., and S.M. McKinlay. 1987. A comparison of responses to mailed questionnaires and telephone interviews in a mixed mode health survey *Am. J. Epidemiol.* 126:962-971.

Brazier, J., N. Jones, and P. Kind. 1993. Testing the validity of the Euroqol and comparing it with the SF-36 health survey questionnaire. *Quality of Life Research*. 2:169-180.

Brazier, J.E., S.J. Walters, J.P. Nicholl, and B. Kohler. 1996. Using the SF-36 and Euroqol on an elderly population. *Quality of Life Research*. 5:195-204

Brimner, T.A., G.J. Gallivan, and G.R. Stephenson. 2005. Influence of herbicide-resistant canola on the environmental impact of weed management. *Pest Management Science*. 61:47-52.

Brooks, R., and EuroQol Group. 1996. EuroQol: the current state of play. *Health Policy*. 37:53-72.

Browne, A.W., P.J.C. Harris, A.H. Hofny-Collins, N. Pasiecznik, and R.R. Wallace. 2000. Organic production and ethical trade: definition, practice and links. *Food Policy*. 25:69-89.

Buckley, L.-A. 1997. Vicarious Liability and Employment Discrimination: Tower Boot Co v, Jones, Waters v Commissioner of Police of the, Metropolis. *Ind Law J*. 26:158-166.

Buckwell, A. 2005. Green accounting for agriculture. *Journal of Agricultural Economics*. 56:187-215.

Bues, R., P. Bussieres, M. Dadomo, Y. Dumas, M.I. Garcia-Pomar, and J.P. Lyannaz. 2004. Assessing the environmental impacts of pesticides used on processing tomato crops. *Agric, Ecosyst and Environ*. 102:155-162.

Bullinger, M., J. Alonso, G. Apolone, A. Leplege, M. Sullivan, S. Wood-Dauphinee, B. Gandek, A. Wagner, N. Aaronson, and P. Bech. 1998. Translating health status questionnaires and evaluating their quality: The IQOLA Project Approach. *Journal of Clinical Epidemiology*. 51:913-923.

Burstrom, B., and P. Fredlund. 2001. Self rated health: Is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? *J Epidemiol Community Health*. 55:836-840.

Burström, K., M. Johannesson, and F. Diderichsen. 2004. Swedish population health-related quality of life results using the EQ-5D. *Quality of Life Research*. 10:621-635.

Butler, S.J., J.A. Vickery, and K. Norris. 2007. Farmland biodiversity and the footprint of agriculture *Science of the Total Environment*. 315:381-384.

Campbell, M.C. 2004. Building a Common Table: The Role for Planning in Community Food Systems. *Journal of Planning Education and Research*. 23:341-355.

Carballo, M., J.J. Divino, and D. Zeric. 1998. Migration and health in the European Union. *Tropical Medicine & International Health*. 3:936-944.

Carreno, J., A. Rivas, A. Granada, M. Jose Lopez-Espinosa, M. Mariscal, N. Olea, and F. Olea-Serrano. 2007. Exposure of young men to organochlorine pesticides in Southern Spain. *Environmental Research*. 103:55-61.

Castaldi, S., M. Costantini, P. Cenciarelli, P. Ciccioli, and R. Valentini. 2007. The methane sink associated to soils of natural and agricultural ecosystems in Italy. *Chemosphere*. 66:723-729.

Castro-Gutierrez, N., R. McConnell, K. Andersson, F. Pacheco-Anton, and C. Hogstedt. 1997. Respiratory symptoms, spirometry and chronic paraquat exposure. *Scandinavian Journal of Work and Environmental Health*. 23:421-427.

CBI. 2004. EU Market Survey 2004: Fresh Fruit and Vegetables. Confederation of British Industry: Centre for the Promotion of Imports from developing countries.

CDC. 2004. Malaria control in Uganda - towards the Abuja Targets. Centers for Disease Control and Prevention http://www.cdc.gov/malaria/control_prevention/uganda.htm, Atlanta.

Chapuis-Lardy, L., N. Wrage, A. Metay, J.L. Chotte, and M. Bernoux. 2007. Soils, a sink for N2O? A review. *Global Change Biology*. 13:1-17.

Chen, H., A.K. Githeko, G. Zhou, J.I. Githure, and G. Yan. 2006. New records of *Anopheles arabiensis* breeding on the Mount Kenya highlands indicate indigenous malaria transmission. *Malaria Journal*. 5.

Cho-Min-Naing, and M.L. Gatton. 2004. Costs to the patient for seeking malaria care in Myanmar. *Acta Tropica*. 92:173-177.

Christie, B. 2000. Doctors revise Declaration of Helsinki. *B.M.J.* 321:913.

Christopher Brown, J., and M. Purcell. 2005. There's nothing inherent about scale: political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum*. 36:607-624.

Christopher, S.F., and R. Lal. 2007. Nitrogen management affects carbon sequestration in North American cropland soils. *Critical Reviews in Plant Sciences*. 26:45-64.

Chu, C.Y.C., and W.-F. Liu. 2001. A Dynamic Characterization of Rawls's Maximin Principle: Theory and Implications. *Constitutional Political Economy*. 12:255-272.

Chuma, J.M., M. Thiede, and C.S. Molyneux. 2006. Rethinking the economic costs of malaria at the household level: Evidence from applying a new analytical framework in rural Kenya. *Malaria Journal*. 5.

Cohn, B.A., P.M. Cirillo, M.S. Wolff, P.J. Schwingi, R.D. Cohen, R.I. Sholtz, A. Ferrara, R.E. Christianson, B.J. van den Berg, and P.K. Siiteri. 2003. DDT and DDE exposure in mothers and time to pregnancy in daughters. *Lancet*. 361:2205-2206.

Cole, D.C., F. Carpio, J.J. Math, and N. Leon. 1997. Dermatitis in Ecuadorean farm workers. *Contact Dermatitis*. 37:1-8.

Conrad, R. 2002. Control of microbial methane production in wetland rice fields. *Nutrient Cycling in Agroecosystems*. 64:59-69.

Cookson, R. 2005. QALYs and the capability approach. *Health Economics*. 14:817-829.

Cooley, D.R. 2002. So Who's Afraid of Frankenstein Food? *Journal of Social Philosophy*. 33:442-463.

Cowl, C.T., M.P. Jones, C.F. Lynch, N.L. Sprince, C. Zwerling, and L.J. Fuortes. 1998. Factors Associated With Fatalities and Injuries From Hot-Air Balloon Crashes. *JAMA*. 279:1011-1014.

CPA. 2005. Minimising the environmental impacts of crop protection chemicals 2005 www.voluntaryinitiative.org.uk/Content/Programme.asp

Crespi, F.L., J.B. Luengo, and J.O. Quinto. 2005. Urban pesticide exposure disables workers in Catalunya. *Pesticide News*. 68:3-5.

Cross, P., and G. Edwards-Jones. 2006a. Variation in pesticide hazard from arable crop production in Great Britain from 1992 to 2002: Pesticide risk indices and policy analysis. *Crop Protection*. 25:1101-1108.

Cross, P., and G. Edwards-Jones. 2006b. Variation in pesticide hazard from vegetable production in Great Britain from 1991 to 2003. *Pest Management Science.* 62:1058-1064.

Cross, P., R.T. Edwards, B. Hounsome, and G. Edwards-Jones. 2008. Comparative assessment of migrant farm worker health in conventional and organic horticultural systems in the United Kingdom. *Science of The Total Environment.* 391:55-65.

Dagfinrud, H., A.M. Mengshoel, K.B. Hagen, J.H. Loge, and T.K. Kvien. 2004. Health status of patients with ankylosing spondylitis: a comparison with the general population. *Ann Rheum Dis.* 63:1605-1610.

Das, R., A. Steege, S. Baron, J. Beckman, and R. Harrison. 2001. Pesticide-related illness among migrant farm workers in the United States. *Int J Occup Environ Health.* 7:303-12.

Davis, R.P., M.R. Thomas, D.G. Garthwaite, and H.M. Bowen. 1993. Pesticide usage report: arable farm crops in Great Britain in 1992. MAFF.

Deeg, D.J.H., and P.A. Bath. 2003. Self-Rated Health, Gender, and Mortality in Older Persons: Introduction to a Special Section. *Gerontologist.* 43:369-371.

DEFRA. 2005a. Basic Horticultural Statistics. DEFRA, National Statistics: vegetables.

DEFRA. 2005b. National Statistics.

DEFRA. 2005c. Progress on the use of pesticides: the voluntary initiative. Environment, Food and Rural Affairs Committee, London.

DEFRA. 2006. Joint announcement by the agricultural departments of the United Kingdom agricultural and horticultural census: United Kingdom. DEFRA.

Delaney, D., and H. Leitner. 1997. The political construction of scale. *Political Geography.* 16:93-97.

Department of Health. 2007. 5 A DAY health benefits. Department of Health, London.

Department of the Environment, T.a.t.R. 1999. Design of a tax or charge scheme for pesticides. Department of the Environment, Transport and the Regions, London.

DFID. 2005. Growth and poverty reduction the role of agriculture: A DFID policy paper. Department for International Development, Glasgow.

Dich, J., S.H. Zahm, A. Hanberg, and H.O. Adami. 1997. Pesticides and cancer. *Cancer Causes and Control.* 8:420-443.

Diener, E., M. Diener, and C. Diener. 1995. Factors predicting the subjective well-being of nations. *Journal of Personality and Social Psychology.* 69:851-864.

Dijkstra, T. 1997. Trading the fruits of the land: horticultural marketing channels in Kenya. Ashgate, Aldershot, UK.

Dinham, B. 2003. Growing vegetables in developing countries for local urban populations and export markets: problems confronting small-scale producers. *Pest Management Science.* 59:575-582.

Dinham, B. 2005. Corporations and Pesticides. *In* The Pesticide Detox: towards a more sustainable agriculture. J. Pretty, editor. Earthscan, London. 55-69.

Dolan, C., and J. Humphrey. 2000. Governance and trade in fresh vegetables: The impact of UK supermarkets on the African horticulture industry. *Journal of Development Studies*. 37:147-176.

Dolan, C., J. Humphrey, and C. Harris-Pascal. 1999. Horticulture Commodity Chains: The Impact of the UK Market on the African Fresh Vegetable Industry. Institute of Development Studies, Brighton.

Dolan, C., and K. Sorby. 2003. Gender and employment in high-value agriculture industries. World Bank, Washington DC.

Dolan, C.S., and K. Sutherland. 2002. Gender and employment in the Kenya horticulture value chain. School of Development Studies and Overseas Development Group, University of East Anglia, Norwich, UK.

Dolan, P., D. Torgerson, and T. Kumar Kakarlapudi. 1999. Health-Related Quality of Life of Colles' Fracture Patients. *Osteoporosis International*. 9:196-199.

Dorman, P.J., F. Waddell, J. Slattery, M. Dennis, and P. Sandercock. 1997. Is the EuroQol a valid measure of health-related quality of life after stroke? *Stroke*. 28:1876-1882.

Dorward, A., J. Kydd, J. Morrison, and I. Urey. 2004. A Policy Agenda for Pro-Poor Agricultural Growth. *World Development*. 32:73-89.

DoT. 2007. Road casulties: Great Britain 2006. Department for Transport, London.

Draper, A., and J. Green. 2002. Food safety and consumers: Constructions of choice and risk. *Social Policy & Administration*. 36:610-625.

Draper, P., and D.R. Thompson. 2001. The quality of life - A concept for research and practice. *Nursing Times Research*. 6:648-657.

Drivsholm, T., L.F. Eplov, M. Davidsen, T. Jorgensen, H. Ibsen, H. Hollnagel, and K. Borch-Johnsen. 2006. Representativeness in population-based studies: A detailed description of non-response in a Danish cohort study. *Scandinavian Journal of Public Health*. 34:623-631.

Drory, A., and B. Shamir. 1988. Effects of Organizational and Life Variables on Job Satisfaction and Burnout. *Group Organization Management*. 13:441-455.

Dubernard, G., R. Rouzier, E. David-Montefiore, M. Bazot, and E. Darai. 2008. Use of the SF-36 questionnaire to predict quality-of-life improvement after laparoscopic colorectal resection for endometriosis. *Hum. Reprod.* Advanced online publication.

DuPuis, E.M., and D. Goodman. 2005. Should we go "home" to eat?: toward a reflexive politics of localism. *Journal of Rural Studies*. 21:359-371.

Durant, L.E., and M.P. Carey. 2000. Self-administered questionnaires versus face-to-face interviews in assessing sexual behavior in young women. *Archives of Sexual Behavior*. 29:309-322.

Ecob, R., and G. Davey Smith. 1999. Income and health: what is the nature of the relationship? *Social Science & Medicine*. 48:693-705.

Eddleston, M., L. Karalliedde, N. Buckley, R. Fernando, G. Hutchinson, G. Isbister, F. Konradsen, D. Murray, J.C. Piola, N. Senanayake, R. Sheriff, S. Singh, S.B. Siwach, and L. Smit. 2002. Pesticide poisoning in the developing world-a minimum pesticide list. *Lancet*. 12:1163-1167.

Edwards-Jones, G., L. Mila i Canals, N. Hounsome, M. Truninger, G. Koerber, B. Hounsome, P. Cross, E.H. York, A. Hospido, K. Plassmann, I.M.

Harris, R.T. Edwards, G.A.S. Day, A.D. Tomos, S.J. Cowell, and D.L. Jones. 2008. Testing the assertion that `local food is best': the challenges of an evidence based approach. *Trends in Food Science & Technology*. In Press, Accepted Manuscript.

Eisen, S.A., H.K. Kang, F.M. Murphy, M.S. Blanchard, D.J. Reda, W.G. Henderson, R. Toomey, L.W. Jackson, R. Alpern, B.J. Parks, N. Klimas, C. Hall, H.S. Pak, J. Hunter, J. Karlinsky, M.J. Battistone, M.J. Lyons, and and the Gulf War Study Participating Investigators*. 2005. Gulf War Veterans' Health: Medical Evaluation of a U.S. Cohort. *Ann Intern Med.* 142:881-890.

Ellis, K.A., G. Innocent, D. Grove-White, P. Cripps, W.G. McLean, C.V. Howard, and M. Mihm. 2006. Comparing the Fatty Acid Composition of Organic and Conventional Milk. *J. Dairy Sci.* 89:1938-1950.

Engel, L.S., D.A. Hill, J.A. Hoppin, J.H. Lubin, C.F. Lynch, J. Pierce, C. Samanic, D.P. Sandler, A. Blair, and M.C. Alavanja. 2005. Pesticide use and breast cancer risk among farmers' wives in the agricultural health study. *American Journal of Epidemiology*. 161:121-135.

Eskenazi, B., A. Bradman, and R. Castorina. 1999. Exposures of children to organophosphate pesticides and their potential adverse health effects. *Environ Health Perspect*. 107:409-19.

EU. 2002. 320 pesticides to be withdrawn in July 2003. European Commission, Brussels.

EuroQoL Group. 1990. EuroQoL: a new facility for the measurement of heath-related quality of life. *Health Policy*. 16:199-208.

Falconer, K., and I. Hodge. 2000. Using economic incentives for pesticide usage reductions: responsiveness to input taxation and agricultural systems. *Agricultural Systems*. 63:175-194.

Falconer, K.E. 1998. Managing diffuse environmental contamination from agricultural pesticides: An economic perspective on issues and policy options, with particular reference to Europe. *Agriculture Ecosystems & Environment*. 69:37-54.

FAO-IFAD-WFP. 2005. Millennium Development Goal No. 1. Food and Agriculture Organization of the United Nations; International Fund for Agricultural devlopment; World Food Programme, Rome.

FAO-ILO-IUF. 2005. Agricultural workers and their contribution to sustainable agriculture and rural development. FAO-ILO-IUF.

Farahat, T.M., G.M. Abdelrasoul, M.M. Amr, M.M. Shebl, F.M. Farahat, and W.K. Anger. 2003. Neurobehavioural effects among workers occupationally exposed to organophosphorous pesticides. *Occupational Environmental Medicine*. 60:279-286.

Farrar, J., M. Hawes, D. Jones, and S. Lindow. 2003. How roots control the flux of carbon to the rhizosphere. *Ecology*. 84:827-837.

Fearne, A., and D. Hughes. 1998. Success Factors in the Fresh Produce Supply Chain: Some Examples from the UK. Executive Summary. Wye College, London.

Fiedler, N., H. Kipen, K. Kelly-McNeil, and R. Fenske. 1997. Long-term use of organophosphates and neuropsychological performance. *American Journal of Industrial Medicine*. 32:487-496.

Fiehn, O. 2002. Metabolomics - the link between genotypes and phenotypes. *Plant Molecular Biology*. 48:155-171.

Fiscella, K., and P. Franks. 1997 Poverty or income inequality as predictor of mortality: longitudinal cohort study. *BMJ*. 314:1724-1727.

Fischler, C. 1988. Food, self and identity. *Social Science Information*. 27:275-292.

Fisk, J.D., M.G. Brown, I.S. Sketris, L.M. Metz, T.J. Murray, and K.J. Stadnyk. 2005. A comparison of health utility measures for the evaluation of multiple sclerosis treatments. *J Neurol Neurosurg Psychiatry*. 76:58-63.

Forger, F., M. Ostensen, A. Schumacher, and P.M. Villiger. 2005. Impact of pregnancy on health related quality of life evaluated prospectively in pregnant women with rheumatic diseases by the SF-36 health survey. Ann Rheum Dis. 64:1494-1499.

Fowler, F.J., P.M. Gallagher, and S. Nederend. 1999. Comparing telephone and mail responses to the CAHPS (TM) survey instrument. *Medical Care*. 37:MS41-MS49.

Freidberg, S. 2003. Cleaning up down South: supermarkets, ethical trade and African horticulture. *Social & Cultural Geography*. 4:27-43.

Freidberg, S. 2004a. The ethical complex of corporate food power. *Environment and Planning D-Society & Space*. 22:513-531.

Freidberg, S. 2004b. French beans and food scares: culture and commerce in an anxious age. Oxford University Press, Oxford.

Frith, M. 2005. How far has your Christmas dinner travelled? *In* The Independent London.

Fryzek, J.P., D.H. Garabrant, S.D. Harlow, R.K. Severson, B.W. Gillespie, M. Schenk, and D. Schottenfeld. 1997. A case-control study of self-reported exposures to pesticides and pancreas cancer in south-eastern Michigan. *International Journal of Cancer*. 72:62-67.

Fuchs, V.R. 2004. Reflections on the socio-economic correlates of health. *Journal of Health Economics*. 23:653-661.

Gabre-Madhin, E.Z., and S. Haggblade. 2004. Successes in African agriculture: Results of an expert survey. *World Development*. 32:745-766.

Gallagher, E.J., M. Liebman, and P.E. Bijur. 2001. Prospective validation of clinically important changes in pain severity measured on a visual analog scale. Annals of Emergency Medicine. 38:633-638.

Gallivan, G.J., G.A. Surgeoner, and J. Kovach. 2001. Pesticide risk reduction on crops in the Province of Ontario. *J. Environ. Qual.* 30:798-813.

Gandek, B., and J.E. WareJr. 1998. Methods for validating and norming translations of health status questionnaires: The IQOLA Project Approach. *Journal of Clinical Epidemiology*. 51:953-959.

Garcia, A.M. 2003. Pesticide exposure and women's health. *Am J Ind Med.* 44:584-94.

Garthwaite, D.G., and M.R. Thomas. 1999. Pesticide Usage Survey Report: arable farm crops in Great Britain in 1998. DEFRA & SEERAD, York.

Garthwaite, D.G., and M.R. Thomas. 2001. Pesticide usage survey report: arable farm crops in Great Britain in 2000. DEFRA & SEERAD, York.

Garthwaite, D.G., M.R. Thomas, A. Dawson, and H. Stoddart. 2003. Pesticide usage survey: arable farm crops in Great Britain in 2002. DEFRA & SEERAD, York.

Garthwaite, D.G., M.R. Thomas, A. Dawson, H. Stoddart, and H. Anderson. 2004. Pesticide usage survey report: outdoor vegetable crops in Great Britain 2003. DEFRA, York.

Garthwaite, D.G., M.R. Thomas, and S. Dean. 2001. Pesticide usage survey report : outdoor vegetable crops in Great Britain 1999. DEFRA, York.

Garthwaite, D.G., M.R. Thomas, and M. Hart. 1995. Pesticide usage report: arable farm crops in Great Britain in 1994. MAFF.

Garthwaite, D.G., M.R. Thomas, M.J. Hart, and S. Wild. 1997. Pesticide usage survey report: outdoor vegetable crops in Great Britain 1995. Ministry of Agriculture, Fisheries and Food & Scottish Office Agriculture, Environment & Fisheries Department, York.

Gerrard, C. 1998. Farmers' occupational health: cause for concern, cause for action. *Journal of Advanced Nursing*. 28:155-163.

Gimeno, D., F.G. Benavides, B.C. Amick, III, J. Benach, and J.M. Martinez. 2004. Psychosocial factors and work related sickness absence among permanent and non-permanent employees. *J Epidemiol Community Health*. 58:870-876.

Goldberg, G. 2003. Plants: Diet and health. The report of a British Nutrition Foundation Task Force. Blackwell Publishing Ltd., Oxford.

Gomes, J., O.L. Lloyd, and D.M. Revitt. 1999. The influence of personal protection, environmental hygiene and exposure to pesticides on the health of immigrant farm workers in a desert country. *International Archives of Occupational and Environmental Health*. 72:40-45.

Goodman, D. 2000. Organic and conventional agriculture: Materializing discourse and agro-ecological managerialism. *Agriculture and Human Values*. 17:215-219.

Gregoire, A. 2002. The mental health of farmers. *Occup Med (Lond)*. 52:471-476.

Greiner, W., C. Claes, J.J.V. Busschbach, and J.M. Graf von der Schulenburg. 2005. Validating the EQ-5D with time trade off for the German population. *The European Journal of Health Economics*. 6:124-130.

Gudex, C., P. Dolan, P. Kind, and A. Williams. 1996. Health state valuations from the general public using the Visual Analogue Scale. *Quality of Life Research*. 5:521-531.

Guthman, J. 2004. Agrarian dreams: the paradox of organic farming in California. University of California Press, London.

Guyatt, G.H., D.H. Feeny, and D.L. Patrick. 1993. Measuring Health-related Quality of Life. *Ann Intern Med*. 118:622-629.

Hale, A., and M. Opondo. 2005. Humanising the Cut Flower Chain: Confronting the Realities of Flower Production for Workers in Kenya. *Antipode*. 37:301-323.

Hall, A., and V. Mogyorody. 2001. Organic farmers in Ontario: An examination of the conventionalization argument. *Sociologia Ruralis*. 41:399-322.

Hamilton, A. 2006. Christmas lunch will fly 84,000 miles to your table *In* The Times, London.

Harari, R., F. Forastiere, and O. Axelson. 1998. Unacceptable occupational exposure to toxic agents among children in Ecuador. *American Journal of Industrial Medicine*. 32:185 - 189.

Havlikova, M., and C. Kroeze. 2006. Evaluation of methods for quantifying agricultural emissions of air, water and soil pollutants. *Science of the Total Environment* 372:133-147.

Hawkes, C., and M. Ruel. 2006. The links between agriculture and health: an intersectoral opportunity to improve the health and livelihoods of the poor. *Bulletin of the World Health Organization*. 84:984-987.

Haworth, J., and F. Paterson. 1995. Access to Categories of Experience and Mental Health in a Sample of Managers. *Journal of Applied Social Psychology*. 25:712-724.

Hebert, J.R., L. Clemow, L. Pbert, I.S. Ockene, and J.K. Ockene. 1995. Social Desirability Bias in Dietary Self-Report May Compromise the Validity of Dietary Intake Measures. *Int. J. Epidemiol.* 24:389-398.

Hill, A., J. Roberts, P. Ewings, and D. Gunnell. 1997. Non-response bias in a lifestyle survey. *J Public Health*. 19:203-207.

Hinrichs, C., and X. Kremer. 2002. Social inclusion in a midwest local food system project. *Journal of Poverty*. 6:65-90.

Hinrichs, C.C. 2000. Embeddedness and local food systems: notes on two types of direct agricultural market. *Journal of Rural Studies*. 16:295-303.

Hinrichs, C.C. 2003. The practice and politics of food system localization. *Journal of Rural Studies*. 19:33-45.

Hinsch, R.T., D.C. Slaughter, W.L. Craig, and J.F. Thompson. 1993. Vibration of fresh fruit and vegetables during refrigerated truck transport. *Transactions of the Asae*. 36:1039-1042.

Hope, A., C. Kelleher, L. Holmes, and T. Hennessy. 1999. Health and safety practices among farmers and other workers: a needs assessment. *Occup Med (Lond)*. 49:231-235.

Houghton, R.A. 2003. Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850-2000. *Tellus B*. 55:378-390.

Hounsome, B. 2006. Investigating the relationship between farmer health and farm income. School of Agricultural and Forest Sciences. Ph.D. thesis. Bangor University, Bangor.

Hounsome, B., R.T. Edwards, and G. Edwards-Jones. 2006. A note on the effect of farmer mental health on adoption: The case of agri-environment schemes. *Agricultural Systems*. 91:229-241.

HSE. 2005. Fatal Injuries in farming, forestry and horticulture 2004/2005. Health and Safety Executive, Injuries reduction programme- policy group, Kenilworth, Warwickshire.

HSE. 2006a. Fatal Injuries in farming, forestry and horticulture 2005/2006. Health and Safety Executive, Injuries reduction programme-policy group. Kenilworth, Warwickshire.

HSE. 2006b. Health and safety in agriculture. Health and Safety Executive.

HSE. 2006c. Migrant Workers: Injury and ill health statistics in Agriculture. Health and Safety Commission and Executive: Agriculture Industry Advisory Committee.

Humphrey, J., N. McCulloch, and M. Ota. 2004. The impact of European market changes on employment in the Kenyan horticulture sector. *J. of Int. Dev.* 16:63 - 80.

Hunt, S.M. 1997. The problem of quality of life. *Quality of Life Research.* 6:205-212.

Hurst, N.P., P. Jobanputra, M. Hunter, M. Lambert, A. Lockhead, and H. Brown. 1994. Validity of EuroQol- a generic health status instrument in patients with rheumatoid arthritis: Economic and health outcomes research group. *Rheumatology.* 33:655-662.

Huyghe, E., T. Matsuda, and P. Thonneau. 2003. Increasing incidence of testicular cancer worldwide: A review. *Journal of Urology.* 170:5-11.

Idler, E.L., and Y. Benyamini. 1997. Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior.* 38:21-37.

IFOAM. 2006. The principles of organic agriculture. International Federation of Organic Movements. www.ifoam.org/about_ifoam/principles/index.html

IGD. 2006. Retail and Foodservice Opportunities for Local Food. *In* Institute of Grocery Distribution. 48.

IPCC. 1995. Climate Change 1995: The Science of Climate Change. Cambridge University Press, Cambridge, UK.

IPCC. 2001. Climate Change 2001: The Scientific Basis. Cambridge University Press, Cambridge, UK.

IPCC. 2007. Climate Change 2007:The Physical Science Basis. Cambridge University Press, Cambridge, UK.

IPCS. 2005. The WHO recommended classification of pesticides by hazard and guidelines to classification 2004: corrigenda published by April 12, 2005 incorporated. International Programme on Chemical Safety, Geneva.

IRIN. 2006. Drought affecting millions of children, says NGO. *In* Integrated Regional Information Networks. Integrated Regional Information Networks: UN Office for the Coordination of Humanitarian Affairs, Nairobi.

Irz, X., L. Lin, C. Thirtle, and S. Wiggins. 2001. Agricultural Productivity Growth and Poverty Alleviation. *Development Policy Review.* 19:449-466.

Jaffee, S. 2003. From challenge to opportunity: Transforming Kenya's fresh vegetable trade in the context of emerging food safety and other standards in Europe. World Bank, Washington, D.C.

Jansen, K. 2000. Labour, Livelihoods and the Quality of Life in Organic Agriculture in Europe. *Biological Agriculture and Horticulture.* 17:247-278.

Jenkinson, C., A. Coulter, and L. Wright. 1993. The Short-Form 36 (SF-36) Health Survey questionnaire: normative data for adults of working age. *BMJ* 306:1437-1440.

Jenkinson, C., S. Stewart-Brown, S. Petersen, and C. Paice. 1999. Assessment of the SF-36 version 2 in the United Kingdom. *J Epidemiol Community Health.* 53:46-50.

Jeyaratnam, J. 1990. Acute pesticide poisoning: A major global health problem. *World Health Statistics Quarterly.* 43:139-44.

Ji, B.T., D.T. Silverman, P.A. Stewart, A. Blair, G.M. Swanson, D. Baris, R.S. Greenberg, R.B. Hayes, L.M. Brown, K.D. Lillemoe, J.B. Schoenberg, L.M. Pottern, A.G. Schwartz, and R.N. Hoover. 2001. Occupational

exposure to pesticides and pancreatic cancer. *American Journal of Industrial Medicine*. 39:92-99.

Jones, A. 2002. An environmental assessment of food supply chains: A case study on dessert apples. *Environmental Management*. 30:560-576.

Jones, A. 2006. A life cycle analysis of UK supermarket imported green beans from Kenya. International Institute for Environment and Development,, London.

Joseph, A., S. Abraham, J.P. Muliyil, K. George, J. Prasad, S. Minz, V.J. Abraham, and K.S. Jacob. 2003. Evaluation of suicide rates in rural India using verbal autopsies. *BMJ*. 24:1121-1122.

Joseph, S., P.A. Linley, J. Harwood, C.A. Lewis, and P. McCollam. 2004. Rapid assessment of well-being: The Short Depression-Happiness Scale (SDHS). *Psychology and Psychotherapy: Theory, Research and Practice*. 77:463-478.

Jungbluth, N., and M. Demmeler. 2005. 'The ecology of scale: Assessment of regional energy turnover and comparison with global food' by Elmar Schlich and Ulla Fleissner. *International Journal of Life Cycle Assessment*. 10:168-170.

Kaiser, M.J., and G. Edwards-Jones. 2006. The role of eco-labelling in fisheries management and conservation. *Conservation Biology*. 20:392-398.

Kant, I. 1998. Groundwork of the metaphysics of morals. M.J. Gregor, editor. Cambridge University Press, Cambridge.

Kaplan, C.P., J.F. Hilton, S. Park-Tanjasiri, and E.J. Perez-Stable. 2001. The effect of data collection mode on smoking attitudes and behavior in young African American and Latina women - Face-to-face interview versus self-administered questionnaires. *Evaluation Review*. 25:454-473.

Karlsson, S.I. 2004. Agricultural pesticides in developing countries: a multilevel governance challenge. *Environmental Health Perspectives*. 46:22-41.

Kato, I., H. Watanabe-Meserve, K.L. Koenig, M.S. Baptiste, P.P. Lillquist, G. Frizzera, J. S., J.S. Burke, M. Moseson, and R.E. Shore. 2004. Pesticide product use and risk of non-Hodgkin lymphoma in women. *Environmental Health Perspectives*. 112:1275-1281.

Kebreab, E., K. Clark, C. Wagner-Riddle, and J. France. 2006. Methane and nitrous oxide emissions from Canadian animal agriculture: A review. *Canadian Journal of Animal Science*. 86:135-158.

Keifer, M., R. McConnell, A.F. Pacheco, W. Daniel, and L. Rosenstock. 1996. Estimating underreported pesticide poisonings in Nicaragua. *Am J Ind Med*. 30:195-201.

Kelly, A.M. 2001. The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. *Emerg Med J*. 18:205-207.

Kelly, T. 2004. Flight of the turkey and other long-haul delicacies *In* Daily Mail, London.

Kim, J., R.A. Henderson, S.J. Pocock, T. Clayton, M.J. Sculpher, and K.A.A. Fox. 2005. Health-related quality of life after interventional or conservative strategy in patients with unstable angina or non-ST-segment elevation myocardial infarction: One-year results of the third

randomized intervention trial of unstable angina (RITA-3). *Journal of the American College of Cardiology*. 45:221-228.

Kimani, V.N., and M.A. Mwanthi. 1995. Agrochemicals exposure and health implications in Githunguri location, Kenya. *East Afr Med J.* 72:531-5.

Kind, P., P. Dolan, C. Gudex, and A. Williams. 1998. Variations in population health status: results from a United Kingdom national questionnaire survey. *BMJ*. 316:736-741.

Kindler, C.H., C. Harms, F. Amsler, T. Ihde-Scholl, and D. Scheidegger. 2000. The Visual Analog Scale llows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. *Anesth Analg*. 90:706-712.

Kishi, M. 2005. The health impacts of pesticides: what do we know? *In* The Pesticide Detox: towards a more sustainable agriculture. J. Pretty, editor. Earthscan, London.

Kishi, M., N. Hirschhorn, M. Qjajadisastra, L.N. Satterlee, S. Strowman, and R. Dilts. 1995. Relationship of pesticide spraying to signs and symptoms in Indonesian farmers. *Scandinavian Journal of Work, Environment and Health*. 21:124-33.

Kobetz, E., M. Daniel, and J.A. Earp. 2003. Neighborhood poverty and self-reported health among low-income, rural women, 50 years and older. *Health & Place*. 9:263-271.

Konradsen, F., W. van der Hoek, D.C. Cole, G. Hutchinson, H. Daisley, S. Singh, and M. Eddleston. 2003. Reducing acute poisoning in developing countries options for restricting the availability of pesticides. *Toxicology*. 192:249 261.

Kovach, J., C. Petzoldt, J. Degnil, and J. Tette. 1992. A method to measure the environmental impact of pesticides. *New York's Food and Life Sci. Bull.* 139:1-8.

Kydd, J., A. Dorward, J. Morrison, and G. Cadisch. 2004. Agricultural development and pro-poor economic growth in sub-Saharan Africa: potential and policy. *Oxford Development Studies*. 32:37-57.

La Trobe, H. 2001. Farmers markets: consuming local rural produce. *International Journal of Consumer Culture*. 25:181-192.

Lahelma, E., P. Martikainen, O. Rahkonen, E. Roos, and P. Saastamoinen. 2005. Occupational class inequalities across key domains of health: Results from the Helsinki Health Study. *Eur J Public Health*. 15:504-510.

Laxminarayan, R. 2004. Does reducing malaria improve household living standards? *Tropical Medicine & International Health*. 9:267-272.

Lee, W.J., A. Blair, J.A. Hoppin, J.H. Lubin, J.A. Rusiecki, D.P. Sandler, M. Dosemeci, and M.C.R. Alavanja. 2004a. Cancer incidence among pesticide applicators exposed to chlorpyrifos in the agricultural health study. *Journal of the National Cancer Institute*. 96:1781-1789.

Lee, W.J., J.A. Hoppin, A. Blair, J.H. Lubin, M. Dosemeci, D.P. Sandler, and M.C.R. Alavanja. 2004b. Cancer incidence among pesticide applicators exposed to alachlor in the Agricultural Health Study. *American Journal of Epidemiology*. 159:373-380.

Levitan, L. 1997. An overview of pesticide impact assessment systems (a.k.a. "Pesticide Risk Indicators") based on Indexing or ranking pesticides by

environmental impact. Organisation of Economic Cooperation and Development, Copenhagen.

Levitan, L. 2000. "How to" and "why": assessing the enviro-social impacts of pesticides. *Crop Prot.* 19:629-636.

Levitan, L., I. Merwin, and J. Kovach. 1995. Assessing the relative environmental impacts of agricultural pesticides: the quest for a holistic method. *Agric, Ecosyst and Environ.* 55:153-168.

Levy, P.E., D.C. Mobbs, S.K. Jones, R. Milne, C. Campbell, and M.A. Sutton. 2007. Simulation of fluxes of greenhouse gases from European grasslands using the DNDC model. *Agriculture Ecosystems & Environment.* 121:186-192.

Li, C.Y., and F.C. Sung. 1999. A review of the healthy worker effect in occupational epidemiology. *Occup Med (Lond).* 49:225-229.

Li., C.S., S. Frolking, and T.A. Frolking. 1992. A model of nitrous-oxide evolution from soil driven by rainfall events 1. Model structure and sensitivity. *Journal of Geophysical Research - Atmospheres 97.* D9:9759-9776.

London, L., S. De Grosbois, C. Wessling, S. Kisting, H.A. Rother, and D. Mergler. 2002. Pesticide usage and health consequences for women in developing countries: out of sight out of mind? *International Journal of Occupational and Environmental Health.* 8:46-59.

Lopez-Carrillo L, B.A., Lopez-Cervantes M, Cebrian M, Rueda C, Reyes R, Mohar A, Bravo J. 1997. Dichlorodiphenyltrichloroethane serum levels and breast cancer risk: a case-control study from Mexico. *Cancer Res.* 57:3728-32.

Lynch, J.W., G.D. Smith, G.A. Kaplan, and J.S. House. 2000. Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *BMJ.* 320:1200-1204.

Lyons, R.A., K. Wareham, M. Lucas, D. Price, J. Williams, and H.A. Hutchings. 1999. SF-36 scores vary by method of administration: implications for study design. *J Public Health.* 21:41-45.

MacGregor, J., and B. Vorley. 2006. Fair Miles? The concept of "food miles" through a sustainable development lens. Institute for Environment and Development.

Mackenbach, J.P., P. Martikainen, C.W.N. Looman, J.A.A. Dalstra, A.E. Kunst, E. Lahelma, and S.w.g. members of the. 2005. The shape of the relationship between income and self-assessed health: an international study. *Int. J. Epidemiol.* 34:286-293.

Mannon, S.E. 2005. Risk takers, risk makers: small farmers and non-traditional agro-exports in Kenya and Costa Rica. *Human Organization.* 64:16-27.

Maroni, M., C. C., A. Ferioli, and A. Fait. 2000. Biological monitoring of pesticide exposure: a review. *Toxicology.* 143:1-118.

Marriott, C. 2005. From plough to plate by plane. An investigation into trends and drivers in the airfreight importation of fresh fruit and vegetables into the UK from 1996 to 2004. Unpublished Thesis. Ph.D. University of Surrey, Guildford, UK.

Martikainen, P., J. Adda, J.E. Ferrie, G.D. Smith, and M. Marmot. 2003. Effects of income and wealth on GHQ depression and poor self rated

health in white collar women and men in the Whitehall II study. *Journal of Epidemiology and Community Health*. 57:718-723.

Matthews, G., T. Wiles, and P. Baleguel. 2003. A survey of pesticide application in Cameroon. *Crop Protection*. 22:707-714.

Mattsson, B., and E. Wallen. 2003. Environmental life cycle assessment (LCA) of organic potatoes. *Acta Horticulturae (ISHS)*. 619:427-435.

Maud, J., G. Edwards-Jones, and F. Quin. 2001. Comparative evaluation of pesticide risk indices for policy development and assessment in the United Kingdom. *Agriculture, Ecosystems and Environment*. 86:50-73.

Mayer, D. 2001. The long-term impact of health on economic growth in Latin America. *World Development*. 29:1025-1033.

Mayou, R., S. Tyndel, and B. Bryant. 1997. Long-term outcome of motor vehicle accident injury. *Psychosom Med*. 59:578-584.

Mbakaya, C.F., G.J. Ohayo-Mitoko, V.A. Ngowi, R. Mbabazi, J.M. Simwa, D.N. Maeda, J. Stephens, and H. Hakuza. 1994. The status of pesticide usage in East Africa. *Afr J Health Sci*. 1:37-41.

McCulloch, N., and M. Ota. 2002. Export horticulture and poverty in Kenya. Institute for Development Studies, Brighton.

McGregor, M., J. Willock, and I. Deary. 1995. Farmer stress. *Farm Management*. 9:57-65.

McKenna, S.P., and L.C. Doward. 2005. The Translation and Cultural Adaptation of Patient-Reported Outcome Measures. *Value in Health*. 8:89-91.

Mela, C.F., and P.K. Kopalle. 2002. The impact of collinearity on regression analysis: the asymmetric effect of negative and positive correlations. *Applied Economics*. 34:667-677.

Mellor, J.W. 1999. Pro-Poor Growth - The Relation between Growth in Agriculture and Poverty Reduction. John Mellor Associates, Inc, USAID, Washington.

Mendonça, G.A.S., J. Eluf-Neto, M.J. Andrada-Serpa, P.A.O. Carmo, H.H.C. Barreto, O.N.K. Inomata, and T.A. Kussum. 1999. Organochlorines and breast cancer: A case-control study in Brazil. *International Journal of Cancer*. 83:596 - 600.

Mepham, T.B. 2000. Symposium on 'The ethics of food production and consumption' The role of food ethics in food policy. *Proceedings of the Nutrition Society*. 59:609-618.

Merrington, G., L. Winder, R. Parkinson, and M. Redman. 2002. Agricultural Pollution: Environmental Problems and Practical Solutions. Spon Press, London.

Michelsen, J. 2001. Recent development and political acceptance of organic farming in Europe. *Sociologia Ruralis*. 41:3-20.

Milà i Canals, L., G.M. Burnip, and S.J. Cowell. 2006. Evaluation of the environmental impacts of apple production using Life Cycle Assessment (LCA): case study in New Zealand. *Agriculture, Ecosystems and Environment*. 114:226-238.

Milà i Canals, L., S.J. Cowell, S. Sim, and L. Basson. 2007. Comparing local versus imported apples: A focus on energy use. *Environmental Science and Pollution Research*. In press.

Mills, P.K., and R. Yang. 2005. Breast cancer risk in Hispanic agricultural workers in California. *International Journal of Occupational and Environmental Health*. 11:123-131.

Minot, N., and M. Ngigi. 2004. Are horticultural exports a replicable success story? Evidence from Kenya and Côte d'Ivoire. International Food Policy Research Institute, Washington, D.C.

Morgan, K., T. Marsden, and J. Murdoch. 2006. Worlds of food. Place, power and provenance in the food chain. Oxford University Press, Oxford.

Morgan, K., and J. Murdoch. 2000. Organic vs. conventional agriculture: knowledge, power and innovation in the food chain. *Geoforum*. 31:159-173.

Morison, J., R. Hine, and J. Pretty. 2005. Survey and analysis of labour on organic farms in the UK and Republic of Ireland. *International Journal of Agricultural Sustainability*. 3:24-43.

Mouron, P., T. Nemecek, R.W. Scholz, and O. Weber. 2006. Management influence on environmental impacts in an apple production system on Swiss fruit farms: Combining life cycle assessment with statistical risk assessment. *Agriculture Ecosystems & Environment*. 114:311-322.

Muldoon, M.F., S.D. Barger, J.D. Flory, and S.B. Manuck. 1998. What are quality of life measurements measuring? *BMJ*. 316:542-545.

Murphy, H.H., A. Sanusi, R. Dilts, M. Djajadisastra, N. Hirschhorn, and S. Yuliantiningsih. 1999. Health Effects of Pesticide Use Among Indonesian Women Farmers: Part I, Exposure and Acute Effects. *Journal of Agromedicine*. 6:61-85.

Murray, D., C. Wesseling, M. Keifer, M. Corriols, and S. Henao. 2002. Surveillance of pesticide-related Illness in the developing world: putting the data to work. *Int. J. Occup. Environ. Health*. 8:243–248.

Myers, C., and D. Wilks. 1999. Comparison of Euroqol EQ-5D and SF-36 in patients with chronic fatigue syndrome. *Quality of Life Research*. 8:9-16.

National Assembly of Wales (NAfW). 1999. Welsh Health Survey 1998: results of the second Welsh Health Survey. HMSO, Norwich.

Nemecek, T., and S. Erzinger. 2005. Modelling representative life cycle inventories for Swiss arable crops. *International Journal of Life Cycle Assessment* 10:68-76.

Nienhuis, and de Vreede. 1996. Utility of the environmental life cycle assessment method in horticulture. *Acta Horticulturae (ISHS)*. 429:531-538.

Norberg-Hodge, H., T. Merrifield, and S. Gorelick. 2002. Bringing the food economy home: Local alternatives to global agribusiness. Zed Books, London.

Nowels, D., J. McGloin, J.M. Westfall, and S. Holcomb. 2005. Validation of the EQ-5D quality of life instrument in patients after myocardial infarction. *Quality of Life Research*. 14:95-105.

Nygard, B., and O. Storstad. 1998. De-globalization of food markets? Consumer perceptions of safe food: the case of Norway. *Sociologia Ruralis*. 38:35-53.

O'Hara, S.U., and S. Stagl. 2001. Global Food Markets and Their Local Alternatives: A Socio-Ecological Economic Perspective. *Population & Environment*. 22:533-554.

Ohayo-Mitoko, G.J.A., H. Kromhout, P.N. Karumba, and J.S.M. Boleji. 1999. Identification of determinants of pesticide exposure among Kenyan agricultural workers using empirical modelling. *Annals of Occupational Hygiene*. 43:519-525.

Ohayo-Mitoko, G.J.A., H. Kromhout, J.W. Simwa, S.M. Boleji, and D. Heederik. 2000. Self reported symptoms and inhibition of acetylcholinesterase activity among Kenyan agricultural workers. *Occupational Environmental Medicine*. 57:195-200.

Okello, P.E., W.I.M. Van Bortel, A.M. Byaruhanga, A. Correwyn, P. Roelants, A. Talisuna, U. D'Alessandro, and M. Coosemans. 2006. Variation in malaria transmission intensity sites throughout Uganda. *Am J Trop Med Hyg*. 75:219-225.

Olaya-Contreras, P., J. Rodríguez-Villamil, H.J. Posso-Valencia, and J.E. Cortez. 1998. Organochlorine exposure and breast cancer risk in Colombian women. *Cadernos de Saúde Pública*. 14.

Onwujekwe, O., R. Chima, and P. Okonkwo. 2000. Economic burden of malaria illness on households versus that of all other illness episodes: a study in five malaria holo-endemic Nigerian communities. *Health Policy*. 54:143-159.

Pacini, C., A. Wossink, G. Giesen, C. Vazzana, and R. Huirne. 2003. Evaluation of sustainability of organic, integrated and conventional farming systems: a farm and field-scale analysis. *Agriculture, Ecosystems and Environment*. 95:273-288.

Parrott, N., N. Wilson, and J. Murdoch. 2002. Spatializing quality: Regional protection and the alternative geography of food. *European Urban and Regional Studies*. 9:241-261.

Parry, G., P. Van Cleemput, J. Peters, S. Walters, K. Thomas, and C. Cooper. 2007. Health status of Gypsies and Travellers in England. *J Epidemiol Community Health*. 61:198-204.

Penagos, H.G. 2002. Contact dermatitis caused by pesticides among banana plantation workers in Panama. *International Journal of Occupational and Environmental Health*. 8:14-18.

Pender, J., P. Jagger, E. Nkonya, and D. Sserunkuuma. 2004. Development pathways and land management in Uganda. *World Development*. 32:767-792.

Perkins, J.J., and R.W. Sanson-Fisher. 1998. An examination of self- and telephone-administered modes of administration for the Australian SF-36. *Journal of Clinical Epidemiology*. 51:969-973.

Peterson, M.G.E., J.P. Allegrante, J.P. Allegrante, C.N. Cornell, C.N. Cornell, C.R. MacKenzie, L. Robbins, R. Horton, S.B. Ganz, S.B. Ganz, and A. Augurt. 2002. Measuring Recovery after a Hip Fracture Using the SF-36 and Cummings Scales. *Osteoporosis International*. 13:296-302.

Picavet, H.S.J., and N. Hoeymans. 2004. Health related quality of life in multiple musculoskeletal diseases: SF-36 and EQ-5D in the DMC3 study. *Ann Rheum Dis*. 63:723-729.

Pollan, M. 2006. Big organic. *In* The omnivore's dilemma: the search for a perfect meal in a fast-food world. Bloomsbury Publishing, London. 134-184.

Powers, S.E. 2007. Nutrient loads to surface water from row crop production. *International Journal of Life Cycle Assessment* 12:399-407.

Pretty, J., and R. Hine. 2005. Pesticide use and the environment. *In* The Pesticide Detox: towards a more sustainable agriculture. J. Pretty, editor. Earthscan, London.

Pretty, J., and H. Waibel. 2005. Paying the price:the full cost of pesticides. *In* The Pesticide Detox: towards a more sustainable agriculture. J. Pretty, editor. Earthscan, London.

Pretty, J.N. 1999. Regenerating agriculture: politics and practice for sustainability and self-reliance. Earthscan, London.

Pretty, J.N., A.S. Ball, T. Lang, and J.I.L. Morison. 2005. Farm costs and food miles: An assessment of the full cost of the UK weekly food basket. *Food Policy*. 30:1-19.

Price, C.I.M., R.H. Curless, and H. Rodgers. 1999. Can Stroke Patients Use Visual Analogue Scales? *Stroke*. 30:1357-1361.

Puuponen-Pimia, R., S.T. Hakkinen, M. Aarni, T. Suortti, A.M. Lampi, M. Eurola, V. Piironen, A.M. Nuutila, and K.M. Oksman-Caldentey. 2003. Blanching and long-term freezing affect various bioactive compounds of vegetables in different ways. *Journal of the Science of Food and Agriculture*. 83:1389-1402.

Quin, F., J.L. Maud, and G. Edwards-Jones. 1999. Trends in environmental risk arising from pesticides applied to cereals in Scotland 1974–1996. In: Proceedings of the Crop Protection in Northern Britain. 23-30.

Quin, F.S., and G. Edwards-Jones. 1997. The use of impact ranking indices in the regulation of pesticide use: The case of taxes. *In* 1997 Brighton Crop Protection Conference - Weeds, Conference Proceedings Vols 1-3. 469-476.

Raoult-Wack, A.-L., and N. Bricas. 2002. Ethical Issues Related to Food Sector Evolution in Developing Countries: About Sustainability and Equity. *Journal of Agricultural and Environmental Ethics*. 15:323-334.

Raphael, D., J. Macdonald, R. Colman, R. Labonte, K. Hayward, and R. Torgerson. 2005. Researching income and income distribution as determinants of health in Canada: gaps between theoretical knowledge, research practice, and policy implementation. *Health Policy*. 72:217-232.

Ravallion, M., and G. Datt. 1999. When is Growth Pro-Poor? Evidence from the Diverse Experience of India's States. *In* Policy Research Paper. World Bank.

Rawls, J. 1999. A Theory of Justice, (revised edition). Oxford University Press, Oxford.

Raynolds, L.T. 2000. Re-embedding global agriculture: The international organic and fair trade movements. *Agriculture and Human Values*. 17:297-309.

Raynolds, L.T. 2004. The globalization of organic agro-food networks. *World Development*. 32:725-743.

RCEP. 2002. The environmental effects of civil aircraft in flight – Special report. Royal Commission on Environmental Pollution, UK.

RCEP. 2005. Crop spraying and the health of residents and bystanders. Royal Commission on Environmental Pollution, London.

Redekop, W.K., G. Rutten, M.A. Koopmanschap, B.H.R. Wolffenbuttel, R.P. Stolk, and L.W. Niessen. 2002. Health-related quality of life and

treatment satisfaction in Dutch patients with type 2 diabetes. *Diabetes Care*. 25:458-463.

Reeves, M., K. Schafer, K. Hallward, and A. Katten. 1999. Fields of poison: Californian farmworkers and pesticides. Pesticide Action Network, North America.

Reeves, M., and K.S. Schafer. 2003. Greater risks, fewer rights: U.S. farmworkers and pesticides. *International Journal of Occupational Environmental Health*. 9:30-39.

Rescher, N. 1983. Risk: A Philosophical Introduction to the Theory of Risk Evaluation and Management. University Press of America, Lanham, MD.

Restrepo, M., N. Munoz, N. Day, J.E. Parra, C. Hernandez, M. Blettner, and A. Giraldo. 1990. Birth-Defects among Children Born to a Population Occupationally Exposed to Pesticides in Colombia. *Scandinavian Journal of Work Environment & Health*. 16:239-246.

Ringback Weitoft, G., and M. Rosen. 2005. Is perceived nervousness and anxiety a predictor of premature mortality and severe morbidity? A longitudinal follow up of the Swedish survey of living conditions. *J Epidemiol Community Health*. 59:794-798.

Roelandt, C., B. van Wesemael, and M. Rounsevell. 2005. Estimating annual N_2O emissions from agricultural soils in temperate climates. *Global Change Biology*. 11:1701-1711.

Romieu, I., M. Hernandez-Avila, E. Lazcano-Ponce, J.P. Weber, and E. Dewailly. 2000. Breast cancer, lactation history, and serum organochlorines. *American Journal of Epidemiology*. 152:363-370.

Ruger, J.P. 2003. Health and development. *The Lancet*. 362:678.

Ruger, J.P. 2004. Health and social justice. *The Lancet*. 364:1075-1080.

Ruger, J.P. 2006. Toward a Theory of a Right to Health: Capability and Incompletely Theorized Agreements. *Yale Journal of Law & the Humanities*. 18:273-326.

Sach, T.H., G.R. Barton, M. Doherty, K.R. Muir, C. Jenkinson, and A.J. Avery. 2006. The relationship between body mass index and health-related quality of life: comparing the EQ-5D, EuroQol VAS and SF-6D. Int J Obes. 31:189-196.

Sachs, J., and P. Malaney. 2002. The economic and social burden of malaria. *Nature*. 415:680-685.

Sandborn, M., D. Cole, K. Kerr, C. Vakil, L. Sanin, and K. Bassil. 2004. Systematic Review of Pesticide Human Health Effects. The Ontario College of Family Physicians, Ontario.

Sanford, R.L., W.J. Parton, D.S. Ojima, and D.J. Lodge. 1991. Hurricane effects on soil organic-matter dynamics and forest production in the Luquillo experimental forest, Puerto Rico – results of simulation modelling. *Biotropica*. 23:364-372.

Sanne, B., A. Mykletun, B.E. Moen, A.A. Dahl, and G.S. Tell. 2004. Farmers are at risk for anxiety and depression: the Hordaland Health Study. *Occup Med (Lond)*. 54:92-100.

Sapin, C., B. Fantino, M.-L. Nowicki, and P. Kind. 2004. Usefulness of EQ-5D in assessing health status in primary care patients with major depressive disorder. *Health and Quality of Life Outcomes*. 2:20.

Saunders, C., A. Barber, and G. Taylor. 2006. Food miles – comparative energy/emissions performance of New Zealand's agriculture industry. Lincoln University, Lincoln, New Zealand.

Schlesinger, W.H., and J.A. Andrews. 2000. Soil respiration and the global carbon cycle. *Biogeochemistry*. 48:7-20.

Schlich, E.H., and U. Fleissner. 2005. The ecology of scale: Assessment of regional energy turnover and comparison with global food. *International Journal of Life Cycle Assessment*. 10:219-223.

Schoenfeld, D., L. Malmrose, D. Blazer, D. Gold, and T. Seeman. 1994. Self-rated health and mortality in the high-functioning elderly-a closer look at healthy individuals: MacArthur field study of successful aging. *J Gerontol*. 49:109-15.

Schrag, A., C. Selai, M. Jahanshahi, and N.P. Quinn. 2000. The EQ-5D, a generic quality of life measure, is a useful instrument to measure quality of life in patients with Parkinson's disease. *J Neurol Neurosurg Psychiatry*. 69:67-73.

Schröder, M.J.A. 2003. Food quality and consumer value: Delivering food that satisfies. Springer, Berlin.

Segarra, E., D. de la Torre Ugarte, J. Malaga, and G.W. Williams. 2003. Social Welfare and Environmental Degradation in Agriculture: The Case of Ecuador. *In* 25th International Conference of Agricultural Economists, Durban, South Africa.

Sen, A. 1983. Poor, relatively speaking. *Oxf. Econ. Pap.* 35:153-169.

Sen, A. 1985. Commodities and Capabilities. Elsevier Science Publishers, Amsterdam.

Senthilselven, A., J.A. McDuffie, and J.A. Dosman. 1992. Association of asthma with use of pesticides - results of a cross-sectional survey of farmers. *American Review of Respiratory Disease*. 146:884-887.

Seyfang, G. 2006. Ecological citizenship and sustainable consumption: Examining local organic food networks. *Journal of Rural Studies*. 22:383-395.

Shadbolt, B., J. McCallum, and M. Singh. 1997. Health outcomes by self-report: validity of the SF-36 among Australian hospital patients. *Quality of Life Research*. 6:343-352.

Shah, H.T. 2004. Kenya: exporting out of Africa- Kenya's horticulture success story. Paper presented at Scaling up Poverty Reduction. *In* A Global Process Conference. World Bank, Shanghai.

Sharma, V.P. 2003. Malaria and poverty in India. *Current Science*. 84:513-515.

Sharpe, R.M., and D.S. Irvine. 2004. How strong is the evidence of a link between environmental chemicals and adverse effects on human reproductive health? *BMJ*. 328:447-451.

Shreck, A., C. Getz, and G. Feenstra. 2006. Social sustainability, farm labor, and organic agriculture: Findings from an exploratory analysis. *Agriculture and Human Values*. 23:439-449.

Silla, I., F.J. Gracia, and J.M. Peiro. 2005. Job Insecurity and Health-Related Outcomes among Different Types of Temporary Workers. *Economic and Industrial Democracy*. 26:89-117.

Simkin, S., K. Hawton, J. Fagg, and A. Malmberg. 1998. Stress in farmers: a survey of farmers in England and Wales. *Occup Environ Med.* 55:729-734.

Singer, P., and J. Mason. 2006. The way we eat: why our food choices matter. Rodale, USA. 328 pp.

Singh-Manoux, A., A. Gueguen, P. Martikainen, J. Ferrie, M. Marmot, and M. Shipley. 2007. Self-rated health and mortality: short- and long-term associations in the Whitehall II Study. *Psychosom Med.* 69:138-143.

Skakkebaek, N.E., E. Rajpert-De Meyts, and K.M. Main. 2001. Testicular dysgenesis syndrome: an increasingly common developmental disorder with environmental aspects. *Apmis.* 109:S22-S28.

Smith, A., P. Watkiss, G. Tweddle, A. McKinnon, M. Browne, A. Hunt, C. Treleven, C. Nash, and S. Cross. 2005a. The validity of food miles as an indicator of sustainable development, ED50254, -103. DEFRA, Oxon, UK.

Smith, D.T., M.K. Harris, and T. X Liu. 2002a. Adoption of Pest Management Practices by Vegetable Growers: A Case Study. *American Entomologist.* 48:236-242.

Smith, S., D. Auret, S. Barrientos, C. Dolan, K. Kleinbooi, C. Niobvu, M. Opondo, and A. Tallontire. 2004. Ethical trade in African horticulture: gender, rights and participation. IDS, Brighton.

Smith, W.N., R.L. Desjardins, B. Grant, C. Li, R. Lemke, P. Rochette, M.D. Corre, and D. Pennock. 2002b. Testing the DNDC model using N2O emissions at two experimental sites in Canada. *Canadian Journal of Soil Science.* 82:365-374.

Soil Association. 2007. Soil Association Standards Consultation-Air Freight Green Paper. Soil Association, Bristol.

Soil Association. 2008. http://www.soilassociation.org. Vol. 2008.

Sonko, R., E. Njue, J.M. Ssebuliba, and A. de Jager. 2005. Pro-poor horticulture In East Africa and South East Asia: The horticultural sector in Uganda. Agricultural Economics Research Institute: Wageningen University and Research Centre, The Hague.

Southgate, D., D.H. Graham, and L. Tweeten. 2007. The World Food Economy. Blackwell Publishing, MA, USA.

Spielmann, M., T. Kägi, and O. Tietje. 2004. Life cycle inventories of transport services. Final report ecoinvent 2000. Swiss Centre for Life Cycle Inventories, Duebendorf (Switzerland).

SPSS. 2003. Statistical Package for Social Scientists. The Apache Software Foundation, USA.

Stadig, M. 1997. Life cycle assessment of apple production – case studies for Sweden, New Zealand and France. SIK, Gothenburg, Sweden.

Stallones, L., and C. Beseler. 2002. Pesticide poisioning and depressive symptoms among farm residents. *Annals of Epidemiology.* 12:389-394.

Stanistreet, D., A. Scott-Samuel, and M.A. Bellis. 1999. Income in inequality and mortality in England. *J Public Health.* 21:205-207.

Stansfeld, S.A., R. Roberts, and S.P. Foot. 1997. Assessing the validity of the SF-36 General Health Survey. *Quality of Life Research.* 6:0.

Stephens, R., A. Spurgeon, I.A. Calvert, J. Beach, L.S. Levy, H. Berry, and J.M. Harrington. 1995. Neuropsychological effects of long-term exposure to organophosphates in sheep dip. *The Lancet.* 345:1135-9.

Stevens, B. 1994. An analysis of corporate ethical code studies: "Where do we go from here?" *Journal of Business Ethics*. 13:63-69.

Stevens, C., and J. Kennan. 2000. Will Africa's participation in horticulture chains survive liberalisation? Institute of Development Studies, University of Sussex, UK.

Stronks, K., H. van de Mheen, J. van den Bos, and J.P. Mackenbach. 1997. The interrelationship between income, health and employment status. *Int. J. Epidemiol.* 26:592-600.

Sundkvist, A., A.M. Jansson, and P. Larsson. 2001. Strengths and limitations of localizing food production as a sustainability-building strategy - an analysis of bread production on the island of Gotland, Sweden. *Ecological Economics*. 37:217-227.

Sustain. 2008. Sustainweb http://www.sustainweb.org

Suwanwaree, P., and G.P. Robertson. 2005. Methane oxidation in forest, successional, and no-till agricultural ecosystems: Effects of nitrogen and soil disturbance. *Soil Science Society of America Journal*. 69:1722-1729.

Tahmaz, N., A. Soutar, and J.W. Cherrie. 2003. Chronic fatigue and organophosphate pesticides in sheep farming: A retrospective study amongst people reporting to a UK pharmacovigilance scheme. *Annals of Occupational Hygiene*. 47:261-267.

Talamo, J., A. Frater, S. Gallivan, and A. Young. 1997. Use of the short form 36 (SF36) for health status measurement in rheumatoid arthritis. *Rheumatology*. 36:463-469.

Thomas, H.V., G. Lewis, D.R. Thomas, R.L. Salmon, R.M. Chalmers, T.J. Coleman, S.M. Kench, P. Morgan-Capner, D. Meadows, M. Sillis, P. Softley, and R. Jenkins. 2003. Mental health of British farmers. *Occup Environ Med*. 60:181-186.

Thomas, M.R., R.P. Davis, and D.G. Garthwaite. 1991. Pesticide usage survey report: vegetables for human consumption 1991. Ministry of Agriculture, Fisheries and Food, Harpenden.

Thomas, M.R., D.G. Garthwaite, and A.R. Banham. 1997. Pesticide usage survey report: arable farm crops in Great Britain in 1996. MAFF.

Thompson, P.B. 2001. Risk, consent and public debate: some preliminary considerations for the ethics of food safety. *International Journal of Food Science & Technology*. 36:833-843.

Thrupp, L.A. 1991. Sterilization of workers from pesticide exposure: the causes and consequences of DBCP-induced damage in Costa Rica and beyond. *Int J Health Serv*. 21:731-57.

Tonitto, C., M.B. David, C.S. Li, and L.E. Drinkwater. 2007. Application of the DNDC model to tile-drained Illinois agroecosystems: model comparison of conventional and diversified rotations. *Nutrient Cycling in Agroecosystems*. 78:65-81.

Tzilivakis, J., K. Jaggard, K.A. Lewis, M. May, and D.J. Warner. 2005. Environmental impact and economic assessment for UK sugar beet production systems. *Agriculture, Ecosystems and Environment*. 107:341-358.

UNDP. 2003. Human development report 2003 Millennium Development Goals: A compact among nations to end human poverty. United Nations Development Programme, Oxford.

UNECE. 2007. United Nations Economic Commission for Europe, Documents of the working party on agricultural quality standards. .

van der Gulden, J.W.J., and P.F.J. Vogelzang. 1996. Farmers at risk for prostate cancer. *In* BJU International. Vol. 77. 6-14.

van Doorslaer, E., A. Wagstaff, H. Bleichrodt, S. Calonge, U.G. Gerdtham, M. Gerfin, J. Geurts, L. Gross, U. Hakkinen, R.E. Leu, O. Odonnell, C. Propper, F. Puffer, M. Rodriguez, G. Sundberg, and O. Winkelhake. 1997. Income-related inequalities in health: Some international comparisons. *Journal of Health Economics*. 16:93-112.

van Emden, H.F., and D.B. Peakall. 1996. Beyond Silent Spring: IPM and Chemical Safety. Chapman & Hall, London.

van Maele-Fabry, G., and J.L. Willems. 2003. Occupation related pesticide exposure and cancer of the prostate: a meta-analysis. *Occupational and Environmental Medicine*. 60:634-642.

Van Oost, K., G. Govers, S. de Alba, and T.A. Quine. 2006. Tillage erosion: a review of controlling factors and implications for soil quality. *Progress in Physical Geography*. 30:443-466.

van Veldhoven, M., J. de Jonge, S. Broersen, M. Kompier, and T. Meijman. 2002. Specific relationships between psychosocial job conditions and job-related stress: A three-level analytic approach. *Work and Stress*. 16:207-228.

Verkerk, M.A., J.J.V. Busschbach, and E.D. Karssing. 2001. Health-related quality of life research and the capability approach of Amartya Sen. *Quality of Life Research*. 10:49-55.

Villarejo, D. 2003. The health of US hired farm workers. *Annual Review of Public Health*. 24:175-193.

Villarejo, D., and S. Baron. 1999. The occupational health status of hired farm workers. *Occupational Medicine: State of the Art Reviews. Special Populations*. 14:613-35.

Vink, J.M., G. Willemsen, J.H. Stubbe, C.M. Middeldorp, R.S.L. Ligthart, K.D. Baas, H.J.C. Dirkzwager, E.J.C. de Geus, and D.I. Boomsma. 2004. Estimating Non-Response Bias in Family Studies: Application to Mental Health and Lifestyle. *European Journal of Epidemiology*. 19:623-630.

Virtanen, M., M. Kivimaki, M. Joensuu, P. Virtanen, M. Elovainio, and J. Vahtera. 2005. Temporary employment and health: a review. *Int. J. Epidemiol.* 34:610-622.

Vogl, C.R., L. Kilcher, and H. Schmidt. 2005. Are standards and regulations of organic farming moving away from small farmers' knowledge? *Journal for Sustainable Agriculture*. 26:5-26.

Vuichard, N., J.F. Soussana, P. Ciais, N. Viovy, C. Ammann, P. Calanca, J. Clifton-Brown, J. Fuhrer, M. Jones, and C. Martin. 2007. Estimating the greenhouse gas fluxes of European grasslands with a process-based model: 1. Model evaluation from in situ measurements. *Global Biogeochemical Cycles*. 21.

Wagner, A.K., K. Wyss, B. Gandek, P.M. Kilima, S. Lorenz, and D. Whiting. 1999. A Kiswahili version of the SF-36 Health Survey for use in Tanzania: translation and tests of scaling assumptions. *Quality of Life Research*. 8:101-110.

WagnerRiddle, C., G.W. Thurtell, K.M. King, G.E. Kidd, and E.G. Beauchamp. 1996. Nitrous oxide and carbon dioxide fluxes from a bare soil using a

micrometeorological approach. *Journal of Environmental Quality.* 25:898-907.

Wandiga, S.O. 2001. Use and distribution of organochlorine pesticides. The future in Africa. *Pure and Applied Chemistry.* 73:1147-1155.

Wangler, Z.L. 2006. Sub-Saharan African horticultural exports to the UK and climate change: a literature review. International Institute for Environment and Development, London.

Wannamethee, G., and A.G. Shaper. 1991. Self-assessment of health status and mortality in middle-aged British men. *Int. J. Epidemiol.* 20:239-245.

Ware, J., and M. Kosinski. 2001. SF-36 Physical and Mental Health Summary Scales: A Manual for Users of Version 1. QualityMetric Incorporated, Lincoln, RI.

Ware, J., M. Kosinski, and S. Keller. 1994. SF-36 Physical and Mental Health Summary Scales: A User's Manual. Health Assessment Lab, Boston, MA.

Ware, J.E., and B. Gandek. 1998. Overview of the SF-36 Health Survey and the International Quality of Life Assessment (IQOLA) Project. *Journal of Clinical Epidemiology.* 51:903-912.

Ware, J.E.J. 2000. SF-36 Health Survey Update. *Spine.* 25:3130-3139.

Weatherell, C., A. Tregear, and J. Allinson. 2003. In search of the concerned consumer: UK public perceptions of food, farming and buying local. *Journal of Rural Studies.* 19:233-244.

Weinberger, K., and T.A. Lumpkin. 2007. Diversification into horticulture and poverty reduction: a research agenda. *World Development.* 35:1464-1480.

Weinberger, M., E.Z. Oddone, G.P. Samsa, and P.B. Landsman. 1996. Are health-related quality-of-life measures affected by the mode of administration? Journal of Clinical Epidemiology. 49:135-140.

Wells, B., S. Gradwell, and R. Yoder. 1999. Growing food, growing community: Community Supported Agriculture in rural Iowa. *Community Dev J.* 34:38-46.

Wesseling, C., L. Castillo, and C.G. Elinder. 1993. Pesticide poisonings in Costa-Rica. *Scandinavian Journal of Work Environment & Health.* 19:227-235.

Wesseling, C., R. McConnell, T. Partanen, and C. Hogstedt. 1997. Agricultural pesticide use in developing countries: health effects and research needs. *International Journal of Health Services.* 27:273-308.

Whitaker, M., and S. Kolavalli. 2004. Floriculture in Kenya. World Bank.

Whitehead, R. 1996. The UK Pesticide Guide 1996. CAB International, Wallingford, England.

Whitehead, R. 2001. The UK Pesticide Guide 2001. CAB International, Wallingford, England.

Whitehead, R. 2003. The UK Pesticide Guide 2003. CAB International, Wallingford, England.

Whitehead, R. 2004. The UK Pesticide Guide 2004. CAB International, Wallingford, England.

WHO. 1990. Diet, nutrition, and the prevention of chronic diseases. N. (WHOTechnical Report Series, editor. World Health Organization, Geneva.

WHO. 2006. Toxic hazards: agrochemicals, health and environment – directory of resources. World Health Organization.

WHO. 2008. The international classification of functioning, disability and health.

Whorton, D., R. Krauss, S. Marshall, and T. Milby. 1977. Infertility in male pesticide workers. *The Lancet*. 310:1259-1261.

Wiklund, K., J. Dich, and L.E. Holm. 1988. Soft-Tissue Sarcoma Risk in Swedish Licensed Pesticide Applicators. *Journal of Occupational and Environmental Medicine*. 30:801-804.

Wild, D., A. Grove, M. Martin, S. Eremenco, S. McElroy, A. Verjee-Lorenz, and E. Pennifer. 2005. Principles of Good Practice for the Translation and Cultural Adaptation Process for Patient-Reported Outcomes (PRO) Measures: Report of the ISPOR Task Force for Translation and Cultural Adaptation. *Value in Health*. 8:94-104.

Williams, A.G., E. Audsley, and D.L. Sandars. 2006. Determining the environmental burdens and resource use in the production of agricultural and horticultural commodities. Main Report. Defra Research Project IS0205. Cranfield University and Defra Bedford.

Williamson, S. 2003. Pesticide provision in liberalised Africa: out of control? Agricultural Research & Extension Network.

Willis, P. 2006. Failure of Kenya's rains puts 2.5m at risk of famine. *In* The Independant On Line Edition.

Wilson, C., and C. Tisdell. 2001. Why farmers continue to use pesticides despite environmental, health and sustainability costs. *Ecological Economics*. 39:449-462.

Winter, M. 2003. Embeddedness, the new food economy and defensive localism. *Journal of Rural Studies*. 19:23-32.

Wolfs, C.A.G., C.D. Dirksen, A. Kessels, D.C.M. Willems, F.R.J. Verhey, and J.L. Severens. 2007. Performance of the EQ-5D and the EQ-5D+C in elderly patients with cognitive impairments. *Health and Quality of Life Outcomes*. 5.

Wood-Dauphinee, S. 1999. Assessing Quality of Life in Clinical Research: From Where Have We Come and Where Are We Going? *Journal of Clinical Epidemiology*. 52:355-363.

World Bank. 2004. Kenya: Exporting Out of Africa - Kenya's Horticulture Success Story. World Bank.

World Medical Organization. 1996. Nuremberg Doctor's Trial Declaration of Helsinki (1964). *British Medical Journal*. 313:1448-1449.

Worrall, E., S. Basu, and K. Hanson. 2005. Is malaria a disease of poverty? A review of the literature. *Tropical Medicine & International Health*. 10:1047-1059.

Wu, A.W., D.L. Jacobson, R.A. Berzon, D.A. Revicki, C. vanderHorst, C.J. Fichtenbaum, M.S. Saag, L. Lynn, D. Hardy, and J. Feinberg. 1997. The effect of mode of administration on Medical Outcomes Study health ratings and EuroQol scores in AIDS. *Quality of Life Research*. 6:3-10.

Wyss, K., A.K. Wagner, D. Whiting, D.M. Mtasiwa, M. Tanner, B. Gandek, and P.M. Kilima. 1999. Validation of the Kiswahili version of the SF-36 Health Survey in a representative sample of an urban population in Tanzania. *Quality of Life Research*. 8:111-120.

Yamazaki, S., H. Nitta, and S. Fukuhara. 2006. Associations between exposure to ambient photochemical oxidants and the vitality or mental health domain of the health related quality of life. *J Epidemiol Community Health*. 60:173-179.

Zahm, S.H., and M.H. Ward. 1998. Pesticides and childhood cancer. *Environ Health Perspect*. 106:893-908.

Appendices

Appendix 1.0

Principle well-being questionnaire used in all participating countries

Well-being survey of horticultural workers

The horticultural sector has undergone important changes in the past twenty years. We are interested in discovering how these changes have affected the lives of people working in horticulture. It is hoped that the following questionnaire will provide us with a better understanding of your working conditions as well as shedding light on your personal well-being and life-style. By responding to the following questions you are providing us with important information that we greatly value.

All information you provide will be kept **confidential** and will only be used for the purposes of this research. It should take approximately 20 minutes to complete all the questions.

Please try to ensure that <u>all</u> questions are answered as this will provide us with a much more detailed and accurate view of your employment situation.

Thank you very much for being so giving of your time.

Please try to complete the following questions as fully as possible. Instructions are given at the beginning of each new question area as to how to answer. Most questions require either a tick to placed in a box or to circle a choice already provided. Where written answers are required, normally one or two words will be sufficient.

Finally, please could you ensure that there are **no unanswered questions** from section 15 onwards.

1. Personal details

Please tick those boxes which apply to you

a. Could you tell us your age? ☐ **b.** gender M ☐ F ☐ **c.** What is your nationality? ☐

d. Are you permanently resident in the UK? Yes ☐ No ☐

e. Marital status

Are you single ☐ married/ partnered ☐ divorced ☐ widowed ☐

f. At what level did you complete your education?

primary ☐ secondary ☐ college ☐ university ☐

g. Would you describe yourself as…

A current smoker ☐ An ex-smoker ☐ A non-smoker ☐

2. Employment

a. Would you tell us what your current job title is? ☐

b. Are you currently employed as a… (Please circle)

Permanent worker | Part-time | Temporary full-time | Seasonal worker | Part-time seasonal

c. How long have you been employed in this type of work?

less than 6 months ☐ 6 months – 1 year ☐ more than 1 year ☐ more than one season ☐ If you are part-time or seasonal, do you return each year ☐

d. How many days per week do you work in your present job? 1 | 2 | 3 | 4 | 5 | 6 | 7

e. Is this your main job in terms of annual income? Yes ☐ No ☐

f. Do you have any other paid jobs? Yes ☐ No ☐ Student ☐

g. If yes then what other jobs do you do out of season? ☐

3. Job description

During a typical working day does your job involve any of the following?
(please write the approximate number of hours per day spent on each task):

tractor driving	using agricultural machinery	using warehouse machinery
hand planting crops	manual crop spraying	hand weeding
hand thinning	hand picking crops	using irrigation equipment
packing	cleaning, lifting	office work

Other (please specify

4. Work equipment

During a typical working day do you use any of the following? **(please tick the appropriate boxes)**

hand tools	boots	hat
mask	overalls	gloves

5. Facilities

a. Do you have access to any of the following at your work? **(please tick the appropriate boxes)**

tea hut	free lunch	work washing facilities	clothes drying facilities
clothing allowance	free housing	free water/gas/ electricity	holiday pay
sick pay	health care	childcare	work-related training

b. How far do you travel to work each day? **(please tick the appropriate boxes)**

Less than 1 km	1-5 km	5-10km	More than 10km

6. Working conditions

By using a scale where 1 is very bad and 5 is very good; how would you rate the following aspects of your work?
(please circle a score for each item that applies to you)

a.	Working outdoors	1	2	3	4	5	Not applicable
b.	Your wages	1	2	3	4	5	Not applicable
c.	Working in a team	1	2	3	4	5	Not applicable
d.	Your workload	1	2	3	4	5	Not applicable
e.	Working alone	1	2	3	4	5	Not applicable
f.	Doing physical work	1	2	3	4	5	Not applicable
g.	Planting	1	2	3	4	5	Not applicable
h.	Picking	1	2	3	4	5	Not applicable
i.	Post-spray picking	1	2	3	4	5	Not applicable
j.	Task repetition	1	2	3	4	5	Not applicable
k.	Handling vegetables	1	2	3	4	5	Not applicable

l. What do you think are the **best** aspects of your work here?

m. What do you think are the **worst** aspects of your work here?

7. Rates of pay

a. Please **circle** how many hours per day you worked last week, excluding overtime

4	5	6	7	8	9	10+

b. How much money did you earn last week?

c. How much do you think you earn each year?

Less than £6000	£6000-£10000	£10000-£14000	More than £14000

d. Do you work overtime? Yes / No

e. If yes how many hours last week?

f. What is the hourly overtime rate?

Same as standard rate	One and half times standard rate	Twice the Standard rate	Other

8. Standard of living

Could you please circle the description that best describes your present standard of living compared to five years ago and last year

	much better than now	better than now	similar than now	worse than now	much worse than now
a. Five years ago (2001) my standard of living was	1	2	3	4	5
b. Last year (2005) my standard of living was	1	2	3	4	5

c. Compared to last year do you have more or less money to spend? More | Less | No change

d. If you have more money, which of the following reasons might explain this change?

support from relatives | income from partner | income from UK horticulture | other

e. If you have less money, which of the following reasons might explain this change?

divorce or death of partner | partner lost their job | You left/lost a better paid job | other

9. Childcare

Please tick the appropriate box

a. Do you have any children? Yes | No

b. How many children do you have in each of the following age groups?

under 5 | 5-11 | 12-16 | 17-21

c. Who looks after the children when you are working?

yourself | partner | family | friends | themselves | day care centre | other

d. Do you pay for childcare? Yes | No

e. If yes, about how much do you pay per week?

10. Housing

Please answer the following in relation to your main place of residence (i.e. where you live for most of the year) **Please tick those boxes that apply to yourself**

a. Do you normally live at home with your parents or relatives?

b. Do you normally live at home with your partner?

c. Do you live in rented accommodation?

d. Do you own your accommodation?

e. Do you share your accommodation and if yes, how many people do you share with?

f. Do you live in a bungalow?

g. Do you live in a semi-detached house?

h. Do you live in a detached house?

i. Do you live in a hostel?

j. Do you live in a terraced house?

k. Do you live in a flat / maisonette?

l. Do you live in a mobile home?

m. Do you live in a type of accommodation not mentioned here?

11. Ownership

Please write in the shaded area how many of each of the items you own from the list below (these items should be possessed where you normally reside)

Item	How many of each item do you own?	Year the last item was bought (last two digits)
a. house, apartment		
b. automobile		
c. motorbike		
d. refrigerator		
e. dish washer		
f. microwave oven		
g. television		
h. satellite/cable television		
i. telephone		
j. mobile phone		
k. CD walkman		
l. video/DVD		
m. personal computer		
n. Internet access		
o. life insurance		
p. health insurance		
q. private pension scheme		

12. Alternative employment

a. What other job could you do if you were not working in horticulture?

b. Which country would you work in?

c. About how much per hour do you think this other job pays?

£5-6 | £7-8 | £9-10 | £11 or more

d. Would you advise young people to go into vegetable horticulture?

Yes | No

e. If yes, what particular job in horticulture would you recommend?

The following sections refer to how you feel emotionally, physically and mentally.
Please answer <u>all</u> questions.

13. Happiness

Please tick. In the past 7 days …	Never	Rarely	Some-times	Often
a. I felt dissatisfied with my life				
b. I felt happy				
c. I felt cheerless				
d. I felt pleased with the way I am				
e. I felt that life was enjoyable				
f. I felt that life was meaningless				

14. Symptoms

Could you tell us if you have suffered any of the following symptoms in the past 7 days?
Please tick the appropriate box.

Symptom	Never	Rarely	Some-times	Often
a. back ache	☐	☐	☐	☐
b. headaches	☐	☐	☐	☐
c. sunburn	☐	☐	☐	☐
d. nausea	☐	☐	☐	☐
e. vomiting	☐	☐	☐	☐
f. fatigue	☐	☐	☐	☐
g. allergies (hay fever etc)	☐	☐	☐	☐
h. aching joints	☐	☐	☐	☐
i. blurred vision	☐	☐	☐	☐
j. flu-like symptoms	☐	☐	☐	☐

15. By placing a tick in one box in each group below, please indicate which statements best describe your own health state today

a. Mobility

I have no problems in walking about

I have some problems in walking about

I am confined to bed

b. Self-Care

I have no problems with self-care

I have some problems washing or dressing myself

I am unable to wash or dress myself

c. Usual activities (e.g. work, study, housework, family or leisure activities)

I have no problems with performing my usual activities

I have some problems with performing my usual activities

I am unable to perform my usual activities

d. Pain/Discomfort

I have no pain or discomfort

I have moderate pain or discomfort

I have extreme pain or discomfort

e. Anxiety/Depression

I am not anxious or depressed

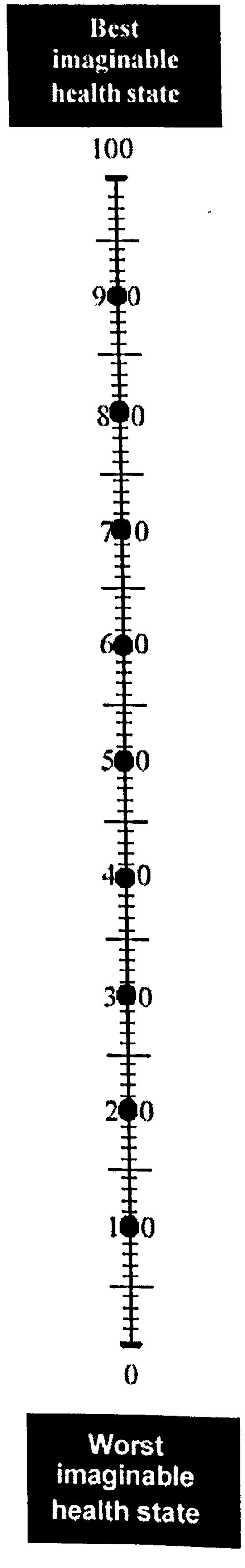
I am moderately anxious or depressed

I am extremely anxious or depressed

16.

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your health state is today.



17. Doctors
Please circle

a. Are you registered with a doctor? Y N

b. Are you required to register with a doctor by your employer? Y N

c. How many times have you seen a doctor / nurse / health care specialist in the past 3 months?

d. If your answer is yes to the previous question would you mind giving a reason why you visited the doctor?

This survey asks for your views about your health, how you feel, and how well you are able to do your usual activities. If you are unsure about how to answer a question, please give the best answer you can.

18. In general, would you say your health is: *Please circle* **one** *number.*

Excellent	Very good	Good	Fair	Poor
1	2	3	4	5

19. Compared to one year ago, how would you rate your health in general now? *Please circle* **one** *number.*

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse now than one year ago	Much worse Now than one year ago
1	2	3	4	5

20. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? *Please circle* **one** *number on* **each** *line.*

	ACTIVITIES	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
a.	**Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b.	**Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, playing golf	1	2	3
c.	Lifting or carrying a bag of shopping	1	2	3
d.	Climbing **several** flights of stairs	1	2	3
e.	Climbing **one** flight of stairs	1	2	3
f.	Bending, kneeling, or stooping	1	2	3
g.	Walking **more than a mile**	1	2	3
h.	Walking **half a mile**	1	2	3
i.	Walking **one hundred yards**	1	2	3
j.	Bathing or dressing yourself	1	2	3

21. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?
Please circle **one** *number on* **each** *line.*

		Yes	No
a.	Cut down on the **amount of time** you spent on work or other activities	1	2
b.	**Accomplished less** than you would like	1	2
c.	Were limited in the **kind** of work or other activities	1	2
d.	Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

22. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?
Please circle **one** *number on* **each** *line.*

		Yes	No
a.	Cut down on the **amount of time** you spent on work or other activities	1	2
b.	**Accomplished less** than you would like	1	2
c.	Didn't do work or other activities as **carefully** as usual	1	2

23. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?
Please circle **one** *number.*

Not at all	Slightly	Moderately	Quite a bit	Extremely
1	2	3	4	5

24. How much bodily pain have you had during the past 4 weeks?
Please circle **one** *number.*

None	Very Mild	Mild	Moderate	Severe	Very Severe
1	2	3	4	5	6

25. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)? *Please circle* **one** *number.*

Not at all	Slightly	Moderately	Quite a bit	Extremely
1	2	3	4	5

26. These questions are about how you feel and how things have been with you during the past 4 weeks.
For each question, please give the one answer that comes closest to the way you have been feeling.
How much of the time during the past 4 weeks...
Please circle **one** *number on* **each** *line.*

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of life?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and low?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
I. Did you feel tired?	1	2	3	4	5	6

27. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends or relatives)?
Please circle **one** *number.*

All of the time	Most of the time	Some of the time	A little of the time	None of the time
1	2	3	4	5

28. How TRUE or FALSE is each of the following statements for you?
Please circle **one** *number on* **each** *line.*

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a. I seem to get ill a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

Thank you very much for your time and consideration

Appendix 2.0

Longitudinal survey questionnaire used to assess changes in farm worker health over a three month period in 2007

Final well-being survey of horticultural workers

This is the **final** questionnaire. If you answered either the first or second questionnaire that we sent you earlier in the season, we would be delighted if you could answer this final set of questions.

Enclosed with this questionnaire are two blank envelopes. The first is for you to write your home address in your country of origin. The second envelope is for you to place your completed questionnaire and addressed envelope inside. If you wish to participate we will send a questionnaire in November to the address you provide in your home country. For each completed questionnaire returned to us we will send you **€10**. This is dependant on you having completed the first and last questionnaires of this summer.

The information you supply is very important to us and will be kept **confidential** and only used for the purposes of this research. It should take approximately 10 minutes to complete all the questions.

Please try to ensure that <u>all</u> questions are answered as this will provide us with a much more detailed and accurate view of your employment situation.

Thank you very much for your time and participation

1. Personal details

Please tick those boxes which apply to you

d. Could you tell us your age? ☐ **e.** gender M ☐ F ☐ **f.** What is your nationality? ☐

d. Are you permanently resident in the UK? Yes ☐ No ☐

f. Marital status

Are you single ☐ married/ partnered ☐ divorced ☐ widowed ☐

h. At what level did you complete your education?

primary ☐ secondary ☐ college ☐ university ☐

i. Would you describe yourself as…

A current smoker ☐ An ex-smoker ☐ A non-smoker ☐

The following sections refer to how you feel emotionally, physically and mentally.
Please answer <u>all</u> questions.

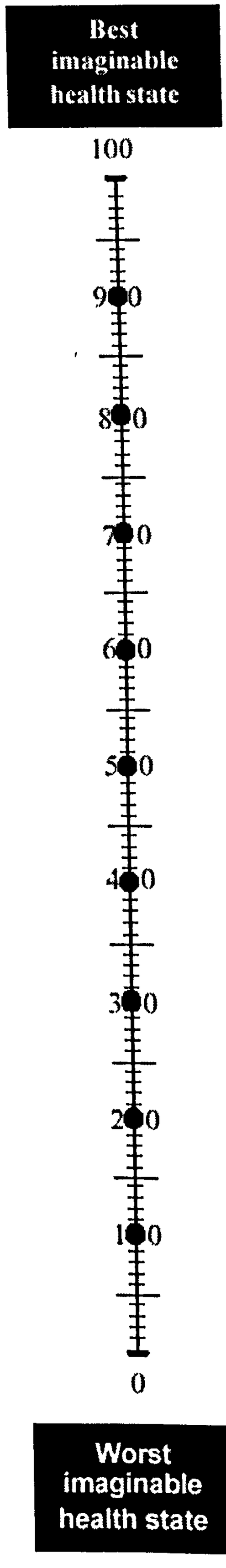
2. Happiness

Please tick. In the past 7 days …	Never	Rarely	Some-times	Often
a. I felt dissatisfied with my life	☐	☐	☐	☐
b. I felt happy	☐	☐	☐	☐
c. I felt cheerless	☐	☐	☐	☐
d. I felt pleased with the way I am	☐	☐	☐	☐
e. I felt that life was enjoyable	☐	☐	☐	☐
f. I felt that life was meaningless	☐	☐	☐	☐

3.

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your health state is today.



This survey asks for your views about your health, how you feel, and how well you are able to do your usual activities. If you are unsure about how to answer a question, please give the best answer you can.

4. In general, would you say your health is: *Please circle* **one** *number.*

Excellent	Very good	Good	Fair	Poor
1	2	3	4	5

5. Compared to one year ago, how would you rate your health in general now? *Please circle* **one** *number.*

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse now than one year ago	Much worse Now than one year ago
1	2	3	4	5

6. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? *Please circle* **one** *number on* **each** *line.*

	ACTIVITIES	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
a.	**Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b.	**Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, playing golf	1	2	3
c.	Lifting or carrying a bag of shopping	1	2	3
d.	Climbing **several** flights of stairs	1	2	3
e.	Climbing **one** flight of stairs	1	2	3
f.	Bending, kneeling, or stooping	1	2	3
g.	Walking **more than a mile**	1	2	3
h.	Walking **half a mile**	1	2	3
i.	Walking **one hundred yards**	1	2	3
j.	Bathing or dressing yourself	1	2	3

7. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?
Please circle **one** *number on* **each** *line.*

		Yes	No
a.	Cut down on the **amount of time** you spent on work or other activities	1	2
b.	**Accomplished less** than you would like	1	2
c.	Were limited in the **kind** of work or other activities	1	2
d.	Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

8. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?
Please circle **one** *number on* **each** *line.*

		Yes	No
a.	Cut down on the **amount of time** you spent on work or other activities	1	2
b.	**Accomplished less** than you would like	1	2
c.	Didn't do work or other activities as **carefully** as usual	1	2

9. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?
Please circle **one** *number.*

Not at all	Slightly	Moderately	Quite a bit	Extremely
1	2	3	4	5

10. How much bodily pain have you had during the past 4 weeks?
Please circle **one** *number.*

None	Very Mild	Mild	Moderate	Severe	Very Severe
1	2	3	4	5	6

11. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)? *Please circle* **one** *number.*

Not at all	Slightly	Moderately	Quite a bit	Extremely
1	2	3	4	5

12. These questions are about how you feel and how things have been with you during the past 4 weeks.
For each question, please give the one answer that comes closest to the way you have been feeling.
How much of the time during the past 4 weeks...
Please circle **one** *number on* **each** *line.*

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of life?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and low?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

13. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends or relatives)?
Please circle **one** *number.*

All of the time	Most of the time	Some of the time	A little of the time	None of the time
1	2	3	4	5

14. How TRUE or FALSE is each of the following statements for you?
Please circle **one** *number on* **each** *line.*

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a. I seem to get ill a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

Appendix 2.0 Longitudinal survey questionnaire used to assess changes in farm worker health over a three month period in 2007

We would like you to consider the following aspects of your stay at the farm. Please read each statement and indicate how much you agree or disagree.

Please tick **one** *column on* **each** *line*	Strongly agree	Slightly agree	Don't know	Slightly disagree	Strongly disagree
15. Integration					
a. It is easy to remain in contact with family and friends	o	o	o	o	o
b. There are few opportunities to meet other people	o	o	o	o	o
c. English people are friendly and welcoming towards me?	o	o	o	o	o
d. It is difficult to communicate and get on with others on the farm	o	o	o	o	o
e. I never feel homesick	o	o	o	o	o
f. It was easy to adapt to the new culture in England (shopping, greetings etc)	o	o	o	o	o
16. Lifestyle					
a. The quality of my accommodation is poor	o	o	o	o	o
b. It is easy to see a doctor or nurse if I needed to	o	o	o	o	o
c. There are few facilities for leisure time activities	o	o	o	o	o
d. There is good access to cultural and religious organizations	o	o	o	o	o
e. Transport to the shops was difficult	o	o	o	o	o
f. I don't have enough leisure time to do what I want	o	o	o	o	o
17. Job satisfaction					
a. I feel that I am valued by this company	o	o	o	o	o
b. I receive poor training for my job	o	o	o	o	o
c. I am satisfied with my income	o	o	o	o	o
d. This job demands too much (physically, emotionally, mentally)	o	o	o	o	o
e. The work I do is interesting	o	o	o	o	o
f. This job adds significant pressure and anxiety to my life	o	o	o	o	o
g. I am very happy with the benefits offered to me through this job	o	o	o	o	o
h. I receive no support from my line manager	o	o	o	o	o

18. Lastly, think about your overall satisfaction with your job. This includes all the different components of your work life, from your pay rate and benefits, to your management and the organisation of your company, to relationships with co-workers and supervisors, to your particular responsibilities. Circle the number on the scale from 1-10 where it best represents your overall degree of job satisfaction (1=very low job satisfaction and 10= very high job satisfaction). On the second line, circle the number that you believe best describes your co-workers degree of job satisfaction.

Your score	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Co-workers	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Appendix 3.0

Farmer health, ethical purchasing and development: can exports of horticultural produce help developing nations?[1]

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Key words - farm worker, health, malaria, vegetable horticulture, UK, Uganda

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1.0 Abstract

The export of vegetables from African countries to European markets presents consumers with an ethical dilemma: should they support local, but relatively well-off farmers, or poorer farmers from distant countries? This paper considers the issue of farm worker health in the UK and Uganda, and considers the dilemma facing UK consumers if Uganda achieves their aim of exporting more vegetables to the UK. Self-reported health scores of 1200 farm workers in the UK and Uganda was measured with the internationally recognised SF-36 questionnaire and compared to an international population norm. The age-corrected health status of UK farm workers was significantly lower than the population norm, whereas Ugandans scored significantly higher (indicating good health) for physical health and lower for mental health. If Ugandan produce enters UK markets, then consumers will need to consider both the potential benefits that enhanced trade could offer Ugandan farmers compared with its impacts on UK workers.

2.0 Introduction

Farm worker well-being is increasingly important as a yardstick by which consumers are expected to evaluate the relative ethical merit of food producers. This growing consumer concern is implicit in the Fair Trade Movement and explicitly enshrined in the Principle of Health underpinning the International Federation of Organic Movements (IFOAM) code of good practice (IFOAM, 2006; Rice, 2001). For a consumer to make informed ethical purchasing decisions with respect to farm worker health necessitates that the health status of farm workers is known and comparable across farming practices and producer countries.

Supermarkets in the UK source their fruit and vegetable produce from a number of countries in both the developed and developing world. Developing countries may be more reliant upon this trade than the developed world because the agricultural sector tends to dominate the economy and is one of the few sectors where economic growth may be stimulated. Furthermore, successful agricultural systems in these countries play an important role in shaping the health of a population by protecting it from malnutrition and debilitating diseases. This is important as health is a factor in determining economic growth rates in developing countries (Hawkes and Ruel, 2006; Mayer, 2001). The modernisation and growth of the agriculture sector is therefore considered as being fundamental to the improvement of the well-being of its citizens (Gabre-Madhin and Haggblade, 2004). It is in this context that export horticulture has been repeatedly promulgated as a model for economic development in sub-Saharan Africa (Jaffee, 2003; Jaffee and Masakure, 2005; Minot and Ngigi, 2004; Stevens and Kennan, 2000; Whitaker and Kolavalli, 2004).

The economic development of a nation is important because income, health and mortality are interconnected at both the international and individual level (Lynch et al., 2000). Higher levels of social expenditure at an international level are associated with greater life expectancy (Gough and Thomas, 1994) whilst an individual's absolute income is a strong predictor of health status

(Diener et al., 1995; Lynch et al., 2000). Thus, both Gross Domestic Product and individual income are important functions of an individual's and a population's health.

The health and income relationship approximates curvilinear and consequently any changes in income levels can have greater or lesser effects on health dependant upon the income category (Mackenbach et al., 2005). For instance, self-reported health scores can improve at a greater rate per unit increase in income for individuals in the low income category whilst for higher income categories increases in health status are lower per unit increase of income (Mackenbach et al., 2005; Stronks et al., 1997; vanDoorslaer et al., 1997). This implies that the health status of an individual from a developing country might be expected to rise by a greater amount per dollar invested than for an equivalent investment in an individual from a wealthier country.

Mortality rates have been shown to be strongly associated with self-reported health (Bowling, 2005; Burstrom and Fredlund, 2001). The strength of this relationship, particularly in the developed world, depends to a large extent upon demographic variables such as education and income (Huisman et al., 2007; Kavanagh et al., 2006; Molarius et al., 2007; Wood et al., 2006). By contrast the health of many in developing countries, particularly those living in rural settings, is periodically undermined by preventable tropical diseases such as malaria. Farmers have an elevated risk of malarial exposure due to agricultural practices (Girardin et al., 2004; Ijumba and Lindsay, 2001; Kebede et al., 2005; Matthys et al., 2006; Sissoko et al., 2004) coupled with a varying ability to cope with the illness due to income (Gallup and Sachs, 2001; Worrall et al., 2005).

Socio-economic successes in export horticulture in Kenya include up to 500,000 workers employed directly or indirectly by the industry (Dijkstra, 1997; Gabre-Madhin and Haggblade, 2004; Jaffee, 2003; Whitaker and Kolavalli, 2004). Importantly, both the urban and rural poor are thought to benefit from the greater employment stability of export horticulture. Uneducated urban women, who were previously considered unemployable, are regularly

employed in pack houses in Kenya. The higher household incomes generated by export horticulture are thought to significantly reduce poverty (McCulloch and Ota, 2002).

Another candidate country for export horticultural development is Uganda. Recent studies suggest that considerable growth potential for export horticulture exists in Uganda (Achterbosch et al., 2005; Pender et al., 2004; Sonko et al., 2005) and that good agricultural performance in countries such as Uganda is thought to be a key determinant of direct pro-poor growth (Kappel et al., 2005). The lives of the poor are thought to improve in a number of ways as a consequence of economic growth. For instance, as income for the poor increases so too does their health status which may be indicative of subsequent mortality rates. Improvements in income levels are also thought to strengthen a household's ability to cope more successfully with tropical diseases such as malaria (Gallup and Sachs, 2001; Laxminarayan, 2004; Worrall et al., 2005). The potential for Uganda to become a vegetable exporter to the developed world presupposes that the benefits to Ugandan farmworkers outweigh the dis-benefits that may subsequently accrue to the developed country workforce.

At present the UK horticulture sector employs approximately 65000 migrant workers principally from Eastern Europe. These workers benefit from earning the UK minimum agricultural wage which is between 3.5-12 times the minimum wage of their own countries (EIRO, 2005). Given the relationship between health and income mentioned above it might be expected that East Europeans employed in UK horticulture would demonstrate increased levels of health. However, a recent study found that UK horticultural workers' self-reported health scores were significantly lower than the population norms for a number of health scales and instruments (Cross et al., 2007).

This paper compares the health status of UK and Ugandan farm workers employed in the vegetable sector. Workers from both countries are employed to provide food for their domestic markets: in the case of the UK this involves those farms supplying to supermarkets whereas for Ugandan workers it

involves supplying mainly inhabitants of the capital city Kampala. Recent reports have suggested that Uganda has the potential to benefit from a reorientation of its horticulture sector by growing vegetables for the export market, much as Kenya did in the early 1980's (Achterbosch et al., 2005; Pender et al., 2004; Sonko et al., 2005). An increase in the availability of Ugandan produce in UK markets may present UK consumers with an ethical dilemma. The dilemma arises as consumers may need to consider the relative social benefits arising from their support of local, UK horticultural businesses with those arising from their support of Ugandan businesses. Enhancing the health of farmworkers is one of the social benefits that can arise from agricultural systems. If consumer purchasing decisions are able to impact farm worker health through altering the income patterns of workers in different supplier countries then the comparable ethical acceptability of the competing purchase scenarios will be dependant upon an appraisal of the farm worker health status in each country.

This study describes the self-reported health and well-being status of farm workers in Ugandan and UK vegetable horticulture and considers the impact that increased consumer purchasing of vegetables from each country may have on worker health. While this study compares the health of workers in two countries, in reality concerned consumers are required to make comparisons of the social benefits associated with agricultural systems of the many countries who supply the types of produce they purchase. So while this paper considers the specific case of UK and Uganda, many of the general conclusions are relevant to the wider set of all countries which supply competing produce to developed markets.

3.0 Methods

3.1 Measuring health

Measuring health can be contentious and contingent upon the definition of health (Bowling, 1997; Mooney, 1992). For instance, the extent to which the World Health Organisation's definition of complete physical, mental and social well-being is either definable or realisable is uncertain. Assuming that a definition can be agreed upon, the decision as to who decides when an individual is in perfect health is equally debatable. For instance a surgeon may perform an outstanding hip replacement operation, faultless in every clinical aspect, and yet the patient may still suffer from restricted mobility. The surgeon's assessment of the operation's success may consequently differ markedly from that of the patient. The need to go beyond bio-medical indicators (such as blood pressure and cholesterol levels) has long been recognised and a raft of health questionnaires have been developed over the past 30 years to help assess the functional health status of individuals, groups and populations. These questionnaires can provide insights into the quality of life and provide a reliable basis for the evaluation of health care interventions (Bowling, 1997).

In light of this questionnaire development, population norms have been developed to facilitate comparisons between groups or populations. These are benchmark scores for the general population and permit analysis of a survey sample by demographic variables such as gender and age group (Ware and Kosinski, 2001).

3.2 Instrument selection

The use of such health instruments facilitates the evaluation of the economic viability of health interventions as well as the quality of life of individuals and groups (Hounsome et al., 2006). In this study four distinct health related instruments were used, three of these have been widely utilised in health research: the SF-36, EuroQol EQ-5D and the Visual Analogue Scale (VAS) (Brooks and EuroQol Group, 1996; Kind et al., 1998; Ware and Kosinski,

2001; Yost et al., 2005). The fourth, the Short Depression Happiness Scale (SDHS), is a more recently developed instrument which has not been widely used in other studies to date. A brief description of each of these instruments is given below.

The SF-36 is an eight-scaled multidimensional health instrument that measures different attributes of an individual's health status: physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and mental health (MH) (Ware and Kosinski, 2001; Ware et al., 1993). There are two summary scales: the physical component summary scale (PCS) and the mental component summary scale (MCS): both of which are aggregated scores for the eight scales. The SF-36 has been translated for use in over 50 countries and its results have been reported in over 4000 publications. It has been widely accepted as a valid instrument for measuring the health related quality of life (HRQoL) for samples from the general population and those with specific health conditions (Yost et al., 2005).

US national norms exist for the eight health scales and the two component scores. Scores are transformed and normalised to facilitate comparison of individual or group aggregate scores with published national norms (Ware and Kosinski, 2001; Ware and Gandek, 1998; Ware, 2000). Unfortunately, norms do not exist for Uganda and as a substantial proportion of the UK horticultural workforce is multi-national the 1998 US national norms were used as the comparator for this instrument (http://www.SF-36.org/). This is considered an acceptable practice in multinational studies that use carefully adapted and translated HQL questionnaires (Ware and Gandek, 1997).

The EQ-5D instrument is a generic public domain HRQoL measure in which a respondent's health status is assessed along five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) with three separate levels of severity for each (EuroQoL Group, 1990; Williams, 1995). The UK EQ-5D index tariff allows scores for the five dimensions to be converted to a single unique value which can then be compared to the UK

population norms for this instrument (Kind et al., 1998; Sapin et al., 2004). It has been widely validated and proven to be sensitive, reliable and internally consistent when used to measure population and group health (Brooks and EuroQol Group, 1996; Dorman et al., 1997; EuroQoL Group, 1990; Hurst et al., 1994; Nowels et al., 2005; Schrag et al., 2000). Health surveys assessing general population health status have been undertaken in a number of countries (Burström et al., 2004).

The Visual Analogue Scale (VAS) is a conceptually simple health instrument comprising a vertical line with equally spaced gradations from 0-100 much like a thermometer. Respondents indicate their present health status by drawing a line on the scale with the understanding that zero represents their worst possible health status and 100 their best. The scale is quick to complete and captures aspects of an individual's physical and mental health attributes simultaneously (Hounsome et al., 2006). Population norms for the UK exist for this instrument (Kind et al., 1998).

The Short Depression Happiness Scale (SDHS) is a public domain instrument which allows measurements of depression and happiness across sample populations (Joseph et al., 2004). It has previously been used in the study by Cross et al., (2008) and was included in this study as it has the potential to provide information that may be missed by the other general health instruments. No population norms exist for this instrument, although a score of 9 or below is considered potentially indicative of mild clinical depression (Joseph et al., 2004).

3.3 Translation of instruments

No formally translated versions of the SDHS, EQ-5D, VAS or SF-36 were available in the two principle languages used in the study districts in Uganda (Luganda and Lukonzo). Consequently, university educated native speakers of the target language translated from English to the respective target language. No backward translation was undertaken due to resource constraints. The SF-36 version 1 was preferred to version 2 as a Kiswahili

translation exists for the former which is the target language to be used in a future study in Kenya.

3.4 Data collection

This work is part of a larger multi-disciplinary study[†] of vegetable production, and the types of farms and range of crops available to be studied here was determined by the aims of the parent project. The initial UK project was restricted to large farms supplying brassicas, peas, beans, onions, leeks, lettuce and endives to UK supermarkets. Consequently, where possible the Ugandan survey frame was restricted to farmers and farm workers cultivating one or more of the above vegetables.

Three of the districts (Mukono, Wakiso and Luwero) were selected due to their proximity to Kampala and were all within a two hour drive of Entebbe international airport. The fourth (Kasese) is the location of a long established irrigation project producing a wide variety of vegetables for the Kampala market. The sample farms were identified through a combination of personal knowledge and extension offices associated with the Department of Forest Biology and Ecosystems Management, Makerere University.

Fieldworkers were defined as those members of staff, whether seasonal or permanent, who spent the majority of their day working in the field. These included all workers who planted, harvested, weeded or sprayed crops as well as those who supervised the workers or drove tractors in the field. Packhouse workers were defined as all those employed in the packhouse and undertaking tasks that involved grading, packing, tray-lining, stacking, washing or tractor work within the packhouse or warehouse. Most field and packhouse workers were employed on a seasonal basis.

[†] The parent project is 'Comparative assessment of environmental, community & nutritional impacts of consuming fruit and vegetables produced locally and overseas' funded by the Rural Economy and Land Use (RELU) programme of the UK Research Councils.

Two trained research assistants undertook face to face interviews with farm workers of adult age of both sexes in the field. Ethical approval was obtained through the University of Wales, School of the Environment and Natural Resources ethics committee.

3.5 United Kingdom workers' induction questionnaire

The workers' induction questionnaire was a shortened version of the more extensive questionnaire used in the 2006 study by Cross et al. (2008). Only the basic demographics section (age, gender, nationality, residency status, marital status, education level and whether respondents smoked) was retained as well as three health instruments (SDHS, VAS and SF-36). Data from the induction questionnaire of 2007 was compared from the data collected mid-season from the same farms in 2006 (see Cross et al., (2008)). The questionnaire was distributed to all field and pack house workers who could read Lithuanian, Polish or Russian whose induction date was on or after the 30th April 2007. Participation was optional and only those who completed and returned the initial questionnaire were considered to be participating.

3.6 Data Analysis

The Ugandan health scores were compared with the UK farm worker health scores published in Cross et al., (2007). Where appropriate both Ugandan and UK SF-36 scores were compared with the US population norms.

Differences between groups were analysed using non-parametric Mann-Whitney *U* test, Kruskal-Wallis and student t-tests. Where appropriate, associations between mean scale scores were explored using Spearman's rank correlations. Differences between groups and population norms were investigated using student t-tests.

Multiple regression analysis was used to investigate the relationship between self-reported health status and twelve potentially relevant variables (house type, malaria within the past three months, distance travelled to work, number

of children per respondent, whether the respondent smoked or had smoked in the past, level of education, annual income, bicycle ownership, radio ownership, mobile phone ownership, job status and number of tasks performed each day).

Candidate variables were entered into a backward stepwise elimination model to explore variation within SDHS, PCS and MCS scores. Multicollinearity can be problematic when including a large number of variables in the analysis as parameter variance and the r^2 value can tend to increase leading to an increased probability of committing a type II error (Mela and Kopalle, 2002). Consequently, multicollinearity was tested by setting the tolerance value at less than 0.2 and the Variance Inflation Factor (VIF) considerably less than 5.

4.0 Results

4. Ugandan sample description

A total of 571 questionnaires were administered to individual farmers and farm workers in Uganda through personal interviews with interviewers. The sample population comprised 282 males and 289 females. The mean sample population age was 37.69 (males 36.63, females 38.72). The marital status category of the questionnaire allowed four possible responses; single (16%), married/partnered (66%), divorced (8%) and widowed (10%). Eighty-five percent of the respondents said they had children and of these, 50% had at least one child less than five years of age. The average number of children per respondent was 3.5. Three responses were possible for the 'do you smoke' question; smoker (7%), ex-smokers (4%) and never smoked (89%). Malaria was the only serious illness explicitly mentioned by respondents, 37% of whom claimed to have experienced an episode in the three months preceding the survey.

4.2 Health scale correlations

All scales of the SF-36, EQ-5D, VAS and the SDHS were highly significantly correlated ($p<0.0001$) (Table 1). Correlations between scales were stronger

Table 1. Spearman's rho correlation coefficients between health scales. All correlations were significant at the <0.001 level

Health scale	SDHS	EQ5D	VAS	PF	RP	BP	GH	VT	SF	RE	MH	PCS
EQ5D	0.57											
VAS	0.49	0.58										
PF	0.42	0.65	0.58									
RP	0.49	0.60	0.55	0.61								
BP	0.51	0.70	0.60	0.66	0.76							
GH	0.54	0.65	0.74	0.66	0.63	0.72						
VT	0.57	0.66	0.55	0.54	0.62	0.65	0.65					
SF	0.32	0.43	0.47	0.50	0.50	0.62	0.57	0.43				
RE	0.48	0.53	0.38	0.45	0.62	0.55	0.49	0.58	0.41			
MH	0.63	0.62	0.58	0.53	0.58	0.62	0.66	0.76	0.47	0.57		
PCS	0.42	0.64	0.63	0.75	0.82	0.86	0.77	0.55	0.56	0.37	0.44	
MCS	0.60	0.59	0.53	0.45	0.56	0.59	0.63	0.81	0.54	0.79	0.89	0.37

than those found in the UK study which gives some degree of confidence concerning the translations.

4.3 Comparison of Ugandan scores with US norms

Except where stated the following reports refer solely to the SF-36 results. Ugandan males scored significantly higher than females on the SF-36 for all scales (Kruskall Wallis, df=1 p=<0.001) although the role-emotional scale (RE) significance value was less (df=1 p=0.002) (Fig.1).

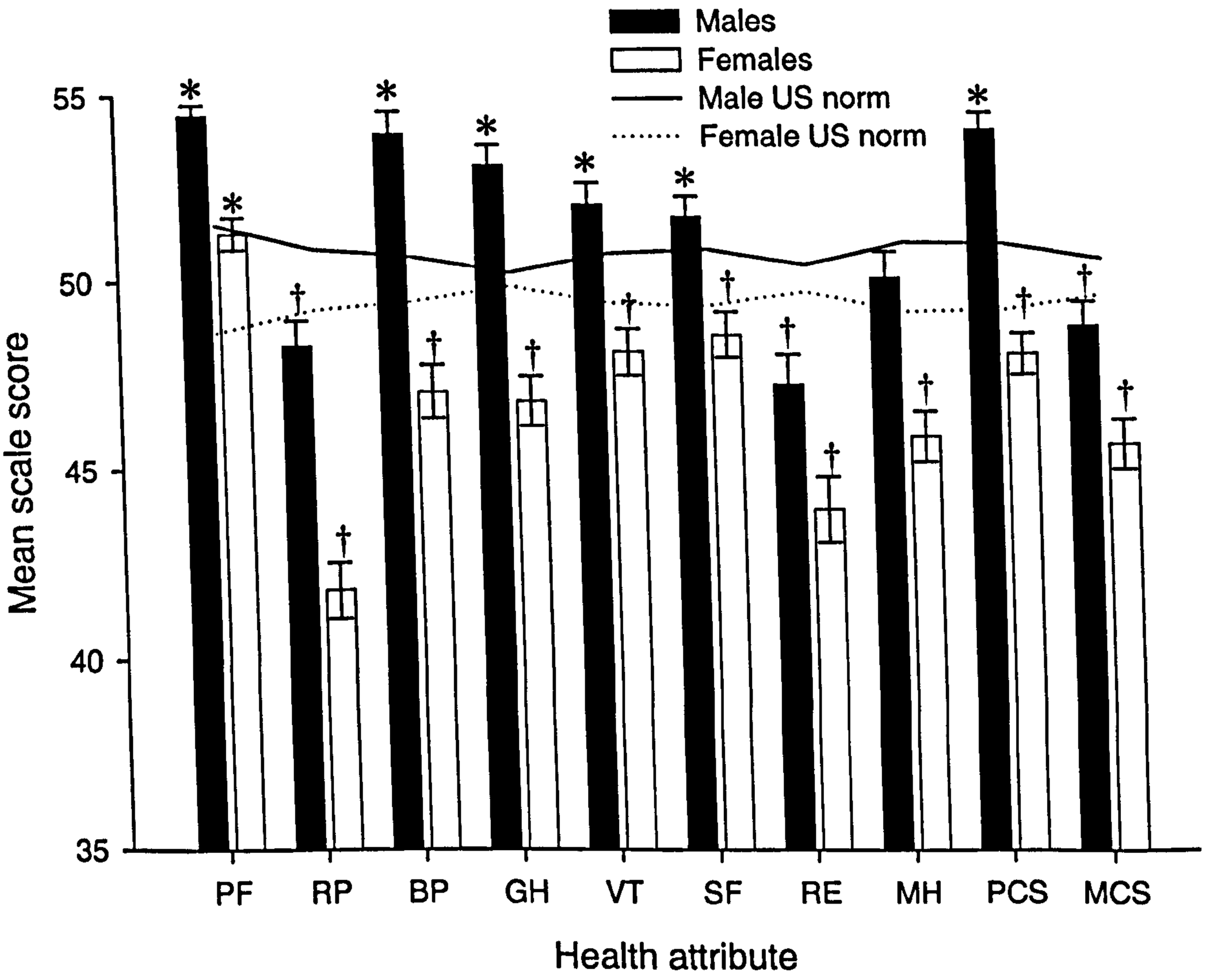

Figure 1 SF-36 scores by gender. Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social-Functioning (SF), Role-Emotional (RE), Mental Health (MH), Physical Component Summary (PCS), Mental Component Summary (MCS). *Ugandan farm worker scale scores were significantly higher than the population norm. †Ugandan farm worker scale scores were significantly lower than the US norm

Males scored significantly higher than the US population norms for physical functioning, bodily pain (BP), general health (GH), vitality (VT) and the physical component summary scale (PCS) and significantly lower for role-

physical (RP), role-emotional (RE), mental health (MH) and the mental component summary scale (MCS) (Table 2). Ugandan female farm worker scale scores were significantly higher than the US norms for physical functioning (PF) and significantly lower for all other SF-36 scales.

The overall population scores were significantly higher than the US population norm for physical functioning (PF) and the physical component summary score (PCS) and significantly lower for role-physical (RP), role-emotional (RE), mental health (MH) and the mental component summary score (MCS).

When the scores for those workers who had suffered malaria in the three months preceding the survey were removed from the sample the overall population scores were higher than the US population norm for physical functioning (PF), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF) and the physical component summary score (PCS). They remained significantly lower for role-physical (RP), role-emotional (RE), and the mental component summary score (MCS) (Table 2).

When the Ugandan farm worker scale scores were controlled for by age the 18-34 age-group was significantly higher than the corresponding US norms for vitality (VT) and significantly lower for role-physical (RP), role-emotional (RE), and the physical component summary score (PCS). When the scores for those workers who had suffered malaria in the three months preceding the survey were removed, scores were significantly higher than the US population norms for bodily pain (BP), general health (GH), vitality (VT) and remained significantly lower for role-physical (RP) and role-emotional (RE) (Table 2).

Table 2 Ugandan farm worker scores for the SF-36 scales Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social-Functioning (SF), Role-Emotional (RE), Mental Health (MH), Physical Component Summary (PCS), Mental Component Summary (MCS).

Comparison of Ugandan farm workers with US population norms

	Males			Females			Total			Malaria control		
Scale	Mean	*df*	*p*	Mean	*df*	*p*	Mean	*df*	*p*	Mean	*df*	*p*
PF	54.44	1064	<0.001[a]	51.28	1486	<0.001[a]	52.84	2552	<0.001[a]	53.45	2372	<0.001[a]
RP	48.25	1064	<0.001[b]	41.85	1486	<0.001[b]	45.01	2552	<0.001[b]	46.81	2372	<0.001[b]
BP	53.92	1063	<0.001[a]	47.07	1486	<0.001[b]	50.44	2551	0.312	52.34	2372	<0.001[a]
GH	53.06	1063	<0.001[a]	46.82	1484	<0.001[b]	49.90	2549	0.662	51.57	2370	0.002[a]
VT	51.98	1062	0.025[a]	48.12	1485	<0.001[b]	50.02	2549	0.962	51.59	2371	0.002[a]
SF	51.65	1064	0.124	48.54	1485	0.015[b]	50.07	2551	0.866	51.38	2371	0.006
RE	47.20	1064	<0.001[b]	43.94	1486	<0.001[b]	45.54	2552	<0.001[b]	47.06	2372	<0.001[b]
MH	50.02	1062	0.009[b]	45.86	1485	<0.001[b]	47.91	2549	<0.001[b]	49.50	2371	0.029[b]
PCS	53.95	1060	<0.001[a]	48.03	1484	0.002[b]	50.94	2546	0.022[a]	52.23	2370	<0.001[a]
MCS	48.72	1060	<0.001[b]	45.64	1484	<0.001[b]	47.15	2546	<0.001[b]	48.63	2370	<0.001[b]

Comparison of Ugandan farm workers aged 18-34 with US population norm

	Total 18-34			Malaria control (18-34)		
	Mean	*df*	*p*	Mean	*df*	*p*
PF	54.19	629	0.745	54.60	552	0.232
RP	46.28	629	<0.001[b]	48.06	552	<0.001[b]
BP	52.05	629	1.000	53.65	552	0.018[a]
GH	51.70	628	0.566	53.06	552	0.008[a]
VT	51.08	628	0.002[a]	52.80	552	<0.001[a]
SF	50.57	629	0.830	51.40	552	0.146
RE	45.69	629	<0.001[b]	47.85	552	<0.001[b]
MH	48.76	627	0.590	50.24	552	0.103
PCS	52.74	627	0.007[b]	53.64	552	0.755
MCS	47.26	627	0.166	49.00	552	0.160

([a]) Ugandan farm worker scale scores were significantly higher than US population norm. ([b]) Ugandan farm worker scale scores were significantly lower than the US population norm. Malaria control = scores were removed from the analysis for workers who self-diagnosed as suffering from malaria in the three months preceding the survey

4.4 Comparisons between the UK and Uganda scores

Ugandan farm worker scale scores for the SF-36 were significantly higher than the corresponding scale scores for the UK for physical functioning (PF), bodily pain (BP), social functioning (SF) and mental health (MH) and significantly lower for role-physical (RP), vitality (VT), role-emotional (RE) and the physical component summary score (PCS). The scores for respondents who had suffered a bout of malaria in the three months prior to the survey were removed from the data set in order to establish the extent to which preventable diseases influence health scores. Mean health scores of Ugandan non-malaria sufferers compared to UK farm worker scores were significantly higher for physical functioning (PF), bodily pain (BP), general health (GH), social functioning (SF), mental health (MH) and the mental component summary score (MCS) and significantly lower for role-physical (RP) and role-emotional (RE) (Table 3). As 96.5% of the sample in the UK study was aged 18-34, the above results may be misleading. For this reason the data was reanalysed by controlling for age.

4.5 Comparisons between scores for the UK and Uganda 18-34 age group

Compared to the UK 18-34 age group Ugandan scores were significantly higher for physical functioning (PF), bodily pain (BP), general health (GH), social functioning (SF) and mental health (MH) and significantly lower for role-emotional (RE). When the scores for those workers who had suffered malaria in the three months preceding the survey were removed Ugandan farm workers aged 18-34 scored significantly higher than UK farm workers for physical functioning (PF), bodily pain (BP), general health (GH), social functioning (SF), mental health (MH), the physical component summary scale (PCS) and the mental component summary scale (MCS) and lower for none of the scales (Table 3).

Table 3 Comparison of the UK and Ugandan scores for the SF-36 scales Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social-Functioning (SF), Role-Emotional (RE), Mental Health (MH), Physical Component Summary (PCS), Mental Component Summary (MCS)

		PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
All age groups combined	UK	49.68	50.64	48.74	49.53	51.55	46.65	50	46.38	52.02	46.97
	Uganda	52.84	45.01	50.44	49.9	50.02	50.07	45.54	47.91	50.94	47.15
	df	1176	1091	1090	1088	1088	1090	1091	1088	1085	1085
	p	<0.001[a]	<0.001[b]	0.003[a]	0.379	<0.001[b]	<0.001[a]	<0.001[b]	<0.001[a]	0.002[b]	0.690
Malaria control all age groups	UK	49.68	50.64	48.74	49.53	51.55	46.65	50	46.38	52.02	46.97
	Uganda	53.45	46.81	52.34	51.57	51.59	51.38	47.06	49.5	52.23	48.63
	df	996	911	911	909	910	910	911	910	909	909
	p	<0.001[a]	<0.001[b]	<0.001[a]	<0.001[a]	0.931	<0.001[a]	<0.001[b]	<0.001[a]	0.591	0.002[a]
18-34 age group	UK	50.26	47.27	48.37	49.37	51.48	45.93	47.95	46.43	51.97	46.79
	Uganda	54.19	46.28	52.05	51.70	51.08	50.57	45.69	48.76	52.74	47.26
	df	826	826	797	779	789	794	804	788	748	748
	p	<0.001[a]	0.091	<0.001[a]	<0.001[a]	0.397	<0.001[a]	<0.001[b]	<0.001[a]	0.081	0.470
Malaria control 18-34 age group	UK	50.26	47.27	48.37	49.37	51.48	45.93	47.95	46.43	51.97	46.79
	Uganda	54.6	48.06	53.65	53.06	52.8	51.4	47.85	50.24	53.64	49
	df	749	749	720	703	713	717	727	713	673	673
	p	<0.001[a]	0.442	<0.001[a]	<0.001[a]	0.088	<0.001[a]	0.867	<0.001[a]	<0.001[a]	0.003[a]

([a]) Ugandan farm worker scale scores were significantly higher than UK ([b]) Ugandan farm worker scale scores were significantly lower than the UK scores
Malaria control = scores were removed from the analysis for workers who self-diagnosed as suffering from malaria in the three months preceding the survey

4.6 SDHS, EQ-5D and VAS results

There were no significant differences between Ugandan and UK male farm workers for SDHS scores (df=563 p=<0.0846). Ugandan female farm workers scored significantly lower than UK females (df=433 p=<0.0001) (Table 4). A third of all Ugandan workers scored 9 or less and might be classified as suffering from mild clinical depression (males 25%, females 35%, total 30%) compared to the UK where only a fifth of the respondents scored nine or below (males 21.6%, females 20.5%, total 21.2%).

Table 4. Farm workers self-reported mean health scores for the SDHS, EQ-5D and VAS

		Uganda			UK				
18-34 age group		mean	n	sd	mean	n	sd	*df*	*p value*
SDHS	Males	12.15	140	3.89	12.44	283	3.50	421	0.1827
	Females	11.04	124	3.74	12.03	147	3.72	269	0.0014[a]
	Total	11.63	264	3.86	12.30	430	3.57	692	0.0002[a]
EQ-5D	Males	0.85	140	0.19	0.85	358	0.21	496	0.8923
	Females	0.77	125	0.22	0.85	194	0.17	317	<0.0001[a]
	Total	0.81	265	0.21	0.85	552	0.19	815	<0.0001[a]
VAS	Males	80.43	136	17.09	80.04	357	18.08	491	0.7941
	Females	70.30	124	16.91	75.87	187	17.86	309	<0.0001[a]
	Total	75.60	260	17.71	78.60	544	18.10	802	0.0001[a]
18-34 age group malaria removed									
SDHS	Males	12.89	101	3.63	12.44	283	3.50	382	0.1982
	Females	11.37	86	3.86	12.03	147	3.72	231	0.0344[a]
	Total	12.19	187	3.81	12.30	430	3.57	615	0.5412
EQ-5D	Males	0.88	101	0.18	0.85	358	0.21	457	0.1241
	Females	0.79	87	0.21	0.85	194	0.17	279	<0.0001[a]
	Total	0.84	188	0.20	0.85	552	0.19	738	0.1432
VAS	Males	84.28	98	15.55	80.04	357	18.08	453	0.0173[b]
	Females	71.52	86	17.86	75.87	187	17.86	271	0.0010[a]
	Total	78.32	184	17.80	78.60	544	18.10	726	0.7107

[a]UK mean significantly higher than the Ugandan mean
[b]UK mean significantly lower than the Ugandan mean

There were no significant differences between the mean UK and Ugandan health scores for the male 18-34 age group for the SDHS, EQ-5D and the VAS (Table 4). Ugandan females for this age group scored significantly lower than UK females for all three health instruments irrespective of controlling for malaria. Ugandan overall scores were significantly lower than the UK scores for all three instruments, although there were no significant differences once those respondents reporting malaria were removed from the analysis.

4.7 Contribution of socio-demographic and occupational factors to health

Two components of the SF-36 instrument each serve to aggregate scores from four of the eight scales. These are the Physical Component Summary score (which aggregates Physical Functioning, Role-physical, Bodily Pain and General Health) and the Mental Component Summary score (which aggregates Vitality, Social Functioning, Role-Emotional and Mental Health).

In an attempt to better understand the relative contribution of different socio-demographic and occupational factors to health, the PCS and MCS scores were utilised as dependent variables in a multiple linear regression model. Independent variables entered into the first model were house type, malaria within the past three months, distance travelled to work, number of children per respondent, whether the respondent smoked or had smoked in the past, level of education, annual income, bicycle ownership, radio ownership, mobile phone ownership, job status and number of tasks performed each day. Stepwise backwards regression was used to remove the variables with the entry criteria being set at 0.01 probability of *F* and removal set at 0.055 probability of *F*. Multicollinearity did not appear to be an issue, as tolerance statistics were above 0.2 and the Variance Inflation Factor (VIF) statistics were below 5.

A significant model emerged for the PCS ($F_{5,504}$=18.86 p=<0.001, adjusted r^2=0.149), with the significant variables being education (β=-0.132 p=0.002), annual income (β=0.23 p=<0.001), malaria (β=-0.119 p=0.004), number of tasks (β=0.179 p=<0.001) and house type (β=0.091 p=<0.033). A significant model also emerged for the MCS ($F_{5,504}$=10.633 p=<0.001, adjusted r^2=0.086). Significant variables were smoking (β= 0.088 p=<0.039), annual income (β=0.084, p=<0.05), malaria (β=-0.204 p=<0.001), travel (β= -0.14 p =0.001) and house type (β=0.09 p =0.037).

The contributing factors to SDHS scores were explored by entering the following independent variables into a stepwise backwards model: house type, malaria within the past three months, distance travelled to work, number of

children per respondent, whether the respondent smoked or had smoked in the past, level of education, annual income, bicycle ownership, radio ownership, mobile phone ownership, job status and number of tasks performed each day. Entry criteria were set at 0.01 probability of *F* and removal criteria set at 0.055 probability of *F*. A significant model emerged ($F_{5,504}$=14.428, p=<0.001 adjusted r^2 =0.117). Significant variables were annual income (β=0.207 p=<0.001), malaria (β=-0.187 p=<0.001), radio possession (β=-0.128 p=0.01), travel (β=-0.084 p=0.046) and house type (β=0.185 p=0.019).

4.8 Socio-economic variables

The mean self-reported annual income per capita was $US 398, with males earning more than twice that of females (males $US 553, females $US 248). Ninety one percent of the sample population earned less than $US 1000 per annum. The incomes of these workers were divided into five income category groups to explore relationships between health scores and income categories. The mean PCS, MCS and SDHS scores were significantly different when differentiated by annual income class (Fig. 2).

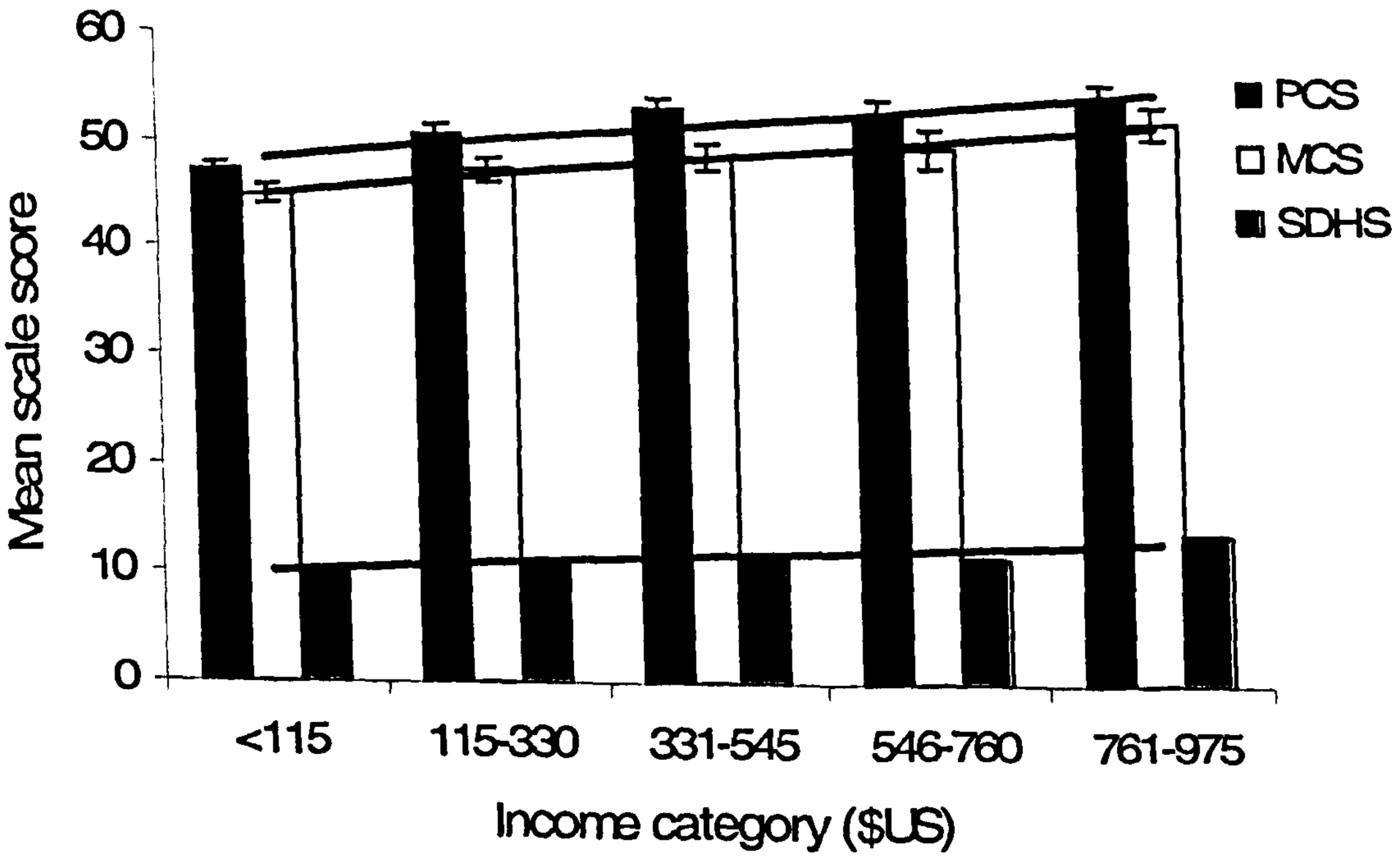

Figure 2. Mean health scale score by annual income (Fitted lines: PCS y = 1.5151x + 46.537 r^2= 0.8522 n=439; MCS y = 1.543x + 43.382 r^2= 0.9816 n=439; SDHS y = 0.6904x + 9.317, r^2= 0.8709 = 0.99, n=444)

As income increased so did the mean score for the health instruments. Health scores differed significantly between income categories (SDHS df 3 p=<0.001; PCS df 3 p=<0.001; MCS df 3 p=<0.001).

Annual income differed significantly with respect to the level of educational attainment (n=437 p=0.02). Mean annual income for those who attended primary school was $US 347 compared to $US 455 for those who attended secondary school.

The type of house occupied by workers appeared to be a function of their annual income. There were significant differences in house type dependant upon income levels (Mann Whitney n=522, p=<0.001). Those who described their house as mud and wattle (n=204, mean annual income $US 275) had an annual income almost half that of those who owned a brick house (n=319, mean annual income $US 475, Kruskal Wallis df=1 p=<0.001).

Bicycle ownership had a significant impact on both mental and physical scales (Mann-Whitney U, PF n=571, p=<0.001 RP n=571, p=0.139; BP n=570 p=<0.001; GH n=568, p=0.001; VT n=568, p=0.043; SF n=570 p=<0.001; RE n=571, p=0.111; MH n=568 p=0.005; PCS n=565, p=0.003; MCS n=565, p=0.015). The mean cost of a bicycle was $US 44.25. The positive effect on health scores was more marked if the respondent owned a radio (Mann-Whitney U, PF n=567, p=<0.001 RP n=567, p=0.002; BP n=566 p=<0.001; GH n=564, p=0.001; VT n=564, p=<0.001; SF n=566 p=<0.001; RE n=567, p=0.017; MH n=564 p=<0.001; PCS n=561, p=<0.001; MCS n=561, p=<0.001). The mean cost of a radio was $US 22.13.

4.9 United Kingdom induction questionnaire

All SDHS, VAS and SF-36 scale and component summary scores (with the exception of physical functioning (PF)) were significantly higher for farm workers at induction for the 2007 cohort than those recorded for workers mid-season in 2006 (Table 5). The sample included only those workers employed

by the four largest farms used in the survey of 2006. There were no significant differences in the gender or age composition for each cohort.

Table 5 Comparison of UK farm worker health scores at the beginning of service in 2007 and mid-season 2006. Means were compared using the Mann Whitney *U* test. Farm worker mid-season 2006 scores were significantly lower for all health scales than the induction scores for 2007.

	Induction 2007			Mid-season 2006				
	Mean	n	S.D.	Mean	n	S. D.	*p*	*n*
SDHS	14.30	133	2.55	12.23	257	3.59	<0.0001	390
VAS	85.94	185	13.16	78.23	388	17.88	<0.0001	573
PF	54.94	193	4.42	54.10	395	7.78	0.3612	588
RP	53.20	193	6.28	50.26	395	8.55	<0.0001	588
BP	54.79	193	8.80	48.46	395	10.54	<0.0001	588
GH	51.57	193	8.08	49.16	395	8.99	0.0031	588
VT	57.05	193	7.84	51.38	395	9.67	<0.0001	588
SF	51.74	193	7.15	46.69	395	10.41	<0.0001	588
RE	52.88	193	6.38	49.97	395	9.27	0.0003	588
MH	51.39	193	8.88	46.10	395	10.60	<0.0001	588
PCS	54.46	193	4.82	52.07	395	6.78	<0.0001	588
MCS	52.03	193	7.70	46.71	395	9.98	<0.0001	588

5.0 Discussion

Ugandan male farm workers scored significantly higher than both females and the US population norm for all SF-36 scales except for physical functioning. This is indicative of better health. This reflects similar findings in a study in Tanzania where males scored higher than females for all SF-36 scales (Wyss et al., 1999).

Uganda and the UK farm workers showed no significant differences between their SF-36 physical and mental component summary scores although there were differences for particular sub-scales. Equally, there were no significant differences for the SDHS. The absence of difference between the two workforces may be a reflection of the poor mid-season health status of UK farm workers rather than an indication of Ugandan good health as the scores for UK workers appears to decline during their stay whereas Ugandan farm workers are constant. However, when those Ugandan respondents who reported malaria were removed the scores were higher for a number of SF-36 scales and lower for none. Similarly Ugandan workers aged 18-34 had similar scores to the US population once malaria sufferers had been removed. The Tanzanian urban dwellers in the study by Wagner et al (1999) also had similar scores to the US population when age differences were accounted for (Wagner et al., 1999).

It is important to note that the method of data collection could have influenced the results. Ugandan respondents may have reported better health as they were interviewed face-to face whereas the UK workers completed the questionnaire alone and in their own time. Only face to face interviews were viable in Uganda due to the high levels of illiteracy. Studies in the US and Australia have shown that respondents tend to report better emotional and well-being health in interviews (Perkins and Sanson-Fisher, 1998; Sanson-Fisher and Perkins, 1998). Alternatively, the Ugandan health scores could be a fair and true reflection of their health status.

5.1 Wider implications

There is now an established curvilinear relationship between income level and health status (Mackenbach et al., 2005) whereby as income for a population increases so too does their health status, although at an ever diminishing marginal rate. An increase in the marginal health rate is generally greater amongst the lower income groups and smallest in high income groups. The relationship implies that the greatest improvement in population health for a unit increase in income would be expected to accrue to the lowest income workers. The Ugandan data suggests that the relationship between income and health is still positive and linear whereby a unit increase in income corresponds to an equivalent increase in good health status (Fig. 2).

To contextualise the importance of the health benefits that may devolve to Ugandan workers through increased revenue from export horticulture it is useful to consider the relationship between per capita GDP and life expectancy (Fig. 3). For instance a 10 index point increase in per capita GDP would be expected to produce approximately an 11 point increase in life expectancy (0.48 to 0.61) for Ugandans whilst a corresponding increase in Polish GDP would result in a modest six point increase from approximately 0.78 to 0.84. Thus, for the same financial investment life expectancy increases by five points more for Ugandans than Poles. Marginal increases in life expectancy are generally highest for the low income countries and lowest for the high income countries. This becomes more than abstraction when we consider the links between self-reported health and subsequent mortality rates.

Whilst self-reported health is commonly used to measure a sample population's health status, it is increasingly employed as a valid predictor of mortality rates (Bowling, 2005; Burstrom and Fredlund, 2001; Deeg and Bath, 2003; Idler and Benyamini, 1997; Ringback Weitoft and Rosen, 2005; Schoenfeld et al., 1994; Singh-Manoux et al., 2007). In these studies, respondents were asked to rate their health as very good, good, fair, poor or very poor (the equivalent in the SF-36 is excellent, very good, good, fair and poor). Those answering poor or very poor had a subsequent increased risk of mortality compared to those answering good or very good.

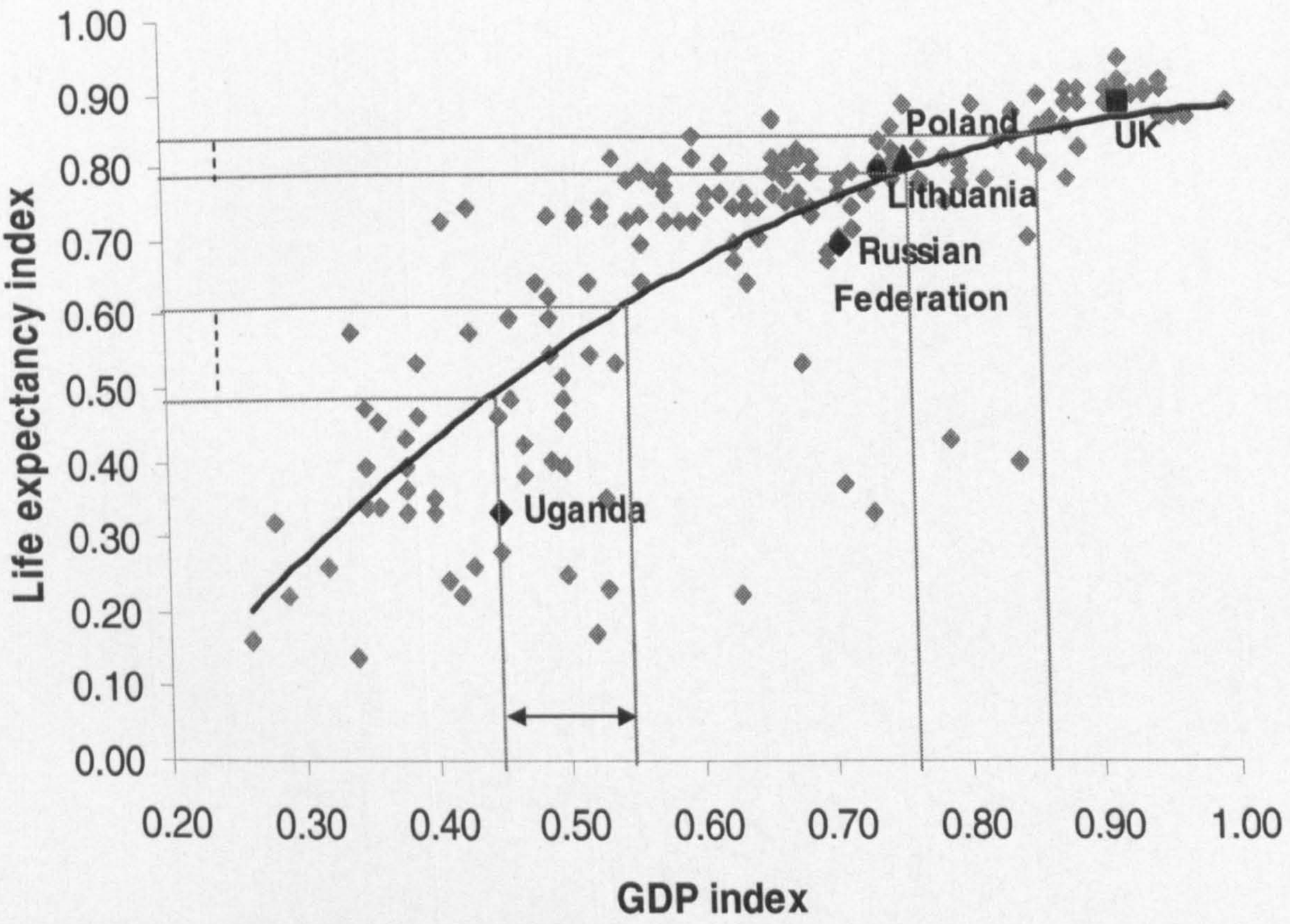

Figure 3. Life expectancy and per capita GDP. A 10% increase in the GDP index could engender an eleven point increase in Ugandan life expectancy (48-59) whilst a similar increase in Polish GDP would only increase life expectancy by three points (81-84). Source: United Nations Development Programme, 2005 http://hdr.undp.org/reports/global/2005/

In the Whitehall study (Singh-Manoux et al., 2007) 3.7% of middle-aged men and 7.1% of middle-aged women described their health as poor or very poor. Their subsequent mortality rate was 3.8 times higher over a ten year recall period than those who described their health as good or very good. In a further study of middle-aged British males (Wannamethee and Shaper, 1991), those reporting poor health had a mortality rate of 45 deaths per thousand

compared with 5.5 deaths per thousand for those reporting excellent health. This equated to an eight fold increase in mortality per 1000 per year.

In the present study, the proportion of UK and Ugandan farm workers aged 18-34 describing their health as poor or fair (the lowest two categories) was 14% and 18% respectively. If the relationship, as described by Singh-Manoux (2007) and Wannamethee and Shaper (1991), between an individual's self-reported poor health and subsequent mortality rate holds, then an apparently greater proportion (14% and 18% compared to 3.7% in the Whitehall study) of both UK and Ugandan farm workers may have an increased risk of mortality.

5.2 Agriculture and tropical diseases: The case for malaria

After controlling for the effects of malaria the Ugandan farm workers' scores were significantly higher than those of the UK workforce and not significantly different to the US population norm. Income and malaria were important explanatory variables in multiple regression analysis. The causality appears to be bidirectional with income levels correlated with malarial infection rates and malarial incidence impacting income levels (Sachs and Malaney, 2002). The importance of this relationship appears to be borne out by a number of studies that suggest that there is an important financial cost incurred following malaria illness (Cho-Min-Naing and Gatton, 2004) which can impact upon a household's ability to maintain living standards (Chuma et al., 2006; Laxminarayan, 2004; Onwujekwe et al., 2000).

Thus the potential of economic improvement to positively influence the health status and longevity for farmers and farm workers in Uganda appears to be disproportionately large when compared to the expected health disbenefits that accrue to East European workers in the UK. Previous research suggests that horticultural production and particularly production directed at the export market can help to alleviate poverty in developing countries (McCulloch and Ota, 2002; Weinberger and Lumpkin, 2007). McCulloch and Ota (2002) also found that households employed in export horticulture had income levels up to five times higher than those households that did not grow horticultural crops.

5.3 Ethical considerations

The ethical implications of buying vegetable produce with a 'made in Britain' label attached are more complex than the simplistic 'intuitively right' of 'buy local' campaigns premised in the British printed press (Gray, 2007; Hailes, 2007; Mackay, 2007; Rudd, 2007; Seager, 2007). There are a number of considerations that need to be evaluated with regard to the ethical appropriateness of continuing to grow vegetables in the UK which extend beyond the food miles debate.

If the self-reported health status of vegetable horticulture workers in the UK declines during their employment then issues such as health risk evaluations and subsequent informed consent may be prerequisites of a number of ethical paradigms (Cooley, 2002; Kant, 1998; Thompson, 2001). Health costs incurred as a consequence of working in the UK, particularly with respect to the increased risk of mortality for those reporting poor health, may ultimately be borne by the donor country. Whilst there is financial reward to workers through higher wages, the extent to which this compensates for a decline in health and an increase in mortality rates remains unexplored.

Consumer purchases of British grown produce may be unethical for two reasons. Firstly, for each British lettuce bought from a UK supermarket the health status of a worker declines. The consumer's purchase decision effectively results in harm to the farm worker. Secondly, there are potential alternative production centres outside the UK worthy of consideration but currently overlooked, such as Uganda, where health may improve as a consequence of consumer purchases. It might therefore be more ethically expedient in terms of human health to export most or all UK vegetable production to the developing world. By choosing not to purchase produce from developing countries the consumer and supermarket may be ethically culpable through omission of suppressing the opportunity to improve income and health.

5.4 Policy implications

The topic of farm worker health is increasingly prominent in food production debates as movements such as Fairtrade and IFOAM re-evaluate concepts of agricultural social justice. The factoring in of the costs of poor health to the farmer and society as a whole needs to be considered by policy makers for both the short and long-term. Long-term health costs may be difficult to detect, particularly for those workers who return to their home country and receive medical care at a later date. Costs may be incurred by the donor country and the extent to which this would be morally acceptable remains unexplored. At a European level the cost of palliative care in one country may be compensated for by the health benefits derived from increased vegetable consumption in another country. For instance, if a Polish worker experiences a decrease in health status of one unit for every ten thousand lettuces that he or she harvests, the consumer's health status may need to increase by an equivalent amount to negate the health costs. However, such a scenario would remain pareto-inefficient as one person's improvement in health involves a decrease in another's, rendering one of the stakeholders worse-off than before. If a Ugandan farm worker cuts the same number of lettuce as the Polish worker but experiences a one unit increase in his or her health status policy makers may want to encourage consumers to buy non-British produce.

If the UK government were ethically bound to encourage consumers to purchase from poorer countries then it is possible that pre-existing international development policy commitments such as the Millennium Development Goal No.1 to which the UK government is a signatory and has promised to aim to eradicate poverty and hunger may be facilitated (DFID, 2005; FAO-IFAD-WFP, 2005). Income and health appear to be positively associated, and the relationship becomes more acute and exacerbated over prolonged periods (Benzeval and Judge, 2001; Mackenbach et al., 2005; Martikainen et al., 2003). Relocating horticultural production to a developing country such as Uganda could engender an increase in workers' income (assuming that the market is efficient and allows revenue to flow back to the producers) in effect redistributing wealth away from middle income nations to

poorer low income countries (Edwards-Jones et al., 2008). If farm worker health is the measure by which the pareto-optimality of competing scenarios is evaluated, then exporting horticulture production to Africa may benefit African workers in terms of increased income, as evidenced by several studies showing rising income levels engendering health improvements (Mackenbach et al., 2005; Stronks et al., 1997; vanDoorslaer et al., 1997).

6.0 Conclusion

The current production process of UK agriculture and horticulture relies extensively upon the annual importation of approximately 60,000 seasonal workers, the majority of whom originate from Eastern Europe. Their self-reported health status has been shown to decline significantly during their stay in the UK and the proportion of workers at risk of increased mortality is of concern. Whilst buying British vegetables results in increased income earnings for these workers, the degree to which this compensates their decline in health status is difficult to quantify. Furthermore, the additional income that returns to their country of origin may have a negligible positive effect on life expectancy. A movement away from UK production would by default improve the health status of those migrant workers who work in the UK. Simultaneously, the health of the workers in a country such as Uganda would be expected to rise due to increased income, the education possibilities that would ensue from increased living standards and the improved ability to prevent and deal with the effects of tropical diseases.

There are two ethical reasons why consumers might wish to purchase produce from Uganda rather than the UK. Firstly, the health of farm workers in the UK appears to decline during their work based stay. Secondly, Ugandan farm worker health would be expected to improve with each unit increase in income. Consumers who purchase UK grown produce in the knowledge that this choice causes harm to the workers may be acting unethically. Equally, the ethical validity of not purchasing Ugandan produce would be questionable as consumers would be impeding Ugandan farm workers from improving their health status due to a lack of increased income.

Further research needs to determine to what extent the health status of farm workers employed in export horticulture differs from those employed in non-export horticulture. If income is higher for Kenyan smallholders employed in the export horticulture market, then a comparison of Kenyan export horticulture employees with horticultural farmers who are independent of the export sector should show higher levels of health, other variables being equal.

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References

Achterbosch, T., A. Allbritton, D.V. Quang, A. de Jager, E. Njue, R. Sonko, M. Stallen, S. Wertheim-Heck, and S. van Wijk. 2005. Pro-poor horticulture in East Africa & South East Asia. DFID, University of Wageningen.

Benzeval, M., and K. Judge. 2001. Income and health: the time dimension. *Social Science & Medicine*. 52:1371-1390.

Bowling, A. 1997. Measuring health: a review of quality of life measurement scales. Open University Press, Buckingham and Philadelphia.

Bowling, A. 2005. Just one question: If one question works, why ask several? *J Epidemiol Community Health*. 59:342-345.

Brooks, R., and EuroQol Group. 1996. EuroQol: the current state of play. *Health Policy*. 37:53-72.

Burstrom, B., and P. Fredlund. 2001. Self rated health: Is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? *J Epidemiol Community Health*. 55:836-840.

Burström, K., M. Johannesson, and F. Diderichsen. 2004. Swedish population health-related quality of life results using the EQ-5D. *Quality of Life Research*. 10:621-635.

Cho-Min-Naing, and M.L. Gatton. 2004. Costs to the patient for seeking malaria care in Myanmar. *Acta Tropica*. 92:173-177.

Chuma, J.M., M. Thiede, and C.S. Molyneux. 2006. Rethinking the economic costs of malaria at the household level: Evidence from applying a new analytical framework in rural Kenya. *Malaria Journal*. 5.

Cooley, D.R. 2002. So Who's Afraid of Frankenstein Food? *Journal of Social Philosophy*. 33:442-463.

Cross, P., R.T. Edwards, B. Hounsome, and G. Edwards-Jones. 2007. Is the quality of life of UK horticultural farmworkers dependant upon the farming method? Evidence from a prospective, population based study. *Science of the Total Environment*. In press.

Cross, P., R.T. Edwards, B. Hounsome, and G. Edwards-Jones. 2008. Comparative assessment of migrant farm worker health in conventional and organic horticultural systems in the United Kingdom. *Science of The Total Environment*. 391:55-65.

Deeg, D.J.H., and P.A. Bath. 2003. Self-Rated Health, Gender, and Mortality in Older Persons: Introduction to a Special Section. *Gerontologist*. 43:369-371.

DFID. 2005. Growth and poverty reduction the role of agriculture: A DFID policy paper. Department for International Development, Glasgow.

Diener, E., M. Diener, and C. Diener. 1995. Factors predicting the subjective well-being of nations. *Journal of Personality and Social Psychology*. 69:851-864.

Dijkstra, T. 1997. Trading the fruits of the land: horticultural marketing channels in Kenya. Ashgate, Aldershot, UK.

Dorman, P.J., F. Waddell, J. Slattery, M. Dennis, and P. Sandercock. 1997. Is the EuroQol a valid measure of health-related quality of life after stroke? *Stroke*. 28:1876-1882.

Edwards-Jones, G., L. Milà i Canals, N. Hounsome, M. Truningerd, G. Koerbera, B. Hounsome, P. Cross, E.H. York, A. Hospida, K. Plassmann, I.M. Harris, R.T. Edwards, G.A.S. Day, A.D. Tomos, C.S.

J., and D.L. Jones. 2008. Testing the assertion that 'local food is best': the challenges of an evidence based approach. *Trends in Food Science and Technology*. In Press.

EIRO. 2005. Minimum wages in Europe. Vol. 2007. European Industiral Relations Observatory.

EuroQoL Group. 1990. EuroQoL: a new facility for the measurement of heath-related quality of life. *Health Policy*. 16:199-208.

FAO-IFAD-WFP. 2005. Millennium Development Goal No. 1. Food and Agriculture Organization of the United Nations; International Fund for Agricultural devlopment; World Food Programme, Rome.

Gabre-Madhin, E.Z., and S. Haggblade. 2004. Successes in African agriculture: Results of an expert survey. *World Development*. 32:745-766.

Gallup, J.L., and J.D. Sachs. 2001. The economic burden of malaria. *Am. J. Trop. Med. Hyg*. 64:85-96.

Girardin, O., D. Dao, B.G. Koudou, C. Esse, G. Cisse, T. Yao, E.K. N'Goran, A.B. Tschannen, G. Bordmann, B. Lehmann, C. Nsabimana, J. Keiser, G.F. Killeen, B.H. Singer, M. Tanner, and J. Utzinger. 2004. Opportunities and limiting factors of intensive vegetable farming in malaria endemic Cote d'Ivoire. *Acta Tropica*. 89:109-123.

Gough, I., and T. Thomas. 1994. Why do levels of human-welfare vary among nations? *International Journal of Health Services*. 24:715-748.

Gray, R. 2007. Greener by miles. *In* The Daily Telegraph, London.

Hailes, J. 2007. How to pick a supermarket. *In* The Daily Telegraph, London.

Hawkes, C., and M. Ruel. 2006. The links between agriculture and health: an intersectoral opportunity to improve the health and livelihoods of the poor. *Bulletin of the World Health Organization*. 84:984-987.

Hounsome, B., R.T. Edwards, and G. Edwards-Jones. 2006. A note on the effect of farmer mental health on adoption: The case of agri-environment schemes. *Agricultural Systems*. 91:229-241.

Huisman, M., F.v. Lenthe, and J. Mackenbach. 2007. The predictive ability of self-assessed health for mortality in different educational groups. *Int. J. Epidemiol.*:1-7.

Hurst, N.P., P. Jobanputra, M. Hunter, M. Lambert, A. Lockhead, and H. Brown. 1994. Validity of EuroQol- a generic health status instrument in patients with rheumatoid arthritis: Economic and health outcomes research group. *Rheumatology*. 33:655-662.

Idler, E.L., and Y. Benyamini. 1997. Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior*. 38:21-37.

IFOAM. 2006. The principles of organic agriculture. Vol. 2006. International Federation of Organic Movements http://www.ifoam.org/about_ifoam/principles/index.html

Ijumba, J.N., and S.W. Lindsay. 2001. Impact of irrigation on malaria in Africa: paddies paradox. *Medical and Veterinary Entomology*. 15:1-11.

Jaffee, S. 2003. From challenge to opportunity: Transforming Kenya's fresh vegetable trade in the context of emerging food safety and other standards in Europe. World Bank, Washington, D.C.

Jaffee, S., and O. Masakure. 2005. Strategic use of private standards to enhance international competitiveness: Vegetable exports from Kenya and elsewhere. *Food Policy*. 30:316-333.

Joseph, S., P.A. Linley, J. Harwood, C.A. Lewis, and P. McCollam. 2004. Rapid assessment of well-being: The Short Depression-Happiness Scale (SDHS). *Psychology and Psychotherapy: Theory, Research and Practice*. 77:463-478.

Kant, I. 1998. Groundwork of the metaphysics of morals. M.J. Gregor, editor. Cambridge University Press, Cambridge.

Kappel, R., J. Lay, and S. Steiner. 2005. Uganda: No more pro-poor growth? *Development Policy Review*. 23:27-53.

Kavanagh, A.M., R. Bentley, G. Turrell, D.H. Broom, and S.V. Subramanian. 2006. Does gender modify associations between self rated health and the social and economic characteristics of local environments? *J Epidemiol Community Health*. 60:490-495.

Kebede, A., J.C. McCann, A.E. Kiszewski, and Y. Ye-Ebtyo. 2005. New evidence of the effects of agro-ecologic change on malaria transmission. *American Journal of Tropical Medicine and Hygiene*. 73:676-680.

Kind, P., P. Dolan, C. Gudex, and A. Williams. 1998. Variations in population health status: results from a United Kingdom national questionnaire survey. *BMJ*. 316:736-741.

Laxminarayan, R. 2004. Does reducing malaria improve household living standards? *Tropical Medicine & International Health*. 9:267-272.

Lynch, J.W., G.D. Smith, G.A. Kaplan, and J.S. House. 2000. Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *BMJ*. 320:1200-1204.

Mackay, M. 2007. Real Food Pioneers. *In* The Timesonline, London.

Mackenbach, J.P., P. Martikainen, C.W.N. Looman, J.A.A. Dalstra, A.E. Kunst, E. Lahelma, and S.w.g. members of the. 2005. The shape of the relationship between income and self-assessed health: an international study. *Int. J. Epidemiol.* 34:286-293.

Martikainen, P., J. Adda, J.E. Ferrie, G.D. Smith, and M. Marmot. 2003. Effects of income and wealth on GHQ depression and poor self rated health in white collar women and men in the Whitehall II study. *Journal of Epidemiology and Community Health*. 57:718-723.

Matthys, B., P. Vounatsou, G. Raso, A.B. Tschannen, E.G.G. Becket, L. Gosoniu, G. Cisse, M. Tanner, E.K. N'Goran, and J. Utzinger. 2006. Urban farming and malaria risk factors in a medium-sized town in Cote D'Ivoire. *American Journal of Tropical Medicine and Hygiene*. 75:1223-1231.

Mayer, D. 2001. The long-term impact of health on economic growth in Latin America. *World Development*. 29:1025-1033.

McCulloch, N., and M. Ota. 2002. Export horticulture and poverty in Kenya. Institute for Development Studies, Brighton.

Mela, C.F., and P.K. Kopalle. 2002. The impact of collinearity on regression analysis: the asymmetric effect of negative and positive correlations. *Applied Economics*. 34:667-677.

Minot, N., and M. Ngigi. 2004. Are horticultural exports a replicable success story? Evidence from Kenya and Côte d'Ivoire. International Food Policy Research Institute, Washington, D.C.

Molarius, A., K. Berglund, C. Eriksson, M. Lambe, E. Nordstrom, H.G. Eriksson, and I. Feldman. 2007. Socioeconomic conditions, lifestyle factors, and self-rated health among men and women in Sweden. *Eur J Public Health.* 17:125-133.

Mooney, G. 1992. Economics, medicine and health care. Prentice Hall Europe, Hemel Hempstead.

Nowels, D., J. McGloin, J.M. Westfall, and S. Holcomb. 2005. Validation of the EQ-5D quality of life instrument in patients after myocardial infarction. *Quality of Life Research.* 14:95-105.

Onwujekwe, O., R. Chima, and P. Okonkwo. 2000. Economic burden of malaria illness on households versus that of all other illness episodes: a study in five malaria holo-endemic Nigerian communities. *Health Policy.* 54:143-159.

Pender, J., P. Jagger, E. Nkonya, and D. Sserunkuuma. 2004. Development pathways and land management in Uganda. *World Development.* 32:767-792.

Perkins, J.J., and R.W. Sanson-Fisher. 1998. An examination of self- and telephone-administered modes of administration for the Australian SF-36. *Journal of Clinical Epidemiology.* 51:969-973.

Rice, R.A. 2001. Noble goals and challenging terrain: organic and fair trade coffee movements in the global marketplace. *Journal of Agricultural and Environmental Ethics.* 14:39-66.

Ringback Weitoft, G., and M. Rosen. 2005. Is perceived nervousness and anxiety a predictor of premature mortality and severe morbidity? A longitudinal follow up of the Swedish survey of living conditions. *J Epidemiol Community Health.* 59:794-798.

Rudd, M. 2007. Locavores: the new food fad. *In* The Timesonline.

Sachs, J., and P. Malaney. 2002. The economic and social burden of malaria. *Nature.* 415:680-685.

Sanson-Fisher, R.W., and J.J. Perkins. 1998. Adaptation and Validation of the SF-36 Health Survey for Use in Australia. *Journal of Clinical Epidemiology.* 51:961-967.

Sapin, C., B. Fantino, M.-L. Nowicki, and P. Kind. 2004. Usefulness of EQ-5D in assessing health status in primary care patients with major depressive disorder. *Health and Quality of Life Outcomes.* 2:20.

Schoenfeld, D., L. Malmrose, D. Blazer, D. Gold, and T. Seeman. 1994. Self-rated health and mortality in the high-functioning elderly-a closer look at healthy individuals: MacArthur field study of successful aging. *J Gerontol.* 49:109-15.

Schrag, A., C. Selai, M. Jahanshahi, and N.P. Quinn. 2000. The EQ-5D, a generic quality of life measure, is a useful instrument to measure quality of life in patients with Parkinson's disease. *J Neurol Neurosurg Psychiatry.* 69:67-73.

Seager, A. 2007. Air-freight flowers greener than Dutch hothouses, say Kenyans. *In* The Guardian Unlimited, London.

Singh-Manoux, A., A. Gueguen, P. Martikainen, J. Ferrie, M. Marmot, and M. Shipley. 2007. Self-rated health and mortality: short- and long-term associations in the Whitehall II Study. *Psychosom Med.* 69:138-143.

Sissoko, M.S., A. Dicko, O.J.T. Briet, M. Sissoko, I. Sagara, H.D. Keita, M. Sogoba, C. Rogier, Y.T. Toure, and O.K. Doumbo. 2004. Malaria incidence in relation to rice cultivation in the irrigated Sahel of Mali. *Acta Tropica Malaria and Agriculture.* 89:161-170.

Sonko, R., E. Njue, J.M. Ssebuliba, and A. de Jager. 2005. Pro-poor horticulture In East Africa and South East Asia: The horticultural sector in Uganda. Agricultural Economics Research Institute: Wageningen University and Research Centre, The Hague.

Stevens, C., and J. Kennan. 2000. Will Africa's participation in horticulture chains survive liberalisation? Institute of Development Studies, University of Sussex, UK.

Stronks, K., H. van de Mheen, J. van den Bos, and J.P. Mackenbach. 1997. The interrelationship between income, health and employment status. *Int. J. Epidemiol.* 26:592-600.

Thompson, P.B. 2001. Risk, consent and public debate: some preliminary considerations for the ethics of food safety. *International Journal of Food Science & Technology.* 36:833-843.

vanDoorslaer, E., A. Wagstaff, H. Bleichrodt, S. Calonge, U.G. Gerdtham, M. Gerfin, J. Geurts, L. Gross, U. Hakkinen, R.E. Leu, O. Odonnell, C. Propper, F. Puffer, M. Rodriguez, G. Sundberg, and O. Winkelhake. 1997. Income-related inequalities in health: Some international comparisons. *Journal of Health Economics.* 16:93-112.

Wagner, A.K., K. Wyss, B. Gandek, P.M. Kilima, S. Lorenz, and D. Whiting. 1999. A Kiswahili version of the SF-36 Health Survey for use in Tanzania: translation and tests of scaling assumptions. *Quality of Life Research.* 8:101-110.

Wannamethee, G., and A.G. Shaper. 1991. Self-assessment of health status and mortality in middle-aged British men. *Int. J. Epidemiol.* 20:239-245.

Ware, J., and M. Kosinski. 2001. SF-36 Physical and Mental Health Summary Scales: A Manual for Users of Version 1. QualityMetric Incorporated, Lincoln, RI.

Ware, J., K. Snow, and M. Kosinski. 1993. SF-36 Health Survey: Manual and Interpretation Guide. Quality-Metric Incorporated, Lincoln, RI.

Ware, J.E., and B. Gandek. 1997. Evaluating the readiness of health outcomes measures for use in multinational health technology assessment. *Annu Meet Int Soc Technol Assess Health Care Int Soc Technol Assess Health Care Meet.* 13.

Ware, J.E., and B. Gandek. 1998. Overview of the SF-36 Health Survey and the International Quality of Life Assessment (IQOLA) Project. *Journal of Clinical Epidemiology.* 51:903-912.

Ware, J.E.J. 2000. SF-36 Health Survey Update. *Spine.* 25:3130-3139.

Weinberger, K., and T.A. Lumpkin. 2007. Diversification into horticulture and poverty reduction: a research agenda. *World Development.* 35:1464-1480.

Whitaker, M., and S. Kolavalli. 2004. Floriculture in Kenya. World Bank.

Williams, A. 1995. The role of the EuroQol instrument in QALY calculations, discussion paper 130. York Centre for Health Economics, University of York.

Wood, R., M. Sutton, D. Clark, A. McKeon, and M. Bain. 2006. Measuring inequalities in health: the case for healthy life expectancy. *J Epidemiol Community Health*. 60:1089-1092.

Worrall, E., S. Basu, and K. Hanson. 2005. Is malaria a disease of poverty? A review of the literature. *Tropical Medicine & International Health*. 10:1047-1059.

Wyss, K., A.K. Wagner, D. Whiting, D.M. Mtasiwa, M. Tanner, B. Gandek, and P.M. Kilima. 1999. Validation of the Kiswahili version of the SF-36 Health Survey in a representative sample of an urban population in Tanzania. *Quality of Life Research*. 8:111-120.

Yost, K.J., M.N. Haan, R.A. Levine, and E.B. Gold. 2005. Comparing SF-36 scores across three groups of women with different health profiles. *Quality of Life Research*. 14:1251-1261.